"The pursuit of agroecological principles by Flemish beef farmers : advancing towards a body of thought for sustainable food systems"

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ABSTRACT

The Flemish beef sector faces growing economic uncertainty and societal criticisms. Agroecology is regularly proposed as an alternative development pathway, yet what this exactly means in this context is largely unexplored. This doctoral research aimed at investigating the relevance of agroecology to beef farming in Flanders. By gathering and analyzing data from a diverse group of Flemish beef farmers with both qualitative and quantitative methods, this dissertation renders agroecology as a practice more concrete conceptually in this context. The analysis of these farmers accounts also served to lay bare important ambiguities and inadequacies within agroecological thought with regard to the transformative potential of these agroecological practices, farmers, and the systems they construct. Out of this dialogue between agroecology and farmers thus emerged a more general societal reflection that advances contemporary ideas and practices to transform food systems

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The pursuit of agroecological principles by Flemish beef farmers

Advancing towards a body of thought for sustainable food systems

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Thèse présentée en vue de l'obtention du grade de Docteur en sciences agronomiques et ingénierie biologique

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Be ruthless with systems, be kind with people.

Michael Brooks, 1989-2020

Summary

The current global food system's sustainability challenges have prompted an expanding academic field and social movement to foster agroecology as a possible solution. In Belgium too, this moment of urgency and of opportunities is grasped by a variety of actors and organizations to promote agroecology at different political levels and sectors of society. The research presented here focuses on the beef sector in Flanders, as it faces growing economic uncertainty and societal criticism. Several authors have proposed agroecology as a more sustainable, alternative development pathway to livestock systems in temperate regions. But what agroecology precisely entails in the context of beef farming in Flanders is largely unexplored. Given the current challenges in Flanders' beef sector and the lack of scientific understanding of what agroecology may entail in this specific context, this research aimed at investigating the relevance of agroecology to Flemish beef farming.

The thesis put forward in this dissertation is that an analysis of the actions and perspectives of a diverse group of Flemish beef farmers will lead to an empirically grounded theory, giving insight into the relevance of agroecology in the context of beef farming in Flanders. We focused on three research questions in particular: (i) what actions can and do these beef farmers take to put agroecology into practice; (ii) what is the role of these farmers' agency in the application of agroecological insights; (iii) wat social-material processes and conditions contribute or limit the application of agroecological insights at these farms? Informed by critical realist philosophy, we developed a mixed methods research design for the reasons of expansion and complementarity. Data were collected on each of the 37 farms with three methods: (i) a structured questionnaire to gather information on structural farm characteristics, (ii) a semi-structured interview in which farmers were confronted with a comprehensive list of principles covering the techno-productive, ecological, social-economic, social-cultural and social-political dimensions of agroecology, and (iii) a direct structured elicitation method to obtain farmer-constructed cognitive maps (CMs) to study farmer's perspectives about and in relation to farm functioning.

Before our own field work, we conducted an exploratory analysis of census data informed by expert knowledge. This led to the construction of an original structural typology based on herd composition. The analysis of farm census data from 2011 revealed that beef farms in Flanders are incredibly diverse in terms of structural characteristics. This insight informed our theoretical sampling strategy to select farmers for interview along three axes: organic/conventional, with/without direct selling, and from specialized to diversified agricultural activities. We explored a comprehensive understanding of agroecology as a practice by confronting the selected

beef farmers in 37 on-farm interviews with 13 principles distilled out of the agroecological literature. A grounded analysis of the transcripts supported by the relevant scientific literature and ILVO expert advice, led to the identification of 690 different practices which were grouped in 36 Pathways of Actions (POA), each linked to one of the 13 principles discussed with farmers. As such, this research took a first major step to concretize agroecology as a practice in this context.

To understand how these principles fit together, we compared the sets of practices of these farmers by using this conceptual framework of 36 POAs, now as an analytical framework. By means of an original scoring system and archetypal analysis, we identified three distinct farming models to which each of these farmers member of in different degrees, based on the practices they mentioned. One farming model represents seven conventional farmers who name a bare minimum of practices contributing to agroecology, and two models representing farmers that integrate multiple elements of agroecology. Conceptually, the second farming model, corresponds with a low-input, low-capital, but knowledge intensive model, embedded within alternative commercial and social network, which actively seeks to become independent from regime institutions. The third farming model finds advantages within the mainstream market environment. It overlaps with a number of practices related to the techno-productive dimension of agroecology with the second model, as far as these maintain or increase productivity, and are compatible with the expectations of value-chain actors. As such this comparative analysis an classification of farmers revealed to us that technical and social reconfigurations along agroecological lines in Flanders go hand in hand. However, as none of the interviewed farmers represented these models in a pure state. In fact, our results indicate that many farmers are situated in between these farming models to different degrees.

The study of the elicited CMs by farmers led to the identification of a connectivity of multiple functional processes of importance to these farmers. Using both qualitative and quantitative techniques to compare the gathered maps, content differences in the maps were revealed, indicating to us that farmers' goals and views are constitutive of the way their farm effectively operates. With CMing we thus ended up affirming their agency in farm functioning. Our attention was also drawn to the importance attributed to income generation by almost all farmers, as well as the complex causal relationships expressed by some farmers in their maps between their involvement in alternative markets and more diverse and less input intensive agricultural practices. This led us to examine the role of market dependence and agroecology in this context.

As we found market dependence in agroecological and associated literature undertheorized, we constructed an analytical framework of market dependence in which a general, neo-Marxian understanding of a capitalist economic system and a New Economic Sociology conception of embedded markets was integrated in a critical realist theory of human behavior. In a new round of analysis of gathered data we applied these analytical lenses. We found all farmers to be embedded and reproduce an economic system that puts severe constraints on their ability and

willingness to put agroecology in action. We also noted there is air in the system for agroecology, however, in that the freedom of the market allows farmers to negotiate, refuse terms, re-arrange their resources, co-operate with others. Such social actions often give them more room for maneuver, though this is not necessarily used to put agroecology into practice. The air in the system is limited, however, as alternative but market-based economic arrangements are continuously undermined by the very social relations that constitute them: *e. g.* farmers competing for resources and customers, excluding each other from resources and information, unwillingness to cooperate. Based on these revealed patterns, we argue that the either lacking or concretistic theorization of the global economic system by agroecological and food system transition theorists results in arbitrary ideal-typical classifications of farmers, attitudes, social networks and practices with no convincing material basis. Instead, the existence of a global economic system constituted by objective personal and impersonal social relations in which both alternative and not so alternative farmers are embedded and are by economic necessity compelled to reproduce, appears to be a much more plausible hypothesis.

Along the way, we made in this research notable methodological innovations for a number of pertinent challenges to scientific fields that take an interest in the establishment of more sustainable food systems. These innovations include the conceptualization of agroecology as a practice, the assessment of the implementation of agroecological practices, the classification of farming systems, the use of CMing for analytical purposes, the explanation of farmer behavior and food systems dynamics generally, and the integration of literature in exploratory empirical research. As such, interdisciplinary researchers may likely draw methodological inspiration from the presented critical realist informed approach. Out of this research emerged a wider reflection to advance agroecology as a practice, science, and as a policy. Most notably we draw attention to the inherent social nature of farming that has taken in today's world the form of farmers literally and figuratively speaking producing their own chains. This points to the need to examine how farmers participate and reproduce an economic system that compels them and other actors to make compromises on agroecological principles, and also the need to construct real and desirable alternative social organization forms to produce and distribute food, an endeavor farmers, activists and scientists can take an active role in. Lastly we emphasize the role of governments in creating the broad social conditions of an agro-ecologically sound agriculture. If policy makers indeed wish to drastically change the capacity and willingness of beef farmers to put agroecology into practice, public policy should interrogate existing systems of control over economic assets, and aim to coordinate at different governance levels (municipal, regional, national, international) the needs and productive capacities of farming and non-farming citizens in an equitable and if feasible participatory manner.

Résumé

Les défis de durabilité du système alimentaire mondial actuel ont incité un champ académique et un mouvement social en expansion à promouvoir l'agroécologie comme solution possible. En Belgique également, ce moment d'urgence et d'opportunités est saisi par une variété d'acteurs et d'organisations pour promouvoir l'agroécologie à différents niveaux politiques et dans différents secteurs de la société. La recherche présentée ici se concentre sur le secteur de la viande bovine en Flandre. Celui-ci est confronté à une incertitude économique croissante et à des critiques sociétales. Plusieurs auteurs ont proposé l'agroécologie comme une voie de développement alternative plus durable aux systèmes d'élevage dans les régions tempérées. Mais ce qu'implique précisément l'agroécologie dans le contexte de l'élevage bovin en Flandre est largement inexploré. Compte tenu des défis actuels du secteur de la viande bovine en Flandre et du manque de compréhension scientifique de ce que l'agroécologie peut impliquer dans ce contexte spécifique, cette recherche vise à étudier la pertinence de l'agroécologie pour l'élevage de viande bovine en Flandre.

La thèse avancée ci-après consiste à établir la faisabilité et nécessité d'une théorie empirique fondée pour le secteur de l'élevage bovin en Flandre, en conclusion de l' analyse des actions et des perspectives d'un groupe diversifié d'éleveurs de viande bovine en Flandre. Nous nous sommes concentrés sur trois questions de recherche en particulier: (i) quelles actions pour mettre l'agroécologie en pratique sont possibles et sont pratiquées par ces éleveurs de viande bovine ; (ii) quel est le rôle de l'agriculteurs en tant qu'acteurs dans l'application des connaissances agroécologiques; (iii) les processus et conditions socio-matériels contribuent-ils ou limitent-ils l'application des connaissances agroécologiques dans ces exploitations? Soutenus par une philosophie réaliste critique, nous avons développé une modèle de recherche à méthodes mixtes afin de pouvoir intégrer la recherche dans un cadre plus large et complémentaire. Des données ont été collectées sur chacune des 37 exploitations agricoles selon trois méthodes: (i) un questionnaire structuré pour recueillir des informations sur les caractéristiques structurelles des exploitations, (ii) un entretien semi-structuré dans lequel les agriculteurs ont été confrontés à une liste complète de principes couvrant la techno- les dimensions productives, écologiques, socio-économiques, socioculturelles et sociopolitiques de l'agroécologie, et (iii) une méthode de sollicitation structurée directe pour obtenir des cartes cognitives (CM) construites par les agriculteurs pour étudier les perspectives des agriculteurs sur et en relation avec le fonctionnement de la ferme.

En amont de notre travail sur le terrain, nous avons effectué une analyse exploratoire des données de recensement éclairées par des connaissances d'experts. Cela a conduit à la construction d'une typologie structurelle originale basée sur la composition du troupeau. L'analyse des données du recensement des exploitations agricoles de 2011 a révélé que les élevages bovins de Flandre sont incroyablement diversifiés en termes de caractéristiques structurelles. Cet aperçu a éclairé notre stratégie d'échantillonnage théorique pour sélectionner les agriculteurs à interroger selon trois axes: biologique / conventionnel, avec / sans vente directe, et des activités agricoles spécialisées aux activités agricoles diversifiées. Nous avons exploré une définition large de l'agroécologie en tant que pratique en confrontant les éleveurs de bovins sélectionnés dans 37 entretiens à la ferme avec 13 principes de la littérature agroécologique. Une analyse fondée des transcriptions, appuyée par la littérature scientifique pertinente et les conseils d'experts de l'ILVO, a conduit à l'identification de 690 pratiques différentes qui ont été regroupées en 36 voies d'actions, chacune liée à l'un des 13 principes discutés avec les agriculteurs. A ce titre, cette recherche a franchi une première étape majeure pour concrétiser l'agroécologie comme une pratique dans ce contexte.

Pour comprendre comment ces principes s'articulent, nous avons ensuite comparé les ensembles de pratiques de ces agriculteurs en utilisant ce cadre conceptuel de 36 voies d'actions, comme cadre analytique. Au moyen d'un système de notation original et d'une analyse archétypale, nous avons identifié trois modèles agricoles distincts auxquels chacun de ces agriculteurs adhère à des degrés différents, en fonction des pratiques qu'ils évoquent. un modèle d'agriculture représente sept agriculteurs conventionnels qui nomment un strict minimum de pratiques contribuant à l'agroécologie, et deux modèles représentant des agriculteurs qui intègrent des éléments d'agroécologie. Conceptuellement, le deuxième modèle d'agriculture correspond à un modèle à faible intrant, à faible capital mais à forte intensité de connaissances, intégré dans un réseau commercial et social alternatif, qui cherche activement à devenir indépendant des institutions du régime. Le troisième modèle agricole trouve des avantages dans l'environnement de marché traditionnel. Il recoupe un certain nombre de pratiques liées à la dimension techno-productive de l'agroécologie avec le second modèle, dans la mesure où celles-ci maintiennent ou augmentent la productivité, et sont compatibles avec les attentes des acteurs de la chaîne de valeur. A ce titre, cette analyse comparative d'une classification des agriculteurs nous a révélé que les reconfigurations techniques et sociales selon des lignes agroécologiques en Flandre vont de pair. Cependant, aucun des agriculteurs interrogés est représentatif d'un de ces modèles à l'état pur. En fait, nos résultats indiquent que de nombreux agriculteurs se situent entre ces modèles agricoles en différentes dégrées.

L'étude des CMs construites par les agriculteurs a permis d'identifier une connectivité de multiples processus fonctionnels importants pour ces agriculteurs. En utilisant à la fois des techniques qualitatives et quantitatives pour comparer les cartes

rassemblées, des différences de contenu dans les cartes ont été révélées, nous indiquant que les objectifs et les points de vue des agriculteurs sont constitutifs de la manière dont leur ferme fonctionne efficacement. Le CMing nous a permis de confirmer leur rôle actif dans le fonctionnement de leur ferme. Notre attention a également été attirée sur l'importance de la rentabilité, soulignée par presque tous les agriculteurs, ainsi que sur les relations causales complexes exprimées dans certains CMs d'agriculteurs entre leur implication dans des marchés alternatifs et des pratiques agricoles plus diversifiées et moins dépendantes d'intrants. Cela nous a conduit à examiner le rôle de la dépendance du marché et de l'agroécologie dans ce contexte.

La dépendance du marché dans la littérature agroécologique et associée est toutefois sous-théorisée, nous avons donc construit un cadre analytique de la dépendance du marché. Nous avons été amenés à y intégrer une compréhension générale et néomarxiste d'un système économique capitaliste, ainsi qu'une conception de la nouvelle sociologie économique par rapport aux marchés encastrées dans une théorie critique réaliste du comportement humain. Dans un nouveau cycle d'analyse des données recueillies, nous avons appliqué ces lentilles analytiques. Nous avons constaté que tous les agriculteurs étaient intégrés dans un système économique qui impose de sévères contraintes à leur capacité et à leur volonté de mettre l'agroécologie en action. Nous avons noté qu'il y avait quand même une marge de manœuvre, dans la mesure justement où la liberté du marché permet aux agriculteurs de négocier, de refuser les conditions, de réorganiser leurs ressources, de coopérer avec les autres. De telles actions sociales leur donnent souvent plus de marge de manœuvre, bien que cela ne soit pas nécessairement utilisé pour mettre en pratique l'agroécologie. Les dégrées de liberté du système sont cependant limités, car les arrangements économiques alternatifs mais fondés sur le marché sont continuellement minés par les relations sociales mêmes qui les constituent: *e. g.* agriculteurs en concurrence pour les ressources et pour les clients, exclusion des ressources et des informations, refus de coopérer. Sur la base de ces modèles révélés, nous soutenons que la théorisation soit absente soit concrétiste du système économique mondial dans les approches des théoriciens de la transition agroécologiques et du système alimentaire aboutit à des classifications arbitraires idéal-typiques des agriculteurs, des attitudes, des réseaux sociaux et des pratiques sans base matérielle convaincante. Une hypothèse plus plausible est qu'il existe un système économique mondial constitué par des relations sociales objectives personnelles et impersonnelles dans lesquelles les agriculteurs alternatifs et non alternatifs sont intégrés et sont contraints de se reproduire.

En cours de route, nous avons élaboré dans cette recherche des innovations méthodologiques notables pour répondre à un certain nombre de défis pertinents pour les domaines scientifiques qui s'intéressent à la mise en place de systèmes alimentaires plus durables. Ainsi nous avons introduit des méthodes pour conceptualiser de l'agroécologie en tant que pratique, pour évaluer de la mise en œuvre des pratiques agroécologiques, pour la classification des systèmes agricoles, pour l'utilisation du CMing à des fins analytiques, pour l'explication du comportement social des

agriculteurs et de la dynamique des systèmes alimentaires en général, et pour l'intégration de la littérature dans recherche empirique exploratoire. Les chercheurs interdisciplinaires pourraient alors s'inspirer de l'approche critique réaliste et informée présentée. De cette recherche a émergé une réflexion plus large pour faire progresser l'agroécologie en tant que pratique, science et politique. Plus particulièrement, nous attirons l'attention sur la nature sociale inhérente de l'agriculture qui conduit actuellement des fermiers à produire leurs propres chaînes au sens propre et figuré. Il ne serait donc pas inutile d'examiner comment les agriculteurs participent et reproduisent un système économique qui les oblige, ainsi que d'autres acteurs, à faire des compromis sur les principes agroécologiques, ainsi que la nécessité de construire des formes d'organisation sociale alternatives réelles et souhaitables pour produire et distribuer l'alimentation, une entreprise dans laquelle agriculteurs, militants et scientifiques peuvent jouer un rôle actif. Enfin, nous soulignons le rôle des autorités dans la création plus largement des conditions sociales d'une agriculture agro-écologiquement saine. Si les décideurs politiques souhaitent changer radicalement la capacité et la volonté des éleveurs de viande bovine de mettre l'agroécologie en pratique, les politiques publiques devraient interroger les systèmes existants de contrôle des actifs économiques et viser une meilleure coordination des besoins et des capacités productives des citoyens agricoles et non agricoles.

Samenvatting

De duurzaamheidsuitdagingen van het globale voedselsysteem leidden een groeiend academisch veld en een sociale beweging tot het naar voren schuiven van agro-ecologie als mogelijke oplossing. Ook in België wordt dit moment van urgentie en kansen aangegrepen door een verscheidenheid aan actoren en organisaties om agro-ecologie te promoten op verschillende politieke niveaus en in verschillende sectoren van de samenleving. Het hier voorgestelde onderzoek spitst zich toe op de rundvleessector in Vlaanderen, die kampt met toenemende economische onzekerheid en maatschappelijke kritiek. Verschillende auteurs hebben agro-ecologie voorgesteld als een duurzamer, alternatief ontwikkelingspad voor veehouderijsystemen in gematigde streken. Maar wat agro-ecologie precies inhoudt in de context van de vleesveehouderij in Vlaanderen is grotendeels onontgonnen. Gezien de huidige uitdagingen in de Vlaamse rundvleessector en gebrekkig wetenschappelijk inzicht in wat agro-ecologie in deze specifieke context praktisch inhoudt, had dit onderzoek tot doel de relevantie van agro-ecologie voor de Vlaamse vleesveehouderij te onderzoeken.

De hypothese van dit proefschrift is dat hiernavolgende analyse van de acties en perspectieven van een diverse groep Vlaamse vleesveehouders, aanleiding kan geven tot een empirisch gefundeerde theorie voor de relevantie van agro-ecologie in de context van de rundveehouderij in Vlaanderen. We concentreerden ons in het bijzonder op drie onderzoeksvragen: (i) welke acties ondernemen deze vleesveehouders om agro-ecologie in de praktijk te brengen; (ii) wat is de rol van de landbouwers als actoren in de toepassing van agro-ecologische inzichten; (iii) welke sociaal-materiële processen en omstandigheden dragen bij aan of beperken de toepassing van agro-ecologische inzichten op deze bedrijven? Geïnformeerd door een kritische realistische filosofie, ontwikkelden we een onderzoeksdesign met kwalitatieve en kwantitatieve methoden van dataverzameling en -analyse. Er werden gegevens verzameld over elk van de 37 boerderijen met drie methoden: (i) een gestructureerde vragenlijst om informatie te verzamelen over structurele kenmerken van het bedrijf, (ii) een semigestructureerde interview waarin landbouwers werden geconfronteerd met een uitgebreide lijst van principes die betrekking hebben op de technologie. productieve, ecologische, sociaaleconomische, sociaal-culturele en sociaal-politieke dimensies van agro-ecologie, en (iii) een direct gestructureerde methode om cognitieve kaarten van landbouwers (CM's) te verzamelen om de perspectieven van landbouwers over en in relatie met het functioneren van hun landbouwbedrijf te bestuderen.

Voorafgaand aan ons eigen veldwerk hebben we een verkennende analyse uitgevoerd van censusgegevens en de inzichten van experten. Dit leidde tot de constructie van een originele structurele typologie gebaseerd op kuddesamenstelling. Uit de analyse van de gegevens van de boerderijtellingen uit 2011 bleek dat vleesveehouderijen in Vlaanderen ongelooflijk divers zijn qua structurele kenmerken. Dit inzicht vormde de basis van onze theoretische steekproefstrategie om landbouwers te selecteren voor een interview langs drie assen: biologisch / conventioneel, met / zonder directe verkoop en van gespecialiseerde naar gediversifieerde landbouwactiviteiten. We hebben een uitgebreid begrip van agro-ecologie als praktijk onderzocht via 13 principes opgesteld vanuit de agro-ecologische literatuur. Een kwalitatieve analyse van de transcripties ondersteund door de relevante wetenschappelijke literatuur en ILVO-deskundig advies leidde tot de identificatie van 690 verschillende praktijken, die werden gegroepeerd in 36 actiepaden, Elk werd gekoppeld aan een van de 13 principes die met landbouwers werden besproken. Dit onderzoek heeft daarmee een eerste grote stap gezet om agro-ecologie als praktijk in deze context te concretiseren.

Om te begrijpen hoe deze principes bij elkaar passen, hebben we de praktijkreeksen van deze landbouwers vergeleken door dit conceptuele raamwerk van 36 actiepaden te gebruiken, nu als analytisch raamwerk. Door middel van een origineel scoresysteem en archetypische analyse hebben we drie verschillende landbouwmodellen geïdentificeerd waarvan elk van deze landbouwers in verschillende mate lid is, gebaseerd op de praktijken die ze noemden. één landbouwmodel vertegenwoordigt zeven conventionele landbouwers die een absoluut minimum aan praktijken noemen die bijdragen aan agro-ecologie, en twee modellen die landbouwers vertegenwoordigen die verschillende elementen van agro-ecologie integreren. Conceptueel komt het tweede landbouwmodel overeen met een laag-input, laagkapitaal, maar kennisintensief model, ingebed in alternatieve commerciële en sociale netwerken, dat actief probeert onafhankelijk te worden van regime-instellingen. Het derde landbouwmodel vindt voordelen binnen de reguliere marktomgeving. Het overlapt met het tweede model voor een aantal landbouwpraktijken die verband houden met de techno-productieve dimensie van agro-ecologie, namelijk zolang deze de productiviteit behouden of verhogen, en verenigbaar zijn met de verwachtingen van actoren in de waardeketen. Zo onthulde deze vergelijkende analyse en classificatie van landbouwers ons dat technische en sociale herindelingen langs agro-ecologische lijnen in Vlaanderen hand in hand gaan, en op uitgesproken verschillende wijze. Geen van de geïnterviewde landbouwers vertegenwoordigde deze modellen echter in zuivere staat. Onze resultaten geven namelijk aan dat veel landbouwers in verschillende mate tussenin deze landbouwmodellen zitten.

De studie van de opgewekte CM's door landbouwers leidde tot de identificatie van een connectiviteit van meerdere functionele processen die van belang zijn voor deze landbouwers. Door zowel kwalitatieve als kwantitatieve technieken te gebruiken

zagen we grote inhoudsverschillen tussen de CM's van landbouwers. Daaruit werd opgemaakt dat de doelen en opvattingen van landbouwers bepalend zijn voor de manier waarop hun boerderij effectief functioneert. Met CMing hebben we dus hun agentschap in het functioneren van de boerderij bevestigd. Onze aandacht werd echter ook gevestigd op centrale rol dat inkomen behalen speeld in bijna alle kaarten van de geïnterviewde landbouwers, evenals op de complexe oorzakelijke verbanden die door sommige landbouwers in hun kaarten worden uitgedrukt tussen hun betrokkenheid bij alternatieve markten en meer diverse en minder uitgebreide landbouwpraktijken. Dit bracht ons ertoe om de rol van marktafhankelijkheid en agro-ecologie in deze context te onderzoeken.

Marktafhankelijkheid in agro-ecologische en aanverwante literatuur is echter te weinig getheoretiseerd en we construeerden daarom een eigen analytisch raamwerk waarin we een algemeen neomarxistisch begrip van een kapitalistisch economisch systeem en de Nieuwe Economische Sociologie opvatting van ingebedde markten integreerden in een kritisch realistische theorie van menselijk gedrag. In een nieuwe analyseronde van verzamelde gegevens hebben we deze analytische lenzen toegepast. We ontdekten dat alle landbouwers ingebed waren in een economisch systeem dat ernstige beperkingen oplegt aan hun vermogen en bereidheid om agro-ecologie in praktijk te brengen. We merkten echter ook op dat er lucht in het systeem zit, net omdat de markt de landbouwers in staat stelt te onderhandelen, voorwaarden te weigeren, hun middelen te herschikken en met andere actoren samen te werken. Dergelijke sociale acties geven hen vaak meer manoeuvreerruimte, hoewel dit niet noodzakelijk wordt gebruikt om agro-ecologie in de praktijk te brengen. De lucht in het systeem is echter beperkt, aangezien alternatieve maar marktconforme economische modellen voortdurend worden ondermijnd door dezelfde sociale relaties waaruit ze bestaan: zo vinden we dat landbouwers concurreren voor grondstoffen, voornamelijk land, en klanten, en dat ze elkaar uitsluiten om grondstoffen of informatie te delen. Op basis van onze bevindingen stellen we dat de ontbrekend of particularistisch begrip van het mondiale economische systeem door agro-ecologische en voedselsysteemtransitietheoretici resulteert in ideaaltypische classificaties van landbouwers, attitudes, sociale netwerken en praktijken zonder overtuigende materiële basis. Het bestaan van een wereldwijd economisch systeem dat wordt gevormd door objectieve persoonlijke en onpersoonlijke sociale relaties waarin zowel alternatieve als niet zo alternatieve landbouwers zijn ingebed in en noodgedwongen reproduceren, schijnt een veel plausibeler hypothese.

In de loop van dit onderzoek werden er ook enkele opmerkelijke methodologische bijdragen geleverd aan de wetenschappelijke velden die zich toeleggen op de verduurzaming van voedselsystemen. Deze omvatten methodes om agro-ecologie als praktijk empirisch te onderzoeken, om de implementatie van agro-ecologische praktijken te beoordelen, om landbouwsystemen te classificeren, om CM's te gebruiken voor analytische doeleinden, om het gedrag van landbouwers en de dynamiek van voedselsystemen in het algemeen te verklaren, en om literatuur in

verkennend empirisch onderzoek te integreren. Interdisciplinaire onderzoekers zullen allicht methodologische inspiratie kunnen putten uit de gepresenteerde benadering. Uit dit onderzoek kwam een bredere reflectie naar voren om agro-ecologie vooruit te helpen als praktijk, wetenschap en als beleid. Met name vestigen we de aandacht op de inherente sociale aard van de landbouw, die in de huidige wereld de vorm heeft aangenomen van landbouwers die letterlijk en figuurlijk hun eigen ketens produceren. Dit wijst op de noodzaak om te onderzoeken hoe landbouwers deelnemen aan en een economisch systeem reproduceren dat hen en andere actoren dwingt compromissen te sluiten over agro-ecologische principes. Dit wijst tevens op de noodzaak om echte en wenselijke alternatieve sociale organisatievormen te ontwikkelen om voedsel te produceren en te distribueren, een streven waarin zowel landbouwers, activisten en wetenschappers een actieve rol kunnen spelen. Ten slotte benadrukken we de rol van overheden bij het creëren van de brede sociale voorwaarden van een agro-ecologisch verantwoorde landbouw. Als beleidsmakers inderdaad de capaciteit en bereidheid van rundveehouders om agro-ecologie in de praktijk te brengen drastisch willen veranderen, zou het overheidsbeleid de bestaande systemen van controle over economische middelen in vraag kunnen stellen met het oog op meer coördinatie van de behoeften en productieve capaciteiten van landbouwers en niet-landbouwers

Acknowledgements

This Ph. D takes up the issue of farmer agency, that is the ability of farmers to make choices, and thus write their own destinies. We argued that farmers must pick up the thread where previous generations left it, and while they mustn't necessarily take the same downtrodden paths, they often take decisions they'd rather not take. We show also, however, that good companionship along the way can make all the difference a times, and so it was also with writing this Ph. D.

I wrote this Ph. D. in the we-form, to recognize that it was written with three mentors in mind: Fleur, Philippe, and Jo. Your astute observations and helpful suggestions to me personally over the last four years made this research truly feel like a team effort. And even if you weren't able to join in, over the years I've gotten to know you well enough that I had only to imagine a conversation between the four of us to know whether I was still on the track. I felt your genuine concern for my personal well-being and development, and your warmth and camaraderie I had the privilege of enjoying over the years, surely fueled this work. As supervisors, you were very keen on letting me experiment, rather than finding the route of least resistance. We've tried to do things a bit differently in this Ph. D., and it's a tribute to your patience, intellectual openness, but also timely judgment to change course at times that we've reached our destination, while still being able to enjoy quite a few literary and philosophical escapades along the way.

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This Ph. D is by extension but significantly an ILVO L&M product. Research is conducted with the methods and theories that happen to cross the researcher's desk. With such open, helpful and considerate colleagues, I never found my desk empty, at the risk of becoming overwhelming. L&M truly is a living lab for social scientific research, with so many bright and talented researchers working on such diverse topics, bringing in their own perspectives, all eager to learn, debate and share, and most importantly eager to laugh. Ph. D. life can be lonely at times, yet the conviviality and solidarity nourished here surely brightened these darker moments. In particular, I would want to thank my office colleagues for supporting me over the years: Ine, Marianne, Laure, and Hanne. It's been fascinating to work with you, learn about learning or participatory methods, or to document why one should (not) have children during a Ph. D.

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To my family and friends, or those that find themselves regularly and inexplicably putting up with my presence without any financial compensation (that counts you out, Koen), I am grateful for our shared moments over the last few years. In the foolishness, misery, absurdity and delights of our intertwined personal lives I found a welcome distraction from work, certainly helping to preserve the limited amount of sanity bequeathed to me. I admit, I often struggled to keep my work out of our conversations. Indeed and likely to your frustration, I found myself spontaneously unpacking and applying concepts from my research, and thus ended up hijacking even the most mundane conversations with my half-baked pseudo-intellectual political and philosophical reflections. I'd like to believe, however, that it's in these heated midnight and early morning debates that I stumbled on the best ideas presented in this dissertation. So if you, dear friend, find your original ideas represented in my work without any attribution, consider this a last attempt to rectify the situation! I'd like to thank Pieter-Jan especially for proof-reading parts of this manuscript and for joyfully accepting to live with a final stage Ph. D. student 24/7 in these weird times.

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Louis Tessier, Gent, March 17, 2021

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PART I
INTRODUCTION

Chapter 1
Setting the Scene

Setting the Scene

The current global food system's sustainability challenges (FAO, 2017) have prompted an expanding academic field and social movement to foster agroecology (HLPE, 2019; Holt-Giménez & Altieri, 2013; IPES-Food, 2019). In Belgium too, this moment of urgency and of opportunities is being grasped by a variety of actors and organizations to promote agroecology at different political levels and in different sectors of society (Stassart *et al.*, 2018). This research focuses on the beef sector in Flanders, as it faces growing economic uncertainty and societal criticism. Declining market prices and increasing production costs have rendered beef production one of the least profitable agricultural activities in Flanders for over a decade. The beef farming population is aging and in decline with few prospective successors available to fill the ranks (Platteau, Lambrechts, Roels, & Van Bogaert, 2018). Although the sector's reputation has recovered since the scandals surrounding hormone malpractices in the 1990s, changing consumer preferences and decreasing meat consumption pose a significant challenge to the sector's long-term viability. Many beef farmers are now at a crossroads: to continue scale enlargement and intensification or to search for alternatives? Several authors have proposed agroecology as a more sustainable, alternative development pathway to livestock systems in temperate regions (Bonaudo *et al.*, 2014; B. Dumont, Fortun-Lamothe, Jouven, Thomas, & Tichit, 2013; Wezel & Peeters, 2014).

In this chapter we present our case study, the Flemish beef sector, by situating it within the broader agricultural region of Flanders, one of the most intensively farmed regions in Europe, presumably making it an unlikely context in which agroecology is put into practice. We then explore the concept of agroecology by tracing its historical roots, its reception in Belgium, and summarizing current agroecological proposals on livestock farming in intensively farmed regions. At the end of this chapter, we consider whether agroecology indeed represents an unexplored and promising approach to solving the severe challenges facing the Flemish beef farming community.

1.1. Farming in Flanders: a challenging activity

Flanders is a small (13,522 km²) but densely populated (490 inhabitants per km²) region in Belgium (Statbel, 2019a). Tucked in between the most affluent and economically productive regions in Europe, Flanders is a center piece of the European market economy. Key highway interchanges connect this region, enveloping the administrative capital of Europe, with the rest of the world. Not in the least through the second largest European port. Given its strategic location Flanders has proven, even after its deindustrialization in the 1970s, to be a fertile place for the development

of a diverse network of home-grown, small- and medium-sized enterprises. Some of which are connected with larger multi-national corporations focused on innovative knowledge-intensive activities often in connection with universities and government initiatives (Oosterlynck, 2011). In such a post-industrial setting, it is easily overlooked that 46 percent of the Flemish land area is still being used for agricultural and horticultural activities (Statbel, 2019b). In the last two centuries, agriculture in Flanders has been shaped largely by neighboring industrial activities. These industries created very specific economic opportunities for farmers to produce specialized agricultural goods granting them access to export markets. Which in turn allowed the import of cheap agricultural inputs from abroad as well as access to industrial by-products. The competition for land between industry, commerce and housing has also further steered agricultural development in this region toward production systems with high land productivity. Land scarcity in this region has led farmers to increase economic efficiency by specializing in the most valuable commodities and intensifying land use by increasing stocking rates, fertilizer dosages and buying off-farm produced feedstuffs (Zanden, 1991). The agricultural sector also benefitted from public and private investments in the technological development and training of farmers, further encouraged by income support from the 1960's Common Agricultural Policy (CAP). As a result, Flanders has become one of the most productive agricultural regions in the world. The combined Flemish agricultural and horticultural sectors realized a production value of 8.24 billion euros in 2016, or about €13,486 per hectare per year. Beef and veal production being the third most important sector after dairy and pork production. This is accomplished by only a very small segment of the working population with 39,315 full-time jobs at 23,981 agricultural businesses as of 2016, and another 106 000 people employed in companies organizing up-stream and down-stream activities in the agri-food sector, generating a total of 61.7 billion euros revenue in 2016 (Platteau *et al.*, 2018).

While these numbers speak to the enormous productive successes of the Flemish agri-food sector, it is also commonly acknowledged that these have come at significant environmental costs. The intensive application of fertilizers and the high concentration of livestock production activities are major causes for the acidification and eutrophication of rain, ground and surface water. These are threatening significant percentages of the terrestrial and aquatic wildlife populations in the region (VMM, 2017). Intensive management of grassland has drastically reduced floral and insect biodiversity whereas the shift away from mowing grassland for forage toward fodder crops, silage maize in particular, has led directly to the loss of grassland biodiversity (Demolder *et al.*, 2014). The reduction in landscape diversity and complexity as a result of the disappearance of traditional farming practices has a noticeable impact on agrobiodiversity by fragmenting habitats (Peeters, 2014). The wide-spread use of pesticides and selection of high-yielding animal breeds and crop varieties have also led to the reduction of genetic diversity in the region. (Peeters, 2014). Throughout the last three decades successive reforms to the European Common Agricultural Policy, as well as important legislation such as the Nitrate Directive (91/676/EEC), the Water

Framework Directive (2000/60/EC) and the Habitats and Birds Directives (92/43/EEC and 79/409/EEC respectively) were put into place by the Flemish government, stalling and even curbing back some of these adverse environmental developments in the region. This was accomplished primarily by making agricultural activities markedly more eco-efficient rather than reducing physical output (Statbel, 2019b; VMM, 2017). Despite these improvements, multiple local environmental thresholds are exceeded (nitrogen deposition, phosphate and nitrate concentration levels in surface waters) (VMM, 2015, 2019), and it is estimated that in the last 30 years increased use of pesticides and mechanical plowing in Belgian agriculture has caused over 60% of bird life to disappear (WWF, 2020). The environmental challenges of the Flemish agriculture, can't be separated from global challenges such as climate change, resource depletion, and freshwater availability, as they are intimately embedded in global value chains. As such, contemporary agriculture in the aggregate continues to play the paradoxical role of feeding (most of) the population (more or less) adequately while degrading the environmental conditions under which further human development is to take place (Campbell *et al.*, 2017). The proportionately high contribution of ruminant livestock production to climate change through enteric methane gas formation (Reisinger & Clark, 2018), in particular, has spurred researchers to debate different land use strategies to provide a growing population with nutritionally complete diet, while still meeting climate targets (Makkar, 2018).

Large-scale, concentrated export-oriented livestock production involves inherent human health risks (Zinsstag, Schelling, Waltner-Toews, & Tanner, 2011). Throughout the development of the livestock sectors in Flanders there have been recurring outbreaks of zoonosis within the Flemish livestock population, and contamination of food with pollutants, hazardous bio-chemicals and pathogens. The inappropriate and excessive antimicrobial usage in Belgian livestock production also raised significant concerns for antimicrobial resistance (Filippitzi, Callens, Pardon, Persoons, & Dewulf, 2014). Whether the result of accidents, negligence or outright fraud, as was the case with malpractices with hormones in the 1990s (Braeckman, 2017), governments as well as the industry itself recognized that such scandals signified serious risks to public health and damaged consumer confidence in their products and public support for these activities in this region. This has led to the implementation of widespread international and national legal frameworks, as well as public-private and private initiatives to set up control and monitoring systems and to promote best practices (Daeseleire *et al.*, 2016). Recent scandals in the Flemish meat packing industry indicate, however, that food safety concerns remain a weak spot threatening the fragile recovery of the sector's reputation (Platteau *et al.*, 2018). According to a five-yearly study, the Flemish people's image of Flemish farmers and the agricultural and horticultural sectors, improved since the 1990s up until 2012 (Verleye & Zadorina, 2017). The average opinion of the Flemish people has since slightly waned. While farmers are believed to produce more environmentally and animal welfare than before, a growing segment has shifted towards buying organic

certified products, and to the consumption of less (red) meat over recent years (Brouwers *et al.*, 2017; Platteau *et al.*, 2018).

The steps taken by governments and the agricultural sector were an effort to reconfigure Flemish agriculture and repair its place in Flemish society. Yet legal measures did impose limits to the further growth of agricultural output in the region. Higher standards on food safety and quality also led to increasing production costs and administrative burdens. Moreover, like other European farmers, Flemish farmers have been increasingly exposed to fluctuations in world market prices. While the prices paid to European farmers for their products are barely increasing, the price of inputs such as land, fertilizers, animal feed and crop protection products have been rising sharply. The income support provided to farmers under the Common Agricultural Policy, which acted as a safety net for farmers, has also been considerably reduced over the past years (Platteau *et al.*, 2018). These developments have put an economic squeeze on farmers. There has been a steady decline of the farming population. In 1980, 124,658 people found employment in agriculture, in 2017 this was 48,453 (Statbel, 2019b). Farming in Flanders presently takes place on much larger farms with a somewhat bigger workforce than it did in 1980 (1.64 labor units and 8.4 ha per holding in 1980, compared to 2.02 labor units and 25.9 ha in 2016) (Statbel, 2019b). The average age of farmers in charge of professional businesses in Flanders has continuously increased over the past few years from 50 years old in 2007 to 54 years old in 2016. Only 10 percent of all farms have a holder younger than the age of 40, while 16 percent are older than the age of 65. Only 13 percent of all farmers older than 50 have a probable successor. Plausible reasons for this are the increasingly capital-intensive nature of these production systems placing high investment burdens on potential successors, combined with low and uncertain expected returns in the sector. While nine out of ten farmers find their work interesting and eight out of ten are satisfied with their job, one in five suffers from high to very high stress. Their main worries are uncertainty of income, administrative burdens and problems regarding the acquisition of additional land (Platteau *et al.*, 2018).

Of all agricultural sectors in Flanders, the beef sector is likely to be in one of the most difficult positions. The widespread selection and rearing of the double-muscled Belgian Blue breed has played a crucial role in the historical development of the sector, and in its foreseeable future. The breed established itself as the only profitable beef breed in the 1970s in this area (Peeters, 2010), as it combined remarkable high feed conversion efficiencies, with tameness, excellent carcass quality, and low ratio of intermuscular fat. The Belgian Blue became the center piece of the whole beef value chain to promote beef consumption in the region, and outcompete beef produced in less intensively farmed regions in Europe. Systematic caesarean sections have raised animal welfare and human health criticisms which undermine the image of the breed and possibly change taste preferences. Undoubtedly, these have made it harder for farmers to realize the high value required to produce it. While still being able to count on a relatively affluent, meat loving Flemish consumer base, domestic

consumption of beef and veal products has shrunk dramatically over the years from 6.7 kg to 4.6 kg in between 2008 and 2017 time period, as the population develops an appetite for more vegetarian or white meat-based diets. The sector has moreover a hard to time to find a secure foothold internationally, leading a steady but declining price for high quality beef carcasses. Together with rising production costs this has led to ever smaller income margins over the years (Platteau *et al.*, 2018; Vrints & Deuninck, 2015). Consequently, there has been a steady and significant decline of farms with suckler cows in production of about 30 percent in between 2007 and 2017, as well as 35 percent decline in total number of suckler cows in production over this same time period (Platteau *et al.*, 2018). Aside from the continuous restructuring, however, the sector as a whole appears to have a hard time imagining alternatives. The shared culture and sunk financial costs of actors involved in the beef sector appear to have locked the sector in a trajectory that few stakeholders benefit from (Stassart & Jamar, 2008).

It appears that beef farmers in Flanders are at a crossroads: to continue investing in an activity and bear through the growing societal criticisms and uncertainties, or to cut their losses, and retire or move on to other more remunerating economic activities. Moreover, this cross-roads is brought about by a society that is confronted also with choices it rather doesn't make. The existence of a feasible and socially acceptable alternative development pathway in this context would be a highly welcome prospect then for many farmers. In recent years, this alternative has taken for some farmers, scientists, and activists, the name of agroecology.

1.2. Agroecology: an alternative development pathway?

"*What is agroecology?*" a question often raised these latest years. Unsurprisingly so, as many people in search for more sustainable ways of producing food will have come across actors and organizations who have embraced the concept wholeheartedly to describe their farm, their research or their political agenda. There have been controversies between actors and organizations about mobilizing the term in bad faith, not in the least in Belgium (Stassart *et al.*, 2018). Agroecology indeed is a "territory in dispute" (Anderson & Maughan, 2021; Giraldo & Rosset, 2017). Some may have become rather wary of the term precisely for this reason. Nonetheless, if these controversies demonstrate anything, it is that for many there is something at stake in agroecology worth losing sleep over, suggesting it may have practical relevance to our everyday lives.

Yet, even a sympathetic bystander curious to know what moves these agroecologists, is likely to be overwhelmed by the plethora of definitions that are thrown around to describe the term. To be fair to this curious observer, those seeking to operationalize the concept of agroecology have not always made it easy for him. An often cited paper, for instance, Wezel *et al.* (2009), states that agroecology could signify respectively a science, a practice, and a movement, leaving the idle observer

wondering what kind of conceptual Hydra could bear such a monstrous description? While it is most certain that agroecology is associated with all of these very different phenomena, it is far from evident how the three legs of this agroecological tripod actually fit together. A history of the concept could prove very helpful in this regard.

1.2.1. Agroecology: a history of transformation and fragmentation.

Many compelling accounts have already been given on what self-identifying agroecologists have written and done (Brym & Reeve, 2016; Gallardo-López, Hernández-Chontal, Cisneros-Saguilán, & Linares-Gabriel, 2018; Nicot, Bellon, Loconto, & Ollivier, 2018; Tomich *et al.*, 2011; Wezel & Soldat, 2009). In this section, we will tread in the footsteps of Jack Buchanan (2013), who conceptualized, quite originally, the history of agroecology as a micro-cultural evolution embedded within a changing macro-cultural context, progressing in sequence through a nested hierarchy of developmental stages.

Stage 1: From improving crop yields with ecological concepts …

The first use of the word "agroecology" in the scientific literature appears in the work of Basil Bensin (Bensin, 1928, 1930), a Russian agronomist who studied and worked primarily in North and Central America (the concept of "agricultural ecology", indicating a loose application of ecological principles to agricultural settings, came about earlier, namely shortly after the birth of ecology as a coherent science in the late 19th century). Bensin used the term agroecology generically to refer to the application of ecological methods to commercial crop plants (Bensin, 1930). The ends of agroecological research in this early period reflected the productivist agenda, which dominated agricultural research activities generally in this period[1], setting in its decline only from the early 1970s (Buchanan, 2013; Buttel, 2003).

Stage 2: to a critique of the Green Revolution, …

In the wake of the environmental and social devastation of the green Revolution in the Global North and South, since the 1960s, agroecologists increasingly started to identify the shortcomings of this productivist agenda. The work of ecologists Eugene and Howard Odum was particularly instrumental in giving this critique empirical rigor, and for planting the seed of the systems paradigm that would take firm root in the burgeoning discipline of agroecology ever since (E. P. Odum, 1964; H. T. Odum, 1967). Systems diagrams proved an effective means of highlighting the systemic imbalances that the industrial agricultural model was levying on the various socio-

[1] Three key research practices characterizing this "Golden age of productivism" in agriculture were: 1) an emphasis on applied, locally adapted research aimed mainly at farmers in a particular state or region; (2) the predominance of public-domain technology and the norm of widespread sharing of research results and materials among scientists; (3) publicly dominated technology transfer, mainly through extension (Buttel 2001).

ecological networks of the food system across various scales (Gliessman, 2013). Agroecologists contrasted these input-intensive systems with existing but disappearing agricultural systems that were more sustainable, in the sense that there was an observable balance of flows among all entities within its bounds. By taking an interest in agricultural systems, which modernization theorists had condemned as anthropological curiosa, agroecologists identified various processes and practices through which such a biophysical equilibrium state could be maintained.

Stage 3: to a participatory action-oriented science…

From the early 1980s onwards, agroecology has provided a conceptual framework for the increasing promotion of principles and practices that would contribute to that objective both in developed and developing countries, but especially in Central and South America. Agroecology was in this regard quite objectively *"the application of ecological science to the study and design of sustainable agriculture"* (Altieri, 1995). Moreover, this transformation came with important methodological developments. Particularly important in the development of the discipline were participatory action-research methods, *i. e.* the active engagement of farmers' knowledge in experimenting and in the creation of scientifically sound propositions. It turned an apparent paradox, namely that traditional agricultural knowledge tends to be profound but local, whereas scientific knowledge tends to be general but superficial, into a lever for knowledge and action (Vandermeer & Perfecto, 2013). Notably, these developments came a decade before the publication of the Brundlandt Report (WCED, 1988), and before the broad recognition of European governments that the productivist research agenda was inadequate to deal with the complex challenge of sustainable development. In other words, years before what is now called the "post-normal turn" of the agricultural sciences towards sustainability science (Funtowicz & Ravetz, 2003; Lang *et al.*, 2012), thanks to the pioneering work of a handful of scientists in the early 1980s and onwards, agroecology had already developed into a "transdisciplinary" science, as it actively and consciously incorporated the knowledge and concerns of the stakeholders they were working with (Méndez, Bacon, & Cohen, 2013). Through these activities, agroecology became increasingly associated not only with the activities of scientists but also with those activities of the stakeholders putting these co-created solutions into practice.

Stage 4: to a political science and movement

Increasingly, however, agroecological researchers and practitioners found that the societal ills that came along with production model of the Green Revolution, couldn't be explained solely in terms of a poor understanding of ecological complexity by farmers, but that these were also caused by the very social context in which farmers had to operate. In other words, there was a steady transformation of the scale, scope and ends of the discipline, and with these also the means. Whereas most often the solutions provided by agroecologists remained technical in nature, such as selecting particular fast-growing tree crops to maintain continual crop cover, avoiding site

degradation and nutrient leaching, they also came to include a social critique and call for political action (Altieri, Letourneau, & Davis, 1983). Moreover, many prominent agroecological researchers are involved members of social movements, which include in particular rural class struggles in Latin America (Guzmán & Woodgate, 2013) but also in some European regions (Calvário, 2017; de Almeida, Hernandez, & Collado, 2014) and the alternative food movements in Europe and North America (Fernandez, Goodall, Olson, & Méndez, 2013). For some rural proletarian movements, agroecology even became the signifier of their "ideology" (Meek, 2014), in the positive and affirmative Lukáscian sense of the word (Eagleton 1991, p 93-94). Many of these movements have come to be connected in the international small farmer federation of La Via Campesina, (literally "the peasant way"). Founded in 1993; it represents to date over 200 million families worldwide, making it by far the largest organization promoting agroecology to date (Rosset & Martínez-Torres, 2012). With this political realignment, however, agroecology has become associated with the notion of food sovereignty[2], and which concisely captures the vision for an alternative food system, a political campaign and an analytical framework of these radical social movements (Alonso-Fradejas, Borras, Holmes, Holt-Giménez, & Robbins, 2015)

Stage 5: with many faces, …

Not all agroecologists, however, frame agroecology nor their activities in these world-historical, political terms. In fact, this transformation of scope, scale and aims over the years came along with an enormous fragmentation, as it took place in very different social contexts, and was shaped by the activities of social agents, including researchers, farmers, politicians, with particular objective interests and cultural beliefs of their own. Agroecology developed in different directions and at different speeds. Even the early productivist tradition continues today in the activities of researchers applying insights from systems ecology to the improvement of crop and animal yields across the world, though they may not necessarily define it as agroecology (Buttel, 2003). A comprehensive overview of all the different positions taken by

[2] The most abbreviated definition of food sovereignty is captured in the following extended quote from the Nyéléni Declaration (World Forum for Food Sovereignty, 2007):

"Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers and users. Food sovereignty prioritizes local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability. Food sovereignty promotes transparent trade that guarantees just incomes to all peoples as well as the rights of consumers to control their food and nutrition. It ensures that the rights to use and manage lands, territories, waters, seeds, livestock and biodiversity are in the hands of those of us who produce food. Food sovereignty implies new social relations free of oppression and inequality between men and women, peoples, racial groups, social and economic classes and generations"

agroecologists across the globe is a project which turned out to be well beyond the scope of this dissertation. Nonetheless the concept's development in Belgium may be illustrative of this fragmentation.

During our research we had the chance to contribute in interdisciplinary collaboration culminating in a paper which documented the activities of various actors operationalizing the concept of agroecology in Belgium in the 2000s and early 2010s (Stassart *et al.,* 2018). The concept "agroecology" in Belgium has likely had a dormant history within Belgian academia for quite some time, but its introduction in the broader public debate on agriculture and food is likely to have stemmed from local anti-GMO and food justice activism circles in the early 2000s. Within these circles the term was picked up through the formal and informal ties these organizations have with development cooperation initiatives in the Global South, where the term had become common. Contrary to common understanding perhaps, the organic farming movement did not introduce the concept of agroecology in this context, even though organic and agroecological farming are often used interchangeably. In fact, the organic farming movement in Flanders has its own complex intellectual history, with strong influences from Germany and England in particular, with authors like Rudolf Steiner, Alfred Howard and Lady Balfour, and with foundations in an extraordinarily eclectic range of political philosophies originating in the early 20th century (David Goodman *et al.* 2011 p. 57-59; De Wilde 2016). Yet despite this diverse and different history, agroecology was eagerly picked up by the Flemish organic farming movement when it was introduced in activist circles. In agroecology the organic farming movement saw an opportunity to break out of the narrow political goal of promoting of production under the organic agriculture label, and renew its commitment to a broader global societal vision. Taking up agroecology allowed it to connect its project to those of other environmentalist and social justice movements within Belgium, and accrues national borders. As a scientific discourse moreover, it also was seen as a way to improve and expand already existing connections with sympathizing researchers from the agricultural and adjacent social sciences. The Belgian professor Olivier De Schutter played a key role, as Special Rapporteur on the Right to Food appointed by the United Nations, to legitimize the concept within scientific circles and stimulated the formation of various agroecological coalitions (De Schutter, 2010). Stassart *et al.* (2018) document various initiatives in which these actors were involved and highlight controversies between and within these coalitions of actors. Underlying these controversies, there are three different but intertwined types of opposition: namely opposing material interests of the actors and organizations involved, differences in epistemological perspectives on what constitutes acceptable scientific work and opposing political ideological traditions. Largely inspired by the general framework of dominant discourses on environmental issues existing in the world developed by (Dryzek, 2013), the article posits three discourses implicit in the communications of various actors and organizations surveyed, namely "Radical Agroecology", "Strong Ecological Modernization", and "Narrow Ecological Modernization" (See Box 1).

In other words, Stassart *et al.*'s (2018) findings indicate that the concept of agroecology in Belgium had not developed in an ideological and organizational vacuum. Rather, it had taken different shapes in the hands of the actors that adopted it and therefore had interacted with other, more established systems of thought. In the case of Belgian agroecology, the article highlights that in particular the liberal and socialist/anarchist traditions. within green political thought (*cfr*. Hay 2002, p. 255-301) had left their imprint on the varieties of agroecology developing in Belgium at the time. Noticeably, however, and mirroring the broader Belgian political culture perhaps, the agroecological movement as a whole in Belgium has come to adopt over the years a mostly consensual and deliberative approach to societal change (IPES-Food, 2019), and moved away from the disruptive grassroots action and civil disobedience of the 2000s.

BOX 1: POLITICAL THOUGHT IN BELGIAN AGROECOLOGY

As the concept of agroecology came to be operationalized in Belgium, the presence of various strains of political thought became evident in the discourses of the actors involved in various initiatives. Stassart *et al.* (2018) identified three stances in Belgium, namely Radical (Agro)Ecology, Strong Ecological Modernization, and Narrow Ecological Modernization.

- The first position is related to a discourse of Radical (Agro)Ecology (RE), which clearly opposes what it has identified as an unsustainable neoliberal system of economic growth, which can only be resolved through political action and structural social change, towards a social and ecological system based on an alternative political model based on collectivist citizenship and social transformation. This discourse is associated with a politics of defiance towards regime actors, political disobedience, and grassroots activism. It is a critical discourse that disqualifies "the other forms of agroecology", which "*perpetuate some of the principles that peasant agroecology contests: the ongoing concentration of land ... seed patenting or techno-science-based and top-down solutions* ... ". RE has also taken a critical position towards contemporary agricultural sciences, which are seen as unwittingly reproducing the system, and therefore complicit in contemporary environmental and social devastation. It therefore looks favorably towards less "extractivist" (Baltazar *et al.*, 2017) and more engaged researcher and advisor practices towards farmers. Radical agroecology in Belgium is a lively place, home to a variety of movements, groups and thinkers and not without inner disputes itself. Yet within RE, civil society actors drawn to the concept of agroecology have taken up a particular strain of green radicalism, strongly inspired if not identical to the discourse of international rural social movements such as La Via Campesina (World Forum for Food Sovereignty, 2007)
- A more reformist position called "Strong Ecological Modernization" considers agroecology as a series of intrusive changes within the capitalist and productivist structure of the contemporary agro-food system (Dryzek, 2013; Potter & Tilzey, 2005). Proponents of this discourse tend to point towards specific evolutions of

the system, such as globalization, industrialization, lack of democratic oversight and top-down science. While it finds these features problematic, it doesn't believe tackling these requires an altogether different kind of political economic system, and as it believes a profound restructuring of the capitalist political economy is possible and sufficient. (Marsden, 2013). Their program defends a "radical move towards a new type of regionally embedded agri-food eco-economy. This is one that includes rethinking market mechanisms and organizations in an altered institutional context and is interwoven with active farmers and consumers' participation." Here too, the traditional mono-disciplinary and top-down approach in agricultural sciences is called into question. The politics is one of engaging with regime actors to change minds and create beneficial change within the conventional farming community, while also giving voice and advocating for support to grassroots activism and alternative farming initiatives, as they are seen as indispensable in making the transition.

- A third position within this continuum of political positions is a version of "Narrow Ecological Modernization (NEM)". NEM treats the issues of hunger and environmental degradation in technical terms, and seeks a managerial structure to retool capitalist industry. Agroecology within this discourse is to be considered alongside concepts such CRISPR-CAS technology, Big Data, and Precision Agriculture, which are all touted as solutions to world hunger, malnutrition and environmental problems. As such, agroecology is understood as a set of techniques that make smart use of ecological interactions, resulting in a long-term improvement of production. While skeptical about the productivity of these systems, NEM is supportive of organic farming and alternative food networks insofar as they function as "nurseries" for technological innovations (Keulemans *et al.*, 2015). Like SEM, this discourse may acknowledge that to speed up the implementation of certain promising innovations, changes in markets, policy, and a rethinking of scientific knowledge creation and dissemination is required.

Stage 6: towards a common program?

We observe that with the rise of agroecology to prominence on the political agenda, agroecology has entered a new stage of development. Many felt that the lack of a clear definition and common agenda was handicapping the effectiveness of the movement. Contradictory understandings of agroecology among researchers, practitioners, political activists and policy makers resulted in unnecessary suspicion and conflict that tied up the effective development and implementation of the discipline (Brym & Reeve, 2016). While (Stassart *et al.*, 2018) contend that agroecology has proven its transformative potential in Belgium, as it had brought actors together and stimulated debate, some were put off by these controversies and refrained from taking the concept of agroecology up any further. Recognizing that internal ideological debates were unlikely to be resolved in the short term, governmental and non-governmental organizations moved to develop more programmatic approaches (CIDSE, 2018; FAO, 2014). These sought to compile the ideas that most of the agroecological community could get behind. A common trait of such programs is that they present a set of propositions, in the form of general

principles, which arose directly or indirectly from scientific bases, backed up by the perspectives of different actors in the agroecological community (Norder, Lamine, Bellon, & Brandenburg, 2016). It is the closest agroecology has gotten to be a unified and general theory of agroecosystem design and management since its expansion from the hard systems ecology of the Odums. While we can't speak of a universally shared set of principles, as new sets of principles continue to be proposed every year, they are fairly effective in giving agroecologists a common agenda, rendering the concept more concrete to laypeople while allowing agroecology to continue to exist as a discursive continuum.

Conclusion & definition of agroecology

What this concise history teaches us is that agroecology has meant different things for different people, making it notoriously hard to pin down as a concept. But this history also allows us to appreciate the links between these people and their activities, and to apprehend that what gives coherence to the distinct categories of science, movement and practice is an underlying mental model (Rivera-Ferre, 2018). Inevitably, individuals have their own interpretation of the concept, and their own way of acting on this interpretation. However, in their collective grappling with this concept, individuals have formed a discursive communities with shared views. This includes, in reference to the three knowledge types which are part of a transdisciplinary project, views on (i) the nature and flaws of our contemporary food systems (system knowledge), (ii) views on what more desirable food systems might look like (target knowledge), and (iii) how to get there (transformational knowledge) (Brandt *et al.*, 2013). Considering this, we believe agroecology is best defined as:

a body of thought shared by a community of actors including farmers, researchers, activists, politicians and citizen-consumers which materializes in various activities such as scientific work, lists of principles, agricultural practices, discourses, activism and public policy. All of which give the world around us a palpably different, namely agroecological nature.

From this perspective, the common-place identification of agroecology with organic farming is a category mistake, very similar to equating nuclear physics with processes going on in a nuclear reactor. Similarly, one can say that identifying agroecology with particular agricultural practices like direct-seeding, mixed grazing or mulching, is like reducing Christianity to reading the Bible and pouring water over the heads of infants. As such phenomena are, however, manifestations of agroecology, empirical study of these can be instructive of coming to grips with agroecology, as one maintains this analytical distinction.

1.2.2. Agroecology: what needs to be done?

The very success of agroecology indeed raises formidable challenges to properly circumscribe its content. Owing in large measure to its emphasis on providing contextualized solutions, many agroecologists have eschewed developing the kind of clearly constructed propositions that would normally accompany a research agenda. Thus, as its influence has spread, the variations of what falls under the rubric of agroecology have increased, yet a common theory has become increasingly hard to discern. From the study of crops in their immediate biophysical environment, all the way to an all-encompassing definition of agroecology as the "ecology of food systems" (Francis *et al.*, 2003), agroecology has been inserted in just about any debate on sustainable agriculture and food. We find that this body of thought is more presented by its proponents as an intellectual orientation or perspective rather than a theory. According to Bell and Bellon (2018) this is a strength as earlier theories of agricultural development are said to have failed to recognize the diversity of agricultural systems observable around the world in terms of biophysical conditions, cultural beliefs and traditions of social practice. This has led scientists to advocate for the rigid application of the same solutions everywhere, with disastrous social and environmental consequences. Instead, Rosset *et al.* (2017, p. 9) propose that agroecology has a more careful and participatory methodology (Figure 1): "*Agroecology combines indigenous knowledge systems about soils, plants and so on with disciplines from modern ecological and agricultural science. By promoting a dialogue of wisdoms and integrating elements of modern science and ethnoscience, a series of principles emerge, which when applied in a particular region take different technological forms depending on the socio-economic, cultural and environmental context)"*. This model of a *diálogo de saberes* leading up to a consize list of principles has been widely adopted by the agroecological research community as well as agroecology-inspired social movements. And certainly in recent years, with the rise of programmatic approaches to institutionalize agroecology further, these lists have

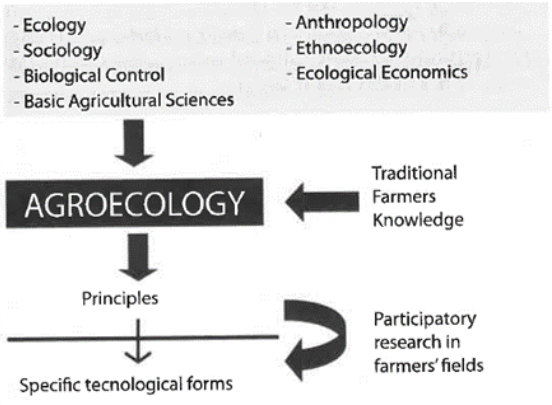

Figure 1 Model of agroecological knowledge generation and practical implementation (Rosset & Altieri, 2017, p. 9)

come to represent the most recognizable and perhaps even most widely accepted forms agroecological knowledge has taken to date.

Several lists of principles have been put forward by independent authors, loose author collectives, and collaborations of scientists and stakeholders within a more formal organization. Closer analysis of these principles shows that these lists may differ in the dimensions of farming they address. Many are limited to guidelines pertaining the techno-productive and ecological dimensions (Altieri, 1995; B. Dumont *et al.*, 2013), whereas others also concern the social-economic, social political and social-cultural dimensions of farming (Stassart *et al.*, 2012). Furthermore, there are differences in the scales at which these principles are to be operationalized (the field, the farm, the agricultural landscape, regionally or globally) and there are differences in the main actors they address (farmers, researchers, consumers, food manufacturers, retail, policy makers, public officials and/or citizens) (HLPE, 2019). Still, these lists can be said to follow some basic principles, connecting these different scales, scopes and stakeholders in one project. Wezel & Peeters (2014) suggest that these basic principles may well include: (1) having a systems or holistic approach, (2) considering simultaneously multiple scales (Dalgaard, Hutchings, & Porter, 2003), (3) having a participatory action-oriented approach (Méndez *et al.*, 2013) and (4) seeking to operationalize the biomimicry principle (*i. e.* designing agroecosystems that mimic the structure and functioning of natural ecosystems) (Ewel, 1999; Malézieux, 2012). We may also add here thinking contextually as Bell and Bellon (2018) propose.

Particularly relevant to our investigation, however, are principles to be operationalized on livestock farming systems in temperate and intensively farmed regions. Wezel and Peeters (2014) found that very few publications examined agroecological practices in a livestock system context up until the last few years. Most of the earlier work of agroecological researchers focused on cropping systems, (Altieri, 1995; Arrignon, 1987; Gliessman, Engles, & Krieger, 1998; Wezel *et al.*, 2014). And while Gliessman (2007) integrated a chapter about animals in agroecosystems in his book, he did not explicitly propose principles for livestock systems specifically. In recent years this situation has changed with more attention now being paid to how animal production can be integrated in sustainable food systems.. A group of researchers at the French agricultural research institute INRAE, proposed five principles for the design of sustainable animal production systems.

- adopting management practices aiming to improve animal health;
- decreasing the inputs needed for production;
- decreasing pollution by optimizing the metabolic functioning of farming systems;
- enhancing diversity within animal production systems to strengthen their resilience and;
- preserving biological diversity in agroecosystems by adapting management practices. (B. Dumont *et al.*, 2013)

These principles were adapted in the report of the International Symposium on Agroecology for Food Security and Nutrition (FAO, 2014) into the five goals of agroecology for sustainable livestock systems:

- integrated animal health management;
- recoupling the C, N, P cycles;
- increasing systems diversity and resilience;
- preserving and using biodiversity;
- reducing the use of external inputs. (FAO, 2014)

Bonaudo *et al.* (2014) analyzed agroecological principles that can help farmers to redesign and improve integrated crop-livestock systems. They also defined agroecological practices for crops, crop-livestock integration, and livestock.

- Diversity, i.e. heterogeneity, in land-use patterns and biotic and abiotic components.
- Maximization of ecological (e.g. predator–prey) or production-based (e.g. complementarities between production cycles) interactions.
- Consider the production, immune, and metabolic functions simultaneously to preserve the functional integrity of the agroecosystem
- Close the energy and material cycles; i.e. minimize losses and external inputs, and substitute chemical inputs with natural inputs.
- Optimize the nutrient availability for crops and animals. Nutrient availability is more often a question of temporal settlement between supply and demand than a question of absolute availability. The temporal dimension of management must therefore be at the center of the redesign process.
- Develop the collective management at the landscape level, including semi-natural elements. Ecological processes like pest control or pollination depend on the landscape scale. Integrated crop-livestock systems management has to extend beyond farm boundaries, which leads to collective landscape management among farmers and other users, including both farmed and semi-natural elements. The questions behind landscape scale management are as much related to biotechnical aspect as they are to the issue of collective management. (Bonaudo *et al.*, 2014)

It was, however, recognized that these lists of principles focus on the techno-productive and ecological dimensions of farming. "*Researchers cannot simply propose generic solutions and tools, but must consider animal production systems both holistically (on different scales from the animal to the landscape) and in their diversity, associating biology with economics and sociology*" (B. Dumont *et al.*, 2013). As such these publications recognized that they failed to elucidate what social reconfigurations of agroecosystems should accompany these technical reconfigurations. Nonetheless, there are recurring themes within the agroecological literature that address these social dimensions, and as A. M. Dumont *et al.* (2016) show in their study of Belgian short-chain marketing vegetable farms in Wallonia, Belgium, also appear to have some applicability at the farm level.

- *Environmental Equity*: enhanced by taking the negative environmental externalities in each economic choice into account
- *Financial independence*: Farmers and agricultural organizations are in control of the economic and technical decisions that they take, even if that means limiting the amounts of inputs used. This theme does not concern independence from the customers of the agricultural organization in question, which is considered a separate theme
- *Market access and autonomy*: access to and independence from markets for farmers and all collective production or processing structures
- *Sustainability and adaptability*: sustainability and adaptability of agricultural organizations stemming mainly from their inclusion in a network of farmers, consumers, technical advisors, and scientists
- *Diversity and exchange of knowledge*: Traditional, empirical, and scientific knowledge is exchanged among the members of an organization
- Social equity: social equity among all the stakeholders on all levels of the food system
- *Partnership between producers and consumers*: Partnership marked by the existence, whether formal or not of a social contract between producers and consumers
- *Geographic Proximity*: geographic proximity of the stakeholders in the various production, processing, and consumption phases
- *Rural development and preservation of rural fabric*: A food system's projects participate in rural development and preserving the social fabric
- *Joint implementation of the various principles in actual practice*: The principles that an organization defends must be implemented together rather than separately (A. M. Dumont *et al.*, 2016)

Except for the conceptual exploration by Wezel and Peeters (2014), little work seems to be done on elaborating this dialectic with the social sphere for livestock systems in particular. Moreover, the exploration of ecological principles on livestock systems are done mostly at a conceptual level, drawing from case studies in literature rather than original research (Soussana, Tichit, Lecomte, & Dumont, 2014; Wezel & Peeters, 2014). And lastly, these explorations draw inspiration from case studies of livestock systems in mountainous and extensively farmed regions rather than intensively farmed regions comparable to Flanders. All of this is insufficient from an agroecological perspective given that these principles are envisioned to be contextually applied. Consequently, there is a knowledge gap in the agroecological literature itself about what forms agroecology may realistically take on beef farms in Flanders.

1.2.3. Agroecology: what does it promise?

As we concluded in the previous section there is insufficient scientific understanding of what agroecology practically entails on Flemish beef farms. This doesn't help to make a case for the implementation of agroecology and its more desirable societal outcomes. The latter is an often heard critique towards agroecology

generally. With its rise to prominence in the public debate on agriculture and food, there have been increasing demands by stakeholders for evidence substantiating that agroecology does not only provide a critique of current food systems, but also a valid alternative. In response, agroecologists have compiled empirical evidence from across the globe in support of agroecology being a solution to many challenges that food systems are facing today. The evidence for agroecology is methodologically very fragmented due to the different time scales and performance criteria considered, and it is substantively diverse due to the various sets of practices in different contexts (FAO, 2019). This diversity stems from the fact that many solutions provided by agroecologists are context-specific, often take very different forms and target different challenges faced by stakeholders. So, while there are ample case studies documenting the societal benefits of agroecological interventions across the world, aggregation of these findings poses enormous methodological and conceptual difficulties. A number of reviews which maintain this comprehensive definition of agroecological interventions exist (Rosset *et al.* 2017, p. 68-97; van der Ploeg *et al.* 2019). Yet in doing so they appear to selectively cite success stories of agroecology, rather than to systematically survey the performance of systems in which actors have sought to implement agroecological insights, including their failures. This hasn't held a range of institutional, scientific and civil society actors back from seeing the major potential of agroecological systems in addressing the systemic challenges in food systems and in delivering many benefits to society. Particularly promising is the participatory, action-oriented research and experimentation methodology of agroecology. This is said to pave the way for knowledge-intensive (rather than capital-intensive) locally-adapted innovations to be developed by and shared between small and medium-scale producers, allowing farmers to meet new and evolving challenges such as adapting to climate change, natural resource scarcity, and new pests and disease threats (IPES-Food, 2019). Scattered as the evidence may be, it must have impressed the European Commission sufficiently to incorporate it as a promising approach in its new "Farm to Fork Strategy" (EC, 2020), further pressing the need to articulate what agroecology practically entails and what it realistically has to offer.

1.2.4. Agroecology: who needs to be doing it?

While agroecologists will generally speaking accept that all kinds of actors may play a role in the transformation of our food systems towards sustainability, in most agroecological theories of social change farmers play a key role (HLPE, 2019). The agency of farmers comes into view, namely their capacity to act otherwise in any given situation, or in realist terms, their ability to engage in a reflexive deliberation and give a normative orientation to their actions (Kok, Loeber, & Grin, 2021). What most agroecologists will readily acknowledge is that if given the space and means to do so, farmers (or at least a section of the farming population) will continuously innovate their practices, through their local knowledge and ingenuity and hence maintain and optimize the resource flows under their control (van der Ploeg, 2013a). The evidence for this claim is found in the countless instances documented by

agroecological researchers over the decades in which traditional and pioneering farmers develop, share and implement innovations amongst themselves with often very limited assistance of scientists (Mier y Terán *et al.*, 2018; Rosset & Martínez-Torres, 2012). The successfulness of this horizontal teaching-learning methodology, the *campesino-a-camesino* method, also provides the rationale to challenge and abandon the traditional top-down technological innovation model that accompanied the industrialization of agriculture in the second half of the 20th century. In this model, modern technologies developed by agricultural scientists and the agro-food industry, were handed down through extension services to farmers, who were expected to adopt these new methods. For many agroecologists, part of the social and environmental failure of the Green Revolution lay in this overconfident push of one-size-fits-all technologies by non-farmers, overlooking the context specific conditions and challenges faced by farmers, creating more new problems than solving existing ones (Bell & Bellon, 2018). Instead, it is argued, it is better to take a more participatory action-oriented approach towards technological innovation in agriculture, in which one should assume that in most cases the farmer will know best, and therefore should lead with the help of researchers and other local stakeholders the development of contextualized solutions.

Over time, however, agroecologists taking this reading of farmer agency within sustainable food system transitions, have found themselves in a growing and unexpected company. The understanding of farmers as innovators and teachers has been spreading within agricultural research community since the 1990s (Klerkx, Mierlo, & Leeuwis, 2012). Today, the involvement of private stakeholders, including farmers, throughout the innovation process has in fact become a key part of EU economic and agricultural policy. And many organizations hardly perceived as allies of the agroecological movement, such as the World Economic Forum and the Food Action Alliance that are advocating for a Fourth Industrial Revolution, are also calling for 'transformative partnerships' with farmers to empower them, and be part of the creation of a more sustainable and inclusive food systems, (Anderson *et al.* 2021, p. 135).[3] Sensing that the language of empowerment, inclusiveness and sustainability can easily be incorporated by perceived political opponents of the agroecological movement, more politically oriented agroecologists have sought to differentiate agroecology more explicitly on the subject of farmer agency from what they see as "depoliticized and technocratic approaches" to sustainable food system transitions (Anderson *et al.*, 2021; Levidow, Pimbert, & Vanloqueren, 2014). It is argued that such approaches deal out only a very limited role for farmers and other marginalized

[3] The scale of this change in attitudes to laymen's knowledge and innovation is such that this shift cannot be attributed to the efforts of the agroecological movement. This movement towards a more horizontal and inclusive approach to scientific discovery and technological development can have quite different epistemological and political underpinnings. For instance, the scientific historian Mirowski (2018) provocatively argues that the call for "open-science" is a concealed attempt by neoliberal intelligentsia to re-engineer science along the lines of platform capitalism, under the misleading banner of opening up science to the masses.

groups in shaping the future of food systems, and involvement is framed by and subjugated to the interests of other more powerful social groups, whose control remains unchallenged.

Instead, political or peasant agroecology promotes community-oriented approaches that look after the subsistence needs of its members. Altieri and Toledo (2011) argue, that agroecology (in their interpretation) very much privileges the local, as it emphasizes self-reliance, and the capability of local communities to experiment, evaluate, and scale-up innovations through farmer-to-farmer research and grassroots extension approaches. It does so because it puts faith in the rural rationality and practices of small peasants and their communities, which make the sustainable management of agroecosystems possible. Rather than looking to the state to take control over production, or negotiate with large companies to alter their ways, political agroecologists seek to limit the influence of the capitalist state and corporations on local food systems, and allowing local farmers and their communities to regain control over local resources. In other words, the key end and means of political agroecology is the offering of political agency to farmers, that is to them and their communities to shape their own individual and collective futures, or in short, Food Sovereignty (Holt-Giménez & Altieri, 2013). Peasant or political agroecology sees itself within the long history of emancipatory peasant struggles over the last two centuries (Guzmán & Woodgate, 2013). It believes that the development and promotion of alternative and traditional ways of farming are a form of resistance to and even a challenge to the existence of systems of dominations such as capitalism, colonialism, racism and patriarchy (Anderson *et al.*, 2021). In rhetoric at least then, political agroecology represents a break from other approaches to sustainable transitions of food systems, such as Climate Smart Agriculture, Sustainable Intensification, Bio-Economy. The latter approaches essentially advocate a retooling of capitalist agriculture with or without a restructuring of governance processes of the capitalist state, respectively corresponding with the earlier described narrow and strong ecological modernization discourses. A key contemporary theorist is the Dutch rural sociologist Jan Douwe van der Ploeg (van der Ploeg, 2011, 2013b), who connects rationality or moral economy that govern the "peasant mode of production" to the wider politics of resistance against the global systems of oppression, theorized as the corporate or corporate-environmental food regime by Harriet Friedmann (2005) and Philip Mcmichael (2013) respectively. In their pursuit of autonomy, van der Ploeg (2011) argues, peasants develop perspectives and views that strongly align with agroecology. Moreover, as large factions of the farming population can be categorized as peasants, they can become the social career that agroecology gravely needs, namely the group of people whose own emancipation (the struggle for its own interests and prospects) strongly coincides with the defense and further development of agroecological practices. Whether such a social group which meets these criteria actually exists, is a matter of on-going conceptual and analytical debate with strong opponents and supporters (Bernstein, 2014; Borras, 2020; Calvário, 2017; Henderson, 2018).

Historically, as the agrarian political economist Bernstein (2001) observes, farmers have proven themselves both allies and opponents of such emancipatory social struggles. It therefore is an empirical question whether their views and actions indeed align with agroecology. In the Flemish context of Flanders, little empirical work has been done on this matter, however, to go from to see if this theory of agrarian change has any purchase in this context. There are, however, both troubling and encouraging indications on the matter. The largest farmer union in Belgium has for a long time maintained a discourse that eschewed critiquing, if not promoted, the export-oriented and industrial nature of Flemish agriculture, while denying organic farming to be a viable alternative for farmers (De Cock, Dessein, & de Krom, 2016). The second largest farmer's union has historically taken up a more oppositional attitude towards the state and the agro-food industry, and has railed against the non-farming interests (marketing, distribution, banks, political party affiliations) influencing the politics of the larger farmers' union. However, in terms of environmental issues they join to more effectively weigh on policy, protecting the right of farmers to intensify and expand production (Crivits, 2016). Undoubtedly, such a negotiation position must not necessarily represent the views of the affiliated farmers, nor for that matter the views of all members working within the organization, yet it is worrisome from an agroecological perspective, given that they are through their many branch organizations an essential part of the cultural and commercial life of Flemish farmers. Over the years negotiation positions taken in by these farmer's unions on environmental issues have softened somewhat. Nowadays, not unlike representatives of the agro-food and retail industry, they tend to position themselves as key partners in the transition towards a more sustainable food system (Crivits, de Krom, Dessein, & Block, 2018). Another promising sign is the existence of activist umbrella organizations like Voedsel Anders and Agroecology in Action, having among their membership, Bioforum representing Flemish organic farmers, as well as many other small and informal associations which take up the concept of agroecology (van Hemert & Peeters, 2020). The existence of such organizations foreshadows then at the very least some willingness and capacity of Flemish farmers to pursue agroecological ends

1.3. Conclusion

In this chapter, we established that farmers in Flanders, beef farmers in particular, are under growing economic pressure and societal criticism. We also established that agroecology is considering its history, best defined as a body of thought, which while fragmented, puts forward a number insights to be implemented at the livestock farm level. While agroecologists may have failed to articulate a shared theory, we observe that this need not necessarily raise suspicions about the soundness of agroecological propositions. In fact, there is limited but thought-provoking evidence that their implementation provides societal benefits in very different contexts across the world. As such, we have to grapple further with the content of these propositions and how they may play out in practice. We also established that strains of political thought

within the agroecological community clearly represent something new for the agricultural sciences even today, challenging researchers, farmers, and activists to coordinate and even join activities with one and other. Not in the least in Belgium, it has given rise to new forms of research and politics, as it sparked the interest of certain elements within environmental and social justice movements, scientists included.

Very little empirical work has, however, been done that articulates what agroecology in practice means in the context of livestock farming in regions as intensively farmed as Flanders, and what role farmer agency plays in the further implementation of agroecology in this context. Considering these findings, we believe that an investigation into the relevance of agroecology as a body of thought to Flemish beef farming is a research topic of both scientific and societal interest.

Chapter 2

Research Questions & Methodological Roadmap

Research Questions & Methodological Roadmap

2.1. Research questions

The thesis put forward in this dissertation is that an analysis of the actions and perspectives of a diverse group of Flemish beef farmers will lead to an empirically grounded theory, giving insight into the relevance of agroecology in the context of beef farming in Flanders. The research questions guiding our inquiry can be put as follows:

1. PRACTICE: What actions can and do these beef farmers take to put agroecology into practice?
2. ACTOR: What is the role of the farmers' agency in the application of agroecological insights?
3. SYSTEM: What social-material processes and conditions contribute or limit the application of agroecological insights at these farms?

Our investigation thus situates itself at three distinct but inseparable levels: the practices of farmers, the agency of farmer, and the social context in which farmers are embedded. These question, furthermore imply a certain definition of the parameters of our inquiry; namely in terms of scale of interest (the farm within its social context), the actors of interest (the farmer), and the scope of the assessment (presence of the means of agroecology, rather than their performance).

Farm-level

While agroecologists endorse working on different levels of society and spatial scales, the farm, as an entry point, remains a privileged level and scale of agroecological analysis and design. As we have shown in this chapter, agroecology stretches for many agroecologists beyond the mere techno-productive and ecological dimensions of agroecosystems, but includes social dimensions often picked up by actors other than farmers. Farming as we contend has always been a social activity, and as such the farm level we hypothesize is likely to be an appropriate level to study both the technical and social dimensions of agroecology. A farm-level study which looks into the implementation of these insights, or lack thereof, in practice by beef farmers, may thus shed light on whether agroecology indeed materializes in practice in the context of beef farming in Flanders. The contextual nature of agroecological solutions, requires us to examine beef farming systems of sufficient diversity to appreciate the different forms it may take in this context.

Farmer-oriented

The role of farmers in sustainable food systems transition is the object of continuous debate within and outside of the agroecological research community, and

moreover largely unexplored empirically in the context of beef farming in Flanders. We observe that farmers are the principal actors at the farm level, particularly in their economic roles as agricultural workers, investors and managers. Hence, the implementation of agroecological insights hinges strongly on the situated self-understanding of farmers (Feola & Binder, 2010). However, in order to provide more generalizable insights on farmer behavior, we intend to take a more structural approach to farmer agency, that goes beyond merely critiquing the values and meanings that particular farmers attach to their actions. In other words, we intend to take a more structural approach, which also highlights the causal role of social and cultural structures mediating farmers' perceptions and behavior. The above mentioned diversity of farming systems, however, also leads us to assume that the implementation of agroecology may hinge on a multiplicity of factors, internal and external to the farm, and may even be specific to each farm in question. As such we need to pay close attention to differences in how farmers perceive their situations, as well as the different social context in which they make decisions.

Means as opposed to performance

As noted, there is no conclusive evidence supporting the societal benefits that a more agroecologically-oriented transition of food systems may entail globally, but also in the context of beef farming in Flanders. From a governance perspective that demands clear systematic and generalizable cost-benefit calculations of agroecological interventions, this clearly would be an important knowledge gap to be filled. Whereas important efforts have been made in recent years in that regard (Botreau, Farruggia, Martin, Pomiès, & Dumont, 2014; FAO, 2019; Landert, Pfeifer, Carolus, & Al., 2019), our investigation will not assess the performance of "agroecological farming systems" as a proxy for agroecology 's social relevance in this context. Such is rather limited, as it takes current institutional arrangements and cultural preferences as given. This is not our view, nor that of many agroecologists. Agroecologists don't propose quick-fix solutions, but rather a program to steadily transform food systems, which include the current institutional arrangements and cultural preferences on which they are based. Consequently, it is more appropriate to examine the relevance of agroecology in this context based on how it may change food systems on the middle and long-term. As argued in previous chapter, agroecology is best understood as of a body of thought, the relevance of agroecology doesn't hinge on the performance of a particular system or sets of practices, but rather on whether it can be of any social consequence, by manifesting itself in the everyday activities of human beings. For an investigation like ours that is focused on the farm-level and is farmer-oriented, this means the following: are agroecological ideas put into practice by the farmer, and if so, how and why?

2.2. Methodological objectives

In this research we aim to develop an empirically grounded theory giving insight into the relevance of agroecology in the context of beef farming in Flanders, by analyzing the actions and perspectives of a diverse group of beef farmers. The implement this approach we need to reach, however, a number of methodological objectives.

- devising a method to sample a group of Flemish beef farmers of interest to our investigation;
- devising a method which allows to explore and compare the implementation of agroecological insights by these farmers.
- devising a method which allows study the role farmers' self-understanding has in implementing agroecological principles.
- devising a method to explain observed behavior by these farmers in terms of their social context.

Scientists have developed over the centuries an enormous diversity of empirical and analytical methods to characterize and explain farmers and farming systems across the world (Lacoste, Lawes, Ducourtieux, & Flower, 2017). It is not our intention, however, to simply adopt methods and theories that happen to be convenient in that they are popular or widely accepted within certain research communities. It would be quite ironic if by examining agroecology, which contains a clear critique of scientific dogma in the agricultural sciences, we would unreflexively reproduce this and other scientific dogmas of our own. Nonetheless, the practical nature of our research compels us, however, to make methodological choices in due time, and not be caught in an infinite loop of philosophical skepticism. It is at this point that philosophy of science may prove useful in applied research, as it may function as a foundation from which to evaluate the efficiency and effectiveness of certain methods in reaching to certain objectives.

2.3. Philosophical foundations

Methodological choices always presuppose an ontology, that is a set of substantive claims about the world, and an epistemology, a set of substantive claims about how knowledge of it arises (Venkatesh, Brown, & Sullivan, 2016). Whereas different philosophical perspectives may have allowed fruitful scientific work, we were inspired throughout this research by critical realist literature to make choices regarding methods of data gathering and analysis, to assess the validity of other scientists' claims and ultimately those of our own. In this section we will elaborate on this critical realist position, as it contributes to the selection of methods used in our research.

Critical realism is a relatively new philosophical perspective that offers a radical alternative to the established paradigms of (post-)positivism or empiricism and

interpretivism or constructivism[1]. Critical Realism is a movement in philosophy and the human sciences and cognate practices most closely associated with, though by no means restricted to, the work of Roy Bhaskar (Archer, Bhaskar, Collier, Lawson, & Norrie, 1998). Fundamentally, Critical realism is a philosophy of science that is founded explicitly upon *a priori* or necessary truths about the nature of the world. It holds to the view that, on the one hand, there is a mind-independent external reality and, on the other hand, that it is possible that some things that exist in the world (external reality) can become progressively known – and that is why science and research, aiming to explore and understand the world, have been developed. In parallel though, Critical realism acknowledges that there is a distinction between the way things are and our knowledge claims about those objects of knowledge as well as the fallibility of knowledge claims – the latter being always relative to the historical, social and political context in which they were produced. (Sorrell, 2018). Critical Realism asserts that reality itself is differentiated as it comprises (1) the empirical; (2) the actual; and (3) the real domain (Figure 2). The 'empirical' consists of our experiences of what happens in the world; the 'actual' is constituted by our experiences as well as by events, independently of whether we experience them or not (i.e. whether they may go unnoticed); and the 'real' comprises of our experiences, events as well as causal powers and deep structures or what might, metaphorically, be called mechanisms with generative power, i.e. the power to produce events (Koutsouris, 2012).

Critical Realism suggests that in order to effectively explain phenomena one needs to move from descriptions of empirical events or regularities to hypothesizing the existence of causal mechanisms, of a variety of kinds, some of which may be nonphysical and non-observable, which could potentially have generated the observed events. This move from the empirical to the domain of the real, is made possible only by the logical operation of retroduction. In contrast to deduction where a rule is tested by an experiment, and to induction where a rule is established based on the frequent recurrence of similar phenomena, retroduction takes an unexplained phenomenon and proposes hypothetical mechanisms that, *if they existed*, would generate or cause that

[1] Positivism is premised on the existence of *a priori* fixed hypotheses or relationships among constructs, which validity are typically assessed by testing these against empirical data gathered through structured instrumentation. Positivists hold that the researcher and the object of inquiry are independent of each other, and therefore that scientific theory and results are objective as opposed to value-laden opinions. Postpositivists accept that theories and researchers' backgrounds, knowledge, and values can influence the study, yet still hold that the positivist method of inquiry to an extent, as they take the position that bias is undesired but inevitable, and therefore the investigator must work to detect and try to correct it. In contrast, constructivist/interpretivists hold that all hypotheses are to be regarded as constructions creating imagined relations between phenomena, and consequently, can never be submitted to decisive empirical tests, since there are no facts independent of the theories to test them against. All researchers can do is try to understand phenomena by accessing the meanings participants assign to them Phenomenological sociology, hermeneutics, and ethnography exemplify the constructivist approach (Bhaskar, Danermark, & Price, 2018; Venkatesh *et al.*, 2016)

which is to be explained[2] (Mingers, Mutch, & Willcocks, 2013). Following from such an epistemology and ontology, a number of principles emerge:

- distinguish between generative mechanisms and the actual events that they cause in particular circumstances (e.g. there is a difference between the falling of an object and the mechanisms that may make it fall)
- distinguish between a theory and the generative mechanisms that the theory describes, (*e. g.* disproving gravity theory doesn't deny that some mechanisms may exists that lead objects to fall)
- distinguish between the actual events and the empirical traces of these events which are observed or experienced, (e.g. failure to observe the fall of an object doesn't deny that that object actually fell)
- follow an iterative research process based on retroductive reasoning in which the central question is "what must the world be like for this phenomenon to be possible" (*e. g.* Isaac Newton considered that the existence of a force pulling things to the earth could explain a whole lot about his lived reality, including the falling of the apple on his head) (Smith & Johnston, 2014).

Such principles allow to anticipate what kind of descriptive and explanatory inferences may conceivably be made based on the data generated through various methods, and as such were of help in choosing and developing the different methods in this research.

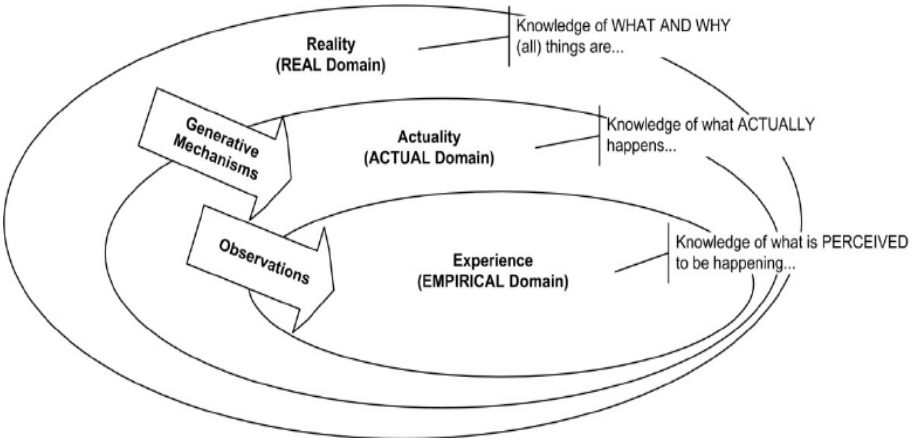

Figure 2 Critical Realism Concept Diagram. Critical (Bennett, 2013)

[2] A fourth mode of inference is abduction, first described by the American pragmatist philosopher Peirce. Like retroduction it is a more comprehensive way of reasoning that seeks to link the individual to the universal/general, as it asks what meanings are given to a phenomenon within a particular conceptual framework, and thus focuses on reinterpreting and contextualizing within a new framework. Unlike retroduction, then, it doesn't depend necessarily on a realist transcendental argument, but on a hermeneutical one (Danermark *et al.* 2019, p. 96-134)

2.4. Empirical research and existing theory

At the beginning of our research, we quickly discovered, by exploring the agroecological scientific literature, but also the literature critical of agroecology, that there is a wide range of conceptual frameworks to characterize and explain the actions and perspectives of farmers, as well as the context in which they are embedded in[3]. Despite the existence of many compelling frameworks, we chose not to commit to a particular conceptual framework, in order not to exclude more fruitful descriptions and explanations of what we were about to witness from the start. As researchers with no formal education in the social sciences, we appreciated that we should continuously take advantage of the enormous body of existing literature along the way. The continuous improvement of our theoretical sensitivity was also estimated to bring the ability of becoming aware of our own implicit sociologies that we brought into the analysis of the data, be more sensitive to particular details in the data the untrained eye would gaze over, and perhaps even develop an original theory that gives a better explanation of the observed phenomena than existing conceptual frameworks could. As the saying goes: "*a dwarf standing on a giant's shoulder may see further than the giant himself*". As such we considered that a more a more pluralistic stance to theory, that still holds to a number of philosophical premises would be possible, and that as the empirical evidence came in, a theory would emerge out of a continued dialogue between gathered data and the literature we would come across throughout our research. Publications outlining the possibility of an informed grounded theory as a method of data gathering and analysis, consistent with a critical realist philosophy, suggested that such a pluralistic and conceptually open approach wasn't just wishful thinking on our part.

Grounded theory has popularized the emergence of theory from data since the publication of "The discovery of Grounded Theory" (Glaser, Strauss, & Strutzel, 1968) has become a dominant data-analytical approach across sociology, anthropology, social work, education, law, management, nursing and medical research, and computer and information sciences. And its coding schemes and heuristic principles have been incorporated into the most widely used qualitative data analysis software programs (S. Timmermans & Tavory, 2012). While grounded theory has been dismissed by some critical realists for its empiricism, rigidity and focus on induction, others have argued that it can be adapted to the needs of critical

[3] We took note for instance of various systems ecological perspectives (*e. g.* Conway, 1987; Cox, Atkins, & others, 1979; Marten, 1988), of agrarian political economic perspectives (*e. g.* Bernstein, 2010; Chayanov, 1966; Marsden, Munton, Ward, & Whatmore, 1996), of agricultural economic perspectives (*e. g.* Colman & Young, 1989), of historical perspectives (*e. g.* Mazoyer & Roudart, 2006; Worster, 1990), actor-oriented perspectives (van der Ploeg, 1994), social-ecological and social-technical systems approaches (Geels & Schot, 2007; Walker, Holling, Carpenter, & Kinzig, 2004). We found so-called relational approaches (Darnhofer, Lamine, Strauss, & Navarrete, 2016) particularly compelling and innovative, and were also inspired by the dynamic and ecological understanding of society outlined by the geographer David Harvey (Harvey 2010, 189-200), which he recognized in a footnote of Marx's *Capital* (Marx, 1867).

realist inquiry (Oliver, 2012). There has been a shift by leading authors in grounded theory methodology, from pure induction to an embrace of abductive logic, *i. e.* inference to the best explanation, to analyze data that fall outside of an initial theoretical frame or premise (Charmaz, 2008). This means that grounded theory can now accommodate researchers' pre-existing theoretical knowledge, hunches and hypotheses as necessary points of departure and building blocks for the development of more abstract theory (Oliver, 2012). Used in conjunction, abduction and retroduction can lead to the formation of new conceptual frameworks and theory (Meyer & Lunnay, 2013). A critical realist grounded theory approach thus emerges that is in line with its ontological and epistemological positions, by stressing the place of abduction and retroduction in theory generation, by having a dual focus on social structure and agency for explaining social behavior, by conceiving of causality as mechanisms rather than as regularities, and by being informed, explicit and agnostic about already existing theories on the observed phenomena to be explained.

2.5. Selected methods

In contrast to interpretivism and positivism, Critical Realism does not commit to a single type of research but rather endorses a variety of quantitative and qualitative research methods, as it accepts the existence of different types of objects of knowledge—physical, social, and conceptual—which have different ontological and epistemological characteristics (Zachariadis, Scott, & Barrett, 2013). Hence, the nature of these objects of knowledge requires scientists to develop a range of different research methods and methodologies to access them. In this view, the strength of quantitative methods is that they may be used to develop reliable descriptions and provide systematic comparisons. In the exploratory phase of an investigation, quantitative methods can identify patterns and associations that may otherwise be masked. This may help to tease out new and unexpected causal mechanisms. Quantitative methods can also be used to test out theories about how causal mechanisms operate under particular sets of conditions. The key strength of qualitative methods, from a critical realist perspective, is that they are open-ended. As such, they may allow themes to emerge during the course of an inquiry that could not have been anticipated in advance. Qualitative methods can help to illuminate complex concepts and relationships that are unlikely to be captured by predetermined response categories or standardized quantitative measures. In many cases, however, it is suggested that the most effective approach will be to use a combination of quantitative and qualitative methods or techniques (Mcevoy & Richards, 2006; Mingers *et al.*, 2013).

In our research we decided to adopt a mixed methods research approach for the reasons of expansion (*i. e.* the combination of multiple methods allows to reach the different research objectives, which a single method could not), and complementarity (*i. e.* the use of multiple methods allows for complementary views, generating a deeper understanding of both the lenses used and therefore the phenomenon under study)

(Maxwell & Mittapalli, 2010). For this research, five methods in particular are significant to our investigation.

2.5.1. Structural typologies

In order to obtain a diverse sample of beef farmers to gather data, we believed it was important to have an overview of the actual diversity of beef production systems in Flanders. The availability of a very large dataset containing quantitative information on a sizable and representative sample of cattle farms by Statistics Belgium, provided an opportunity to contribute empirically to this question ourselves. Both expert-driven and data-driven structural typologies are proven tools to explore farm diversity (Andersen, Elbersen, Godeschalk, & Verhoog, 2007). We believe, however, that a mixed approach which on the one hand uses the opinions of experts familiar with the sector and on the other hand, builds on the patterns revealed by data itself, may provide rich insights into the diversity of Flemish beef farming systems.

2.5.2. Semi-structured Interviews

To disclose what supports or limits the application of agroecological insights on our case study farms, a method needs to be developed to estimate the current and actual implementation of these insights on beef farms. A list of practices contributing to the implementation of agroecology in this unexplored context does not exist. Consequently a more open-ended approach needed to be developed. Grounded theory (Glaser *et al.*, 1968) has popularized the idea that theory should emerge from data, rather than the other way around, which led us to believe that simply by asking farmers how they put agroecology into practice, a concept of agroecological practices in this context could be articulated. In our intuition very few farmers in Flanders were familiar with agroecology as a concept and for this reason, a framework needed to be provided to farmers. We therefore hypothesized that a discussions of a list of principles assembled from a literature review with farmers in a semi-structured interview would produce rich accounts on which basis the agroecological nature of individual farmers sets of practices could be inferred, as well as the mechanisms and conditions leading to these particular pursuits.

2.5.3. Cognitive Mapping

The diversity and complexity of farming systems requires us to come to grips with the different processes which may varyingly sustain farms as a whole, as this may impact the feasibility and form of agroecology at different farms. Farmers' perspectives on this topic are crucial to this question, as they are first-hand witnesses of these processes day in, day out. Ecologists have characterized ecosystems as open systems of marked complexity including various feedback loops and processes, which maintain and at times transform its structure (Holling, 1996). Systems methodologies have proven powerful tools to come to grips with this complexity. Increasingly such modeling tools are also applied in research on social-ecological systems, such as

agroecosystems, particularly CM has come to the attention, because it allows actors holding knowledge types to include model complex relationships which are full of feedback loops, which may at times not be known with certainty, or pertain to more abstract and aggregate ideas (Özesmi & Özesmi, 2004). It is our contention, however, that the application of such methodologies to study social phenomena will also invite us to consider how farmers themselves are part of these processes, and thus help us come to grips with farmer agency as a causal force in its own right in shaping the development of farming systems. Indeed to explain the very existence of agroecosystems, it is necessary to account for actors' beliefs about their lifeworld as this shapes their situated behavior (Archer, 2003). Cognitive mapping may provide us insights not only into what farmers believe about their farm, and what and how interactions between various objective processes occurring on the farm contribute to the maintenance of the farm as a whole, but also into the dynamic between a farmer's perceptions and farm functioning itself.

2.5.4. Theoretical sampling

As we estimated that a qualitative approach was pertinent to explore farmers' perceptions and agroecological practices on Flemish beef farms, we are constrained to a medium-sized sample of farmers. A population with large structural diversity is, however, hard to fully represent in such a sample. Moreover, a representative sampling approach would like fail to include 'alternative' agricultural systems such as organic and short-chain-food networks in urban and peri-urban areas are regularly touted as emblematic instances of agroecology in this region (Stassart *et al.*, 2018). It seemed therefore more appropriate to adopt a theoretical sampling approach, which Corbin and Strauss (2014) define as "data gathering driven by concepts derived from an evolving theory and based on the concept of making comparisons, whose purpose it is to go to places, people or events, that will maximize opportunities to discover variations among concepts and to densify categories in terms of their properties and their dimensions. Such a flexible sampling approach, which took into account the data as they were coming in, was estimated as the most efficient to explore the scope of agroecology as a practice in the Flemish beef sector apparent with a medium-sized sample.

2.5.5. Structured questionnaires

By applying a theoretical, rather than a representative sampling approach, we risk losing sight of the representativeness of our sample for the Flemish beef farm population at large. We hypothesized that a structured questionnaire, that extracts from our case study farms information similar to that in the dataset of Statistics Belgium, may allow a cross-reference from our sample to the general population of Flemish beef farms. It was also estimated that these questionnaires may also provide an additional and more systematic account of the activities that took place on these farms in our sample, further strengthening our descriptive and explanatory inferences about the selected farms and farmers.

2.6. Overview of the research process

Our approach combines the above-mentioned methods of data gathering and analysis in one design (Figure 3). We first made an exploratory analysis of quantitative data of a large number of cattle farms in Belgium made available by Statistics Belgium, by way of a structural typology informed by insights gathered through literature review and interviews with experts familiar with the beef sector (1). Based on these insights we established a theoretical sampling strategy to select farmers to interview (2). After initial experiences with the methods of data gathering in four pilot interviews, we devised an interview guide to conduct interviews with farmers that consisted out of seven steps (see Annex 1 for the full interview guide) (3):

1. First, as a way of social introduction, the interviewer presents him-/herself[4] and the research project.
2. Then, the farmers are provided an informed consent agreement specifying the further use and processing the gathered data, and asked to read and sign it.
3. To familiarize ourselves with each situation, the farmer is asked a series of open-ended questions on the farm's history, current agricultural activities, perceived strengths and weaknesses of the farm, and their future perspectives.
4. Then, the farmer is assisted in drawing a cognitive map of his/her farm, which includes an explanation of the mapping process, the mapping itself, and some follow-up questions to farmers to reflect on the map they drew (for more details on the method see chapter 6).
5. Then, the farmers are confronted with a set of principles addressing common themes in the agroecological literature in semi-structured interview format, and asked how and why they believed they were applying or failed to apply this principle on their farm (For more details see chapter 4).
6. Then the farmer is asked to fill out a structured survey form,
7. Lastly farmers are asked for referrals of other beef farmers.

Data is thus collected on our case study farms in three distinct formats (an audio recording, a physical map drawn by the farmer, and a filled out questionnaire). These data are then processed (4) and analyzed (5) sequentially to describe the whole sample of farms and then group farms based on indicators, practices mentioned and the content of the CMs. After this initial description the data are triangulated in order to identify correspondences and discrepancies between the views that these different methods grant us. Concepts provided by the scientific literature are actively incorporated in these analyses to enhance our perceptivity. These analyses are supposed to lead to both a more complete description of the farms, the farmers and

[4] Ten interviews were conducted concurrently with the other interviews by a master thesis student (Monsieurs, 2018).

their practices, and to an explanation on what sustains or limits the implementation of agroecological principles at these beef farms. A cross-reference of the survey data (structured questionnaire) and the Belgian Statistics dataset allows us to situate the identified sample groups of farms within the wider farm population, and to extrapolate our findings (6).

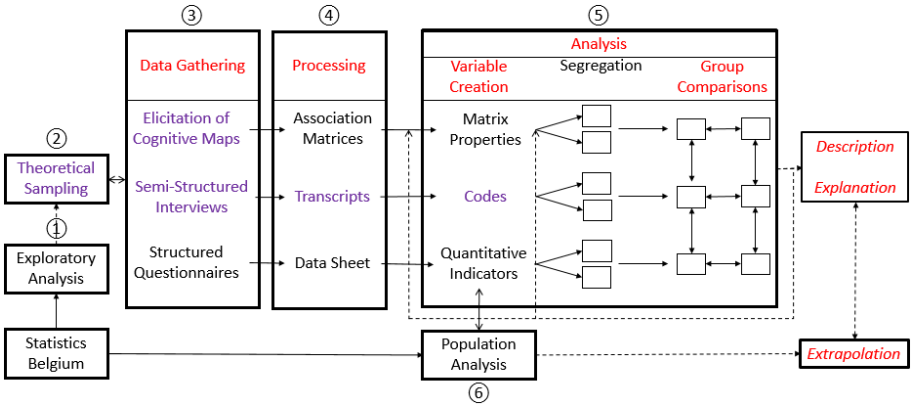

Figure 3 Diagrammatic representation of the research process. Steps in black are mainly of quantitative nature, in purple mainly of qualitative nature, and in red of mixed nature. In contrast to the full lines that represent steps where data flow, are juxtaposed or transformed, the dashed lines represent inferences that influence these data transformations: based on previous observations new hypotheses are made, which in turn will inform data gathering and analyses.

2.7. Chapter outline

For the sake of clarity and due to the complexity of the method, we have carved out different chapters, each with a different focus, and each with its own specific method of data gathering and analysis, each covering a part of the research process and a part of the findings that emerged out of it. Figure 4 visualizes in diagrammatic form the method of presentation followed in this dissertation.

Part II consists out of four chapters, each presenting parts of the results of our empirical work, and establishing preliminary findings on our research questions in the light of the relevant literature. Chapter 3 lays out the groundwork for our field work. Here we present the materials, methods and results that lay at the basis of our sampling strategy (namely an original structural typology of beef farming systems in Flanders based on expert interviews and multivariate and descriptive analyses of farm census data), the articulation of the sampling strategy itself, and we situate the obtained sample of 37 beef farms within the broader beef farm population based on the information gathered through the quantitative questionnaires. This chapter provides first empirically grounded insights into the scope of agroecological practices (RQ1) on farms operated by beef farmers (RQ2) in the Flemish context (RQ3). In chapter 4,

it is explored what agroecology may practically entail at Flemish beef farms, based on the accounts these farmers gave when they were confronted with a list of 13 principles derived from the literature. The output of this chapter is a conceptual framework describing 36 Pathways of Action the interviewed beef farmers follow to put agroecology into practice. This chapter contributes mainly to answering RQ1. In chapter 5, the conceptual framework developed in chapter 4 is applied to compare the sets of practices mentioned by each farmer from an agroecological perspective. With Archetypal Analysis we identify groups of farmers pursuing agroecological in a similar way and describe and compare the different farming models that underlie their sets of practices. Chapter 5 therefor further contributes to answering RQ1. Chapter 6 presents an analysis of the functioning of these farming systems, *i. e.* what different processes may varyingly sustain the farm as a whole, and in particular what role farmer agency plays in this. This is done by developing and applying a cognitive mapping approach. This chapter contributes mainly to RQ2.

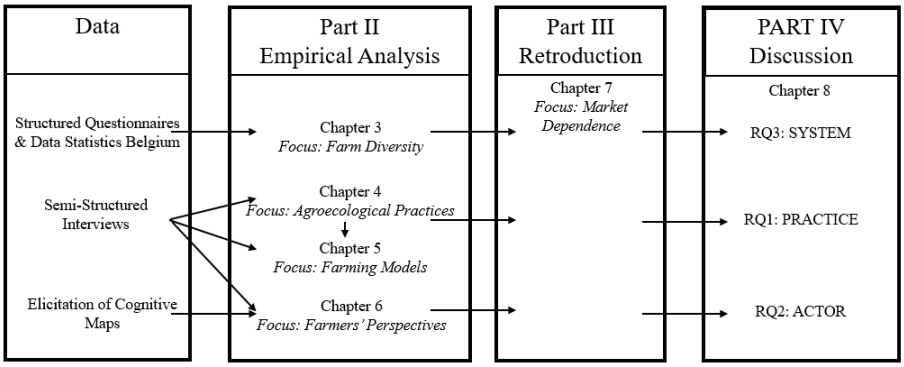

Figure 4 diagrammatic representation of our method of presentation followed in this dissertation, highlighting the interrelation between the data used for this research, chapters and the research questions.

Part III contains a lengthier chapter, in which we take the patterns revealed in Part II, and ask the retroductive question: what must necessarily be true about the world farmers are living in and farmers themselves that we would get the accounts farmers have given about their actions and beliefs? Considering the findings of Part II, we decide to focus our attention on a particular aspect of these farmers' social reality, namely their market dependence. From there we develop a critical realist informed grounded theory to explain the diversity perspectives and sets of practices observed. We present this theory as an analytical framework that emerged out of the literature review and then explore this framework in the light of the accounts farmers gave about themselves, their actions and their social environment. In the discussion section, we discuss what new insights this exploration brought forward about the varying role market dependence may play in enabling or constraining farmers ability and willingness to put agroecological principles in this context. We also reflect on how this theory problematizes a number of conceptions of market dependence common in the agroecological literature. Lastly, we consider whether certain aspects of farmer's

social reality were undertheorized and underexplored empirically. This chapter contributes mainly to RQ3, and revisits insights on RQ1 and RQ2 provided in the previous chapters.

In Part IV, which contains the last chapter, we reflect on the scale, scope and aims that we were able to cover in this research with the followed approach outlined in this chapter. We then proceed by discussing the findings of the followed approach with regard to the three research questions, as well as the methodological contributions we made along the way. We conclude with a societal reflection on how to advance agroecology as a practice, science and policy for sustainable food systems in this context.

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PART II
EMPIRICAL ANALYSIS

Chapter 3
Sampling for Diversity

Sampling for diversity

In this chapter we present the materials and the methods that lay at the basis of our sampling strategy to explore the relevance the relevance of agroecology to beef farming in Flanders, articulate the sampling strategy, and situate the obtained sample within the broader beef farm population. A key part of this is the construction of an original structural typology of beef farming systems in Flanders based on expert interviews and multivariate and descriptive analyses of farm census data from 2011 provided by Statistics Belgium. Out of these analysis the fuzzy boundary definition of beef farms, emerges which is handled in this dissertation. We find that beef farms, both broadly and narrowly defined, are diverse along multiple dimensions, such as scale, employment, degree of specialization, forage strategies and land use intensity, based on a small set of indicators that can be calculated on farm census data from 2011. These insights are then used to formulate the theoretical sampling strategy applied that led to the sample of farmers from whom further data was gathered for the purposes of this research. To conclude this chapter, we situate the sample of the 37 beef farms within the beef farming population, by comparing the structural characteristics of these farms, based on the analysis of the gathered structured questionnaires filled out by the interviewed farmers, with those in the dataset provided by Statistics Belgium,. We find that our sample consists on average out of relatively large farms and full-time employed farmers, which takes, as intended, a disproportional interest in organic and direct selling farmers.

3.1. Introduction

While the industrialization of agriculture came about through a move from diversified subsistence agriculture to more specialized market-oriented agriculture (Mazoyer & Roudart, 2006; Worster, 1990), there is empirical evidence suggesting that an enormous diversity of (livestock) farming systems exists in the Western Europe in terms of structural characteristics such as crop and livestock species, holding size, external input use intensity, within regions and across regions (Gibon *et al.*, 1999; Guiomar *et al.*, 2018; Landais, 1998). This has led some scholars to suggest that there remains scope for a diversity of practices to produce agricultural commodities, among which more agroecological ones, even in regions where modern technologies, such as chemical pesticides, motorized agricultural vehicles and commercial hybrid seeds and breeds have been introduced since their development (van der Ploeg, Laurent, Blondeau, & Bonnafous, 2009), This hypothesis of persisting or even emerging farm diversity is relevant for our investigation, but we would also like to verify it in this context.

Yet, in order to explore the diversity of beef farms in Flanders, we first need to arrive at a definition of beef farms suitable to our empirical investigation. The

definitions put forward by the European Commission (EC 1242/2008), farms are classified based on the size of their agricultural output and the relative contribution of different agricultural activities to that output. Such a definition[1] would close the analysis off, however, from those farmers who combine beef production with significant other agricultural activities, such as dairying, pork or poultry production, cash cropping *etc.* This is problematic from the vantage point of the questions raised by this dissertation, given that agricultural diversification is precisely a key theme in the agroecological literature (Dumont *et al.* 2016). Consequently a more comprehensive definition for Flemish beef farms needs to be established first.

This chapter covers the methods and the corresponding results of the following steps of our research presented in this chapter (figure 5): (i) the construction of a structural typology in order to come to a definition of beef farms and explore the diversity of beef farms in Flanders, (ii) formulating a sampling strategy based on the patterns revealed by this structural typology in light of our objectives, and (iii) situate the obtained sample of farms within the broader beef farm population to examine the representativeness of our sample.

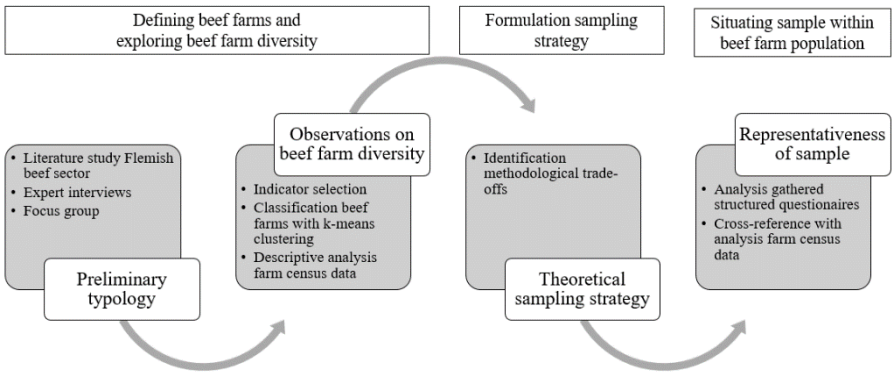

Figure 5 Diagram of methods and steps to obtain and situated the sample of beef farms studied in this research

3.2. Materials and methods.

3.2.1. Defining beef farms and exploring beef farm diversity

In agricultural research, typologies are longstanding and proven tools for the inquiry of farming system diversity (Andersen *et al.*, 2007). Ideally, a typology is a

[1] Beef farms by this definition are farms where at least two thirds of their standard output coming from forage production and grazing livestock products, with at least a third coming from grazing livestock products, with two thirds of this grazing livestock output coming from cattle and one tenth or less from dairy cows (type 460).

classification showing a maximum amount of heterogeneity between types and a maximum homogeneity within types (Köbrich, Rehman, & Khan, 2003). Whatever the farm characteristics considered, a classification of farming systems can be based on two sources of information: *a priori* knowledge and collected data (Alary, Tillard, Messad, & Taché, 2002; Iraizoz, Gorton, & Davidova, 2007; Lebacq, 2015; Madry *et al.*, 2013; Righi, Dogliotti, Stefanini, & Pacini, 2011). Depending on the emphasis of these two sources of information, one can distinguish between expert-based and data-driven methodologies. In the first class, the farm types are built based on the knowledge and judgment of key informants, in the second class, data on a large number of variables is analyzed with an algorithm which finds interlinkages between these variables to create a classification of farms different for these variables overall. In reality, however, all typologies make use of some form of *a priori* knowledge, because a critical phase in typology construction is variable selection. A major challenge of typology identification typically consists in the large variability of farm production systems, socio-economic circumstances and biophysical conditions, which are distinctive of the agricultural sector. To this end, it is often beneficial and sometimes imperative to include local expert knowledge (Pacini *et al.*, 2014), and insights based on literature research in the process of typology identification. Once the variables for classification have been selected a new hurdle arises as a method of categorization needs to be selected. While analytical methods are preferred due to their objective replicability, their statistical foundations and their efficient use of information (Köbrich *et al.*, 2003; Madry *et al.*, 2013; Pacini *et al.*, 2014), and therefor necessary lead to proper farm classifications on their own terms, they may remain poorly recognizable to many stakeholders involved in the process of dealing with farm diversity. Instead, we opted for a mixed approach for variable selection, indicator design and classification that consisted out of a qualitative phase followed by a quantitative phase.

3.2.1.1. Qualitative phase: defining and classifying beef farms

We started out from unpublished exploratory research conducted in 2015, aiming at enlarging agroecological knowledge in the Flemish bovine sector (Schotte, Baret, & Marchand, n.d.)[2]. In that study, in-depth interviews were conducted with several field experts (n=3) in order to grasp the complexity of the sector. Topics discussed during this interviews were, among others; the evolution of the sector's structure, value chain, stakeholders and policies. Based on research of this exploratory phase a preliminary typology of the Flemish bovine sector was created. An interdisciplinary

[2] The qualitative data gathering as well as an initial analysis of both the qualitative and quantitative data was conducted by Laura Schotte. All other steps in this dissertations are original contributions of the candidate.

focus group was held to discuss and fine-tune this typology. To organize this focus group an invitation was send to different stakeholders from the bovine sector (n=17), ranging from researchers, policy makers, advisors and farmer's associations. The response rate was low, so the final focus group consisted of three persons, one moderator/interviewer and one note taker. Despite the small group size all the participants had different backgrounds and contributed to the group discussion, two important requirements leading to valuable results. The structure and content of the focus group were discussed and revised several times beforehand, resulting in three iterative steps (Figure 6).

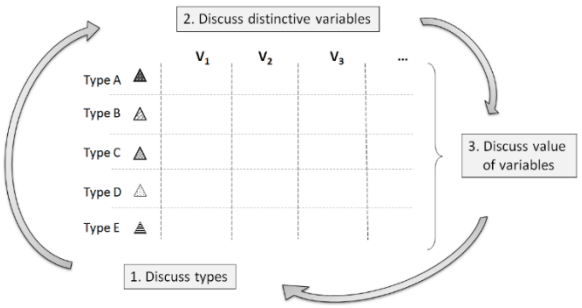

Figure 6 Iterative process of focus group (Schotte *et al.*, n.d.)

During the first step the preliminary types were discussed. The proposed classification was withheld if it was deemed a representative and exhaustive description of the diversity existing in the entire sector. Step two and three handled the distinctive variables. The participants were free to put forward as many variables as seemed appropriated and indicate expected values. Afterwards there was an evaluation of the variables to determine which were distinctive for at least one of the types. These were withheld the ones suitable for constructing a structural typology.

3.2.1.2. Quantitative Phase: classifying and describing farms with Farm census Data

In this phase, we sought to implement the typology proposed by the experts to classify cattle farmers in Flanders. For these analysis, we used data from Statistics Belgium (Statbel, 2013). This is a farm structure survey which was conducted every year for the entire Flemish agricultural sector until 2007. Due to administrative simplification the survey was reduced to a sample of farms (75 percent), complemented with data from other sources. In 2010 the entire agricultural sector was surveyed again to comply with European Regulation. Since then the sample size and number of variables questioned decreased every year, so we chose to work with the complete dataset from 2010. To calculate the indicators, we first created a dataset containing all farms having minimum ten bovine animals in the whole of Belgium (n= 22,147). We then proceed by defining indicators for the variables put forward by the experts that were appropriate to classify farms, and also a set of indicators for

variables deemed relevant but not characteristic to differentiate between types. We used a data-driven technique to identify groups of farms with similar characteristics for the variables deemed appropriate to classify farms by the experts. The identified types of beef farms were then further described by way of the indicators not used for classification.

3.2.2. Formulation sampling strategy

In this research, a theoretical rather than representative sampling strategy was followed to select farms (Corbin & Strauss, 2014, p. 201-217), for the reasons already outlined in section 2.5.4. We therefore consider the patterns revealed by the constructed typology in the light of available literature, as well as practical considerations to set up an effective sampling strategy.

3.2.3. Situating the sample within the population

To get insight in what way our sample is skewed towards a certain type of farms, we juxtapose the characteristics of the beef farming population with those of the sample. This is made possible by the information that we gathered through structured questionnaires filled out after each interview we conducted with these farmers. These questionnaires were designed in a similar way as the forms used by Statistics Belgium, precisely with this goal in mind.

3.3. Results

3.3.1. Defining and classifying beef farms

Based on our exploratory research, it was found that the bovine sector could be separated intuitively into a number of sub-populations of farms, based on the kind of cattle-related activities that took place on the farm. In the focus group a first typology was therefore presented which included six types: (i) namely farms with only dairy cattle, (ii) farms with suckler cows and bulls for fattening, (iii) farms with suckler cows without fattening activities, (iv) farms with bulls for fattening, (v) farms with both dairy and suckler cows, and (vi) farms with calves for slaughter. The experts agreed, that while there multiple variables that could be considered relevant to classify cattle farms in Flanders, a typology based on the types of cattle that were present on these farms made sense. On this basis, however, the initial typology was refined and additional types were described. Before, we give a description of the types of cattle farms identified by the experts, we will short consider the population dynamics of the cattle herds in Flanders as the typology is most easily understood by reflecting on the different life stages of the cattle and their offspring (Figure 7). Distinction is made between dairy cows [a] and suckler cows [h]. Although some breeds may serve both purposes, on a farm, individual cows are usually allocated to either dairy or beef production, according to the experts.

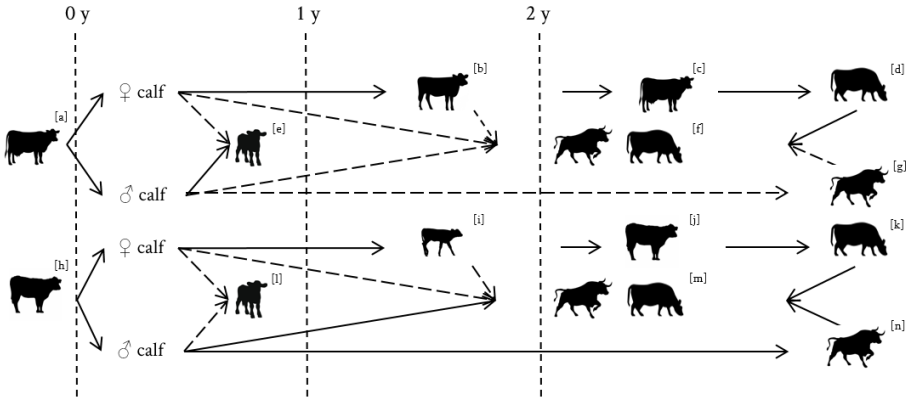

Figure 7 Diagram representing possible population dynamics on Flemish cattle farms. Dashed lines indicate this move is uncommon according to experts in Flemish bovine production systems

Within the dairy sector, the most common breed is the Friesian-Holstein. The majority of male calves of dairy cows is destined for veal production [e] as they have no further use for dairying. A small share is kept as a breeding bull [g], but this practice is uncommon in the dairy sector as they use mainly artificial insemination. Most female calves are raised as dairy heifers [b], to later on replace the older dairy cows [c] and go into milk production. Other female calves are either sold for veal production or sold as (pregnant) heifers to other dairy farms to enlarge their production capacity. Some dairy farms outsource the rearing of young heifers to specialized farming systems, which in turn sell the heifer just before or after (less common) to the original farm. An old dairy cow taken out of production for slaughter is called a cull cow [d]. While uncommon, male calves from dairy cows can be destined for beef production (crossbreeds with Belgian Blue bull) [f], moreover, farmers often choose the best heifers for the replace of old dairy cows, as such weaker female calves or heifers also end up being slaughtered between 12 and 24 months [f].

The dominant breed in the beef sector is the double-muscled Belgian Bleu. Male calves of suckler cows – bulls – are usually fattened to the age of 18 months, and slaughtered for beef production [m]. Some farming systems choose to fatten the bulls themselves, others specialize in keeping suckler cows and selling their bulls, cooperating with specialized systems fattening these bulls. A smaller share of the bulls is sold at very young age for veal production [l], though these practices are uncommon, according to experts, or kept as breeding bull [n]. Most female calves are used as replacement for older suckler cows [j]. Occasionally they are used for veal or beef production [l], or sold as pregnant heifers [i] to other farms. Belgian Blue suckler cows usually breed three to four times and leave the herd at a young age as cull cow [k] (because of the caesarean section), so replacement rate is high. The productive period of extensive breeds last substantially longer, so replacement rate is lower.

Based on this diagram we can broadly distinguish six distinct cattle-related activities tied with the presence of specific types of cattle: (i) veal production (VP), (ii) dairying (D), (iii) rearing of dairy cows (RDC), (iv) rearing of suckler cows (RSC), (v) maintaining productive suckler cows (S), and fattening bulls and cows (FAT). One or more of these activities can be practiced on one farm, however the following combinations were considered by the experts to be dominant.

- Specialist closed system dairy farms (DRDC): these farms combine the rearing of dairy cows with milk production. Bulls are rarely present, as male calves are sold to firms specialized in veal production and dairy cows are artificially inseminated.
- Specialist open system dairy farms (D): some dairy farms outsource the rearing of young heifers
- Specialist rearing of heifers (RH): these farms buy young female calves and sell pregnant heifers to dairy or suckler cow farms.
- Specialist veal production (VP): these farms buy calves, mainly male calves from specialized dairy farms, to produce veal.
- Specialist closed system suckler cow farms with fattening activities (SRSCFAT): these farms rear and maintain suckler cows, and the male calves and cull cows are reared and fattened for beef production. An older breeding bull is usually present on the farm.
- Specialist closed system suckler cow farms without fattening activities (SRSC): these are suckler cow farms do not engage in fattening activities and sell their male calves and cull cows
- Specialist fattening (FAT): these specialist farms buy young bulls for beef production. Other cows might also be present for fattening
- Mixed closed system dairy and beef (DSRH and DSRHFAT): according to the experts a significant but declining number of farmers combine dairying, rearing of suckler cows, with or without fattening activities

These types would be distinct for multiple variables, but there was agreement that indicators based on the types of cattle present on the farm, would be sufficient to classify farms. These characteristics would be the sex, age, and purpose of the cattle present at the farm. The variable breed was considered less reliable, due to the existence of dual-purpose breeds and cross-breeds. Aside, from the types of cattle typically present on these farmers, the initial types described were according to the experts also different for a variety of variables pertaining to various dimensions of farming (Table 1).

Table 1 Variables identified by the experts in the focus group distinctive for certain types identified.

Variable	Distinctive types
Age of farmer	SRSC(FAT) higher
Dependence on family labor	VP lower
Agricultural activities as part-time job	More in SRSC(FAT). Very low in DRDC
Presence of short-chain marketing activities	Types with beef production (FAT) higher
Scale of operation	VP high, FAT low.
Profitability	SRSCFAT low.
Preference for mowing or grazing	Higher for types with dairying (D)
Degree of specialization in cattle activities	More in SRSC(FAT) and DSRH(FAT)
Degree of Mechanization	Lower in SRSC(FAT)
Extensive grazing	Very Low in VP, low in DRDC
Grass-based diets	SRSC(FAT) higher, DRDC lower
On-farm re-use of manure	Low in VP and FAT, lower in DRDC
Compatibility with Organic Farming	Not in VP, FAT and SRSC. Mostly in DSRHFAT, DRDC or SRSCFAT

Based on this classification one can define beef farms broadly as any farm with minimum one of the following three beef-related activities (fattening of cows and/or bulls, the rearing of suckler cows, and maintaining suckler cows), or more narrowly either by excluding those farms with significant other non-beef-related activities (dairying, veal production, rearing dairy cows, other agricultural activities such as cash crop production and raising other livestock species), and/or by requiring all beef-related activities are present on the farm. For simplicity's sake, we will proceed to analyze the characteristics of beef farms within the Flemish cattle farm population based on the following four definitions:

- Definition 1: Farms with at least one of these activities: fattening of cows and/or bulls, the rearing of suckler cows, and maintaining suckler cows
- Definition 2: Farms of definition 1, but also with none of the non-beef related activities: namely veal production, dairying, and the rearing of dairy cows
- Definition 3: Farms of definition 2, with all of the activities enumerated in definition 1
- Definition 4: Farms of definition 3, without other agricultural activities such as cash crop production and raising other livestock species

Little is known about the particular characteristics and frequency of these beef farms based these various definitions proposed. Consequently, we developed indicators that would allow us to classify the 12,558 cases in the available dataset. A typology was created to classify cattle farms based on the presence of certain types of cattle, as they were according to the experts tied to the presence of certain cattle-related activities at a farm. For the indicator design, we had to take into account that some animals present at the farm may serve a double purpose (bulls for breeding and for beef production), and that some animals' purpose wasn't yet determined (female

calves not for slaughter, which could either be destined for cow replace or for fattening). To observe the presence and extent of these six activities, we defined the following six continuous indicators:

- VP_ind: calves for slaughter on total cattle;
- FAT_ind: cull cows, male cattle (no calves for slaughter) and heifers for fattening on total cattle minus female calves not for slaughter;
- D_ind: dairy cows in production on total cattle;
- S_ind: suckler cows in production on total cattle;
- RSC_ind: replacement heifers for suckler cows on total cattle minus female calves not destined for veal production.
- RDC_ind: replacement heifers for dairy cows on total cattle minus female calves not for slaughter.

These indicators are so designed that a value of zero corresponds with a total absence of this activity on a farm, and a value one with the total absence of all other cattle-related activities other than this one. Based on these indicators, the types described earlier can be identified as they are likely to have a high score for the indicators related to the activities they engage in, and a score close to zero for those they are not. There were 47 farms that had no other cattle but calves not for slaughter (scored zero for all indicators), these have been removed before the analysis.

Initial data analysis revealed the presence of farms which didn't fit in the description of the types identified by the experts. In order to also identify and describe these farms, we chose to classify farms with a non-hierarchical k-means clustering algorithm and set to the number of clusters to 50. We then proceeded by labeling each of these fifty clusters by the cluster means cores for the six herd composition indicators. Based on these labels, we then interpretatively grouped these clusters into groups corresponding with the definitions provided in the previous section (Annex 2).To make a distinction between specialized and more diversified beef farms of the SRSCFAT, we designed the following indicators.

- Specialization Indicator 1 (SI1): area allocated to the production of forage crops, grassland and wheat (as this is also used to produce on-farm straw) on total utilized agricultural area
- Specialization Indicator 2 (SI2): livestock units corresponding to all cattle present at the farm on the livestock units corresponding to all livestock units on the farm

Beef farms fitting definition 3, and with a value higher than 0.70 for both these indicators are deemed sufficiently specialized to fit within definition 4. With these different indicators, we classified the observations in the dataset.

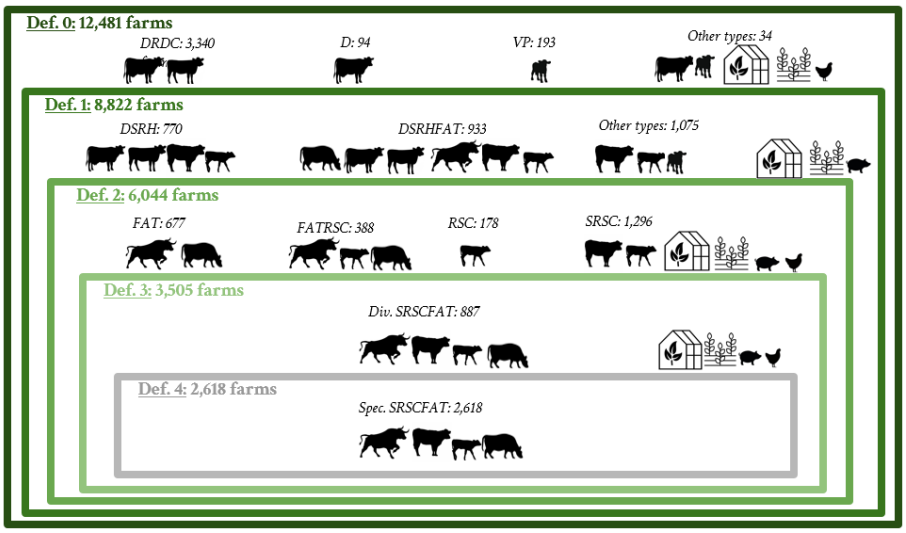

Figure 8 Venn-diagram representing the different types and frequencies of Flemish cattle farms classified by the different definitions.

The number of farms that fit these definitions of beef farms are presented in a Venn-diagram form in Figure 8. Table 2 presents in more detail the characteristics of farms corresponding the different types, under the narrowest definition of beef farms they fit. Only a small third of the livestock units associated with beef production were present on farms fitting the narrowest definition (Def. 4). The broadest definition (Def. 1) covered over 97 percent of the LU associated with beef production. Whereas closed systems (Def. 3) are the most numerous type of beef production systems in Flanders, mixed systems with dairying (DSRH, DSRHFAT), and open systems (SRSCFAT, RSC, FAT), are not uncommon in numbers, and in fact house a substantial part of cattle destined for beef production. Less than 10 percent of the farms and cattle were present in clusters with a label that did not correspond with a type described by the experts (namely D0.4, D1.3, and D2.3).

Table 2 Overview cattle and beef farm types along proposed definitions, with corresponding total number of farms and number of farms with specialization indicators above the .7 threshold, or classified as beef farm by EU regulation), number of beef livestock units (= LU eq. of suckler cows, heifers, bulls and cows destined for fattening, for calves not destined for slaughter and heifers for replacement of suckler cows); agricultural area, and annual worker units.

	N	SI1 > .7	SI2 >.7	Type 460	Beef LU	UAA	AWU
D0: Cattle farms	12,481	11,061	10,206	3,512	347,103	410 895	17,925
D0.1 Cattle farms of type DRDC	3,340	3,045	2,547	0	9,085	141 354	5,572
D0.2 Cattle farms of type D	92	79	74	44	102	2 273	121
D0.3 Cattle farms of type VP	193	153	182	191	819	2 815	298
D0.4 Other types wo S, RSC or FAT	34	32	28	4	83	1 457	51
D1: Beef farms w S, RSC and/or FAT	8,822	7,752	7,375	3,273	337,014	262 996	11,884
D1.1 DSRH	770	689	573	0	22,840	31,485	1,243
D1.2 DSRHFAT	933	835	731	2	47,579	42,136	1,589
D1.3 Other types w S, RSC and/or FAT	1 075	962	906	192	26,300	36,124	1,586
D2. Beef farms with only S, RSC, and/or FAT	6,044	5,266	5,165	3,079	240,296	153 251	7,466
D2.1: FAT	677	578	597	350	32,671	15,078	784
D2.2. FATRSC	388	349	345	196	15,056	8,195	460
D2.3. RSC	178	162	153	82	3,536	3,182	191
D2.4. SRSC	1,296	1,120	1,119	697	32,667	26,500	1,489
D3: Beef farms w S, RSC, and FAT	3,505	3,057	2,951	1,754	156,366	10,0297	4,542
D3.1 Div. SRSCFAT	887	439	333	42	40,618	33 052	1,450
D4 Spec. SRSCFAT	2,618	2,618	2,618	1,712	115,748	67 244	3,092

3.3.2. Characterizing the diversity among beef farms

Based on the available data we also devised a set of categorical and continuous indicators related to a number of variables of interest mentioned by the experts (Table 1). Table 3 presents the means and standard deviations for these indicators for beef farms based on the four definitions provided in the previous section. There is considerable diversity among beef farms for all definitions for the variables of scale, degree of mechanization and employment. A small but not unsubstantial share of beef farms have less than one annual worker unit. The share of farms with organic beef production is under one percentage point. Short chain marketing is a more common activity on beef farms, though under ten percent. On average beef farmers hold little livestock other than cattle, and use 90 percent of their available land for forage production. Three quarters of this forage area is moreover permanent or temporary grassland. This degree of specialization and also the land use intensity differs however markedly from farm to farm.

Table 3 Average and standard deviation in brackets of beef farms based on the four definitions for the indicators designed for variables of interest to characterize different types of cattle farms.

Variable	Indicator	Def. 1	Def. 2	Def. 3	Def. 4
Employment	AWU	1.35 (0.74)	1.24 (0.75)	1.3 (0.72)	1.18 (0.66)
Full-time Occupation	AWU lower than 1 (%)	19.76	26.14	22.65	27.32
Degree of mechanization	Livestock Units per AWU	70.6 (95.5)	64.7 (101.1)	68.1 (79.2)	52.6 (50.6)
Compatibility with Direct Sale	Short Chain Marketing (%)	8.94	8.65	9.79	9.55
Scale	UAA (ha)	29.8 (26.2)	25.4 (24.9)	28.6 (26.8)	25.7 (23.8)
	Livestock Units	89.6 (106.0)	73.1 (101.4)	83.4 (107.8)	54.8 (55.5)
Degree of specialization	Bovine LU on total LU	0.88 (0.26)	0.88 (0.26)	0.88 (0.26)	0.98 (0.05)
	share of forage crops and grains on total UAA	0.9 (0.16)	0.9 (0.17)	0.9 (0.16)	0.95 (0.08)
Land and Input use intensity	Share of grassland on forage Area	0.71 (0.20)	0.74 (0.21)	0.73 (0.18)	0.74 (0.18)
	grassland (ha) per GLU	0.28 (0.21)	0.31 (0.23)	0.29 (0.20)	0.30 (0.21)
	Organic or transitioning to organic (%)	0.26	0.26	0.34	0.27
Frequency	Number of cases	8822	6044	3505	2618

Table 4 presents additional insight into beef farm diversity, showing that even on beef farms defined more narrowly there is marked diversity along multiple dimensions.

Table 4 Minimum, maximum and quantile values for the indicators, for beef farms by definition 3

Indicator	Min	Q1	Median	Q3	Max
AWU	0.13	1	1.13	1.67	7.65
AWU lower than 1 (%)	0	0	0	0	1
Livestock Units per AWU	1.2	22.4	43.8	83.2	981.8
Short Chain Marketing (%)	0	0	0	0	1
UAA (ha)	0	11.6	21.2	37.1	388.7
Livestock Units	5.6	20.7	46.3	98.9	1601.3
bovine LU on total LU	0.02	0.96	1	1	1
share of forage crops and grains on total UAA	0	0.84	1	1	1
Share of grassland on Forage Area	0	0.61	0.72	0.85	1
grassland (ha) per GLU	0	0.17	0.24	0.34	2.92
Organic or transitioning to organic (%)	0	0	0	0	1

3.3.3. Definition of the Sampling Strategy

These analyses revealing a number of patterns of interest to our exploration of agroecology in the context of beef farming in Flanders.

First, the distribution of scores for indicators largely associated with the factor endowments of beef farms in Flanders (land, labor, livestock), whether one defines these narrowly or more broadly, indicate that there is beef farmers collectively are able to operate under very different material conditions (or at the very least in 2011), insofar as this is defined by the resources they mobilize in production. This diversity moreover applies not only in terms of the size of this endowment (number of hectares of (grass-)land in use, livestock units, people employed), but also in terms of the composition of this endowment (livestock density, share of forage area, LUs per worker, *etc.*). This is relevant for our investigation into agroecology, because diverse conditions farmers face very likely have gone hand in hand with diverse solutions, even if all of these farmers were to pursue the same goals. In fact, we can be fairly sure of this as some of these diverse solutions (diversification-specialization, organic farming, part-time work, extensive or intensive land use, forage strategies, direct sale) also correlate with some of the indicators scores for these farms with the available data. This gives us reasons to believe that we are likely to witness a diversity of practices even if we would sample beef farmers at random.

Second, we find that by defining beef farming systems too narrowly in this context, as the EU classification does (EC, 2008), one risks excluding a large number

of farms with significant beef production activities, a large number of people directly involved in beef production, *i. e.* beef farmers, and sizeable part of the actual livestock specifically raised for beef production. Indeed, we find that beef production related activities are often combined with other agricultural activities, including other livestock species, as well as other cattle-related activities, dairying in particular.

Third, we also observe that beef farms with direct selling or organic production activities, often associated with agroecology (Stassart *et al.*, 2018; van Hemert & Peeters, 2020) represent but a small and in the case of organic farming a very small minority of beef farms in Flanders. A representative sampling strategy is therefore unlikely to result in the gathering of organic and direct selling farmers who supposedly have implemented agroecology to a much further extent than conventional and whole-selling beef farmers, the overwhelming majority of the beef farming population.

Considering these three main observations, we decided to focus our field work on beef farms of a somewhat to very specialized nature, namely definition 3, *i. e.* those with the cattle-relating activities to rearing suckler cows and fattening bulls and cows, all of these and none other. This way we can include farms with significant other agricultural branches, which is important given that (agricultural) diversification is an important theme within the agroecological literature (A. M. Dumont *et al.*, 2016), while also retaining some of the specificity of beef production as opposed to dairying and veal production. Furthermore, we believed that in order to be sufficiently comprehensive in our exploration of agroecology in this context, we couldn't risk missing out on developing an understanding of the functioning of the more emblematic examples of agroecology in this region, even if they represent but a small minority of farms. We chose to contact farmers of different types along the range of three axes: organic (labeled O--)/conventional (C--), direct sale of meat (-D-) or not (-N-), specialized beef production (--S) or more mixed agricultural activities (--D). Given the composition of the actual beef farming population, as there are very few organic beef farmers, let alone specialized, non-direct selling organic beef farmers (I. Timmermans & Van Bellegem, 2019)) and the exploratory nature of our research, it was deemed unnecessary to obtain a balanced or representative sample. To further increase the diversity in management practices in our sample, we complemented the data gathering with a variational sampling approach by contacting farmers of potential interest based on previous interview experiences (Corbin & Strauss, 2014). A sample size of 35 to 40 was set as the goal at the outset before our field work, as this would allow us to partition our sample in a limited number of smaller subgroups, that are sufficiently large that particular views or practices expressed by farmers could be separated from the more commonly held views or practices that would define and separate the group.

3.3.4. Situating our sample

We now turn to situating the obtained sample of 37 farms within the beef farming population. These were selected along three *a priori* axes, organic/conventional, direct

selling of meat/ not direct selling of meat, and specialized or diversified agricultural activities. The distribution along those axes is presented in discussed in detail in section 4.4.

Based on the scores for the herd composition scores calculated from the data obtained from the structured questionnaires filled out by the farmers, one farms would not be characterized as a beef farm based on even the broadest definition handled to classify farms in the dataset, as it would be classified under DRDC (Table 5). On the farm in question, cross-bred double purpose cows are raised and held which are milked as they still have significant milk production. Seven of the 36 remaining cases didn't fall under definition two: the sample includes two farms with one or two double-purpose breeds, in which part of the cows are kept mainly for dairying and others are kept as suckler cows, which classifies them as DSRHFAT. We also interviewed one farmer with two specialized breeds, one for dairying, one for beef production, which is the more common system of practice, classifying them as DSRHFAT. One farm has two separated cattle-related activities, veal production (VP), and a closed system of rearing and fattening cows and bulls (SRSCFAT) which in head numbers is significantly smaller. We also have one case farm on which a few dairy cows are kept to produce milk to raise calves of the suckler cows, two farms on which some calves are slaughtered before the first life year (SRSCFATVP). Of the remaining 29, there were two farms on which no fattening activities took place (SRSC). The rest of fitted the definition 3. Only 12 of the remaining 27 cases, had a score higher than 0.7 for both indicators tracing the degree of specialization in cattle production (26 out of 37, and 19 out of 27) and forage production (29 out of 37, and 12 out of 27).

Table 5 Table with number of sample farms fitting definition 1, 2, 3, 4

Definition	Number of sample farms
Cattle farms – definition 0: D, S, RSC, RDC, VP, and/or FAT	37
Beef farms – definition 1: S, RSC or FAT	36
Beef farms – definition 2: only S, RSC, and/or FAT	29
Beef farms – definition 3: S, RSC and FAT	27
Beef farms – definition 4: S, RSC and FAT, and Specialized in forage production and cattle	12

The obtained sample of 37 farms has markedly differently distributed scores for a number of variables than the farms classified as beef farms by definition 3 (but also by other definitions) in wider dataset (Table 6). Compared to the beef farm population, we find that the sample consists on average out of relatively large farms, both in terms of employment, livestock units, and land size. All but one farm employs the equivalent of one full-time worker. Still, marked differences in size are present within the sample, as we have cases with indicators scores for these variables comparable to the lower quantiles of the population. There are also markedly more farms with direct selling (28 out of 37) and organic beef farming activities (12 out of 37), which in the beef

farming population are only a small and very small minority. In terms of degree of specialization, and land use intensity the sample is more comparable in distribution to the beef farm population, with a slight bent towards more diversified, and extensive land uses.

Table 6 Number of cases with values within different ranges given by the extreme and quantile values of the population of beef farmers by definition 3 for the selected indicators.

Variable	Indicator	Population Mean	Sample Mean	Min-Q1	Q1-Q2	Q2-Q3	Q3-Max
Employment	AWU	1.3	2.5	1	5	3	28
Full-time Occupation	AWU lower than 1 (%)	22.7	2.7		36		1
Degree of mechanization	Short Chain Marketing (%)	9.8	75.7		9		28
Compatibility with Direct Sale	Livestock Units per AWU	68.1	96.6	6	7	8	16
Scale	UAA (ha)	28.6	90.8	2	2	6	27
	Livestock Units	83.4	210.7	3	3	7	24
Degree of specialization	bovine LU on total LU	0.88	0.84	14	3	20	
	share of forage crops and grains on total UAA	0.9	0.84	15	12	10	
Land and Input use intensity	Share of grassland on Forage Area	0.73	0.6	20	2	9	6
	grassland (ha) per GLU	0.29	0.44	12	7	6	12
	Organic or transitioning to organic (%)	0.34	32.43		25		12

3.4. Conclusion

In this chapter we explored the diversity of beef farming system in Flanders, by constructing a structural typology based on expert interviews and multivariate analyses. Through this mixed method we were able to produce an innovative classification of cattle farms based on herd composition, shedding some new light on the structural diversity of the Belgian bovine sector. The inclusion of expert knowledge gave us insight in a particularly important dynamic at work on cattle farms, namely the economic possibility of organizing different parts of herd movements in one or in different enterprises. The experts also suggested that in the context of Flanders this was not merely be a possibility but is an actual reality in Flanders. The conducted exploratory data-analysis confirmed that there was indeed such a dynamic at work in Flanders, and expanded our understanding by giving an estimate of the relative importance in terms of frequency, scale of production and employment of the

types defined by experts, as well as lesser known types of cattle farms existing in Flanders.

Furthermore, through descriptive analysis of the census data we were also able to trace empirically other aspects of farm diversity (land use intensity, forage strategies, degree of specialization, off-farm employment, short-chain marketing, *etc.*). In our interpretation, this observed diversity suggests that there may just like with cattle-related activities, be the economic possibility to separate or combine parts of other agricultural and other economic activities on one or multiple farms in association with beef-related activities of different intensities and scales. Yet this diversity also highlights that beef farmers appear to have made vastly different land use choices in this context, potentially leading them to adopt more or less agroecological practices.

In the light of this observed diversity, we adopted a theoretical sampling strategy, rather than a representative one, as we intended to explore the full scope of agroecology with a medium-sized sample. The obtained sample certainly reflects some of this diversity, in terms of scale, diversification and land use intensity. As intended, our sampling is clearly skewed (relative to the Flemish beef farm population) towards organic beef farmers, and to a lesser extent direct selling beef farmers. And, importantly, our sample consists almost completely out of farms on which at least one person works full-time. Given that it wasn't our intention to survey the state of agroecological practice on Flemish beef farms at large, this is not an issue. Nonetheless, in the general discussion of our findings, we will discuss whether the skewed or limited size of the sample led us to overemphasize the importance of certain practices, certain actors, and certain social systems with regard the implementation of agroecology in the context of beef farming in Flanders.

Chapter 4
From Principle to Practice

From Principle to Practice

In the face of longstanding social and technological trends, the application of agroecological insights at beef farms in Flanders may at first seem a curious proposition. We found, however, that beef farmers pursue agroecological principles through an impressive diversity of practices in this context. In 37 semi-structured interviews we asked farmers how they put into practice a set of principles which covers many themes addressed in agroecological literature. Inspired by a grounded theory approach, but also based on literature and consultation of fellow researchers, we conceptualized for each principle distinctive pathways of action to categorize relevant practices. By documenting farmers' practices, we show that an agronomic interpretation of agroecology as a practice obfuscates the many ways farmers can contribute to the social dimensions of agroecology too, which also problematizes those food systems approaches that undervalue the farmers' agency in changing their social context themselves. This grounded conceptual framework may be used to further assess how each beef farmer addresses these different principles together in practice. Given these results and perspectives, we contend that empirical inquiries such as these are instrumental in maintaining the connection between agroecological theory and practice, allowing both to move dialectically forward.

Reference

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2020. Pathways of action followed by Flemish beef farmers–an integrative view on agroecology as a practice. *Agroecology and Sustainable Food Systems*, 45:1. 111-131.

4.1. Introduction

The current global food system's sustainability challenges (FAO, 2017) have prompted an expanding academic field and social movement to foster agroecology as a possible solution (HLPE, 2019; Holt-Giménez & Altieri, 2013; IPES-Food, 2019). In Belgium too, this moment of urgency and of opportunities has been grasped by a variety of actors and organizations to promote agroecology at different political levels and sectors of society (Stassart *et al.*, 2018). In our research, we focus on the beef sector in Flanders, as it faces growing economic uncertainty and societal criticism. Low and over the years declining market prices in combination with increasing production costs have rendered beef production one of the least profitable agricultural activities on average in Flanders for over a decade. The beef farming population is declining and aging with few prospective successors (Platteau *et al.*, 2018). With the malpractices with hormones in the 1990s still in the public memory, recent food safety and quality scandals in slaughter houses have further deteriorated the reputation of the sector. This compounds the economic and psychological stresses on beef farmers.

Many beef farmers are now at a cross-road: continue scale enlargement and intensification or search for alternative pathways. Several authors have proposed agroecology as a more sustainable, alternative development path for livestock systems in temperate regions (Bonaudo *et al.*, 2014; B. Dumont *et al.*, 2013; Wezel & Peeters, 2014), yet what agroecology practically entails for beef farmers, remains largely unexplored.

In the face of longstanding social and technological trends, the application of agroecological insights in this context may strike one as a curious proposition at first. Agriculture in Flanders has clearly retreated from agroecology over the last centuries. Whereas many productivity improvements made in the 16th and 17th century by farmers in these regions were arguably in line with agroecology (Mazoyer & Roudart, 2006), productive forces continued to be revolutionized in order to increase marketable surpluses, giving rise to more industrialized forms of agriculture (Worster, 1990). The region witnessed a progressive disappearance of mixed subsistence-oriented farming, in favor of market integration, specialization, intensification of land use, mechanization and land concentration, before and after the implementation of the Common Agricultural Policy (Peeters, 2010; Zanden, 1991). However, an enormous diversity of cattle production systems in Flanders still persists, indicating that the industrialization of beef farming is incomplete, and perhaps withstood and even reversed. Indeed, by exploring the structural characteristics of Belgian cattle farms based on farm census data from 2011 (Statbel, 2013), we found that few farmers are specialized in one cattle-related activity (dairying, rearing cows, veal production, fattening of cows and bulls, and breeding). This study will mainly focus on beef farms of the more specialized type, namely those only rearing suckler cows and fattening bulls and cows. Yet among these systems too, an impressive diversity was observed along multiple dimensions such as scale (herd size, area in use, labor force), stocking rates, marketing strategies and degrees of specialization, through part-time activities, raising other livestock species or growing non-forage crops. Underlying this diversity, we surmise, is the ability of farmers to produce agricultural commodities in very different ways and circumstances, and perhaps the persistence and emergence of practices in line with agroecology. If so, we may discover agroecology already in the daily practice of Flemish beef farmers.

As such, the aim of this chapter is to explore through what Pathways of Action (POA) Flemish beef farmers may put agroecology into practice. We elaborate upon this concept of POA in the next section. In Section 3 we lay out our method and in Section 4, we present the conceptual framework obtained with this method. In the Discussion section we examine the contribution of our results to agroecology, the methodological merits and limits of our approach, and the perspectives this study provides for future research.

4.2. Concepts: from principles over POAs to practices

Agroecology cannot be reduced to a set of specific practices, rather it promotes *"a dialogue of wisdoms"* and integrates *"elements of modern science and ethno-science"* which allows it to provide a series of principles*, "which when applied in a particular region take different technological forms depending on the socio-economic, cultural and environmental context"* (Rosset *et al.*, 2017). There remains, however, a methodological gap to be bridged between the ideal models of agroecological farming systems and the specific practices encountered on actual farms (Toffolini *et al.*, 2018). This disconnect has as a consequence that practitioners are left figuring out themselves how agroecology is to be translated in practices fit to their situation, whereas agroecological theory may have insufficiently absorbed the lessons from local experiences. Grounded theory (Glaser *et al.*, 1968) has popularized the idea that theory should emerge from data, rather than the other way around, which led us to believe that simply by asking farmers how they put agroecology into practice, a concept of agroecological practices in this context could be articulated. While promising, this proposition was flawed, because in our intuition very few farmers in Flanders were familiar with agroecology as a concept. For this reason, a framework needs to be provided to the farmers. Given that multiple authors have proposed that principles may a fertile middle ground for empirical inquiry into agroecological practices (Bell & Bellon, 2018; A. M. Dumont *et al.*, 2016), a list of principles assembled from a literature review, may constitute an acceptable frame for our discussions with farmers on putting agroecology into practice.

While taking this initial, comprehensive stance towards agroecology as a practice, we also wish to be attentive to a longstanding tradition in agroecological thought, that highlights particular ways of pursuing principles (*e. g.* Rosset and Altieri 1997). To investigate the applicability of various normative stances to categorize practices mentioned by farmers, we propose and mobilize the concept of POA to identify clusters of practices related to each principle. We define a POA here similarly as what Chantre *et al.* (2014) call an "agronomic-coherence class", *i. e.* "*a range of practices whose coherence is defined by adherence to some action principles*". Yet, whereas this concept was originally only applied to the sphere of nitrogen input use, we extend it to other themes addressed by agroecology.

Recently, Toffolini *et al.* (2018) proposed the concept of "way of acting", which refer to "*specific combinations of practices by which farmers target farming systems properties in line with agroecological principles*". We don't believe that this concept can be mobilized in an exploratory study such as ours. According to Toffolini *et al.* (2018), the "ways of acting" are discovered through the study of farming systems said to be run in line with agroecological principles. Whereas we appreciate the contribution of this approach to discover commonalities between such cases, we found this approach contradictory to a comprehensive view on agroecology as a practice. By snubbing, for instance, the vast majority of conventional whole-selling farmers, we

are potentially closing off ways of implementing agroecological principles from the beginning. Moreover, it is perfectly conceivable that farms identified *a priori* as agroecological, may turn out to fall short for some agroecological principles in the end. So rather than defining the agroecological way to pursue a principle based on the particular way they are tackled in *a priori* defined systems, we delay this judgment and first explore the various ways these principles are tackled by beef farmers generally. The concept of POA also has two major practical advantages for analysis. As each POA is tied to only one principle explicitly, the range of practices to consider for each POA is confined, and there is no need to consider whether practices categorized under a POA are actually compatible with the pursuit of other principles. The other remarkable analytical advantage of the concept POA to "ways of acting", but also strategy, is that it is dissociated from the particular actors' intent or understanding of their actions. Being on a POA requires no commitment, articulated or otherwise, to agroecology from the farmer. It merely marks a position occupied by farmers happening to have similar activities. By stripping away the need to analyze actors' reasoning behind an action, the categorization of practices can be simplified.

Whereas we seek to be initially at least agnostic on the agroecological nature of particular ways pursuing certain principles, we stipulate that in our research we support an integrative rather than an agronomic perspective on agroecology as a practice generally. *"At its origins, agroecology as a practice shows a mental model that clearly sees the linkages and interactions among all three approaches (science, movement, practice) and dimensions (ecological and techno-productive, socioeconomic and cultural, and sociopolitical) of agroecology"* (Rivera-Ferre, 2018). Our main contention in this chapter is that both social and technical dimensions of agroecology are operative at the farm level, and that therefore the farm level remains an excellent place to explore both the social and technical dimensions of agroecology as a practice in their interconnectedness.

4.3. Materials and methods

To explore how agroecology can be put into practice by beef farmers, we developed a four-step method as depicted in Figure 9.

We reviewed a number of lists of principles proposed in the literature (Altieri & Nicholls, 2005; Bonaudo *et al.*, 2014; Debruyne, Triste, & Marchand, 2017; B. Dumont & Bernués, 2014; Duru, Therond, Martin, *et al.*, 2015; Levidow *et al.*, 2014; Malézieux, 2012; Méndez *et al.*, 2013; Stassart *et al.*, 2012), and created a list of our own fitted for the requirements of our study. We selected principles to be implemented by (livestock) farmers, and also reformulated these into more direct and comprehensible language. We required that the list covered all recurring themes in the agroecological literature, as identified by A. M. Dumont *et al.* (2016), namely environmental equity, financial independence, market access and autonomy, sustainability and adaptability, diversity and exchange of knowledge, social equity,

partnership between producers and consumers, geographic proximity, rural development and preservation of the rural fabric.

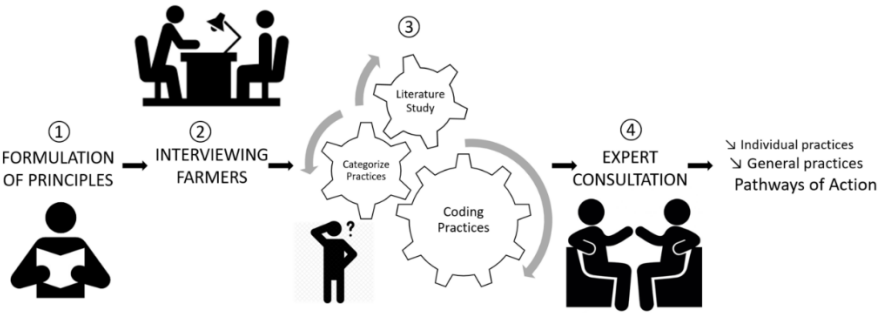

Figure 9 Diagram of the method, which involves four steps: (1) creating a list of principles based on literature review, (2) gathering accounts on practices in relation to agroecological principles from farmers selected through theoretical sampling, (3) identification and categorization of practices through qualitative analysis of interview transcripts informed by literature review, and (4) triangulating preliminary results by consulting experts for validation.

To make the full scope of agroecology as a practice in the Flemish beef sector apparent, a theoretical rather than a representative sampling strategy was followed (Corbin & Strauss, 2014). Hypothesizing that diverse circumstances may lead to equally diverse solutions, we sampled farms to obtain a large and diverse set of beef farmers. In the public debate on agroecology, 'alternative' agricultural systems such as organic and short-chain-food networks in urban and peri-urban areas are regularly touted as emblematic instances of agroecology in this region (Stassart *et al.*, 2018). As farmers involved in such initiatives may be well placed to contribute to the question at hand, we sought to include these farmers in the sample. Yet we were also interested to hear from 'conventional' whole-selling farmers, the overwhelming majority of beef farmers in Flanders, as they may very well have taken significant steps to put agroecological principles in practice too. As an initial sampling design, we therefore sought to include farmers along the ranges of three axes: organic/non-organic, short-chain-marketing/wholesale marketing of meat, and different degrees of specialization (other agricultural activities). Halfway the data gathering, it was deemed unnecessary in the light of the objective, to obtain an evenly distributed sample along these axes. Instead, it was decided to adopt a theoretical sampling approach, by contacting farmers of potential interest based on previous interview experiences, To get into contact with farmers we relied on existing farmer networks, webpages of farms, online press articles, online phone books, and asking interviewed farmers for referrals. During semi-structured interviews we presented one or more members of the farm household with the established list of principles and asked them how they put each principle into practice. Given the at the times contentious history between farmers and environmental movements in these regions (Hermans, Horlings, Beers, & Mommaas, 2010), we realized that agroecology could turn out a divisive

issue for farmers. At the beginning of the interview, we therefore stated our aim was to discover the potential relevance or irrelevance of agroecology to beef farming in Flanders, and thought that farmers may have valuable perspectives on this topic.

The interviews were transcribed and analyzed in Nvivo 11. In the first stage of the analysis, we coded in an open-ended manner any action farmers said to take that furthered or was at odds in their estimation with a principle, thus creating an inventory of codes referring to practices related to at least one principle. Using the matrix coding function of Nvivo, the practices coded and mentioned by farmers during the discussion of each principle could be identified, thus creating initial subsamples of practices to consider for each principle. In a second stage, we created principle by principle new codes in an attempt to find a common denominator for various practices contributing a principle by conceptualizing more general practices of often lower level of detail, by merging and revisiting initial codes, a process referred to as axial-coding (Corbin & Strauss, 2014). In the third stage, we compared these various practices to pursue a principle, and sought concepts to create coherent groupings of practices, leading up to the description of at least two POAs for each principle, under which these general practices are categorized. We aimed to create a conceptual framework that fits the accounts of farmers, rather than rigidly impose an already existing one. Nonetheless, we also sought to deliberately and explicitly integrate insights from scientific literature on these various agroecological themes. To remain sufficiently grounded, we followed a couple of data-sensitizing principles when using literature in grounded theory as outlined by Thornberg (2012), namely theoretical agnosticism, theoretical pluralism, theoretical sampling of literature, staying grounded, theoretical playfulness, memo-ing extant knowledge associations, and constant reflexivity. Initial conceptualizations regularly led to an uneasy fit with the data, resulting in the exploration of new concepts. The concepts we thus ended up proposed to refer to practices mentioned by farmers and the POAs to categorize them, emerged through an iterative process of engagement with relevant scientific literature and the transcripts themselves.

As a validation step, we triangulated our preliminary results by consulting researchers at ILVO (N=8) familiar with Flemish agricultural context, of different disciplinary background and expertise. In one-to-one encounters, we presented each researcher with the coding and categorization related to three principles lying closest to his/her expertise to weigh in on the codes and categorizations made and our qualitative assessment of these practices contributing to a certain principle. We used these insights to finalize the analysis.

4.4. Results

Table 7 shows the list of principles investigated in this study. The first principles (1-5) correspond with the goals of agroecology for livestock systems proposed by the report of the International Symposium on Agroecology for Food Security and Nutrition (FAO, 2014), adapted from principles for livestock systems proposed by B.

Dumont *et al.* (2013). Added to these ecological principles we reformulated a couple of principles (6-10) proposed by Debruyne *et al.* (2017) which was an effort to make the principles proposed by Stassart *et al.* (2012) more comprehensible to Flemish stakeholders. We also added three principles (11-13) to cover additional socio-economic themes associated with agroecology, but not yet covered by the list.

Table 7 List of agroecological principles used in the semi-structured interviews.

Principle	Source
1. Strengthen animal health in an integrated manner	FAO 2014
2. Close nutrient cycles	FAO 2014
3. Maintain a high diversity of species and genetic varieties in time and space	FAO 2014
4. Preserve and use biodiversity	FAO 2014
5. Reduce the use of external chemical inputs	FAO 2014
6. Increase the resilience and adaptability of the farm-ecosystem against environmental shocks	Debruyne *et al.* (2017)
7. Strive for autonomy from powerful input suppliers and purchasers	Debruyne *et al.* (2017)
8. Pursue financial independence and control over economic and technical decisions	Debruyne *et al.* (2017)
9. Exchange knowledge from a diversity of sources to solve problems	Debruyne *et al.* (2017)
10. Maintain the social network on the countryside	Debruyne *et al.* (2017)
11. Strengthen the bonds between producers and consumers	Authors addition
12. Create locally embedded food systems of production and consumption	Authors addition
13. Divide the burdens and the benefits of food production and consumption equitably	Authors addition

In total 37 cases were included for this study. In 24 cases we spoke with only male identified members of the farm household, in 5 with only female identified, and in 8 cases with both male and female identified members of the household. These were spread unevenly along the three axes used during sampling (Table 8). The under-sampling of conventional whole-selling farmers was based on the assumption that additional accounts of such farmers would result in the elicitation of relatively few new practices related to agroecological principles. We were unable to identify organic, specialized farmers not engaging in direct sale of meat.

Table 8 Distribution of cases along the three axes of the initial sampling design: (transitioning to) organic or not; Direct Sale of meat or not; Diversified Agricultural Activities or not in terms rearing other livestock species than bovines for sale and/or growing cash crops (excluding wheat).

Organic?	Direct Sale of Meat?	Diversified Agricultural Activities?	N
Yes	Yes	Yes	10
		No	1
	No	Yes	1
		No	0
No	Yes	Yes	4
		No	3
	No	Yes	15
		No	3

The open-ended coding yielded 690 different codes for individual practices. These were clustered into 336 general practices each linked to a single principle. Some of these individual practice nodes are clustered in multiple general practices, and some general practices are identical but for being linked to a different principle. In the next part of this section, we present the different POAs arrived at after grounded analysis and external validation. In Table 9, 10 and 11 we give a non-exhaustive list of codes for practices associated with each POA (see Annex 3 for a full overview of these general practices and associated frequencies).

Principle 1: Strengthen animal health in an integrated manner

When asked how low drug use is accomplished, farmers mention a whole range of actions to prevent clinical disease. Struck by the incommensurability of some practices mentioned by different farmers, we used the Control management and Adaptive management models conceptualized by Napel, Bianchi, & Bestman (2006) to categorize practices mentioned by farmers. We also identified a number of practices contributing to animal health, which were – after deliberation with two experts – compatible with both approaches. Therefore we identified three POAs for these principles: the CONTROL POA, revealed in practices which reduce exposure to pathogens by controlling environmental conditions; the ADAPTIVE POA, revealed in practices to adapt animals to a relatively uncontrolled environment; and the BASIC HEALTH POA, revealed in practices which are necessary to maintain in general the metabolic functioning of the animal in either approach.

Principle 2: Close nutrient cycles

Initially, we found two POA's: the INTERNAL CYCLING POA which reveals itself in practices related to the partial or complete re-use of nutrient streams produced at the farm, and to the partial or complete satisfaction of nutrient needs by on-farm production; and the LOSS MITIGATION POA which reveals itself in practices related to reducing losses to the environment at different sites. However, from a landscape ecology perspective (Martin *et al.*, 2016), nutrient cycles can also be closed beyond the farm gate, which was also noted by some farmers. A third POA then is the

EXTERNAL CYCLING POA, which reveals itself in practices related to the partial or complete return of on-farm produced biomass through third parties.

Principle 3: Maintain a high diversity of species and genetic varieties in time and space

This principle covers one facet of agrobiodiversity, namely those species and genetic variants that are harvested (Duru, Therond, Martin, *et al.*, 2015). This planned biodiversity encompasses several aspects, including species diversity, varietal diversity within species, and genetic diversity within species and varieties at different spatial-temporal levels. In agroecology, diversification goes beyond species richness, it is about functional interaction (Khumairoh, Groot, & Lantinga, 2012; Rosset *et al.*, 2017). That is the way many species are integrated into the landscape and are allowed to interact, thus supporting ecological processes of nutrient cycling and pest control. Equally species rich systems can thus be very integrated or not, and we therefore distinguishes two POAs: the WITHOUT SEPARATION POA, revealed in practices which increase species and genetic diversity at farm level, without separating these in space and time; and the WITH SEPERATION POA, revealed in practices which increase species and genetic diversity at farm level, with separating these in space and time,

Principle 4: Preserve and use biodiversity

The fourth principle discussed with farmers, covers farmers' practices in relation to non-harvested species, or associated biodiversity. Farmers mentioned an enormous variety of practices contributing (but also weakening) biodiversity. As many farmers replied that they did little (or didn't care) for non-useful organisms, but did look after biodiversity in the soil, we operationalized the concept of conservation agriculture, in which soil life is enhanced as long as it is functional to crop production, and juxtaposed this to nature conservation, which looks to preserve and increase associated biodiversity in its own right. Two POAs emerge from this distinction then: the CONSERVATION AGRICULTURE POA, revealed by practices indicating the farmer is looking to enhance biological processes to improve and maintain yields; and the NATURE CONSERVATION POA, revealed by practices that contribute to the conservation and even augmentation of associated agrobiodiversity species, which may have little or even negative effects on yields.

Principle 5: Reduce the use of external chemical and fossil inputs

During the interviews we discussed the reduction of the following four "chemical" inputs (chemical fertilizers, chemical pesticides, fuel, electricity. We found the Efficiency-Substitution-Redesign framework (Hill & MacRae, 1996) initially useful to categorize practices, but also identified two other groups of practices related to input use, and therefore identified five separate POAs: the EFFICIENCY POA, revealed in practices indicating the farmer has moved to a more rational use of inputs, but without replacing these with an alternative input and requiring no radical changes in the farm's functioning; the SUBSTITUTION POA, revealed in practices indicating

the farmer has replaced synthetic inputs with alternative inputs, including solar and renewable energy inputs; the REDESIGN POA, revealed in practices indicating the farmer has moved towards the use of local inputs, through integrated ecosystem design and management; the LOW-OUTPUT POA, revealed in practices indicating the farmer reduces chemical inputs drastically, while accepting lower overall physical yields; and the TRANSFER POA, revealed in practices indicating the farmer has transferred the question of pest management, nutrient availability and energy use partly to other actors.

Principle 6: Increase the resilience and adaptability of the farm-ecosystem against environmental shocks

The sixth principle concerns actions taken by the farmer that strengthen ecosystem resilience against environmental shocks, such as pathogens and temporary adverse weather conditions. In our discussion of this principle with farmers we emphasized that we were particularly interested in practices that could make the ecosystem in biophysical terms more resilient to environmental shocks, rather than discussing what technical and social means allowed them to bridge these. Yet, we found that many farmers could think of very little practices that allowed them to avoid or mitigate the effects of an environmental shock on biophysical yields, and thus also considered the many ways farmers can cope with the effects of adverse environmental shocks. Three POAs were distinguished then: the AVOID POA, revealed in practices that indicate the ecosystem is designed in such a way that the chance of an environmental shock reaching the production system is reduced; the MITIGATE POA, revealed in practices indicating that the physical damages when an environmental shock does hit the farm, are or can be contained; and the COPE POA, revealed in practices that allow the farmer to sustain temporary reductions in physical yields.

Principle 7: Strive for autonomy from powerful input suppliers and purchasers

In our analysis of practices related to the pursuit of this and the next principle, concerning commercial and financial autonomy, we take up the work of rural sociologist Jan Douwe Van der Ploeg (1990, 2010). From an analytical point of view, farming consists of three interrelated and mutually adapted processes: the mobilization of resources, the conversion of resources into end-products; and the marketing and re-use of the end-products. These three processes can to a different degree be commodified. Farmers' responses echoed Van der Ploeg's contention, that commercial autonomy not only appear in farmers gaining independence from markets, but also in the ability to establish advantageous market relations. Two distinct groups of mentioned practices were consistent with the latter interpretation, and we therefore defined three POAs: the DO-IT-YOURSELF POA, revealed in practices that allow the farmers to distance him-/herself from markets generally; the CONTROL POA, revealed in practices that indicate the farmer is able to flexibly redefine the commercial relations they have with powerful commercial players; and the

ALTERNATIVE PARTNERS POA, revealed in practices that indicate the farmer looks to circumvent powerful commercial players.

Principle 8: Pursue financial independence and control over economic and technical decisions

Likewise, the notion of autonomy as it relates to financial decisions, is translated by farmers, on the one hand, in actions related to becoming independent from financial institutions, and on the other hand, being able to define these creditor-debtor relations. We also identified a set of practices regularly mentioned by farmers that we deemed conducive to either approach, and we therefore suggest three POAs: the INDEPENDENCE POA reveals itself in practices that allow to minimize lending from financial institutions; the LEND ON OWN TERMS POA reveals itself in practices indicating a willingness to lend from banks while having the ability to define the terms of this relationship; and the MANAGE FINANCES POA reveals itself in practices to maintain the farm's own financial fund.

Principle 9: Exchange knowledge from a diversity of sources to solve problems

Knowledge exchange involves getting access to it and sharing it. Farmers mentioned practices often mentioned practices that fitted both sides, as knowledge exchange has often a co-creative aspect to it. Even so, we found that for individual practices one side outweighed the other. We therefore identified the following two pathways: the KNOWLEDGE BUILDING POA revealed in instances where farmers gather information from a variety of sources; and the KNOWLEDGE SHARING POA revealed instances where farmers share information with other farmers and/or researchers.

Principle 10: Maintain the social network on the countryside

Farming takes place in a social context, and plays from an agroecological point of view a key role in the maintenance of the rural fabric (A. M. Dumont *et al.*, 2016). A range of instances were mentioned by which farmers were integrated in local rural networks, yet in deliberation with the experts we categorized these to construct two POAs: the RURAL ECONOMY POA reveals itself by practices which connect the farmer with business partners and customers in the local community, and the RURAL SOCIAL LIFE POA reveals itself by practices which connect the farmer with regular citizens in the local community.

Principle 11: Co-operation between producers and consumers

We found that farmers engage with other producers and consumers for a variety of goods and services. In many instances these arrangements are market-based, yet we did observe other forms of social relations. To distinguish those forms we take up the work of anthropologist Karl Polanyi (Polanyi, 1944), to categorize practices by the principles of exchange, reciprocity and redistribution which regulate economic relations between humans. At first glance, most relations with consumers are market-based, yet we found that many of these exchanges appear to be heavily structured by

personal relations, giving them a more reciprocal nature (W. A. Jackson, 2007). We therefore defined three POAs: the EXCHANGE POA, which is revealed in practices by which the exchange of goods and services (through money) is based on the socially determined value these goods and services possess, and actors act and treat each other as mere possessors of commodities; the RECIPROCITY POA, which is revealed in practices by which goods and services are exchanged between actors who have an enduring give-and-take personal relationship; and the CO-OPERATIVE POA, which is revealed in practices whereby goods and services are pooled and shared in a larger organization, and the benefits of this enterprise are distributed within the collective.

Principle 12: Create locally embedded food systems of production and consumption

Analysis of practices mentioned by farmers shows that both on the input and output side of the equation, farmers can create local food systems through two POAs: the SELF-RELIANCE POA, revealed in practices indicating a self-supplying of inputs which would usually be sourced from far away, and in practices indicating that distribution to local consumers is done by farmers themselves; and the LOCAL PARTNERSHIP POA in contrast reveals itself in practices where farmers look to local partners to supply them with inputs and commercialize their products to local consumers.

Principle 13: Divide the burdens and the benefits of food production and consumption equitably

Almost every farmer is convinced that s/he does not or would not get a 'fair price' within the conventional value chain. There is a common conviction that such work is not remunerated in a fair way, feeding into a feeling of not being appreciated by society. While some of these chain industries are in the hands of farmer organizations, the general perception is that these industries do not or aren't able to put producer interests at the right place. Agro-industrial and retail capital are said to have a tight hold on the production process and the terms of trade. Breaking the power of this corporate food regime, individually and/or collectively, is a key theme in much of the political agroecological literature (Guzmán & Woodgate, 2013; Holt-Giménez & Altieri, 2013; Rosset *et al.*, 2017). While many farmers do feel powerless, we were able to identify three POAs: the WITHIN THE REGIME POA, which is revealed through practices that improve the social position of the farmer while working within the mainstream institutional environment; the AROUND THE REGIME POA, revealed through practices indicating that farmer is looking to create alternative networks which may prove to be more just; and the OUT OF AGRICULTURE POA which is found within practices that indicate the farmer looks for opportunities outside of agricultural production to improve his/her social position.

Table 9 General practices corresponding with the POAs identified for each principle.

Principle	Pathways of Action	General Practices
ANIMAL HEALTH	CONTROL	Early weaning, separating and binding of animals, using preventive medication, using artificial insemination techniques, maintaining high hygienic standards for housing and feed, immediate treatment of diseases, shearing and washing, nematicides in grazing areas.
	ADAPTIVE	Robust breeds and crossbreeds, long grazing season, extensive and diverse grazing, no preventive medication, herbal medicine and repellents, strategic rotation of mowing and grazing lands, rotating grazing species, social learning within herd to adapt to challenging environments, tolerate some disease, avoid C-sections.
	BASIC HEALTH	Investing in good housing conditions, vaccination, avoiding nutritional deficiencies, access to colostrum, awareness for disease, strawing stables, selective breeding.
NUTRIENT CYCLING	INTERNAL CYCLING	Self-sufficiency in own concentrates, straw and roughages, on-farm re-use of manure, composting, feeding on-farm produced harvest residues, recycling roadside clippings, trees for firewood and composting.
	LOSS MITIGITATION	Efficient fertilizer application, preference for solid manure, soil cover during winter, agroforestry systems, extensive grassland management, reduced, timely and no-tilling practices, permanent grasslands, sufficient strawing in stable, manure stocking facilities.
	EXTERNAL CYCLING	Mutual exchange of manure, straw, roughage with other farmer, re-use of effluents slurry processing, re-use beet pulp from sugar factory.
PLANNED DIVERSITY	WITH SEPARATION	Long rotations of monocultures, multiple but separated branches of livestock species and breeds, single-species catch crops, multiple commercial varieties in rotation.
	WITHOUT SEPARATION	Mixed grazing of cattle breeds and other grazing species, cross-breeding, and importing new genetic material (stud or artificially insemination), strip agriculture, agroforestry, seed cultivation and saving, cultivation of genetically heterogeneous land races, multi-species catch crops, polycultures such as grain-legume mixtures and grass-clover, various practices which induce or install higher sward diversity in grasslands.
ASSOCIATED DIVERSITY	SOIL CONSERVATION	Reduce soil disturbance, incorporate organic matter in soil, maintain soil cover, avoid acidifying fertilizers, maintain and install grasslands, agroforestry.
	NATURE CONSERVATION	No or little pesticide use, low or no fertilizer use on grasslands, extensive grazing, maintain non-crop habitats such as bushes, trees and flower strips, respect and broaden field margins, install biodiversity friendly crops such as grass-clover, ecological focus areas, agroforestry systems, accept yield losses, attract birds and insects near stable and farm yard.

Table 10 Table 9 Continued

EXTERNAL INPUTS	EFFICIENCY	Targeted and efficient use of pesticides and artificial fertilizers on crops and grasslands, efficient engines and economic driving, turn off unnecessary lighting and engines, power-saving light bulbs.
	SUBSTITUTION	Buy pesticides and fertilizers (including manure) of organic origins, install heat pumps, solar panels and wind mills, use various mechanical methods for weed control.
	REDESIGN	Legumes, high crop diversity, grass-based feeding systems, long grazing season, no-till cultivation, on-farm re-use of biomass, incorporating organic matter in soil, rotating grazing species, agroforestry.
	LOW-OUTPUT	Extensive grassland management, accept weeds and pests, reduce fertilization rate, choose more robust but slower growing varieties.
	TRANSFER	Buy feed and straw.
ECOLOGICAL RESILIENCE	AVOID	Closed herds, indoor livestock systems.
	MITIGATE	Drainage, irrigation, dredge ditches, robust breeds and varieties, building up organic material in soil, reduce stocking densities in stable and grazing areas, monitor and compensate soil mineral deficiencies, maintain soil cover, less and timely tilling, wide crop rotations or strip cropping.
	COPE	Diversify income sources (off-farm employment, multiple agricultural branches, pluri-activity), maintain a financial buffer or build physical feed and forage stocks, risk transfer (insurance, contract farming, seasonal subscriptions by customers).
COMMERCIAL AUTONOMY	DO-IT-YOURSELF	No or little pesticide and fertilizer use, own self-provisioning of roughage, concentrates and straw, own seed and planting material, own spraying and harvesting equipment, own processing, own transporting, processing, and/or distribution of products.
	CONTROL	Put commercial partners in competition, avoid commercial debts, built in financial buffer, differentiate product, purchase in group, gather and exchange market information, avoid contracts in favor for free markets.
	ALTERNATIVE PARTNERS	Alternative suppliers and sale channels, involvement within farmers' co-operatives for processing and/or distribution.
FINANCIAL AUTONOMY	INDEPENDENCE	Reduce investments costs and needs, share investments, find alternative financing sources.
	LEND ON OWN TERMS	Negotiate interest rates with banks, lend cautiously and strategically.
	MANAGE FINANCES	Know your numbers, build in a financial buffer, spread risk by income diversification, share or transfer production risks with consumers and acquaintances through seasonal subscriptions or an alternative legal structure, as well contract farming.
KNOWLEDGE EXCHANGE	BUILD KNOWLEDGE	Visit other farms, look outside, gather documentation on internet and books, monitor own activities, do experiments, consult other farmers, commercial partners, research institutes and professional consultants, go to info meetings.
	SHARE KNOWLEDGE	Give farm demonstrations, professional consulting, employ trainees, be involved in formal learning networks, exchange insights with colleagues informally, or at info meetings, be involved in participatory research activities.

Table 11 Table 9 and 10 continued

RURAL FABRIC	RURUL ECONOMY	Contact with local consumer through direct sale of products, work together with other farmers and locals for a variety of goods services (land, products, planning, processing, political organizing, intermediary products, machinery, labor, knowledge, distribution, …), make local publicity and organize open-farm days and festivities for costumers and potential partners.
	RURAL SOCIAL LIFE	Be involved in local social organizations, municipal government, activate and assist people with disabilities, talk regularly to neighbors, organize school visits and open-farm days.
PRODUCER-CONSUMER TIES	EXCHANGE	One-way sale and buying of goods and services on the market from producers or consumers (land, agricultural products and intermediaries such as livestock, straw, manure and feeds, selling knowledge accountancy, agricultural wage labor and transport services).
	RECIPROCITY	Double exchanges with other farmers of land, machinery, agricultural products and intermediaries, regular exchanges of knowledge, help each other out, direct sale of agricultural products to consumers, gifts of labor and land from costumers.
	CO-OPERATION	Small farmer co-operatives for production planning, processing, and distribution, co-ownership of land and machinery, collective political organization, group buying, formal knowledge networks, farm shares (land and or capital) owned by costumers, seasonal subscriptions of costumers.
LOCAL FOOD	SELF-RELIANCE	Sale of products on the farm or at farmers' markets, harvesting by customers, production of own concentrates and seeds, reduce need for concentrates and off-farm inputs.
	LOCAL PARTNERS	Sale of products by local butcheries, convenience stores and supermarkets, alternative food networks, and/or neighboring farmers, local sourcing of agricultural inputs rather than relying on concentrates with components from overseas.
SOCIAL EQUITY	WITHIN THE REGIME	Produce High-Value niche market products for wholesale, apply for government subsidies, put mainstream players in competition, negotiate higher price by bargaining and following markets, cut out handlers, contract farming, invest to stay competitive, engage in collective political action like demonstrating or being involved in pressure groups, purchase in group, be involved in supply chain initiatives.
	AROUND THE REGIME	Organize upstream and downstream processes yourself or with other non-regime actors and create demand for your own product.
	OUT OF AGRICULTURE	Off-farm employment, non-agricultural activities at the farm (*e. g.* agro-tourism, nature conservation, education), retire.

4.5. Discussion

The main result of this study is a conceptual framework on how the various dimensions of agroecology are put into practice by Flemish beef farmers. The combination of a qualitative semi-structured data gathering method and an initially open-ended analysis let to the discovery of many practices through which farmers can pursue an array of agroecological principles. The open-ended nature of questions yielded diverse answers on which basis the scope of each principle was explored. In so doing, we were able to uncover the many ways beef farmers still and already today put agroecology into practice. This bears scientific, practical, and political relevance, as these practices constitute in the words of David Goodman (D Goodman, 1999), "*a*

material base from which to interrogate hegemonic industrialized metabolic relations and to construct alternative political and institutional futures." Frequently we were surprised to learn about practices, we did not anticipate, such as "fodder trees", "hanging up holly branches in the stable", "sharing current market prices offered by handlers to other farmers", "building a stable yourself", "weigh-beam at the farm", "promote personally local meat in the supermarket", or "using on-farm produced wood for heating". Such references enticed us to reconsider the scope of a principle and categorizations, we may have had before this study. A grounded analytical approach thus gave us the ability create a comprehensive account of agroecology as a practice, which a deductive approach such as using a checklist of practices derived from literature couldn't possibly have.

The results of this study vindicate our main contention in this chapter, namely that farmers can and do take actions to operationalize not only technical but also social dimensions of agroecology. There is a tendency to reduce agroecology at the farm level to the agronomic sphere, and reserve the social dimensions of agroecology to particular actors such as policy makers and movement representatives. In so doing farmers are artificially severed farmers from social movements (Rivera-Ferre, 2018). By skipping the farm level as legitimate level of social analysis, one disregards, the many ways farmers may create the social conditions favorable to putting agroecology into practice themselves. Attention therefore must be paid to the everyday politics farmers may be engaged in (Kerkvliet, 2009). Our results invite agroecologists to consider how farmers are addressing the socioeconomic, the sociocultural, and the sociopolitical dimensions of agroecology, and how this may indirectly contribute to addressing the techno-productive and ecological dimensions.

In our analysis, we moved backed and forth from a comprehensive understanding of these principles to various normative understandings. The formulation of POAs revealed many questions and contradictions concerning the boundaries of agroecology as a practice in this context. Namely about the compatibility of control measures in an agroecological animal health management model (P1), about the open nature of most beef farming systems (P2), about the appropriate scales for installing diversity (P3), about the place of nature conservation for its own sake within agroecology (P4), about the compatibility of efficiency, substitution and low-output measures within an agroecological approach to reduce inputs (P5), about the substitutability of natural for social capital (P6), about farmers' ambiguous role in the commoditization of agriculture and the reproduction of agro-industrial and financial capital (P7, P8), about the origins of farmers' knowledge (P9), about the necessity of local economic activities to maintain the social fabric (P10), about the role of often informal, reciprocal and redistributive arrangements in sustaining agroecological food systems (P11), about the role of large retailers in supplying local food (P12), and about the political strategy to reform rather than resist and work around regime institutions (P13). We concede, that the translation of principles into POAs by farmers, may be very different in situations which markedly differ in terms of social organization of

agriculture (for example tribal or communal systems), physiological nature of the particular product concerned, pedoclimatic conditions, or cultural traditions. Yet given the prevalence of (family labor based) commodity production, modern technologies and hegemonic discourses across the globe, we wouldn't be surprise that these POAs are applicable in other sectors and regions, and that the questions raised by such conceptualization, may be pertinent in other contexts.

While it was our initial intention to adopt a grounded theory approach, in practice we deviated from this approach in important ways, most significantly when gathering the data (see further), but also to some extent in the analysis phase and in selecting cases. Ideally for theoretical sampling, decisions for additional data gathering are taken based on through analysis of previous interviews, yet for practical reasons these were made based on general observations made during data gathering and transcription. Additionally, the active and intentional integration of literature in data analysis may appear contradictory to the core proposition of grounded theory, namely that theory emerges from the data without theoretical preconceptions. Thornberg (2012) provides convincing practical and epistemological arguments to abandon the dictum of delaying literature review in classical grounded theory. The selection of relevant practices for each principle was based on a theoretical triangulation of three sources: the judgment of the farmers interviewed, the judgments of the scientific literature we were aware of before and during the analysis, and the judgment of the experts consulted at a later stage. Given our findings, we believe this "informed, grounded analytical approach" allows to construct theory sensitive to currently standing academic debates, while still grounded in the accounts of farmers. To this end, the analytical advantages of mobilizing the POA concept in an exploratory setting became clear, namely the smaller scope of practices to consider for each POA, and the ability to disjoin practices from farmers' motivations. This allowed us to flexibly consider, enrich and detail different existing frameworks.

In this study, we take as empirical entry point the accounts of farmers when confronted by list of principles on their practices. The data gathering method is therefore deeply hermeneutical and context-dependent, as it depends on these particular farmers' understanding of these principles, their understanding of their own actions, and their understanding of the interviewers' motives. Hostile or sympathetic predispositions of farmers towards agroecology can easily lead to distorted accounts on their actual practices. We sought to undercut these by communicating that we ourselves had not yet made a determination on the relevance of agroecology in this context, and that we valued their perspective of farmers on this matter. We concede, however, that the accounts from which these results derive are incomplete. Yet, the identification and categorization of practices is done at the sample level, rather than based on a case-by-case characterization of individual farmers. This attenuates the influence of particular farmers embellishing or downplaying their actual practices. Rather, the results depend on the total diversity of perspectives on agroecology and its principles, which was precisely the objective of our sampling strategy. While a

diversity of perspectives is represented in this study, one can levy the legitimate criticism that only one group of actors' has been consulted to define the scope of each principle, namely individual farmers. This exposed us to underplaying the interests of other vulnerable social groups and also other farmers. For instance, while the last principle on social equity also concerns relations within the farm-enterprise or the household, farmers mentioned mostly practices focused on dealings with actors outside the farm. Farmers' answers were therefore insufficient to conceptualize POAs that addressed internal power dynamics of a class nature or generational, race and gender issues. Whereas the involvement of other perspectives, through literature review, critical self-reflection, and consultation of experts, did reveal such blind spots, this could be more appropriately addressed by involving other stakeholder groups.

Semi-structured interviews imply that these accounts of farmers in relation to agroecology are framed significantly by the selection and wording of these principles. While our intuition that very few farmers would be familiar with the term agroecology, proved correct, our particular framing of agroecology needs examining. We don't presume to have created a complete or accurate list of agroecological principles, but this is to our mind no reason for concern. Anybody who seeks to pin down agroecology in a definitive list of principles, should be aware that such an exercise is futile. We concur with Bell & Bellon (2018) that agroecology as a theory of and for sustainable agriculture is bound to remain incomplete and social-historically contingent, and that agroecological challenges and preferences may and will change over time. Principles are continuously re-assessed and re-negotiated by the different actors involved in the agroecological community, and they should be, if agroecology is to qualify as a critical theory. Between the moment when we established our own list of principles, September 2017, and the moment of submission, we found a number of existing and new lists and reviews of principles which we did not take into consideration (CIDSE, 2018; HLPE, 2019; Migliorini & Wezel, 2017). These lists of principles are often formulated to address a much broader audience then farmers. Our list is designed for a particular group of actors, namely Flemish beef farmers, and this has its consequences. When categorizing practices, we became aware that a farm-/farmer-oriented list of principles can easily lose sight of how farms are physically embedded in wider landscapes and how contemporary farmers are part of a wider social division of labor. Input use, nutrient cycling, agrobiodiversity have dimensions that go beyond the field margin and farm gate, and improving the social position, autonomy and resilience of individual farmers may come at the cost of other farmers and vulnerable social groups. This vindicates recent efforts to produce principles to be operationalized at the landscape and/or food system level as well. This entices us to reconsider the principles proposed, and explore principles more in tune with this unescapable reality of social and ecological interconnectedness. As to the scope, we found our list lacking a principle that directly spoke to the role of farmers in establishing food systems acceptable to local social values and diets. Yet, considering that our study revealed both significant advantages and limits of our list with respect to other lists of principles, we contend that

exploratory, empirical inquiries of principles can be instrumental in maintaining the connection between agroecological theory and practice.

Lastly, we note, that it does not escape us that the qualitative data gathered for this study can serve to further explore other worthy topics, such as the analysis of perspectives and attitudes of the interviewed farmers towards these principles (see chapter 6 and 7), or the theorization of the social structures and conditions that explain farmers engaging in activities in line or at odds with agroecology (see chapter 7). Moreover, the accounts of farmers on their practices may prove a sufficient basis to make case comparisons between individual farmers' sets of practices in relation to agroecology. The conceptualization of POAs raised many questions on how to delineate agroecology as a practice. By assessing whether the sets of practices of these farmers as a whole address all principles sufficiently, and if so whether there are different combinations of POAs that accomplish this, we may be able to substantiate or call into question the salience of particular normative views on agroecology as a practice in this context. Such interlinkages in practice between POAs are the subject of the following chapter. Considering these findings and perspectives, we suggest that the formulation of principles, and empirically exploring these in semi-structured interviews with farmers, may be a valuable method to come to grips with actual farmers' practices, and therefore to improve scientific recommendations for agroecosystem design and management.

Chapter 5

From Sets of Practices to Farming Models

From Sets of Practices to Farming Models

Agroecology is increasingly recognized as a valuable perspective to face the sustainability challenges of contemporary foods systems. Yet case-comparisons based on a holistic assessment of actual farmer practices have been lacking. In this chapter, we seek to identify the different farming models underlying the sets of practices of Flemish beef farmers. For this, we rely on 37 accounts of a diverse group of Flemish beef farmers. Their practices were gathered through semi-structured interviews. These practices were categorized along 36 pathways of action to pursue 13 agroecological principles, identified in research published earlier. To compare how and to what extent each farmer is pursuing these principles, we turned this qualitative information into sets of indicator scores. With Archetypal Analysis, we identified three farming models underlying their diverse pursuits of agroecological principles: one farming model represents seven conventional farmers who name a bare minimum of practices contributing to agroecology, and two models representing farmers that do integrate elements of agroecology. Conceptually, the second farming model, which represents nine direct selling farmers, eight of them organic, corresponds with a low-input, low-capital, but knowledge intensive model, embedded within alternative commercial and social network, which actively seeks to become independent from regime institutions. The third farming model represents five mostly whole-selling conventional beef farmers that find advantages within the mainstream market environment. It overlaps with a number of practices related to the techno-productive dimension of agroecology with the second model, as far as these maintain or increase productivity, and are compatible with the expectations of value-chain actors. These results provide an empirical basis for concepts such as “peasant farming” and “sustainable intensification” to understand the diverging translation of agroecological principles into practice. However, the remaining half of the farmers is found in the continuum between these models, indicating that these models are combinable in practice to some extent, and that not all farmers go as far as the most emblematic instances of these models. While a more systematic assessment of the presence of means of agroecology at each studied case is still lacking, our study may well have laid the foundation for such an assessment tool. Moreover, our study already demonstrates that such assessments have the potential to empirically ground theorizations of different farming models and connect them with existing farmers’ sets of practices.

Reference

Tessier, L. Bijttebier, J., Marchand, F., & Baret, P. V. 2021. Identifying the farming models underlying Flemish beef farmers’ practices from an agroecological perspective with Archetypal Analysis. Agricultural Systems, 187, 103013.

5.1. Introduction

There is increasing awareness that agriculture is multifunctional, *i. e.* that besides the production of food and fiber, agriculture provides multiple services to our societies (Caron *et al.*, 2008; HLPE, 2019). While current farming systems cannot be separated from down-stream and up-stream processes of production, and from the consumption and from the global environment, it is recognized that farmers' activities affect the various services agriculture delivers to society. This recognition has given rise to many studies seeking to determine how farming practices may shape the delivery of multiple use-values characterized as relevant in various conceptual frameworks. Endeavors to formalize actual social concerns into functions or services delivered by agricultural systems, came, however, hand in hand with the recognition that this process of abstraction is inherently normative. Indeed, there is a plurality of values underlying actors' preferences for certain farming models, as they highlight different aspects of agricultural systems (Plumecocq *et al.*, 2018). One of these emerging models in both public and academic circles is agroecology. Agroecology embraces a science, a set of practices and a social movement and has evolved over recent decades to expand in scope from a fields and farms focus to embrace complete agriculture and food systems (Wezel *et al.*, 2009). As a body of thought, agroecology sets out to analyze contemporary agricultural systems, particularly traditional and 'alternative' systems. This analysis feeds into and on a vision to transform agricultural systems. This vision articulates most concisely into a set (or rather sets) of principles for agricultural and ecological management of agri-food systems as well as wider ranging socio-economic, cultural and political principles (HLPE, 2019). Prominent agroecology advocates have opposed this model to more mainstream "bio-economy" and "sustainable intensification" agendas, supposed to be scientistic, neo-productivist, and conforming to corporate power (Altieri, Nicholls, & Montalba, 2017; Levidow, 2015). Such characterizations of the contemporary agricultural landscape as opposing models may appear a tendentious reduction of the complexity and diversity of farming systems embedded in European agricultural landscapes (Vanloqueren & Baret, 2009), and we thus spot a need to further ground these debates empirically. In this chapter, we aim to differentiate between the sets of practices of a diverse group of Flemish beef farmers from an agroecological perspective, in order to discover the different farming models which underlie the practices of these farmers.

5.2. Concepts, materials and methods

At its origin, "agroecology as a practice", shows a mental model that clearly sees the linkages and interactions among all three approaches (science, movement, practice) and dimensions (ecological and techno-productive, socio-economic and cultural, and sociopolitical) of agroecology (Rivera-Ferre, 2018). Consequently, agroecology involves the combinations of practices specifically adapted to the local biophysical and social context, including interacting and changing this social context. While there is broad consensus that agroecology requires contextualized solutions

(Bell & Bellon, 2018; Rosset *et al.*, 2017), it is also commonly accepted that some ways of pursuing a principle may be more agroecological than others. For instance, in the literature Efficiency and Substitution measures to reduce on-farm use of external chemical inputs are often perceived as less agroecological compared to redesign measures (see Hill & MacRae, 1996). Altieri *et al.* (2017) argue that while the Efficiency and Substitution measures are good first steps, putting agroecology really into practice requires Redesign measures, as these enable holistic approaches to pursue all principles. As such, an agroecological perspective encourages in a global analysis of farmers practices to make conceptual distinctions that allow to trace how different dimensions of farming can be interconnected through practice.

We operationalized this approach in a study published earlier, by developing a conceptual framework to describe the pursuits of agroecological principles by a diverse group of Flemish beef farmers (Tessier, Bijttebier, Marchand, & Baret, 2020). We identified practices of 37 cases in semi-structured interviews with farmers, in which we confronted them with a list of 13 agroecological principles. These principles addressed not only the ecological and techno-productive dimension of agroecology (principle 1 to 6), but also covering the social dimensions regularly addressed in agroecological literature (principle 7 to 13) (A. M. Dumont *et al.*, 2016). Based on qualitative analysis of interview transcripts, extensive literature review and expert consultation, a conceptual framework was developed. 36 Pathways of Action (POA) were described, each linked to one principle. Each of these POAs envelops several practices mentioned by these farmers (Table 12, 13, 14). In that study (Tessier *et al.*, 2020), we contributed to concretizing agroecology as a practice in the context of Flemish beef farming, by linking individual principles associated with agroecology to real life practices already taken by these farmers today. What that study didn't elucidate, however, was how these POAs went together in practice: namely, whether some farmers pursued all principles in multiple ways, and others didn't, or whether there a specific combinations of POAs through which farmers pursue multiple principles, but in a markedly different way.

Table 12 Short descriptions of Pathways of Actions followed by Flemish beef farmers. These were identified through an analysis published earlier of the same 37 interviews transcripts used in this study (Tessier *et al.*, 2020)

PRINCIPLES ADRESSING THE ECOLOGICAL AND TECHNO-PRODUCTIVE DIMENSIONS	
1. Strengthen animal health in an integrated manner	
CONTROL	reduce exposure to pathogens by controlling environmental conditions
BASIC HEALTH	maintain in general the metabolic functioning of the animal
ADAPTIVE	adapt animals to a relatively uncontrolled environment
2. Close nutrient cycles	
INTERNAL CYCLING	re-use nutrient streams produced at the farm, and to satisfy nutrient needs by on-farm production.
LOSS MITIGITATION	reduce losses to the environment at different sites
EXTERNAL CYCLING	organize a partial or complete return of on-farm produced biomass through third parties

Table 13 Table 12 Continued

3. Maintain a high diversity of species and genetic varieties in time and space	
WITH SEPARATION	increase species and genetic diversity at farm level, with separating these in space and time
WITHOUT SEPARATION	increase species and genetic diversity at farm level, without separating these in space and time
4. Preserve and use biodiversity	
SOIL CONSERVATION	enhance biological processes to improve and maintain crop yields
NATURE CONSERVATION	conserve and even augment associated agrobiodiversity species, even if it reduces yields
5. Reduce the use of external chemical inputs	
EFFICIENCY	move towards a more efficient use of chemical inputs
SUBSTITUTION	replace synthetic inputs with alternative inputs, including solar and renewable energy inputs
REDESIGN	move towards the use of local inputs, through integrated ecosystem design and management
LOW-OUTPUT	reduce chemical inputs drastically, by accepting lower overall physical yields
TRANSFER	transfer the question of pest management, nutrient availability and energy use to other actors
6. Increase the resilience and adaptability of the farm-ecosystem against environmental shocks	
AVOID	designed the ecosystem in such a way that the chance of an environmental shock reaching the production system is reduced
MITIGATE	design the system so that physical damages are reduced when an environmental shock does hit the farm
COPE	design a business which can sustain temporary reductions in physical yields
PRINCIPLES ADRESSING THE SOCIAL DIMENSIONS	
7. Strive for autonomy from powerful input suppliers and purchasers	
DO-IT-YOURSELF	organize the mobilization of resources, the conversion of resources into end-products and the use and re-use of end-products without recourse to market mechanisms
CONTROL	improve and make use of the ability to flexibly redefine the commercial relations they have with powerful commercial player
ALTERNATIVE PARTNERS	circumvent powerful commercial players by exchanging with other partners
8. Pursue financial independence and control over economic and technical decisions	
INDEPENDENCE	minimize lending from financial institutions
LEND ON OWN TERMS	lend from banks as long as you are able to define the terms of this relationship
MANAGE FINANCES	establish and maintain the farm's own financial fund.
9. Exchange knowledge from a diversity of sources to solve problems	
BUILD KNOWLEDGE	gather information from a variety of sources.
SHARE KNOWLEDGE	share information with other farmers and/or researchers
10. Maintain the social network on the countryside	
RURUL ECONOMY	engage in activities connecting farmers with local business partners and customers
RURAL SOCIAL LIFE	engage in activities which connect farmers with regular citizens in the local community
11. Strengthen the bonds between producers and consumers	
EXCHANGE	exchange goods and services in which actors treat each other as mere possessors of commodities interested in commodity price and quality alone
RECIPROCITY	exchange goods and services between actors having an enduring give-and-take personal relationship
CO-OPERATION	share and pool goods and services in a larger organization

Table 14 Table 12 and 13 continued

12. Create locally embedded food systems of production and consumption	
SELF-RELIANCE	avoid sourcing inputs from far away by self-supplying, and organize distribution to local consumers yourself
LOCAL PARTNERS	rely on local partners to supply them with inputs and commercialize their products to local consumers
13. divide the burdens and the benefits of food production and consumption equitably	
WITHIN THE REGIME	seek advantages within the mainstream institutional environment to improve social position
AROUND THE REGIME	create alternative networks of agricultural production and consumption
OUT OF AGRICULTURE	find opportunities outside of agricultural production to improve social position

To assess if and how each of these farmers sought to address these agroecological principles together we transformed this descriptive framework of these farmers' practices, as it is presented by (Tessier *et al.*, 2020), into an analytical framework. Our approach consists of six steps involving both qualitative and quantitative methods (Figure 10). We started from the qualitative data on these farmers' practices gathered through 37 semi-structured interviews with beef farmers and the conceptual framework we put forward in our study published earlier (Tessier *et al.*, 2020), which took these same interviews as empirical entry point. These interviews contain not only references to practices related to the 13 principles we confronted them during the interviews, but also comments on their farms' history, their personal views on these principles, on the practices of other farmers, *etc.* In other words, these data are very

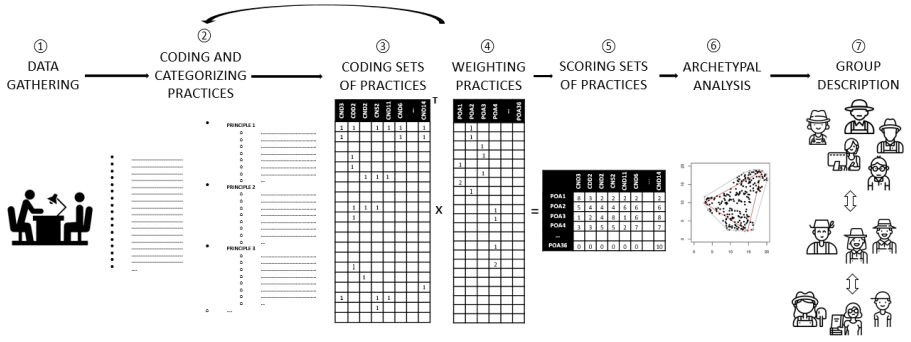

Figure 10 Diagram representing the seven steps of the method of data gathering and analysis

content-rich. In unaltered form, however, they are too overwhelming for the analyst, and unpresentable to lay persons given the size of the source material. Therefore, we devised a method to transform these data into scores indicating how and to what extent each principle is pursued by each farmer relative to others, guided by the conceptual framework outlined by us in study published earlier (Tessier *et al.*, 2020). We then applied an Archetypal Analysis (AA) algorithm on these scores, to discern the

different models (or ideal types) that may underlie the actual sets of practices of these beef farmers.

For the sake of clarity, we have presented the analytical process as a more or less linear, deductive process. Readers should be aware, however, that there is some interdependence between this study and our study published earlier, but conducted to an extent simultaneously (Tessier *et al.*, 2020). Both studies share the same empirical starting point, but steps 2 to 4 of the analysis process also built upon and contributed to the coding infrastructure that led to the definition of the POAs put forward by Tessier *et al.* (2020). Indeed, codes and categorizations for practices mentioned by these farmers had a double use in in our analysis of these farmers' practices from an agroecological perspective: (i) to conceptualize the different ways these farmers taken together pursued individual principles (Tessier *et al.*, 2020), and (ii) to characterize and compare the sets of practices of each farmer and group the farmers in archetypes based on these practices (this study). Because of these distinct objectives, however, the analytical steps contributing to the presented findings in this study can be isolated and presented separately, as we have done in the rest of this section. This way, we may also consider readers more interested in methods to compare different groups of farmers, rather than the analytical process laid out by Tessier *et al.* (2020).

STEP 1: data gathering

As stated before, this study made use of the same interview data used by a study of ours published earlier (Tessier *et al.*, 2020). To explore the full scope of agroecology as a practice in a context, we followed, initially, a theoretical sampling strategy, by contacting farmers along the range of three axes: organic (labeled O--)/conventional (C--), direct sale of meat (-D-) or not (-N-), specialized beef production (--S) or more mixed agricultural activities (--D). Given the composition of the actual beef farming population, as there are very few organic beef farmers, let alone specialized organic beef farmers (I. Timmermans & Van Bellegem, 2019)) and the exploratory nature of our research, it was deemed unnecessary to obtain a balanced or representative sample. Consequently, to further increase the diversity in management practices in our sample, we complemented the data gathering with a variational sampling approach by contacting farmers of potential interest based on previous interview experiences (Corbin & Strauss, 2014). As a result, farmers were spread unevenly along the three axes used during sampling (Table 15). Information on farmers' practices in relation to agroecological principles was gathered through semi-structured interviews with one or multiple members of the farm household. During these interviews we confronted the selected farmers with the 13 agroecological principles presented in Table 12, 13 and 14, and asked how they saw each principle in practice on their farm. In total 37 cases were included for this study. In 24 cases, we spoke with only male-identified members of the farm household, in 5 with only female identified, and in 8 cases with both male and female-identified members of the household.

Table 15 Distribution of cases along the three axes used for theoretical sampling: (transitioning to) organic or not; Direct Sale of meat or not; Diversified Agricultural Activities or not in terms rearing other livestock species than bovines for sale and/or growing cash crops (excluding wheat).

Organic?	Direct Sale of Meat?	Diversified Agricultural Activities?	N
Yes	Yes	Yes	10
		No	1
	No	Yes	1
		No	0
No	Yes	Yes	4
		No	3
	No	Yes	15
		No	3

STEP 2: coding and categorizing practices

The transcripts of these interviews were further analyzed in Nvivo 11®. A coding tree is created which contains all the practices mentioned by the interviewed individual farmers related to the 13 principles proposed by Tessier *et al.* (2020). This is done by first inductively coding all practices mentioned by the interviewed farmers which are in line or at odds with one of these principles. This first round of coding yielded 690 codes for practices mentioned by these farmers in relation to agroecological principles. In a second phase, we clustered and selected relevant codes to identify a set of practices within each principle. In total 307 of such codes were created.

STEP 3: coding sets of practices

We re-read the transcripts and applied the coding tree more systematically to make sure all practices referred to by farmers were correctly coded. To truthfully characterize the practices mentioned by each farmer, we allowed revisiting of the initial codes, by going back to the second phase of step 2. With the query tool provided by the NVivo 11 software, the result of this qualitative analysis is summarized in a binary "Sets of practice matrix" containing information on all the practices mentioned by each farmer.

STEP 4: weighting of practices

All practices linked to a principle created in the second round of coding were given a weight for their contribution to a POA of their corresponding principle. These weights are based on a qualitative assessment of the relative contribution of practices linked to a particular POA, to that POA. In this process, experts (N=8) at ILVO were also consulted to make the scoring more robust. Each expert was given three principles lying closest to their expertise, to look at the individual practices mentioned by the farmers during the discussion of the principle, the grouping of similar practices, categorization of these practices under the proposed POAs and the initial weights assigned to the practices. Importantly, these expert interviews also contributed to the

refinement of preliminary POAs, and hence to the final definitions and descriptions of these POAs as found in Tessier *et al.*, (2020). This evaluation provided, moreover further input to reconsider initial codes (step 2), and hence the eventual "Sets of practice matrix" (step 3). The conclusion of this qualitative assessment is summarized in a final "Weights matrix" containing the weights of all the 307 practice codes contributing to all POAs. The weights and frequencies of these practice codes can be found in Annex 3.

STEP 5: scoring sets of practices

A score was then calculated for each farmer for each POA based on these two matrices created. The summation of the weights of all practices mentioned by each farmer is used as a measure for the extent a farmer may be pursuing a principle along each POA. In the case a POA score depended on one or two practices, we recombined POAs, to avoid paying undue attention to a single practice to characterize farmers' sets of practices. For the POA External Cycling (Principle 2 on the theme of Nutrient Cycling) and Avoid (Principle 6 on the theme of Ecological Resilience), little contributing practices were found, and we therefore combined these POAs with the POA Internal Cycling, and Mitigation into Biomass Recycling and Avoid & Mitigation respectively. Consequently, the number of dimensions is reduced from 36 to 34. The matrix product of the "Sets of practices matrix" and the "Weights matrix" results in the "Preliminary scoring matrix". We rescaled each indicator with a linear transformation so that the range for each indicator is exactly to 0 to 10.

STEP 6: Archetypal Analysis

The quantification of sets of practices into indicators scores allows us to characterize, compare and group our cases with quantitative analysis techniques. To identify the main models underlying these sets of practices, we conducted an archetypal analysis on the 34 POA indicator scores of these 37 cases. AA is a statistical method aiming at synthesizing a set of multivariate observations through a few, not necessarily observed points (archetypes), which lie on the boundary of the data scatter and represent a sort of 'pure individual types', rather than typical observations or cluster centers. Mathematically, AA as proposed by Cutler and Breiman (1994), is an unsupervised learning method that seeks extremal points in the multidimensional data – which are convex combinations of observations (convex combinations are linear combinations of points where all coefficients are positive and sum one). To conduct our analysis, we made use of the functions implemented in the R package "archetypes" (http://CRAN.R-project.org/package=archetypes) by (Eugster & Leisch, 2009). We ran the algorithm for different values of the parameter k, that is the number of archetypes, 1000 times each to avoid choosing a local minimum solution. The determination of the correct value for k is no different than the open problem of choosing the number of components in other matrix decomposition approaches (Mørup & Hansen, 2012). We plotted the relative Residual Sum of Squares (RSS) of the best solutions for increasing number of archetypes.

Breaks in the resulting scree-plot were used to detect solutions with a potential favorable trade-off between complexity and model fitness. Archetype Analysis is very susceptible to outliers and may suffer from rotational ambiguity (Moliner & Epifanio, 2019; Mørup & Hansen, 2012), and we therefor compared the solutions the algorithm found by running it on different sets of scores obtained by slightly changing the weights matrix, as a way of sensitivity analysis.

STEP 7: group description

The loadings of each case for the different archetypes were used to classify cases. The membership of each case to an archetypes was determined in function of their loadings with respect to a given archetype being above a certain threshold arbitrarily set (*cfr.* Tittonell, Bruzzone, Solano-Hernández, wLópez-Ridaura, & Easdale, 2020). To describe and compare the groupings thus obtained, we go back to a lower level of abstraction, namely the sets of practices mentioned by farmers with full membership of each archetype.

5.3. Results and analysis

The result of the scoring is summarized in the scoring table (Figure 11), showing the 34 POA indicator scores of the 37 cases. We sorted cases by increasing sum of their scores, in order to classify farmers. A gradient is thus revealed, rather than a clear-cut separation of farmers into two extremes, with one group of farmers mentioning little or no practices for all principles and another group mentioning a great many contributing practices. Rather, the scoring table presents a mosaic of cases with strong scores for some indicators and rather low scores for others. We see some farmers pursuing a principle through all identified POA's to relatively strong degree in terms of contributing practices, while failing to mention practices contributing to any POA of another principle (*e. g.* CND7 has a relatively high score for both POAs for principle 6 but low POAs scores for principle 12). And we also observe some farmers failing to mention any practices in line with most principles, yet mentioning relatively many practices contributing to some particular POA's or principles (CNS5). Furthermore, we find that some farmers pursue a principle through one POA (*e. g.* ODS1 for Principle 3), whereas others pursue most principles through multiple POA's (ODD4). What scoring reveals then is that individual farmers appear to have different options to address each principle, and that they might neglect some principles entirely, while still pursuing other principles relatively strongly. Or they clearly choose for one POA within a principle, or address the principle through combining POA's. This confronts us with a gray area, difficult to analyze. For this we turn to the results of the AA.

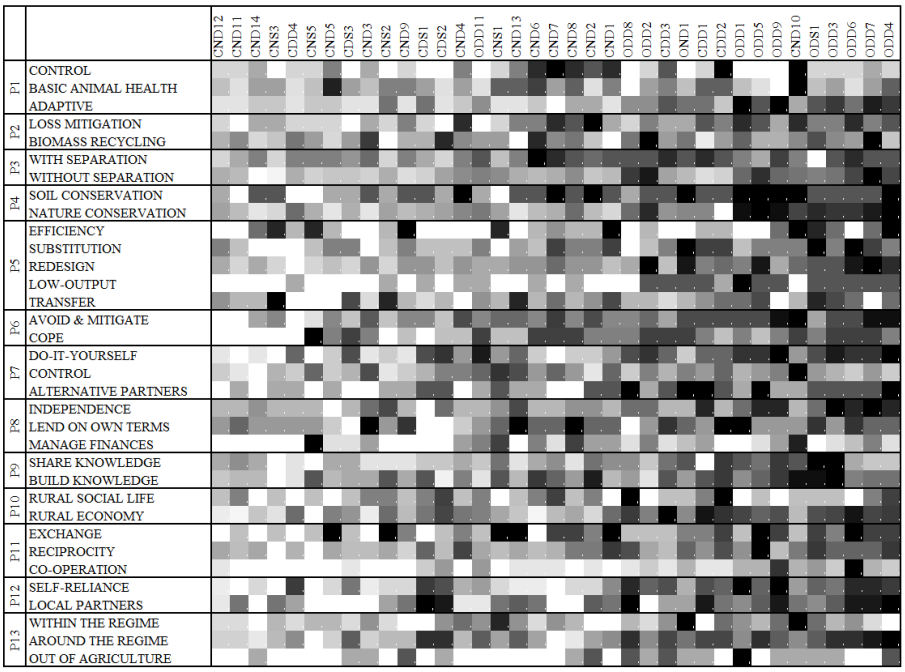

Figure 11Individual color codes of each case for POA indicators (white 0, black 10). cases sorted by summation of all indicator scores

In order to select the appropriate value of k, we compared the model fitness (RSS) of various values of k. The strong break at the value of four in the scree plot, indicated this as an appropriate value, yet we observed that small changes to the weights assigned to practices resulted in rather different archetypes identified for this value of k (see Annex 3). The solutions for three archetypes were more robust to these slight changes in weighting, and we therefore chose this solution as the most appropriate model to differentiate between cases at the expense of slight drop in model fitness (RSS = .276 instead of .240). See Annex 4 for more details on model selection.

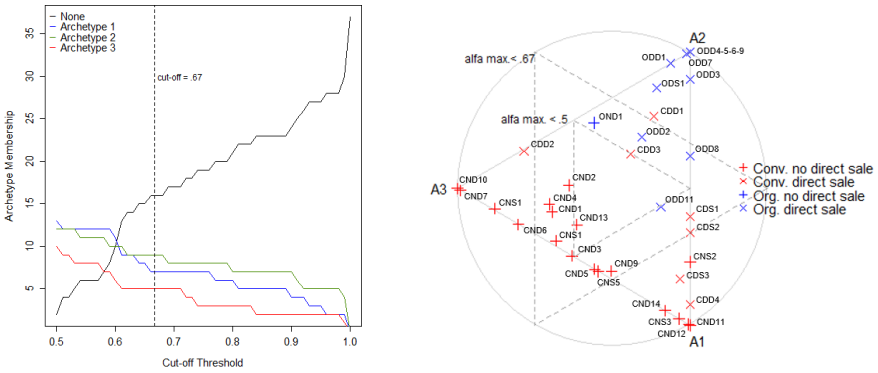

Figure 12 Left: simplex visualization of observations with respect to the archetypes identified for k = 3. Right: memberships to Archetypes in function of cut-off thresholds.

The loadings can be used as a measure for the extent each case is represented by the three archetypes identified. The simplex plot (Figure 12, left) shows that a good number of cases are represented by a single archetype, as they are found near the vertices of the triangle. A number of cases are a blend of two archetypes, as they are found at the edges of the triangle, whereas a number of cases include elements of all three archetypes, though never in equal proportions. We set the cut-off threshold at two thirds, given the plateauing number of membership for the different archetypes around this number (Figure 12, right). By this threshold, a group of 16 farmers remains without distinct membership to a single archetype in the middle, but still heterogeneous in terms of the proportions in which their pursuit of agroecological principles resemble that of each of the three archetypes.

As depicted by Figure 13, there are strong differences among the three identified archetypes for most of the 34 POA indicator scores, except for "Biomass Recycling", "Transfer" where all archetypes have somewhat similar scores, as well as "Rural Social Life" and "Out of Agriculture", though differences are larger. Archetype 1 (A1) represents farmers who mentioned no or little practices contributing to most POAs, except for the POAs just mentioned, resulting in scores markedly below the sample average. At the 66.7% threshold level, seven farmers are represented by A1. These are all conventional farmers, five without direct selling of meat to consumers, four with diversified agricultural activities, three are specialized in beef production. Archetype 2 (A2) represents farmers that mention sets of practices that contribute to a considerably higher than average score for at least one of the POAs for every principle. The membership of A2 includes nine farmers, all but one producing organically, all but one with diversified agricultural activities, and all with direct sale of meat to consumers. Archetype 3 (A3) is similar to A2, in that it represent farmers mentioning practices related to all principles, but the theme of local food systems covered by principle 12. The membership of A3 is composed of five conventional farmers, all with diversified agricultural activities, and all but one without direct selling meat to consumers. A2 and A3 have some POAs in common, whereas other

POAs are typical for just one of these archetypes. The common POAs include “Loss Mitigation”, “With Separation”, “Soil Conservation”, “Substitution”, “Redesign”

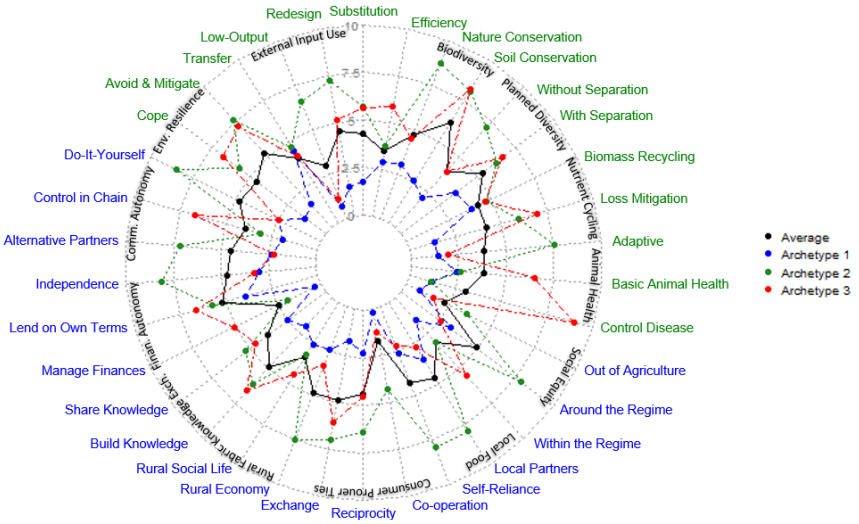

Figure 13 Radar chart showing the scores of the identified Archetypes as well as the average for POA indicators related to social (blue) and ecological and techno-productive (green) dimensions of farming.

(though slightly more for A2), “Avoid & Mitigate, “Cope”, “”Lend on Own Terms”, “Build Knowledge”, “Share Knowledge”, and “Exchange”. A number of POAs are characteristic for A2, namely “Adaptive”, “Without Separation”, “Nature Conservation”, “Low-Output”, “Do-It-Yourself”, “Alternative Partners”, “Independence”, “Rural Economy”, “Reciprocity”, “Co-operation”, “Self Reliance”, “Local Partners”, “Around the Regime”. The POAs characteristic for A3 are “Control Disease”, “Basic Animal Health”, “Efficiency”, “Control in Chain”, “Manage Finances”, “Within the Regime”.

These groups of farmers have a number of particular practices in common. As these practices contributed to a number of particular POA indicator scores, they also help to explain the distinct score sets of these farmers on which basis they have been classified. In the following section we enumerate the various scored practices which two thirds or more of the farmers in at least one grouping mentioned. A1 represents farmers which mentioned, relatively speaking, few practices contributing to the implementation of agroecological principles. Still, they share a number of practices contributing to a number of POAs, setting a base level of any beef farmer in our sample is crossing: a crop rotation of minimal length, the re- use of on-farm solid manure and slurry as organic matter in the field, and in this avoiding fertilizers and slurry, which may be more harmful for soil life. They also look to reduce losses during fertilizer application. Other practices shared by two-thirds of these farmers include the import of off-farm animal genetic material (in the form of artificial insemination

or breeding bull), provide adequate housing for the animals, and go to info meetings organized for farmers. A number of practices put them however, at odds with a number of POAs, such as their dependence on off-farm concentrates, selling their products through whole-sale channels, and also holding a breed (Belgian Blue) which is unable to calve naturally.

The nine farmers represented by A2, share a large set of practices related to all themes covered by the principles investigated in this study. In terms of land use strategies, these farmers engage in a variety of extensive grassland management practices, in particular grazing cattle on natural and diverse grasslands (limited stocking rate, no application of fertilizers, manure or pesticides). They tend to use cattle breeds and cross-breeds adapted to these rough grazing conditions, and requiring little concentrates for good growth. Some meadows in management may, however, be managed more intensively. Furthermore, these farmers tend to fill in at least a part of their feeding requirements for fattening cattle by producing their own concentrates in the form of grass-clover or grain-legume mixtures, and hold also different species of livestock separately. In the fields, most of these farmers use neither chemical nor organic pesticides, and rely on mechanical methods, augmentation of natural enemy populations associated with the bushes and trees installed around the fields, and crop diversification to keep pests within acceptable limits. Soil fertility is maintained by incorporating organic matter in the form of on-farm solid manure or other off-farm organic inputs, by installing green manures, legumes and temporary grasslands in the field rotation, by reduced and timely tilling resulting in lower soil disturbance. In social terms, this low-input production farming model also leads to increased commercial autonomy. For products these farmers all sell products directly to consumers on the farm, aside from local or regional sale channels via alternative third parties. Most of these farmers attested to avoid lending for farm investments, and have ties with other farmers, by rendering services to other farmers, by exchanging machinery with other farmers, by exchanging intermediary products such as fodder, feed and straw, but also by selling end-products from or to other farmers. Furthermore, they are actively involved in knowledge networks with fixed groups of (organic) farmers, but paid consultants too appear to also be a common source of knowledge for these farmers. Diversification of income sources, including subsidies, are a typical part of the sets of practices mentioned by these farmers.

The five farmers represented by A3 share a number of agricultural practices contributing to the techno-productive dimension of agroecology. In particular practices related to soil management are common, such as to monitor and limit fertilizer doses on the fields, re-use and incorporating on-farm manure and slurry in the field, maintain soil cover in winter by installing cover crops and green manures (often species mixtures). Farmers grow a variety of vegetables that are included in a crop rotation with the commonly cultivated forage crops (grass and maize for silage). The higher share of arable land to produce forage and cash crops in the farm holding also is associated with the practice of applying all on-farm produced manure and

slurry produced on the farm. Compared to A2 these farmers have a rather distinct set of practices to improve animal health and reducing medical interventions, even though all of these farmers keep the Belgian Blue breed, which requires systematic C-sections and is rather sensitive for flue and scab. Typical measures mentioned are vaccination, providing adequate housing, early weaning and separating calves in the first weeks of life in small huts or boxes, while feeding colostrum, providing pathogen-free and nutritionally balanced out nutrition, and sufficient strawing in stables, and bringing in off-farm animal genetic material. For four out of these five cases, all or most cattle are sold through whole-sale channels. Even though the potatoes and vegetables grown are produced for industry and often based on a seasonal contract, in contrast to A1, farmers mention building in a financial buffer, but also to negotiate from which give them more commercial control in the "mainstream" value chain, namely. They also seek to put commercial partners in competition, to be informed about market prices, and to follow and anticipate market trends, and also seek to reduce services needed (such as spraying, transporting, planting or harvesting). These farmers mention many practices contributing to their knowledge base, be it from commercial partners, by monitoring their own activities systematically, yet they also share information with farmers both informally with colleagues and in formal learning networks with fixed groups.

5.4. Discussion

At first glance, the scoring delivers a mosaic of indicator scores, reflecting the great diversity of agroecological practices mentioned amongst the farmers interviewed. This is hardly surprising: our sampling design was specifically set up to identify the broadest spectrum of agroecological practices. Whereas our sample is far from representative of the Flemish beef farming population, the mere existence of these observed coordinates reveals the subsistence and perhaps emergence of a myriad of ways to produce beef in this context. The marked diversity in land use strategies, marketing strategies, fodder strategies, underlying these scores, rejects modernization theories which would classify farmers as those at the innovation front, and those who follow or fall behind (van der Ploeg *et al.*, 2009). This diversity discredits binary characterizations of existing farming systems as either conforming completely to a conventional "industrial farming" model or to an "organic farming" model. Insofar as the sum of POAs indicators can scale the agroecological nature of the systems considered, we see organic direct selling beef farmers on one end of the spectrum, and conventional whole-selling farmers on the other, yet in between these extremes there is a continuum where these *a priori* categorizations cease to be helpful. In this chapter, we sought to map out this grey area with a less traditional data-driven approach, namely Archetypal Analysis. Before we implemented this algorithm, however, we also analyzed the scores with a more commonplace principal component analysis followed by cluster analysis, but found that it resulted in poorly interpretable classifications. From these earlier multivariate analyses emerged the hypothesis that the diversity of scores could be trace back to a smaller number/set of potentially

overlapping farming models underlying the individual pursuits of farmers. This is the core assumption of the Archetypal Analysis (Oberlack *et al.*, 2019).

We identified three farming models: one model representing farmers mentioning a bare minimum of practices contributing to agroecology A1, and two models, A2 and A3, representing farmers that do integrate elements of agroecology. Farmers represented by A1, due to their silence on practices related to various principles, may be termed "un-agroecological", compared to the other farmers in the sample. In an absolute sense, some of their practices (e.g. production and incorporation of solid manure) do contribute to agroecology, in particular on the themes of biomass recycling and the maintenance of soil life at the local and regional level. Based on these farmers' accounts, many go beyond these basic steps, we identified two models, which overlap a number of POAs. Particularly but not exclusively these models can relate to the techno-productive dimensions of agroecology, even if they markedly diverge from most of the agroecological principles related to social dimensions.

Conceptually, A2 represents a low-input, low-capital, but knowledge intensive farming model embedded within alternative commercial and social networks, which actively seeks to become autonomous from regime institutions. It therefore bears resemblance to the "peasant farming" model (van der Ploeg, 2011). There are differences, however: this model is rather similar in terms of biomass cycling to the other models, with its dependence on off-farm produced straw, manure and/or feed. This illustrates that even for these Flemish beef farmers the involvement in markets for such external, though often locally-produced, inputs is not uncommon, and they manage their farm as a semi-open system. Furthermore, low-output practices are also associated with this model, suggesting that this model does not prioritize yields *per se*. This may indicate that these farmers have transitioned to a "post-productivist" form of agriculture, long overdue according to some authors (*e. g.* Wilson, 2008), yet also accentuates the on-going academic and public debate on how to address the issues of food security and food sovereignty in the coming decades (Bernstein, 2014; Edelman, 2014).

The third model, A3, may fall short for the principle of local food systems, it represents farmers predominately involved in whole-selling of their products. These farmers have taken significant steps to implement agroecological principles, even though they are strongly involved in national to global commodity circuits. For a number of POA scores ("Loss Mitigation", "With Separation", "Soil Conservation", "Redesign"), these farmers are even undistinguishable from farmers from A2. Some practices may be in line with some agroecological principles that seem to be compatible with a conventional circuit, as they may improve or maintain crop yield and quality, without extra costs in the long term. On the opposite, practices which come at the cost of total factor productivity, specifically those associated with 'Low-Output' and 'Nature Conservation' POA, are not adopted in of this farming model, indicating that this model of pursuing agroecological principles still fits within a productivist logic. According to Holt-Giménez and Altieri (2013), such neo-

productivist farming models, generally labeled "sustainable intensification" and "bio-economy", do not challenge the current social world order. Our research results do bear out that these farmers are not uncoupling their food systems from agro-industrial companies, yet their position is not entirely submissive either. These farmers have their own way of seeking advantages within the mainstream chain, though admittedly, these strategies may well require good social position to begin with in terms of factor endowments and negotiation skills.

We noted some overlap between A2 and A3, but in terms of animal health management A3 is the opposite of A2. As such, this study presents more evidence of a lock-in of conventional beef production into what Stassart & Jamar (2008) called the "Belgian Blue référentiel". The Belgian Blue breed is famous for its unparalleled levels of production efficiency, and has been for decades now the dominant breed held for beef production in Belgium (Peeters, 2010). In order to reach these performances, however, the animals require particular intensive care and feeding practices. In Belgium, actors involved in the beef value chain are completely dedicated to and designed the processing, transporting, and selling of Belgian Blue meat. Likewise, farms are equally dedicated to produce meat compatible with these expectations. Currently, whole-selling of beef is embedded in these particular management practices. As meat from other breeds does not meet these particular standards, farmers choosing to hold other cattle breeds have to rely on other sale channels, in order to be economically viable. We would note, however, that the observation of such a lock-in doesn't make conventional beef production in Flanders an exceptional case. There is ample evidence that the terms and conditions of trade with the food manufacturing and retail industry confine the choices farmers have to produce agricultural commodities (Burch & Lawrence, 2009; Fuchs & Kalfagianni, 2010), suggesting these current management practices need to be explained in social structural terms.

In this study, information on farmers' practices related to different dimensions of agroecology and farming more generally, has been gathered from a heterogeneous group of farmers. This sets it apart from studies focusing only on the ecological and techno-productive dimensions of agroecology as a practice (Botreau *et al.*, 2014; D'Annolfo, Gemmill-Herren, Graeub, & Garibaldi, 2017; Guthman, 2000; Merot, Ugaglia, Barbier, & Del'homme, 2019), and those limited to the study of "proto-agroecological" instances (A. M. Dumont *et al.*, 2016; van der Ploeg *et al.*, 2019). There is an urgent need for tools that can verify the promise of agroecological practices (HLPE, 2019). While our research interests for this study lie in establishing the presence of the means of agroecology, *i. e.* agroecological practices, on our case study farms, rather than their effectiveness in meeting certain agroecological ends, this study's methodological contribution to such an assessment does not escape us. After all, the identification of systems managed more along agroecological lines is prerequisite to studying the performance of such systems. Our research results establish the value of a scoring system that condenses qualitative information on farmers practices into carefully designed, case study specific indicators. The

developed scoring system allowed to condense this complexity into indicators, so that this multidimensionality and diversity of farmer's practices could be analyzed in its totality, while remaining relatively grounded. The scoring system showed its usefulness as a cross-case analysis tool to differentiate between sets of practices in relatively large sample sizes. Furthermore, we shed light on this complexity by identifying different farming models underlying sets of practices of these farmers. For this we mobilized Archetypal Analysis as a data-driven classification method, which we believe greatly enhanced the interpretability of the observed diversity. As Moliner & Epifanio (2019) suggest, humans understand the diversity among observations better when the individual observations are shown through the extreme observations in the sample rather than as linear combinations of the variables (as is the case of Principal Component Analysis), or distance to cluster centers exhibiting close to average behavior.

We would stipulate, however, that the presented method and the presented application of the method has its limits. This study relies on a framework which was derived from the very same accounts of these farmers (Tessier *et al.*, 2020). While it demonstrates the internal validity of this grounded framework, the application of this framework in other settings is still lacking. However, it must be noted that the accounts given by farmers constituted only one of the three bases from which the framework described by Tessier *et al.* (2020) emerged. Practices mentioned by farmers were triangulated with literature review and expert opinions. Moreover, categorizations of practices was done based on an assessment of mentioned practices in the aggregate, rather than looking at sets of practices on a case-by-case basis. This process of abstraction allowed a more detached and thus objective assessment of individual cases. Still, the weighting of practices can be criticized for introducing researcher bias. Indeed, assigning weights to practices is inherently a judgment call, albeit a scientifically motivated one. We asked experts to weight the practices, but found that some rejected this as a simplification, or felt ill-positioned to do so, whereas others, particularly those with social scientific background had little objections. These abstractions were necessary simplifications given the nature of the data used for this study. The advantage of our method, however, is that the clear separation of coded practices and weights, renders the qualitative assessment of the sets of practices mentioned by farmers more transparent, flexible and easy to evaluate the robustness of the findings. This last feature proved particularly useful to choose among the solutions found by Archetypal Analysis Algorithm. The main limitation of the studies presented in this the previous chapter is that they take farmers' accounts of their actions as empirical entry point. The method of data gathering is deeply hermeneutical, as it greatly depends on the farmers' understanding of these principles, their understanding of their own actions, and their understanding of interview situation itself. This is not without its downsides: a farmer may misinterpret the question or misrepresent his/her practices, or s/he may not be able or willing for a range of reasons to articulate what actions are taken to pursue a certain principle during the interview. Based on our analysis we found that the identification of

agroecological practices through a semi-structured interview does far from guarantee that all practices taken by a farmer related to the pursuit of agroecological principles, are registered. The method therefore does not allow to separate *empirically* the less talkative but agroecological farmers in actual practice, from those who are not, as they have also little to say. Other methods of data gathering such as a structured questionnaires, could be developed to trace in a more systematic way the actions taken by farmers, which will lead to a more accurate characterization of sets of practices. However, while a more systematic assessment of the presence of means of agroecology at each studied case is still lacking, our study may well have laid the foundation for such assessment tool.

5.5. Conclusion

Our study shows that by taking an integrated agroecological perspective, different archetypes can be identified which underlie the sets of practices of this diverse group of Flemish beef farmers. This interdisciplinary investigation of actions taken by actual farmers may thus further ground empirically theorizations of farming models in this context. Concepts put forward in the literature to distinguish between different sustainable development pathways at the farm level, such as "Sustainable Intensification" and "Peasant Farming" were shown to be useful to some extent to describe the different models based on a data-driven classification of our cases. Hence, our study suggests that these concepts aren't merely academic constructions divorced from farmers' realities, but indeed have some validity in this context and indeed provides empirical grounds to make such distinctions. But still, none of the interviewed farmers represented these models in a pure state. In fact, our results indicate that many farmers don't go very far in either approach, or are situated in between these farming models, As Brédart & Stassart (2017) suggested, farmers are on their own trajectory of combining various practices fitting their situation and their judgment. The sets of practices they end up constructing therefore resist ideal-typical classification. In fact, the ability of farmers to blend practices fitting both or either one of these models, may actually explain some of the controversies surrounding the definition and delimitation of agroecologically managed farming systems. Without going into the legitimacy of the concerns surrounding the co-optation of agroecology by powerful institutions (Holt-Giménez & Altieri, 2013; Norder *et al.*, 2016), we would suggest that disputes on the definition of agroecology may stem from the overlap in management principles and indeed actual farming practices of the different farming models being proposed.

Chapter 6

Mapping Farm Functioning with Farmers

Mapping Farm Functioning with Farmers

In this chapter we reflect on the effectiveness of cognitive mapping (CMing) as a method to study farm functioning in its complexity and its diverse forms in the framework of our own experiment with a diverse group of Flemish beef farmers. With a structured direct elicitation method we gathered 30 CMs. We analyzed the content of these maps both qualitatively and quantitatively. The central role of the concept "Income" in most maps indicated a shared concern for economic security. Further, the CMs indicated that farmers dealt with this shared social reality differently, as the relationships included in their maps referred to different functional processes relating to revenue streams, marketing strategies, investment decisions, dependence on production inputs, on-farm resource management, and personal well-being. With a clustering algorithm we grouped farmers based on the relationships in their maps, which allowed us to trace some of the broader patterns within the data, such as the existence of more business- and investment-minded farmers, in contrast to farmers focused on their quality of life, and animal production-oriented in contrast to marketing-oriented farmers. Taking into account farmers' comments, we find that the methods had limited capability to classify farmers based on their perspectives on farming. Still, the system presentations proved useful to study what aspects farmers were working on or towards, and how these aspects may fit together as a whole. CMing was therefore mostly effective in exploring farm functioning in its complexity, and less so in exploring farm functioning in its diversity.

Reference

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. Cognitive Mapping, Flemish beef farmers' perspectives and farm functioning: a critical methodological reflection. *Agriculture and Human Values.* (Accepted March 12, 2021)

6.1. Introduction

Transition of agricultural systems towards more sustainable agricultural practices would be greatly eased by sound intervention strategies and an appropriate governance of agricultural systems implemented at different institutional and spatial scales. The effectiveness of such strategies hinges on both a critical understanding of the social-ecological systems farmers are embedded in, and of farmers' situated self-understanding and behavior as key actors within these systems (Feola & Binder, 2010). Empirical inquiry methods that can facilitate the development of such a critical interdisciplinary understanding are in high demand. The overall objective of this chapter is to assess the effectiveness of cognitive mapping (CMing) as a method to

study farm functioning in its complexity and its diverse forms in the framework of our own experiment with a diverse group of Flemish beef farmers.

CMing refers to a family of semi-qualitative methods to obtain and condense actors' beliefs about a system of interest into directed graphs consisting of defined variables (nodes) and relationships between these variables (edges). CMing methods have increasingly been used over the years in the agricultural sciences to solve all kinds of "wicked problems" researchers are confronted with (Christen, Kjeldsen, Dalgaard, Martin-ortega, & Binding, 2015). Farms are now commonly conceptualized as complex systems, consisting of human, technical and natural components, with their many linear and non-linear interrelations in between these components (Restrepo, Lelea, Christinck, Hülsebusch, & Kaufmann, 2014). System diagrams are in that regard fitting to visualize this conceptualization of farms, and CMing methods in particular has come to the attention as one of such methods, because the obtained directed graphs, can be used as ecological or bio-economic models to simulate system dynamics quantitatively (Özesmi & Özesmi, 2004). Studies of this kind which included farmers as key informants, have for example sought to model late blight control systems in potato production in the Netherlands (Pacilly, Groot, Hofstede, Schaap, & Bueren, 2016), grass forage management systems in Belgium (Vanwindekens, Baret, & Stilmant, 2014), and cotton yield management systems in Greece (Papageorgiou, Markinos, & Gemptos, 2009). Yet, CMing has also gained currency within the agricultural sciences for a rather different analytical purpose, namely to study the beliefs of stakeholders themselves about a particular problem or situation. Studies of this kind include explorations on the views of different stakeholder groups on water management in the Camargue reserve in France (Mathevet, Etienne, Lynam, & Calvet, 2011), decision making processes regarding the uptake of agroecological practices by vineyard growers in Italy (Garini, Vanwindekens, Scholberg, Wezel, & Groot, 2017), and investment decision making in peri-urban South Ontario, Canada (Akimowicz, Cummings, & Landman, 2016).

It struck us, however, that even though CMing had been successfully used to model system dynamics and also to analyze actors' perspectives themselves (Ditzler *et al.*, 2018), the use and interpretation of CMs for analytical purposes has, however been rather one-sided. Namely, 'hard' (the biological and technological components) and 'soft'(the meanings that actors give to these components) sides of farm functioning are studied separately rather than integrated. To overcome this separation of technical and social aspects of farm functioning, and the one-sided interpretation of CMs that it encourages, we put forward in this chapter an affirmative but cautious perspective on CMing mapping to study farm functioning, which is informed mainly by critical realist philosophy[1] (Archer *et al.*, 1998; Danermark, Ekström, & Karlsson,

[1] Critical realist philosophy is according to multiple authors (Jansen, 2009; Koutsouris, 2012; Nuijten, 2011) a more adequate philosophical foundation for the application of systems methodologies in the agricultural sciences. Critical realism helped us to analytically distinguish

2019). In our view, models created with systems methodologies such as CMs need first of all be taken as hermeneutical enablers to help structure debate about certain issues, rather than as a blue-print of a phenomenon 'out there' (M. C. Jackson, 2001). While these may refer to this intransitive dimension of reality, they are necessarily incomplete and inaccurate models. This is not only because participants' subjective misconceptions and biases about reality are built into the map, but also because of the influence of a double hermeneutic that necessarily develops during elicitation itself (a term used in cognitive science to describe the process of inquiry to encourage a person to externalize a mental model). Just as a researcher tries to understand the world of the people s/he studies, the people being studied try and understand the motives and intentions of the researcher and the purpose of the research setting generally, and thus modify their behavior (Nuijten, 2011). So even though stakeholders may appear to capture the situation so well, a functionalist over-appreciation of these models as adequately representing real-world phenomena needs to be resisted (M. C. Jackson, 2001). Furthermore, it is necessary to recognize that beliefs about farm functioning, and farm functioning itself are ontologically distinct. While the concept of social-ecological systems emphasizes that the nature in these systems is socially produced and thus dependent on the concepts employed by human agents embedded in these systems, the components within such systems are not exhausted by the discourses about them (Zachariadis *et al.*, 2013). It is therefore required from scientists to postulate the existence of real entities and objective social structures with causal powers of their own, which may have influenced an actor's representation of a system. This being said, CMs constructed by farmers about their farm are likely to be useful hermeneutical enablers for scientific inquiry into functioning of farming systems, given that farmers are not only privileged witnesses of these processes day in, day out, but also because they are part of these processes through their agency as main decision makers within these systems.

This rest of this chapter is organized as follows: after a short presentation of context and aim of the CMing experiment on which our reflection on CMing will be based, we discuss in section 3 the different elicitation methods operationalized in the agricultural sciences, as well as the different analysis methods. In section 4, we present the method of data gathering and analysis of our experiment with Flemish beef farmers. In section 5, we describe the results of the application of the devised method. In section 6, we come back to the overall objective of this chapter, by discussing in

between systems representations, the actual beliefs of farmers and their farms, which we put forward in this paper. Critical realism also heavily informed the assumptions we make throughout this paper about the existence of a concept-depended yet not concept-exhausted social world. Critical Realism indeed provides a sophisticated account about the nature of natural and social entities and mechanisms, and how they give rise to actual events and experience. In this chapter we don't attempt, however, a systematic assessment of CMing from a critical realist perspective. Our discussion remains in this chapter mostly at the level of experience and actual events. In next chapter we will engage more thoroughly with the social ontology critical realist theorists have put forward.

depth whether the devised and applied CM method was effective in bringing insights about farm functioning.

6.2. Context of the presented experiment

This study was conducted within the frame of a wider research aiming at exploring the relevance of agroecology to beef farming in Flanders, Belgium. Flemish beef farmers find themselves more and more in search of alternative pathways, as the traditional prospects of further production intensification and scale enlargement are closing off in this densely populated and affluent region (Platteau *et al.*, 2018). Though Flemish beef farmers may take all kind of actions to pursue agroecological principles (Tessier *et al.*, 2020), we found that individual farmers may pursue these principles to a rather different extent or in a different way (Tessier, Bijttebier, Marchand, & Baret, 2021). In order to account, however, for this observed diversity in practices, there is a need to understand whether these farming systems function differently, *i. e.* whether different processes varyingly sustain these farms as a whole, including the role of farmers' perspectives herein. Anticipating this challenge, and considering the arguments made in previous section, CMing appeared to us a suitable method of inquiry for this purpose.

Concomitantly, the selection of farmers for the presented CMing experiment was also driven by this broader objective. As we aimed exploring the full scope of agroecological practices on Flemish beef farms, we sought to obtain a sample of beef farmers diverse in their agricultural and marketing practices, rather than a representative sample of the beef farming population or subpopulations of it (*cfr.* Tessier *et al.* 2020). Therefore we selected farmers along the range of three axes: organic/conventional, direct sale of meat or not, specialized beef production or more mixed agricultural activities. To further increase the diversity in management practices in our sample, we complemented the data gathering with a variational sampling approach by contacting farmers of potential interest based on previous interview experiences.

6.3. Methodology

Our review of numerous recent CMing studies, which seek to capture farmers' beliefs on various aspects of their living environment, delivered an inventory of methods used to obtain CMs. This is reminiscent of the fact that across disciplines, despite the widespread popularity of these techniques, no consensus has formed within literature as to the most appropriate way to elicit CMs in general (Hodgkinson, Maule, & Bown, 2004; Van Winsen *et al.*, 2013). One commonly distinguishes between (i) indirect elicitation procedures, where the researcher is required to re-create or infer the network of concepts and edges from an oral interview or from questionnaire data (*e. g.* Vanwindekens *et al.* 2013; Van Winsen *et al.* 2013) and (ii) direct elicitation procedures, where a network representation of a mental model is

directly elicited from the interviewee through a diagrammatic interview or drawn by the interviewee him or herself (Jones, Ross, Lynam, Perez, & Leitch, 2011). Indirect elicitation methods are by their very nature unstructured, and depend heavily on the researcher's interpretation of what was said by the farmer. This is less the case with direct elicitation methods, but here again, two approaches are available. Either one lets the respondents come up with their own concepts to form a causal map (semi-structured) (*e. g.* Christen *et al.* 2015; Bosma *et al.* 2017) or the researcher provides a list of concepts *a priori* established (structured) (*e. g.* Fairweather and Hunt 2011; Akimowicz *et al.* 2016). The main disadvantage of structured methods is that it precludes the elicitation of novel constructs. This constrains the participants ability to represent the situation, potentially forcing an alien conceptual framework onto farmers. The upshot is that the elicitation process can be better controlled by the researcher as the respondents are presented by the same conceptual stimuli. Furthermore, by using identically worded factors direct comparison of maps can be carried out, without the researcher having to decide whether two similarly worded factors are the same (Markóczy & Goldberg, 1995). As a result, one chooses to deal with the inevitable coding problem prior to elicitation as opposed to after elicitation, which simplifies further analysis. To elicit the causal relations in structured direct elicitation two contrasting techniques have been adopted for direct elicitation: the use of relatively intensive methods involving pairwise judgments of causal relationships and techniques that seek to capture participants' causal belief systems directly in visual form. The former category of procedures uses implications grids or structured questionnaires. The latter category includes approaches whereby participants represent their causal belief systems using a hand-drawn paper-and-pencil procedure. Hodgkinson *et al.* (2004) compared the two methods and found that the latter free-hand method was more likely to elicit too few relations and concepts (omission), while the pairwise comparison techniques was more likely to elicit too many or irrelevant relations (commission). We could conclude that such method issues of 'memory error' are inherently part of the elicitation process.

Independently of the elicitation method chosen, the attractiveness of CMing for social-ecological systems researchers is their compatibility with adjacency matrices for further quantitative inquiry. Many CM studies in agricultural sciences have used quantitative methods indeed (calculation of steady-state values, simulation of scenario's) to uncover how system components and processes may affect one another, or used quantitative techniques in order to compare stakeholders' perceptions of a similar system. (Ditzler *et al.*, 2018; Vanwindekens *et al.*, 2014). In critical realism, the predictive use of mathematical models is discouraged on ontological grounds, particularly for approximating the dynamics of "open systems" such as farming systems (Jansen, 2009). Nonetheless, the patterns revealed by quantitative analyses can play a significant part in developing propositions about existing causal mechanisms, and can help to assess and explain the results in the analysis phase. (Zachariadis *et al.*, 2013). Furthermore, disentangling differences in perceptions of farm functioning from actual farm functioning, requires to take into account the

context in which each of these maps arose. In fact, we observe that qualitative information such as interviewees remarks, field notes and observations made during the elicitation process was often instrumental in interpreting and discussing the obtained maps.

In considering the aim of our empirical study at the time, namely to identify the different processes that may varyingly sustain Flemish beef farms as a whole, we spotted a trade-off between considerations of practical nature (feasibility given limited research resources and demands on participants' time and mapping abilities) and analytical nature (our capacity to use CMs to identify system dynamics of interest and farmers' perceptions of these). These considerations led us to prefer a direct structured elicitation with the free-hand technique. In our estimation this approach would place tolerable demands on the farmers' time and cognitive abilities, while allowing farmers to communicate their own causal beliefs with limited involvement of the researcher. Our preference for the free-hand method was mainly practical, as we were concerned that participants might find the task too difficult and insufficiently engaging. Considering the arguments above, we hypothesized that a mixed method of analysis may maximize our chances of addressing both issues of feasibility and analytical utility. That is by using a limited set of quantitative techniques to identify general patterns within the data, and to contextualize and interpret these patterns through qualitative analysis of the comments made by farmers during elicitation.

6.4. Materials and methods

The developed method consists out of three steps: (i) a preparatory step consisting of concept pool construction and pilot interviews, (ii) data gathering including both the physical maps as well as an audio recording of the whole elicitation process and (iii) an analysis step in which explored the content of the maps in light of the comments made by the farmers with mixed methods.

6.4.1. Preparatory step

For structured elicitation methods a concept pool has to be created for interviewees to draw and construct their mental model. This concept pool should consist of concepts that are variable, unambiguously understood, unduplicated and cover multiple aspects of farming. We took inspiration from a study conducted by Bijttebier *et al.* (2016), who identified relevant factors influencing farmer's decision making, based on seven interviews with organic beef farmers in Flanders, and from the concept pool constructed by Fairweather and Hunt (2011) used for CMing with dairy farmers in New Zealand. Straight-up copying of these concept pools wasn't possible, however, as both studies put forward many non-variable concepts, which is problematic for effective causal mapping (*cfr.* Nakamura *et al.* 1982). The preliminary concept pool contained 63 variables and we tested this concept pool in four pilot interviews (one with organic direct selling farmers, and three with conventional whole-selling farmers). Based on this initial experience, we slightly adjusted the elicitation

procedure, and constructed through merging, reformulating and scrapping of initial concepts, a list of 48 concepts (Table 16).

Table 16 Translated list of concepts used for CMing. Concepts are grouped interpretively: internal economic decision making (yellow), external social relations (blue), soil and environment (brown), plant production related (green), animal production related (red), daily farm life experience (purple).

Accounting/Administration	Product and Sale Channel Diversity	Animal Diseases, Plagues and Deaths
Available Land	Regional Embeddedness	Animal Handling and Welfare
Business Expansion	Regulatory Requirements	Animal Resilience
Continuity Enterprise/ Succession	Subsidies	Hygiene and Food Security
Debt	Biodiversity	Meat Quality
Income	Nutrient Emissions and Losses	Medical Interventions
Investments	Renewable Energy	Other Livestock
Stable Infrastructure	Soil Cultivation	Share of Concentrates in Ration
Technical Innovation	Soil Organic Matter	Stocking Rate
Contact with Consumers	Use of Manure	Technical Results
Co-operation with other Farmers	Buying Fodder	Total Yearly Animal Production
Direct Sale	Cash Crops	Activities outside Agriculture
Firm Image	Crop Diversity in Time and Space	Autonomy
Hired Labor	Fertilizer	Leisure
Knowledge Network	Pesticides	Satisfaction
Pricing	Roughage Quality	Work Pressure

6.4.2. Data gathering

As a way of social introduction and in order to familiarize ourselves with each situation, we asked a series of open-ended questions on the farm's history, current agricultural activities, perceived strengths and weaknesses of the farm, and their future perspectives. CMs were then obtained as follows: first, we explained how to draw a CM by using an unrelated map, then we asked the farmer(s) to sort all the concepts into three piles: one for the factors important to their farming system, one for the factors unimportant in their farming system and the remainder for the factors that were of some importance in their farming system. Then we asked the farmer to select post-it's from the important pile and put these on a piece of A2 paper. Once about four concepts were chosen, we gave the farmer(s) a pen and we asked to draw the signed (+/-) causal connections between those concepts in order to show how they are related. Next, farmers built up their causal map by adding in concepts of any pile, up to 20 concepts. During the process we reminded farmers to consider each concept for what it causes and, in turn, what causes it. When a respondent appeared to have difficulties drawing relations, we resorted to propositional statements such as "*does this concept influence this concept?*", or "*is this concept related to this concept?*" as well as inquiring statement such as "*so if this concept improves, this decreases?*", particularly

when edges were drawn that seemed inconsistent with what the farmer(s) had expressed verbally. During the elicitation, farmers were encouraged to comment and explain their thought process. The full exchange was recorded for each case and transcribed.

6.4.3. Analysis methods

For the purposes of complementarity and compensation, we used both quantitative and qualitative methods to characterize and compare the content of the processed CMs (Zachariadis *et al.*, 2013).

Qualitative content analysis and processing.

Our qualitative analysis had two purposes: to identify the meanings attached to concepts and relationships included in the maps, and to check the consistency of the drawn maps with farmers' stated beliefs in order to prepare them for further quantitative analysis. Some farmers were mostly silent during elicitation. This compelled us to focus on the part of the data that was gathered most systematically from the farmers, namely the information contained in the physical maps. Nonetheless, we interpreted these patterns in the light of the comments farmers made during elicitation. The combination of both sources deliver a more complete picture from which to make inferences about what farmers sought to represent with the relations they drew and why so. In an inductive and iterative manner, we conceptualized functional processes which refer to particular meanings farmers attached to the relations they drew, and kept track of the maps and the relations the functional processes referred to on a spreadsheet. To explore the content of the CMs quantitatively, we had to convert the maps drawn by farmers, into adjacency matrices. The resulting matrices are a combination of both the maps drawn by the farmers and the transcripts of the audio records. This combination is supported by following observations: farmers were regularly drawing edges implying relationship which were in conflict with their descriptions of these relations; and farmers often used correlational rather than causal language to describe relations between concepts, leading them to be rather imprecise at times about the orientation of the edges. Combining both maps and records allowed us to assess the consistency between both in order to create matrices optimally representing farmers' perspectives on farm functioning.

Quantitative descriptive and comparative analysis.

We computed several graph theoretical metrics relating to the structure of the maps (number of nodes, number of edges), as well as the components of these maps (concepts and relations included, out-degree, in-degree, centrality of concepts). Computation of these metrics was done in the R programming environment using the functions implemented in the FCMapper package, developed originally for Microsoft Excel (Bachhofer & Wildenberg, 2011). We quantified the content difference between individual CMs based on the generalized Distance ratio Formula as described by

Markóczy and Goldberg (1995). This formula developed by Langfield-Smith and Wirth (1992) combines various distance measures, which include differences in strengths of common communicated causal beliefs, the differences due to the existence or non-existence of such relations involving common concepts, and the difference due to such relations consisting of unique elements. With a hierarchical agglomerative clustering algorithm using the Ward's minimum variance method as linkage criterion, and with the distance measures as inputs, we generated a Tree plot diagram generated, on which basis clusters of farmers were identified. By aggregating the maps of farmers classified in each cluster, we created group maps. These maps were visualized and compared in terms of the included relations, the centrality of the concepts, and the functional processes referred to by the farmers.

We concluded our analysis by assessing the homogeneity of clusters identified quantitatively by considering the comments that these farmers had made on their map and their outlook on farming that could explain farmers being part of one cluster and not another.

6.5. Results and analysis

For this study we conducted 35 interviews with beef farmers, aside from the four pilot interviews (Table 17). We decided to exclude five interviews from further analysis: in two cases, the circumstances for mapping were unfavorable (in one case the farmer was clearly too tired, and in the other case the mapping was interrupted by the entry of a family member, who hijacked the interview), and in the other three cases, farmers drew interactions between groups of concepts rather than individual concepts, making it impossible to transform these maps into adjacency matrices needed to apply the chosen quantitative methods. Still, the 30 remaining maps were successfully converted into adjacency matrices, after we changed in total 73 relations and six concepts, so that these were in accordance with what farmers were saying about their relations in the map while they were mapping. Of these 30 maps, 23 were elicited from individual farmers (18 men, five women). The other seven maps were elicited from two or three members of the household from both sexes.

Table 17 Distribution of cases along the three *a priori* axes used for theoretical sampling: Organic (or transitioning) to Organic or not; Direct Sale of meat or not; Diversified Agricultural Activities, defined here as rearing other livestock species than bovines for Sale or growing cash crops excluding wheat.

Organic or transitioning to organic?	Direct sale of meat?	Diversified agricultural activities?	Number of cases participating	Number of maps Retained
Yes	Yes	Yes	9	7
		No	1	1
	No	Yes	1	1
		No	0	0
No	Yes	Yes	4	3
		No	4	3
	No	Yes	13	12
		No	3	3

These CMs included in total 331 different non-zero relations connecting all but one concept ("Nutrient Losses and Emission") to a varying degree. Individual maps after processing differ markedly in elaborateness with on average 14.8 ± 2.8 Std concepts, and 21.0 ± 4.6 Std connections (Figure 14), but also in terms of the kind of concepts they include. Some farmers extensively drew on concepts related to "Animal Production" to communicate what was important to them about their farm, whereas others mainly integrated concepts related to "External Social Relations" or use many concepts from the "Internal Economic Decision Making". The aspects "Plant Production", "Soil and Environment" and "Daily Life Experience" are less consistently included by farmers in their map. Many farmers said they could include many more concepts, though only two farmers effectively reached the 20 concepts allowed. Some farmers said that it would become a tedious affair or that it would take too much time to integrate more concepts, or that it was better to stick with the most important concepts.

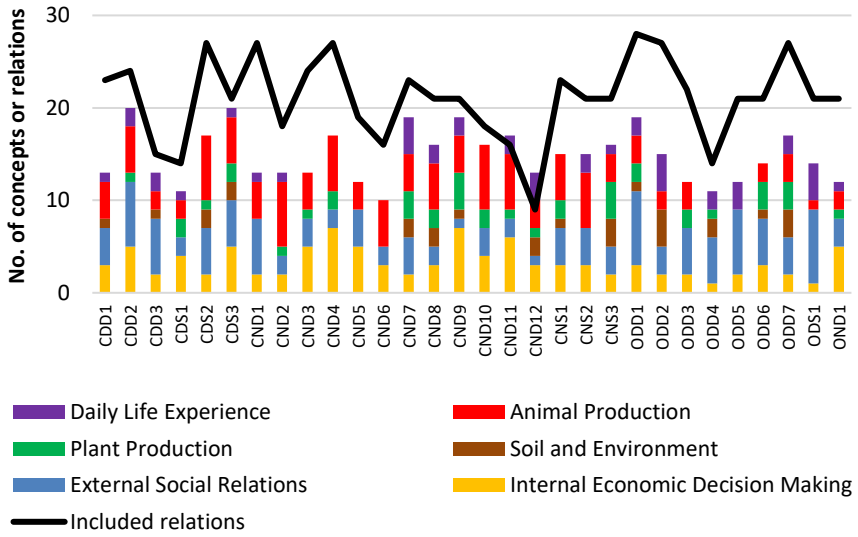

Figure 14 Bar and Line Chart showing the final number concepts, sorted by their respective concept groups into stacked bars, and final number of relations included (black line) in each individual CM. Cases sorted by label: (O--) organic, (C--) conventional, (-D-) direct sale of meat or (-N-) no direct sale of meat, (--S) specialized beef production or (--D) more mixed agricultural activities.

Figure 14 shows the number of times concepts were integrated in the maps, and the average of centrality scores for these concepts, in all maps, and in those maps including the corresponding concepts. The concept "Income" stands out for all of these metrics, with 27 farmers including it in their map, and with 5.5 edges on average overall going from and to it. The next three most included concepts ("Meat Quality", "Pricing", "Satisfaction") play a markedly less central role in the maps on average, compared to "Income". A couple of concepts, particularly "Technical Results", but also "Direct Sale", "Investments", "Autonomy", "Technical Innovation" and "Cash Crops"), differ from other concepts as they are less regularly included in the maps, but when they are, they do play a central role in those maps.

While there are considerable content differences between maps, as Figure 14 and 15 show, we observe the frequent and central role of "Income" in the overwhelming majority of individual maps. "Income" indeed appears to be the main reference point for farmers to assess what concepts are worthwhile to consider integrating in their systems, and farmers also frequently verbally noted that this was the most important concept in their map. "*Eventually, that's what we do it for. Working to have a good income and a good life, and if you have a good income, then you can work on your leisure, and your quality, and whatever else*." (CNS2). While some maps present a

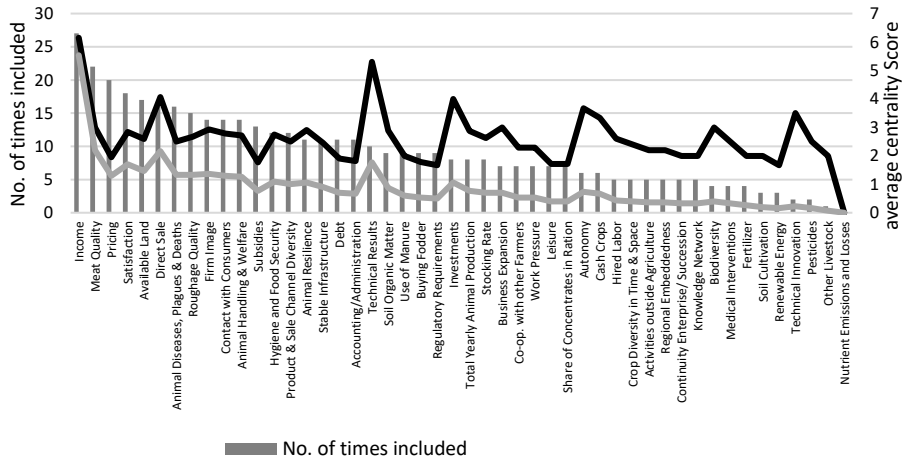

Figure 15 Average centrality scores of concepts in the maps containing them and overall on average, sorted by times included by farmers.

system in which "Income" is the only end, it figures often as a means for the pursuit of autonomy, satisfaction, social standing, business expansion, paying off debts or generational succession. This suggests that farming systems are at least in part, driven by other motives than maximizing income. In three maps, "Income" isn't even included, which suggest that in some cases lack of income may be less pressing or more acceptable, such as would be the case in non-commercial farming, that farmers are less involved in farm financial matters personally, or that income generation shouldn't play in the mind of these farmers a role. Still, exclusion of "Income" may also derive from a belief that gaining an income is so self-evident that it doesn't have to figure on the map. As one farmer (CND6), who did not include "Income" in her map but instead organized concepts around "Animal Handling & Welfare", put it: "*Without income you can't go further, but we are a bit older, and have some room to do something else. But if your* [animal] *welfare is good, then you'll have good results too. Without putting your heart and soul in it, it won't work."* From this we may conclude that generally speaking continued income generation is presented by farmers as a necessary and system defining functional process on their farm. As further analysis of the comments in conjunction with the maps, indicate, however, income generation is not the only process that is communicated by farmers to be important.

By examining the maps and the comments made by farmers next to each other we found that farmers often expressed similar ideas, but that these could be expressed through different concepts and relations. For instance, we find that out of the 20 maps which contain both the concepts "Income" and "Meat Quality", six contain a direct relation between these two concepts, whereas four others contain the indirect relation "Meat Quality → "Pricing" → "Income". Based on the comments made by these farmers, however, we have no reason to believe that these farmers were actually

conveying a different idea with these different relations. Furthermore, some concepts were used interchangeably. This was most clearly the case for the concepts "Direct Sale" and "Contact with Consumers", where we found that either or both of these concepts were used by farmers to describe the activity of selling their own produce to consumers themselves. Other pairs of interchangeably used concepts include "Diversity of Species in Time and Space" and "Diversity of Products and Sale Channels", "Leisure" and "Activities Outside of Agriculture", and "Animal Diseases, Plagues & Deaths" as a negative substitute for "Animal Welfare and Handling". Yet, we also found that similar concepts and relations could have rather different meanings attributed to them. For instance, while most farmers interpreted "Direct Sale" as selling directly to consumers, some farmers used this concept to refer to the activity of selling agricultural products to a restaurant (CND2) or a supermarket chain (CND5) as opposed to a cattle trader or a meat processing company.

Through qualitative analysis of the digital visualizations of individual maps, along with the statements made by farmers during elicitation, we identified 35 functional processes referred by these 30 farmers. Some of these functional processes refer to a specific relation or specific combination of relations, such as for instance the functional process "Renewable Energy for revenue", which is specifically tied to the relation "Renewable Energy → Income". However, most of the functional processes were recognizable in multiple sets of relations drawn by individual farmers, and often require the additional information provided by the recordings to correctly categorize. Table 18 illustrates this phenomenon for one such functional process.

Table 18 Relations corresponding with functional processes "set-up/improve direct sale activities on your own"

Set up/improve direct sale activities on your own	contact with consumers → firm image → product and sale channel diversity; meat quality → direct sale ↔ income (3x); meat quality → direct sale ← cash crops; meat quality → direct sale → contact with consumers; business expansion → direct sale → contact with consumers; autonomy ← direct sale → pricing; direct sale → contact with consumers → firm image; autonomy → direct sale → contact with consumers; co-op with other farmers → contact with consumers → product and sale channels diversity; income ↔ contact with consumers → direct sale; direct sale → pricing; firm image → contact with consumers ↔ direct sale;

We grouped these 35 functional processes, listed in Table 19 and 20, in six categories for heuristic purposes only: (i) the procurement of monetary means generally and through various revenue streams in particular, (ii) marketing strategies, (iii) the procurement of physical inputs, (iv) investment strategies, (v) management strategies to improve the internal flows of these resources, and (vi) experiences of the farmer as manager and worker in this whole. On average, farmers referred to 9.8 ± 2.0 Std functional processes in their map and share between zero and nine functional

processes with other maps, with an average of 3.7. We find that almost two-thirds of the farmers expressed in one way or another that they sought to differentiate themselves by the particular characteristics of their products, whereas exactly half of the farmers referred to "setting up or improving direct selling activities on your own to consumers", and to "other things than income brought satisfaction". Ten other functional processes were also referred to by at least a third of the farmers in their maps.

Figure 16 shows the tree-plot diagram which was generated after hierarchical cluster analysis of adjacency matrices. This algorithm compared the similarity of the maps based on the Langfield-Smith and Wirth's (1992) general distance measure, and then selected in an iterative manner similar maps for clustering with the Ward's minimum Variance method as linkage criterion. The tree-plot diagram shows that a good part of the overall variability among the maps can be explained by the existence of more homogeneous groups of maps in terms of concepts and relations included within maps. The labeling of these separate branches, based on the *a priori* categorization criteria, shows that farmers of a similar type also drew maps that are quite similar in content, as far as the distance measure for clustering is concerned. Based on inspection of this tree-plot we selected four as the appropriate number of clusters. Notwithstanding the smaller distance between clustered individual maps, the proportionately high within cluster error of the lower-level clusters (visualized by the long initial stalks of the tree) indicates that even maps closest to each other don't overlap for a large share of the relations and concepts that they include. In fact, maps only share a maximum of 13 concepts with other maps, 5.8 on average, and a maximum of 7 non-zero relations, 1.9 non-zero relations on average, and only 126 out of the 331 different relations was drawn more than once.

While there is significant within-cluster heterogeneity, we find that the maps of these farmers classified by the applied clustering algorithm have a shared content, both in terms of the concepts and relations included (Figure 17 and 18)), and in terms of the meanings attributed to these included relationships (Table 19 and 20).

- The most distinct group of farmers (cluster 4) based on the distance measure used

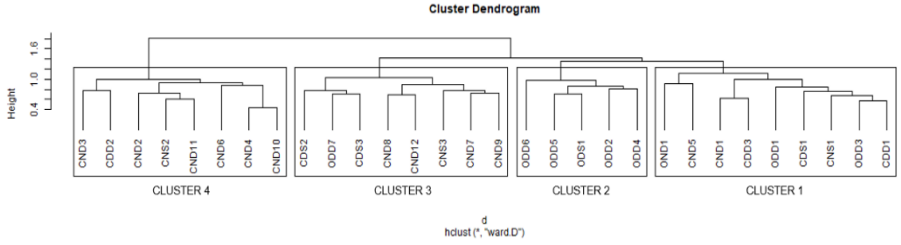

Figure 16 Tree-Plot diagram created based on Hierarchical Agglomerative Clustering of cases based on the similarity of maps based on the general Distance Formula, using the Ward's Minimum Variance method.

for clustering consists out of 8 conventional farmers, all of which but one are not

selling meat directly to consumers (CDD2, CND2, CND3, CND4, CND6, CND10, CND11, CNS2). Cluster 4's group map is the most distinct from the other group maps, as it core revolves around 5 concepts rather unfrequently included in other maps, namely "Animal Diseases, Plagues & Deaths", "Animal Handling & Welfare", "Hygiene and Food Security", and most prominently "Technical Results" and "Total Yearly Animal Production". The concept "Income" is the most central, as it is in other group maps. Concepts related to soil and plant production management, are mostly absent, and so are concepts related to external social relations or personal well-being concepts, namely "Satisfaction" and "Work Pressure". Instead, we find a strong focus on animal production-related concepts and farm economic concepts, and also the inclusion of feedback mechanisms from income back to production through investments. More than half of the farmers in this cluster referred to the following eight functional processes: "Get subsidies", "Commercial advantage through qualities of the product", "Increase scale animal production", "Invest in stable infrastructure and technical innovation", "Isolate from and eradicate pests and treat diseases", "Improve technical results", "Improve/maintain income", "Use knowledge of financial and technical results".

- Cluster 3 is a more heterogeneous grouping in terms of the activities these farmers engage in with three direct selling farmers (CDS2, CDS3, ODD7) and five not direct selling conventional farmers (CND7, CND8, CND9, CND12, CNS3). In the group map the concepts "Meat Quality", "Satisfaction", "Roughage Quality" come to the fore. The core of this group map is a number of returning relations connecting concepts like a spine. It starts from the "Use of Manure and goes to "Soil Organic Matter", to "Roughage Quality", directly to "Meat Quality" or indirectly via "Animal Resilience", and goes further either via "Direct Sale" or "Pricing, or directly to "Income, to end either in "Satisfaction, "Investment" or in reducing "Debts". "Cash crops" and "Subsidies" have also a relatively high percentage of inclusion. Qualitative analysis of these maps presents a similar story, with at least half the farmers referring to the following nine functional processes: "Crop production for sale", "Integrated soil management", "Reduce debts/maintain financial autonomy", "Other things bring satisfaction", "Balance workload", "Get subsidies", "Re-Use Biomass ", "Commercial advantage through qualities of the product", and "Improve/maintain income".
- Cluster 2 consists out of five direct selling organic farmers, in four cases with diverse agricultural activities (ODD2, ODD4, ODD5, ODD6, ODS1). The group CM is the most balanced of all clusters, with multiple concepts having a centrality score on average almost equal as "Income" has in this map, namely "Direct Sale", "Contact with Consumers", "Product & sale channel diversity", and "Autonomy". Other concepts of importance are "Satisfaction", "Soil Organic Matter", "Available Land", and "Work Pressure". Notably absent in these maps are concepts related to animal production and animal health, as well as concepts related to internal economic decision making such as "Accounting & Administration", "Debts" and "Investments". The relation "Contact with Consumers → Satisfaction" is characteristic for this cluster. At least three out of these five farmers refer in their map to ten functional processes. These include

"Regulations hamper progress/vision", "Set up alternative channels on your own", "Prod. diversification for technical or commercial advantages", "Income gives satisfaction", "Integrated soil management", "Balance workload", "Re-Use Biomass ", "Improve/maintain income", "Other things bring satisfaction", "Set up/improve direct sale activities on your own".

- Cluster 1, is a rather heterogeneous grouping of nine farmers in terms of *a priori* set types (CDD1, CDD3, CDS1, CND1, CND5, CNS1, ODD1, ODD3, OND1). The most central concept in the cluster map is "Income", then "Direct Sale", "Meat Quality" and "Firm Image". The core of this map consists out of these four elements standing in relation with each other, with many other elements, less consistently integrated in the maps. Compared to cluster 2, these maps have a lower centrality score on average of "Satisfaction and Contact with Consumers" in favor for "Firm Image" and "Income". At least half of the farmers drew relations to refer to the following four functional processes: "Commercial advantage through qualities of the firm", "Set up/improve direct sale activities on your own", "Commercial advantage through qualities of the product" and "Improve/maintain income".

The clustering algorithm brought forth four groupings with some homogeneity in terms of included relations but also in terms of functional processes expressed through these shared relations. We now turn to interpret these groupings in the light of the comments farmers made before, during and just after the mapping exercise.

We find that a sizeable grouping of farmers (cluster 4) presented their farm in a rather distinct way. These conventional mostly whole selling beef farmers drew maps that revolved around the optimization of animal production, As one farmer in this cluster remarked: "Everything depends on your [technical] results […] Now, we have a calving interval of about 370. In Belgium it's 405-408 on average, and we don't even follow this up too well, so we can still go lower." (CND11). This optimization of animal production envelops a number of interrelated processes related to intensively managing the feed and health of the animals, accompanied with on-going monitoring and investment in technical and economic progress of the farm. Farmers clearly sought to represent this complexity with the concepts and relations they included in their maps: "So, your technical results need to be good, and then it's about creating added value of your product. Of course, it can't come at the cost of other things. So now we have primarily focused on getting good technical results, good animals, our own forage, airy stables, labor-efficient stables, so we can tend to many animals, high-quality animals, on our own, my wife and I" (CDD2). The improvement of technical and economic results is also communicated to go together with making substantial investments in both land and infrastructure to cut costs through scale efficiencies. One farmer for instance remarked that he intended to "… double in numbers [of livestock], as these days, when they come get your animals with a truck and a driver, it makes a big difference whether they can take one, or they can take ten. And the cost price, you need to drop your cost price. So you need to be able to produce more cheaply." (CND4). Most of the mapping exercise was spent by these famers to communicating this synergy between animal production-related and internal

economic decision making paying little attention to other aspects of farm functioning. Farmers also communicated the importance they attached to this complex, albeit reduced picture. "It's about what you get to keep at the end of the year, the rest is all tied to it. The welfare of the animals, the meat quality, the food safety, it's all the same group, it all ties together, always. If you have less mortality, welfare is better, through hygiene you 've got better welfare, if it's better for your animals, you get better meat quality. It all hangs together!" (CND6). Compared to other maps within the sample, there is little focus on influencing the terms of trade directly other than trying to meet the quality demands of the wholesale industry to get a good price.

We find a somewhat inverted situation for cluster 1, as what sets these maps apart from the other groups is their strong focus on external social relations. While for these farmers too, income generation is a central concern, the focus lies on the marketing of a product of a distinct quality tied to the reputation of the farm that attracts customers willing to pay a higher price for their product. In terms of managing internal physical resource flows, this cluster is, however, very heterogeneous. We in fact observe that these farmers handle very different definitions of meat quality, and hence the way it can be achieved in production. One farmer who sometimes promotes his product in the local supermarket, enumerated for instance similar quality characteristics valued by farmers in cluster 4: *"*[Our strong point] *is that through experience built up over the years, as well as because we can process our own concentrates and therefore know what we give to the animals,* […] *that we can market a remarkable cattle product, that meets all requirements, regarding [carcass] yield, health requirements, meat conversion, genetic origins* [..] *that we can produce in an economic way"* (CNS1). Other farmers interpreted quality in a rather different manner: "*We don't force our animals. We never slaughter them when they are not ready,* […] *We let things develop at their natural pace, and that's also the cheapest way.*" (ODD3). From these two statements we can infer that farmers within this cluster may target quite different productivity levels. Nonetheless, they ended up in the same cluster, likely because the algorithm picked up on their shared articulation of the marketing aspects of their operation, compensating for the different or lacking articulation of the animal health and production management aspects. Furthermore, like farmers in cluster 4, farmers in cluster 1 pay on average little attention to functional processes integrating the farmer as a worker and manager in this whole. Consequently, this cluster envelops farmers, which presented farming, including their involvement alternative food networks as an economic activity first rather than as a way of life.

By contrast, the five farmers in cluster 2 communicated their involvement in alternative market channels not merely as a business opportunity, but also as a pursuit of autonomy, social contact, and/or personal satisfaction. One of these farmers put this also into words: "*Contact with consumer, that goes directly to this here, to satisfaction. Those Saturdays, they really are high days for me. That is when you get an answer on whether you have a good product, or not so much* […] *but also, just for that social contact, you know. If you have a small farm, and work alone, it really are*

pretty lonely days…" (ODD5) Because of the inclusion of these other goals, the concern for a good income presents itself as only one of the considerations alongside the attention to soil and crop management, and personal satisfaction and well-being. While some concepts related animal production, the group map of these mostly diversified farmers shows that the optimization of animal production is less of a concern for these farmers than in other clusters. A key factor foregrounded by these farmers were labor and leisure time. There are different reasons, however, for these farmers behind including this aspect in their map. On the one hand, farmers may refer to the constant time-constraints they face when operating a diversified farm without (generally speaking) labor-saving technologies such as fertilizers and pesticides, while also needing to allocate time for processing and marketing activities. One farmer elaborated on this continuous balancing act represented in the connectivity he was drawing as follows: *"If you have diversity in sale channels, you can decrease your work pressure, because if you just depend on whole sale trading, it happens that they call at half 2 p. m,, and say, "it needs to be all there at dawn." Help! But in the summer months there is no* [help]. *By contrast, if I work with stores, I know in advance what they will order.* […] *So, if you have diversity here then you'll have less* [work pressure], […] *more work pressure means you need to involve more hired labor, and that has obviously a negative effect on your income.* […] *that hired labor, if you need that, that weakens your autonomy, because you need to find those people, find good ones, and that's a lot of stress."* (ODD5) On the other hand, one farmer in the cluster noted a sudden shortage of labor was in fact a driver behind him switching to organic farming and direct selling rather than expanding production the conventional way.: "*If you want to earn something in beef production, you either have to be enormously big, or you have do it differently, start direct selling, and being able to set yourself apart* […] *free time has been and is a bottleneck for me. Ten years ago, I thought totally differently, I was going for more volume, but my wife got sick,* […] *she was three years incapacitated, and then she's been able to think a lot, and then she has told me, "I don't want to work exclusively on the farm"* […], *but that made it so that I had to take over a lot of her tasks, and then you're confronted with your own limitations."* (ODS1). Land availability also shows up as a constraint on production in the cluster map, yet the lack of concepts such as "Debts", "Investments" and "Accounting/Administration" suggests these farmers less intent to borrow for land: *"Debt is very important, but not here,* […] *if you have debts, you can't be autonomous."* (ODD5).

The final grouping, cluster 3, is of mixed nature in terms of activities of these farmers, but also in terms of functional processes. That this cluster is somewhat lacking in homogeneity is confirmed by the rather contradictory statements from farmers when asked about what were the most important aspects in their map. One farmer responded, "*Hygiene, cleanliness, quality and that you get your money's worth for what you do*" (CNS2). We heard a somewhat different story from a farmer in the same cluster who said that they were mainly concerned with animal welfare and "*keeping everything as natural as possible, without spraying products and so on,*

keeping the soil in order to produce good fodders, and keeping costs as low as possible." (CDS3). While there is a common concern about debts, though the group of farmers is mixed for their reason for including this concept. To most farmers in the cluster debts were significant, because they were looking to pay already incurred debts off, however, there was also a farmer who clearly were looking to make more investments. *"Look, if you have more income, then you'll invest more, then you'll have a better stable infrastructure, and a better stable infrastructure, gives you less work pressure, well less manual labor* […] *Business expansion that means more land, which increases your stocking rate,* […] *the more manure you use, the less fertilizers you require, the better your feed is, the less you need to buy, which brings it back to income"* (CND9). Still, on average, we find that compared to other clusters farmers in cluster 3 have less of a focus on income generation and investment, and more on personal well-being of the farm household. Furthermore, while their marketing strategies may differ, these farmers communicate that they also depend on other revenue streams such as cash cropping and subsidies. A number of farmers within this cluster indeed sought to represent how attention to the management of on-farm resources could lead to both good quality on-farm produced feed and meat quality, and hence a good income. One farmer put it as follows: *"In fact, the soil needs to be good, and your available land. Then you'll have good fodder to improve meat quality. If that's good, then that* [direct sale]*'s good. And then you have to make sure the animal's robustness is good, so that the meat quality is good.* […] *and the meat quality needs to be good for direct sale. And if you have direct sale, then you have contact with the consumer, right?* […] *And if this all good, that direct sale, how should you I put this, then your income is going to be good too, right. And if your income's good, you can do business expansion, which is why we do it in part. And if we have good income, we can invest, right? Yes, it all hangs together with this."* (CDS3).

Table 19 Functional processes represented in the maps of each farmer grouped by cluster, based on qualitative analysis.

	Cluster	1								2				
		OND1	CND5	CND1	CDD3	ODD1	CDS1	CNS1	ODD3	CDD1	ODD6	ODD5	ODS1	ODD2	ODD4
Revenue streams	Improve/maintain income	1	1	1	1	1	1	1	1	1		1	1		1
	Get subsidies				1	1						1			
	Crop production for sale	1							1		1				
	Other remunerating activities				1	1							1		
	Revenue from renewable energy				1					1					
	Nature conservation					1									
External social relations	Comm. advantage through qualities of the product	1	1	1	1			1	1	1			1		
	Set up/improve direct sale activities independently			1	1	1	1		1	1	1	1	1	1	1
	Set up/ improve alternative chain independently			1	1							1	1	1	
	Commercial advantage through qualities of the firm			1		1	1	1	1	1					
	Co-operation in alternative chain		1							1			1		1
	Negotiate in whole-chain	1													
	Make publicity in supermarkets							1							
inputs	Re-Use Biomass							1		1	1			1	1
	Reduce dependence on off-farm fodder					1			1		1	1			
	Establish partnerships for production factors					1			1		1				1
	Increase output with bought feeds, pesticides, fertilizers,														
Investment	Increase scale animal production		1					1			1				
	Reduce debts/maintain financial autonomy					1									1
	Invest in stable infrastructure and technical innovation	1	1	1											
	Debt Finance Investments	1	1												
management	Isolate from and eradicate pests and treat diseases				1		1	1							
	Use knowledge of financial and technical results	1					1								
	Improve technical results	1				1				1					
	Integrated soil management										1			1	1
	Healthy housing conditions		1				1	1							
	Resilience and welfare through feed					1	1		1						
	Prod. diversification for techn. or commercial advantages										1			1	1
	Make use or build a knowledge network					1							1		
	Graze more extensively				1		1			1	1				
Personal experience	Other things bring satisfaction				1		1			1		1	1	1	1
	Income gives satisfaction			1	1		1					1	1		1
	Balance workload											1	1	1	
	Regulations hamper progress/vision							1			1	1			1
	Satisfaction is instrumental						1			1					

Table 20 Table 19 continued for cluster 3 and 4

	Cluster	3								4							
		CDS2	ODD7	CDS3	CND8	CND12	CNS3	CND7	CND9	CND3	CDD2	CND2	CNS2	CND11	CND6	CND4	CND10
Revenue streams	Improve/maintain income	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1
	Get subsidies	1	1	1	1			1		1					1	1	1
	Crop production for sale		1	1				1	1							1	
	Other remunerating activities								1								
	Revenue from renewable energy							1									
	Nature conservation																
External social relations	Comm. advantage through qualities of the product	1	1	1		1	1	1	1			1	1	1			1
	Set up/improve direct sale activities independently	1	1	1							1						
	Set up/ improve alternative chain independently		1				1				1	1	1				
	Commercial advantage through qualities of the firm	1					1				1						
	Co-operation in alternative chain																
	Negotiate in whole-chain				1												
	Make publicity in supermarkets																
inputs	Re-Use Biomass	1	1	1	1	1	1		1								
	Reduce dependence on off-farm fodder			1			1		1	1	1	1					
	Establish partnerships for production factors																
	Increase output with bought feeds, pesticides, fertilizers,							1								1	1
Investment	Increase scale animal production				1	1			1	1			1	1		1	
	Reduce debts/maintain financial autonomy			1	1	1	1		1				1				
	Invest in stable infrastructure and technical innovation								1		1				1	1	1
	Debt Finance Investments															1	
management	Isolate from and eradicate pests and treat diseases	1						1	1		1	1	1		1	1	1
	Use knowledge of financial and technical results				1					1	1	1	1	1	1	1	1
	Improve technical results				1					1	1	1	1	1	1		
	Integrated soil management	1	1	1	1	1											
	Healthy housing conditions	1										1		1			1
	Resilience and welfare through feed		1	1	1												
	Prod. diversification for techn. or commercial advantages	1	1		1												
	Make use or build a knowledge network			1						1	1						
	Graze more extensively															1	
Personal experience	Other things bring satisfaction		1	1	1		1	1				1	1	1			
	Income gives satisfaction				1		1	1			1		1				
	Balance workload		1		1	1		1	1		1		1	1			
	Regulations hamper progress/vision							1		1	1		1				
	Satisfaction is instrumental					1					1	1					

Figure 17 Visualizations of cluster maps created by aggregating the maps. Relations and concepts in black and red are mentioned by more than 3 out of 10 farmers in the group, Thickness of relations and node label size correspond with strength of relations and centrality of concepts respectively

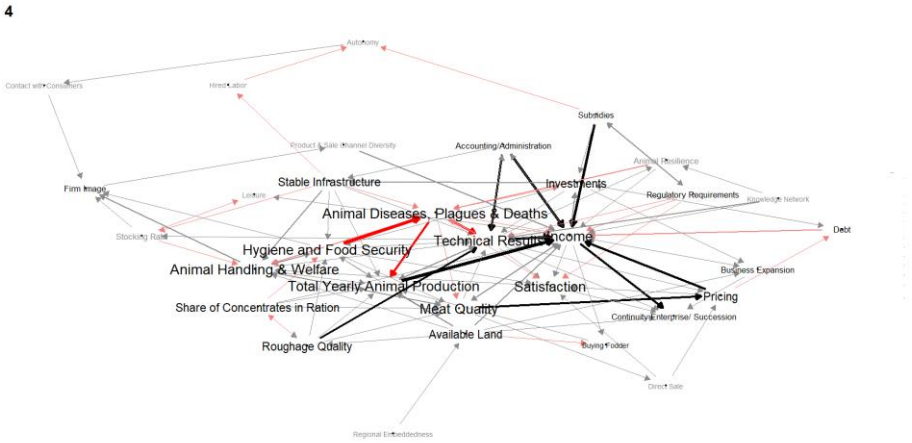

Figure 18 Figure 17 continued for cluster 4

6.6. Discussion

Like previous researchers (Akimowicz *et al.*, 2016; Fairweather & Hunt, 2011), we showed that it is possible to obtain CMs from farmers with a structured direct elicitation procedure with a free-hand technique. The quality of the maps obtained from these farmers varied markedly, as we experienced that for some farmers causal mapping was a challenging exercise, whereas for others, it appeared to be just a matter of translating onto a map a personal or acquired vision without challenging it. Based on the comments by farmers it is evident that the elicited causal maps are neither complete nor accurate representations of farmers' actual beliefs on the functioning of their farm. At some point, farmers could be so overwhelmed by the web of relations they were drawing, that it discouraged them from adding more concepts and relations. Many farmers said they could include many more concepts, but that it would become a tedious affair to do so or that it was better to stick with concepts that reflected most strongly their vision of farming. So rather than looking to recall all the relations they believe to operate at their farm, farmers are intentionally omitting certain concepts, to give a certain account of their farm. As observed by Jones *et al.* (2014), there is a difficulty representing a complex and dynamic phenomenon, such as farm functioning, on a two-dimensional, static visual-based medium.

Still, when it comes to eliciting comparable CMs for analytical purposes, we can speak of a relative success, and this is in no small part due to the methods chosen and developed. First, we believe that the choice for a structured, rather than a semi-structured approach, played a major role in our success. Fairweather & Hunt (2011) observed that farmers had difficulties to cite the most important factors themselves. Given that some respondents had already difficulties with weighing the importance of given concepts, asking them to come up with the concepts themselves would likely have overburdened them. Second, we believe that careful construction and testing was a key to develop a concept pool that proved to be sufficiently diverse and wide in

scope so that all farmers found concepts that resonated with their vision of their farm, without being overwhelmingly large. A third success factor was the choice for the free-hand technique, as this technique gives immediate overview of their presentation of their farm up to that point. Several farmers even said they had enjoyed and learned something from the exercise. A less interactive technique, such as the pairwise comparison technique with a questionnaire would presumably have made it harder to keep farmers engaged. Lastly, we note that the quality of maps in terms of detail and consistency improved throughout the gathering of the data, as the required interviewer skills for direct elicitation, such as teaching the rules of the mapping process, encouraging and making the farmers comfortable, were gained through experience with the method. We therefore highly recommend including sufficient pilot interviews.

When audiotaping the mapping process, we noticed discrepancies between what farmers orally stated and the relationships they drew. This was an obstacle to characterize these farmers' beliefs and the functioning of their farms. We decided therefore to overlay the relations drawn by farmers with our own judgments about what farmers may have intended to draw, based on their oral report. This is not unheard of in the CMing research community at all, as this precisely agrees with how one would obtain CMs with any indirect elicitation method. Moreover, it is consistent with our understanding of these models as hermeneutical enablers, not only to farmers, but also to researchers. The processing step allowed us to more fully absorb the information farmers were providing us into matrices, which were instrumental in turn to (i) visualize individual maps and group maps, (ii) discern aggregate patterns and (iii) compare the content of these maps in an automated manner. However, our analysis of comments made by farmers, revealed that this stylization presses subtle but important differences in meanings attributed to the connections out of the analysis, which we compensated by identifying functional processes in these maps. Just as other CMing studies with farmers (Christen *et al.*, 2015; Micha *et al.*, 2019), we found that income generation is of great importance to farmers. Yet, the CMs also show that the income generation process is but a part, though a crucial one, of a tight connectivity of production and marketing activities that generate not only income but also satisfaction, feeding back into further investment to improve production conditions in a variety of ways or improve marketing arrangements directly. So while income generation clearly is recognized by farmers as a necessary condition to continue farming, this reality can be perceived and acted upon differently by farmers and their CMs and comments reflect that. Table 18 and 19 indeed show farmers prioritize different functional processes in unique ways, highlighting that farmers in this context may socially construct multiple contrasting optima (van der Ploeg, 2010a). All of this suggests that content analysis needs to go beyond the nodes and edges included in the maps, but should extensively rely on qualitative information gathered alongside the physical maps to check the quality of the information going into quantitative analyses and to further interpret the results these may yield.

While multivariate methods are rather blunt tools to classify, our application of a clustering method confirmed that this sample could be split up into smaller groups farmers representing their farm in a somewhat typical manner. One cluster of mostly conventional whole selling farmers focused on the control of diseases and improving economic efficiency of animal production to optimize income generation. They may very well represent a section of beef farmers which have accepted to work within an intensive "Belgian Blue" system for beef production and commercialization in Belgium (Stassart & Jamar, 2008), with the further indication that farmers are part of the reproduction and expansion of this system by continuously reinvest in optimizing and expanding these systems. Farmers in a second cluster emphasize personal satisfaction, as well as the improvement of meat quality through optimal roughage production and soil management. A third cluster, consisting exclusively of organic direct selling farmers, sought to improve autonomy and satisfaction by establishing good relations with consumers. The last cluster of farmers, focuses marketing aspects to improve income, but were mixed in terms of actual production strategies. Clustering thus proved useful to trace some of the broader patterns within the data, such as the existence of farmers who appear to be more business-minded versus those foregrounding their quality of life, farmers who are more focused on production and other more on marketing-minded, farmers who are more investment-minded, and others who look to get by with little inputs and capital investment. The identification of distinct clusters conforms with other recent empirical findings (Beingessner & Fletcher, 2020), suggesting that farmers may position themselves differently towards the dominant agri-food system, with some farmers resigned to or even promoting going standards of production and consumption, others withdrawing from intensive production and actively constructing alternative channels around other, potentially contradictory notions of quality.

The clustering thus highlighted that this diverse group of farmers may represent their farm differently, but also that there is no one-to-one relationship between the activities of farmers and how they would draw a CM to represent their farm. This of course has ontological reasons (farmers may have different priorities despite their similarity in activities), but also methodological reasons, namely the lacking capacity of the method to register actual differences in viewpoints. The distance measure used for clustering doesn't consider the content differences in terms of meaning attributed to concepts and relations (Markóczy & Goldberg, 1995), which our qualitative clearly showed to be present. This hampers accurate content comparison. Moreover, given the many omission errors bound up with the chosen data gathering method, no systematic account of farmers' beliefs is produced. With little shared drawn relations between individual maps, the data on which the clustering happens can be rather circumstantial. The information on which this classification is based has its limitations, and therefore the classification itself, as further study of the comments made by farmers confirmed. While other publications have touted CMing as an effective method for comparative analysis of actors' perspectives (*e. g.* Mathevet *et al.* 2011; Bosma *et al.* 2017), based on our findings, we believe that other

methodologies, like Q-methodology, would have been more efficient and effective to classify cases based on farmers' perspectives. The key advantage CMing has, however, over other data gathering methods is that it produces systems representations, rather than sets of discrete beliefs about different aspects of farming. Individual maps show that even with little concepts and relations, farmers are enticed to represent their farm as a connected whole that involves multiple aspects. Farmers were therefore able to communicate to us how these beliefs are linked together, instead of leaving this job entirely to the analyst. As such we would say that our approach was effective in exploring farm functioning in its complexity, that is how different aspects of farming may be put together by farmers, and less effective in exploring farm functioning in its diversity, that is in what way particular complex systems are different.

6.7. Conclusion

CMs are best interpreted as communication tools for the respondent farmers to construct an image of their farm, rather than complete or accurate representations of their beliefs. CMs may disclose what aspects farmers are working on, and what they are working towards, and help theorize how these aspects fit together as a whole. They therefore help us to consider the material impact of farmers' views being constitutive of farm functioning, as they translate into actions that reconfigure the farm and its environment, giving the farm as a whole dynamism and purpose. While the applied CMing method showed a limited capability of classifying farmers based on their beliefs about farming, it did provide systemic representations constructed by farmers on varying /the range of connection between different aspects of farming. Considering these findings, we believe CMing, may inform further interdisciplinary and holistic analyses of farmers' decision making and of the actual functioning of these systems.

PART III
RETRODUCTION

Chapter 7

From Practices to Theory… and back

From Practices to Theory… and back

In this research it is our ambition to go beyond mere description, namely to explain. Following a critical realist social science paradigm, we will do so by the logic of retroduction, that is by hypothesizing the existence of mechanisms and entities that, if they existed, would explain the diverse perspectives and actions of the farmers we interviewed. Building on the patterns revealed in the chapters of Part II, we focus in this chapter our attention on a particular aspect of these farmers' social reality, namely their market dependence, and from there develop a theory to explain the diversity perspectives and sets of practices observed. Consistent with the *informed, critical realist grounded theory approach* that we outlined in section 2.4., this theory emerged out of the continuous and iterative dialogue between the data and developing theory, in which the data was reconsidered in the light of new insights gained from literature review, and previous conceptual frameworks were abandoned (after testing) in search for new ones in the light of new observations made during these data analyses. The theory presented in this chapter integrates a general, neo-Marxian understanding of the capitalist economic system and the New Economic Sociology of embedded understanding of embedded markets in a critical realist theory of human social behavior. We explore this theory as framework at length in the light of the accounts farmers gave about their situation and themselves. In the discussion section, we discuss what new insights this exploration brought forward about the varying role market dependence may play in enabling or constraining farmers ability and willingness to put agroecological principles in this context. We also reflect on how this theory put forward problematizes a common conception of market dependence in the agroecological and sustainable food system transition literature. We argue that the either lacking or concretistic theorization of the global economic system by agroecological and food system transition theorists results in arbitrary ideal-typical classifications of farmers, attitudes, social networks and practices, with no convincing material basis. Instead, the existence of a global economic system composed of personal and impersonal relations in which both alternative and not so alternative farmers are embedded, appears to be a much more plausible hypothesis. Lastly, we consider whether certain aspects of farmer's social reality were undertheorized and underexplored empirically. There were indeed such aspects, as a result of the main focus of this chapter being on market dependence. Nonetheless, we conclude that the Critical Realist conception of human behavior put forward in this chapter is likely flexible and sensitive enough to integrate these aspects more fully. This opens up exciting perspectives for rethinking and synthesizing contemporary analytical frameworks to food system transitions.

7.1. Introduction

Within global discourse on sustainable agricultural development, agroecology as a whole represents a market-challenging perspective. Most if not all prominent agroecological scientists and movements link current environmental and social crises to the liberalization and globalization of international markets over the last four decades and are critical of the market-friendly development agendas (*cfr*. WEF 2009), that would carry this project further (De Schutter, 2009; HLPE, 2019; Silici, 2014). Likely the most influential agroecological discourse on this issue is the one carried by the international farmers' movement federation La Via Campesina and the broader Food sovereignty movement. In line with number of radical scholars (Holt-Giménez & Shattuck, 2011; McMichael, 2006; Rosset & Martínez-Torres, 2012; van der Ploeg, 2013b; Wittman, 2009), the ongoing integration of land, capital, and agricultural commodity markets is considered to underpin and reinforce the functioning of an international food regime or system dominated by corporate industrialized agriculture to the detriment of small farmers and the more sustainable farming practices and systems associated with them (Bernstein & Oya, 2014; Henderson, 2018). As an alternative the concept of food sovereignty is advanced, to which end it is argued that rigorous national regulation of markets is needed in order to control effectively foreign trade in food and other agricultural commodities, both imports and exports, as well as the interest of foreign capital in selling energy-intensive inputs and buying, or otherwise acquiring, large areas of land and water resources for the production of food, biofuel and livestock (Rosset & Martínez-Torres, 2012).

Whereas the position of agroecologists on the role of international markets is quite clear, Bernstein and Oya (2014) observe that the envisaged nature and role of domestic markets in facilitating self-sufficient and sustainable food production and consumption within countries is less developed. One strand in the Food Sovereignty literature centers the notion of 'the peasant way', a virtuous model of low external-input and biodiverse family or community based farming along with the protection and promotion of indigenous ways of farming. This is counterposed to environmentally and socially destructive realities of corporate or entrepreneurial industrialized agriculture that is highly dependent on external, and often imported, inputs (van der Ploeg, 2013b). The emphasis of this strand is on developing and implementing practices which reduce the dependence of farmers on input markets, and therefore also expose them less to the influence of downstream actors, as the amount of money need to continue farming is reduced (Figure 19), and hence reduces the dependence on global agricultural commodity markets which are dominated by large transnational corporations[1].

[1] As Bernstein and Oya (2014) note, this opens up, however, important questions about how a subsistence-oriented agriculture is going to feed the non-farming sections of the population both in

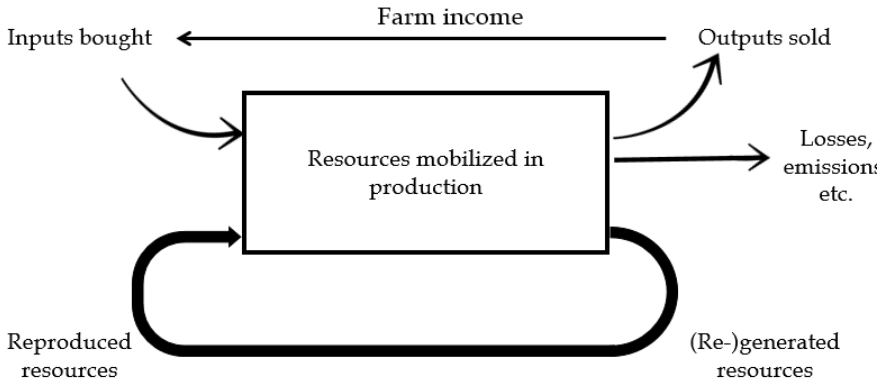

Figure 19 Flows of resources entailed in farming (van der Ploeg 2013, p. 58)

A second - but practically compatible - strand doesn't problematize farmers' involvement in markets *per se*, as it sees these as "*collective devices that allow compromises to be reached, not only on the nature of the goods to produce and distribute, but also on the value to be given to them*" (FAO & INRA, 2018). It does propose, however, that farmers today should get involved in other markets than they are today, by organizing cooperatives, by creating their own 'nested markets' that connect them directly with consumers, or by augmenting incomes from farming with cooperative processing and other value-adding activities and services, like eco-tourism (van der Ploeg, 2020). It argues that farmers may overcome the constraints of 'price-taking', as they are capable through collective action, to negotiate the terms of their participation in markets, particularly when these markets are designed – by the state or local authorities - in such a way that they coordinate local demands with local products in an equitable way (Mier y Terán *et al.*, 2018). In other words, while the more radical strains of agroecology represent themselves to be anti-capitalist, they are not necessarily anti-market, even though the construction of this alternative, domestic, equitable, market environment remains in practice an aspiration in many cases, rather than a blue-print (Bernstein & Oya, 2014). In the absence of a conclusive answer on how to resolve the market question, we observe that agroecology suggests farmers should limit their dependence on 'bad' markets (for corporate agro-inputs; and for export products) and seek to construct and be involved in "better" markets, namely local, alternative, farmer or community controlled markets.

If this is indeed the pragmatic resolution of the market question put forward by agroecologists, one may wonder what a correct agroecological position towards market dependence may be in the context of Flemish beef farming. On this topic, we

rural and urban population. *cfr*. van der Ploeg 2013a; Bernstein 2014; Edelman 2014; Coopman and Grenade 2018

already revealed a number of relevant patterns in our previous analyses. In chapter 4, we found that both aspects of market dependence (the degree to which and the kind of markets farmers depend on) come into the picture when exploring different themes addressed in the agroecological literature. Farmers mentioned numerous practices that limit the degree to which they depend on certain inputs and services in relation to the themes of Integrated Animal Health (drug use), Nutrient Cycling (manure, feed and by-products) and Chemical Input Reduction (energy, pesticides, fertilizers). In the exploration of social-economic, social-political and social-cultural themes (Commercial and Financial Autonomy, Ties with Consumers and Producers, Local Food and Social Equity) farmers brought also this more qualitative dimension of market dependence to the forefront. In the discussion of chapter 4 we also drew attention to the fact that the contradictory interpretation of certain principles raised questions about compatibility of farmers' dependence on (certain) markets within an agroecological model. Chapter 5 provided further answers on this question, as we found a clear correlation between the pursuit of ecological dimensions of agroecology (implying a reduced dependence on input markets) and the pursuit of social dimensions through strategies that made the farmer either less dependent on the selling or buying of goods and services from other actors, (by becoming self-sufficient or through reciprocal and redistributive arrangements), but also by being involved in 'alternative' commercial networks, one farming model, or by actively negotiating better terms in a more 'mainstream' market environment, the second model. We noted there were differences between the two more agroecological farming models emerging out of the analysis in terms of agricultural practices, also suggesting a correlation between these different market environments and the agricultural practices of beef farmers. While at an individual farmer level, the degree and kind of markets farmers are involved in, varied, our analysis clearly suggested that both aspects of market dependence are closely associated with, if not determining, the pursuit of ecological dimensions and techno-productive of agroecology in this context. Our analyses suggest thus far that an expansion of agroecologically sound agricultural practices in the context of Flemish beef farming, is likely to go hand in with an expansion of these alternative commercial arrangements. Chapter 6 brought further insight into this correlation between market environments and agricultural practices, as farmers represented this relationship as causally related one, and in a few individual cases, and definitely in the aggregate as a dialectical one. Namely, the kinds of trades farmers are involved in (wholesale, niche markets, on-farm sale, organic certified, with or without bank loans) is determined by the type of production systems they are able to set up (large/small, diversified/specialized, input intensive/extensive, types of breeds and varieties), and vice versa. Importantly, the coordination between these trade and production type was regulated primarily by their shared concern for income generation, complemented with other motivations (work pressure, leisure, social contact, autonomy, social status).

While these patterns reveal a whole lot about the relationship market dependence and the pursuit of agroecological principles by Flemish beef farmers, they also raise

important questions that we cannot as of yet answer, but are important to assess the relevance of agroecology in this context. If alternative market-based arrangements indeed go well together with agroecologically sound agricultural practices as they appear to do, why did they fail to become the rule in this context, rather than the exception? And if farmers have some say in the more mainstream market environment, would whole selling beef farmers be able to influence the terms of trade so much that they could engage in the same kind of agricultural practices as the organic direct selling farmers? Indeed, to what extent can farmers influence the price of their product, and if this depends on the markets farmers involved in, what makes these markets then so different? Furthermore, how to explain the lack of involvement of most beef farmers in these alternative markets? Is this a question of different preferences of these farmers for more intensive and large-scale production systems? And if so, is this then a broader cultural problem of the sector? Or is there a deeper and more general structural dynamic at work, that can explain the spectrum in degrees and kinds of markets the interviewed farmers apparently depend on?

As we could not content ourselves with leaving these questions unresolved, we've looked for answers in the scientific literature, while paying close attention what beef farmers themselves had said about their situation. Out of this dialogue, an original general theory of human behavior and market exchanges emerged, which we will present in the following section. After that, we explore this theory at length in the context of Flemish beef farming by bringing up the relevant empirical evidence that we gathered ourselves. In the discussion section, we discuss first what new insights this exploration brought forward about the varying role market dependence may play in enabling or constraining farmers ability and willingness to put agroecological principles in this context. Then we will discuss how this framework improves existing agroecological theory on the subject of market dependence. We conclude by highlighting the limits of the theory and application of the theory as it is presented, and as well as the promising perspectives that this chapter offers for further research.

7.1. Analytical framework

The analytical framework presented in this chapter emerged out of a dual appreciation and critique of two incommensurable conceptions about markets which at the surface appeared to hold in this context, namely that markets are always embedded in wider local social networks as suggested by the new economic sociology approach, and that it is the "Invisible Hand of the Market" rather than the farmer that determines what farming practices are possible on the farm, as suggested by (neo-)classical economic theory.

Despite the pervasiveness of market exchanges in the everyday life of farmers, markets, rarely figure as an object of contemporary sociological analysis *per se*. As W. A. Jackson (2007) speculates, this may be because of their daunting complexity, but perhaps also because they are such a common phenomenon across the board, that they couldn't possible explain the diversity of meanings and practices that one may

observe in anthropological field work, and leaving the influence of these markets to their economist colleagues. Largely speaking, empirical sociological studies of farmer behavior who do include markets as an object of study, follow what has come be called a "New Economic Sociology" approach (Granovetter, 1985), including FAO's recent publication aptly titled "constructing markets for agroecology" (FAO & INRA, 2018). Within this approach, market exchanges figure as a part of the many institutional practices found within social networks of actors, and they are explained as a more or less path-dependent product of rule-following behavior and negotiation of conventions and expectations among actors. This approach is justified based on the observation that most actual exchanges don't take place under neoclassical ideal competitive market conditions, *i. e.* impersonal, voluntary, and uncoordinated trade, but are in fact embedded within social networks of interpersonal relationships (Granovetter, 1985). This makes an analysis of these networks indispensable, if one wants to explain why particular trades between people happen the way they do. By whittling away at the neoclassical market construct, by revealing that an ever-greater share of transactions are enacted through interpersonal relationships, contemporary sociologists thus successfully re-appropriated the market as a subject , and find a way back at the table along with economists with regard to the appropriateness of markets to solve social problems (Krippner *et al.*, 2004).

This approach is myopic, however, because it fails to draw attention to the fact that all market exchanges, no matter how instantaneous, are social in the broader sense of the term in two interconnected ways. First, the mere possibility of exchanging commodities depends on such institutions as property and contract law, and the common recognition of such institutions (Krippner *et al.*, 2004; Tordjman, 2004). Such social conditions were absent and perhaps even unconceivable in most of human history (Empson, 2014; Polanyi, 1944). Every market exchange today presumes a long history of struggle and contestation that has produced actors with beliefs about themselves and about the world that they would be prepared or able to exchange anything in the first place. In this sense, the state, culture and politics are contained in every market act. They do not variably exert their influence on some kinds of markets more than others. (Krippner *et al.*, 2004). Second, and this is a crucial insight of Marx's critique of political economy (Marx, 1867), market exchange cannot be separated from the sphere of material production in a capitalist society, as it is the particular form social relations of production have taken and have to take in a society that consists mostly out of formally independently acting producers. In the absence of direct social regulation of production (*e. g.* planning in the factory, the household, within the tribe, or by the state), the working activity of members of a market society is regulated through and only through the exchange of commodities. It is the circulation of commodities on the market, the rise and the fall of their prices that lead to changes in the allocation of the working activity of separate commodity producers, and thus to their entry into certain branches of production or their exit from them (Rubin 1928, p. 11). While direct social regulation of production plays its part in contemporary society, influential social theorists, as disparate as Marx, Polanyi,

Hayek, Schumpeter and Keynes (Richards, 2018) have contended that market dynamics form an autonomous mechanism that regulates social production in capitalist societies. As such, it is easy to dismiss visions of "the Invisible Hand of the Market" or "Laws of Supply and Demand" as illusory reifications of actors parroting neoliberal ideologies and mistaken economic beliefs (*e. g.* Long, 1997). Much harder is it to come to terms with the reality that miraculously enough, a society composed chiefly of autonomously acting buyers and sellers of products is more or less able to materially and socially reproduce itself without any direct co-ordination.

Considering the arguments above, we could not satisfyingly theorize market dependence merely in terms of interpersonal relationships among actor-networks directly affected by specific trades. We had to include also a social theory explaining how the actions of all buyers and sellers in society influenced the trades of farmers. In our search for such a theory, we came across two publications that were instrumental to overcome these two hurdles. The first challenge is to accommodate the emphasis of Marxian political economy on objective material conditions motivating human behavior and the emphasis of the actor-oriented approaches on (inter-)subjective cultural rules in one theory of agency. We believe that Douglas Porpora's (1993) theorization of agency is an interesting point of departure to bring the insights of these schools of thought together. The second challenge is to create a single framework of market exchanges that accommodates the possible influence of personal relations among actors on actual exchanges. We believe that the work of heterodox social economist William A. Jackson (2007) is a substantial contribution herein, as he theorized market exchanges of more and less relational nature in social structural terms. Jackson (2007) proposes a layered structure of social positions occupied by buyers and sellers determined by personal and impersonal social relations among these positions. The integration of these two frames are a powerful point of departure to explain the market exchanges that actually take place in agro-food systems.

7.1.1. Synthesizing social relations, cultural rules and agency

Porpora (1993) observed that there are at least two important traditions within sociology, the first following Marx (or at least a particular strain in Marx's thought), and the second, following Winch and Giddens, that agree that social behavior has to be explained in terms of its context. They disagree, however, on the nature of that context. Whereas Winch and Giddens stressed the cultural context created by constitutive rules, the relevant Marxian tradition emphasizes the material context created by objective social structural relations. Porpora (1993) goes on to argue that a more complete account of the social context for explaining behavior involves both constitutive rules and material relations, and that this context analytically precedes actor's further self-understanding and behavior. His framework includes three different analytical moments that dialectically influence each other: cultural

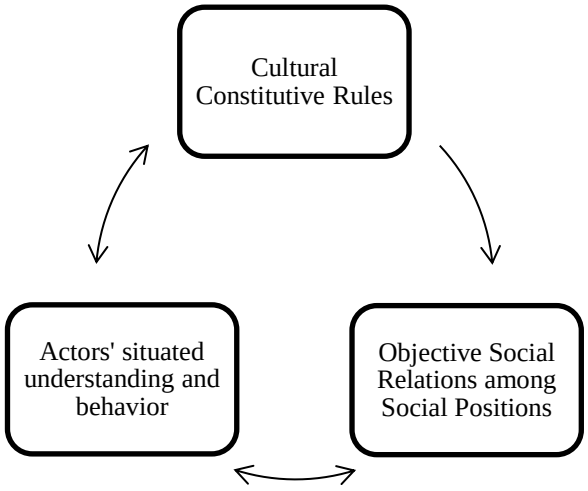

Figure 20 The three analytical moments outlined by Porpora (1993).

constitutive rules that establish objective social relations, the social relations themselves, and the situated behavior and self-understanding of actors (Figure 20). In this vision, objective social relations arise from the constitutive rules that constitute a group's way of life. For instance, it is the historically specific, shared understandings within a slave society that define who is a slave and who is a slave master, and the expected behaviors that go along with this position. Although such relations depend on the conscious rule-following behavior of actors, they have an objective existence independent of actors' specific awareness. To go further with the example, whether a specific person understands him- or herself to be a slave, makes no difference at all to that person being in that particular social position. In fact, these relations may remain opaque to their understanding, just as generative mechanisms and processes of the natural world, like gravity or photosynthesis, may remain so. Yet, since this objective social position is necessarily part of the life-world of any subject in this position, a subject will develop some understanding of these social relations. According to Porpora (1993), these social positions themselves contain built-in objective interests[2] and provide distinct reasons for action insofar as actors are aware of them. A slave may, for instance, realize he or she would do well not to speak ill of his or her master in public, but may also be well advised to seek to overthrow the system of slavery altogether. In this conception then social relations can motivate and enable certain behaviors, they are therefore socially consequential, and thus are part of a causal explanation of social behavior. Moreover, the social relations generated by the

[2] Interests are distinct from reasons as the latter are based on beliefs, wants, values, which are culturally constructed. Interests, on the other hand, derive their explanatory power from their connection to agents' supposed needs, which are not specific to a particular culture, but have a more universal character, such as the simple need for physical well-being (Gert 1990; Chibber 2013, p. 197).

constitutive rules may differentially benefit and empower certain actors, for instance slave-masters vis-à-vis slaves, who are thereby enabled to maintain or change the rules. Objective social relations are therefore a piece of the puzzle in explaining why the rules are what they are. However, there is no guarantee that a person will become aware of these interests nor act accordingly. People tend to live their lives as a series of routines, which they practice as a matter of habit, on norms that they have adopted and internalized. Beliefs, values, and obligations are usually rather uncritically treated as givens, as parameters, not variables. However, part of being a social agent is to have the capacity for reflection and introspection, and this capacity incorporates the cultural beliefs they have internalized, as well as the demands made on them because of their social position. At the very least, agents practice a reflexive monitoring of their daily interactions, at other times they initiate what Margaret Archer (2003) refers to as an "inner conversation" about their received roles and beliefs. This is a more active conscious rumination on the reasons behind their actions, their legitimacy, possible alternatives, and so on. This is especially so when agents are subject to conflicting demands, or when demands on them run up against their own perceived needs and desires (Chibber 2013, p. 194-195).

7.1.2. Impersonal social relations

In line with Porpora (1993), then, and based on Isaac Rubin's account of Marx's theory of value (Rubin, 1928)[3], but also following Ehrbar's (2001) and Richards' (2018) lead, the underlying structure of competitive market exchanges can be conceived of as a network of objective social relations among actors occupying specific social positions, as they are possessors of different commodities which are exchangeable in principle. While these are social relations, these are curiously enough impersonal, as they are mediated through things and things alone. Simply by virtue of the exchangeability of their commodity, any owner of a commodity stands in relation to other owners. Not only is he or she connected with those entering with him or her into a contract of purchase and sale, but in fact by a thick network of indirect relations, with innumerable other people (for example, with all buyers of the same product, with all producers of the same product, with all the people from whom the producer of the given product buys means of production, and so on), in the final analysis, he or she is connected with all buyers and sellers of society As also argued by Karl Polanyi (Machado, 2010), these relations have a profoundly dis-embedding influence on local economies, as economic actors are now forced to take into account (already in the sphere of production!)[4] not only the behavior of people they trade with, but in fact of

[3] For the purposes of our investigation, we will limit ourselves to the most fundamental elements of Marx's general theorization of social relations under capitalism. The labor theory of value only presupposes production relations among commodity producers. Further theorizations, such as the theory of production prices, presuppose more elements, such as the production relations between capitalists and workers and among various groups of industrial capitalists (Rubin 1928, p. 309).

[4] As Rubin (1928, p. 12) points out: "*This thick network of production relations is not interrupted at the moment when commodity producer A terminates the act of exchange with his buyers and*

the working activity of *all* other members of society, to the extent that it influences the movement of commodity prices on the market. Of course, the decisions what to exchange for what are individual decisions, but the proportions in which these things can be exchanged are determined - but note solely - by these social relations (Rubin 1928, p. 12).

Of course, the existence of these impersonal social relations, which Richards (2018) refers to as the "basic structure of the market", is predicated upon the constitutive rules of the market such as the institutions of property and contract law, and the general adherence of actors to these rules. The continued reproduction of this system also relies on broader norms and customs which have long been internalized by market participants. After all, economic actors don't need to reach for a manual or consult a therapist to know what to do when the prices change. In fact, to most people in our society, these rules appear as the natural way of doing things, and they are accepted and reproduced in every act of exchange. These cultural rules and objective social relations pre-exist the understanding of individual members of contemporary capitalist societies, as they are literally born into a world with such rules and relations. Yet through lived experience they develop an understanding on how to act upon this reality. An owner of commodity learns to exchange his/her commodity for another commodity, insofar as it is of better use to him/her. And as most buyers figure that it is in their interest to secure a purchase at the lowest possible price, they tend to act accordingly. And those people who own nothing except for their ability to work, will be compelled to sell their labor power to anybody willing to hire them, in order to acquire the necessary means of subsistence. Actors are not condemned to specific roles, for instance a merchant may choose to give away his or her wares, a corporate chief executive may refuse to sack hundreds of employees in times of recession, and even an oligarch may advocate for the abolishment of private property. Nonetheless, given the interests inscribed in the social positions they occupy in this system, they do tend to act in a predictable fashion. Indeed, at a micro-level, the existence of such social structure can explain a substantial set of beliefs and actions of members in such a society. Moreover, because commodity owners follow a consistent and predictable pattern of continued trading, this system is continuously reproduced. Closer analysis of this system, both empirically and theoretically, moreover shows that this predictable pattern of behaviors also leads to particular tendencies at a macro-social level, for instance, the emergence of a self-correcting price mechanism of over- and underproduction (Richards, 2018). By virtue of these relations, buyers and sellers set in motion through the exchange of commodities, independently from their will or knowledge of this laws regulating social production and consumption. As this system

returns to his shop, to the process of direct production. Our commodity producer makes products for sale, for the market, and thus already in the process of direct production he must take into account the expected conditions of the market, i.e. he is forced to take into account the working activity of other members of society, to the extent that it influences the movement of commodity prices on the market."

of social relations does not require economic actors to know much about the world to act effectively in it, it relieves economic actors from directly organizing production in society (Morozov, 2019). Then again, as argued compellingly by Moishe Postone (2017), the economic system – the capitalist mode of production - that these social relations partly comprise, are an extremely resilient form of abstract social domination, which subjects people to impersonal and increasingly rationalized, structural imperatives and constraints.

7.1.3. Personal social relations

Actual market exchanges occur under circumstances that diverge from anonymous role playing, as sellers and buyers may be loyal or bound to each other and thus swayed by things other than price. Jackson (2007) proposes that such trading behavior is mediated through other social structures too, and he discusses in particular the 'personal social structures' developed through enduring trading, between and among buyers and sellers. Likewise, these structures are objective and of social consequence, but they are a softer form of social structure. As they are constituted by rules negotiated at a lower-level, but also are more intelligible to actors involved, they are more subject to change. The rules that are established at this level include those that Tordjman (2004) refers to as procedural rules, by which exchange is concretely organized. Jackson studies three interactions in particular: between sellers, between buyers and between buyers and sellers, through which market exchanges gain a more personal character. We would, however, also include other actors such as governments and state bureaucracies, sector organizations, and family members, personal friends, and employees, which create particular cultures within social networks (Abolafia, 1998), thus redefining the particular social positions commodity owners find themselves in. As it is through this personal network that commodity owners form an opinion about what, with whom and how commodities should be traded, they play a vital role in explaining actual trading behavior. Insofar that these personal relations are endowed with power, these are direct power relations between individuals or between groups of individuals, such as we can find in the patriarchal family, between the feudal lord and the serf, between a creditor and a debtor, or between the employer and employee in capitalist enterprise within the sphere of production (Chibber 2013, p. 102-129).

7.1.4. Layering of social structures

By making a distinction between actual events and the mechanisms that generate them, in accordance with a critical realist ontology, we can explain market exchanges in terms of a layered social structure. This social structure exists out of both impersonal and personal social relations among social positions, constituted by two sets of cultural rules at different levels of society (Figure 21). These two sets of relations co-exist and define together objective social positions which motivate, enable and constrain actors' behavior. Following Jackson (2007), a layered approach can accommodate a wide range of competitive and relational trade within a definition of markets that distinguishes them from purely direct reciprocal and redistributive economic arrangements. Based on an analysis of the varying prominence and combinations of these personal and impersonal ties among buyers and sellers, Jackson (2007) demonstrates that a typology of markets can be constructed, which include particular roles actors in these various positions tend to play. However, given the indeterminateness of agency, it remains crucial to study how cultural rules and impersonal and personal relations are reproduced in different contexts. We will therefor now turn to exploring in the next section the applicability of this framework in the context of Flemish beef farming in Flanders, and its usefulness in describing and explaining the different degree and kinds of market dependence observable, and how that this influences their ability and willingness to put agroecological principles into practice.

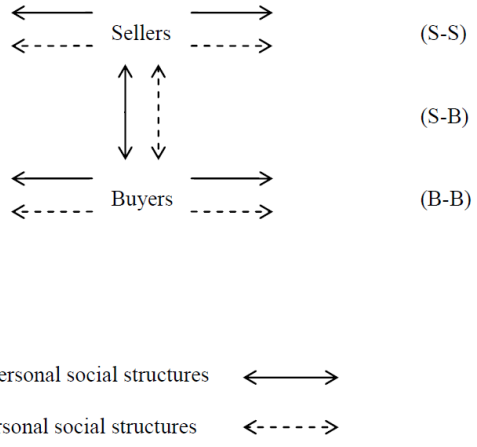

Figure 21 General social structure underlying market exchanges (W. A. Jackson 2007)

7.2. Grounding the analytical framework

For the purpose of this chapter, we have re-read the transcripts, and coded instances, which were indicative of the varying influence farmers situated self-understanding and behavior, their objective social positions within a system of

personal and impersonal social relations, constituted by particular cultural rules, have on the pursuit of agroecological principles by the interviewed farmers.

7.2.1. Data gathering

These data include the 37 semi-structured interviews with beef farmers in Flanders, who were selected along the range of three axes *a priori* established (explained in depth in chapter 3. These data weren't gathered with the objective to construct, nor for that matter ground an analytical framework to explain market dependence. Therefore the following analysis is based on material that is far from ideal for that purpose, as we didn't consciously and systematically probe the particular aspects of social life that this framework would lead us to focus on[5].Furthermore, the presented analytical framework draws attention to the causal role the situated self-understanding behavior of all kinds of actors of particular interest not interviewed (bankers, input suppliers and sales personnel, cattle traders, butchers, retailers, customers, *etc.*). Direct accounts of these actors would have been preferable, as we know have to infer the motivations of these actors based on farmers accounts, which renders our analysis more speculative than one would wish. Nonetheless, the gathered data, we hypothesized would be sufficient to demonstrate the salience of the open-ended nature of the data gathering method. In exploring a holistic understanding of agroecology as a practice, we gathered data on themes that have a strong connection to the market dependence of these actors (nutrient cycling, external input use, commercial and financial autonomy, rural fabric, producer-consumer ties, knowledge exchange, and social equity). Second, the semi-structured nature of the interviews compensated for that in some part as farmers spontaneously brought elements of significant interest to our attention.

7.2.2. Case

Beef farmers in Flanders require a whole lot of material resources. These include suitable land, the appropriate tools and equipment, stable infrastructure, livestock and the specific inputs that go with particular production systems. Furthermore, as workers, farmers, require a whole lot of other goods and services to be able to be engaged as skilled labor on a farm (from basic requirements such as food, shelter and clothing, to an education, and generally caring and safe environment. In the context of contemporary beef farming Flanders, however, to individual actors the access to many of these resources is mediated by the institutions of private property and contract law, which are ultimately enforced by the state, and generally respected by the

[5] Questions that come to mind are among others: what material resources do they own and/or how is their access to these resources limited, how did they gain access to these material resources in the first place, what kind and what quantities of inputs and outputs farmers were buying and selling, to whom they would be trading these commodities, why these actors and not others, on what terms, what potential farmers saw in non-market channels, who are the information sources influencing farmers decisions?

Flemish population in practice, including the interviewed farmers. In so doing, however, the resource base that individual farmers have access to becomes largely defined, as property rights come with important (but not unlimited) exclusive use and trading rights. Hence by the acceptance of such notions in this context, farmers are in a position where they have important control over certain resources, while being locked out of most other resources. Farmers, however, also must accept the gross inequalities that have arisen among farmers in these area. Some of the interviewed farmer households own over fifty hectares of land and have in addition over hundred on a long lease. Others own no land at all and farm on under ten hectares under long lease. From this perspective then, table 3 and 4 in chapter 3 illustrate not only some of the structural diversity of beef farms in Flanders and in our sample, but also the very unleveled playing-field on which they carry out their activities.

Despite differences in their resource base, farmers face similar questions about their reproduction, however, they all need to consider whether they can and wish to subsist on the resources available to them through this system of social relations, or whether it is more desirable to use their available resources to produce goods and services of better use to others and seek to sell these in order to buy certain goods of greater use to them. As there are however innumerable actors to potentially trade with, and innumerable use-values to produce or to offer, this opens up a wide range of possibilities for farmers to live their lives despite the limited direct access these farmers have to resources. In Figure 22 we attempt to represent this social complexity in a visual form.

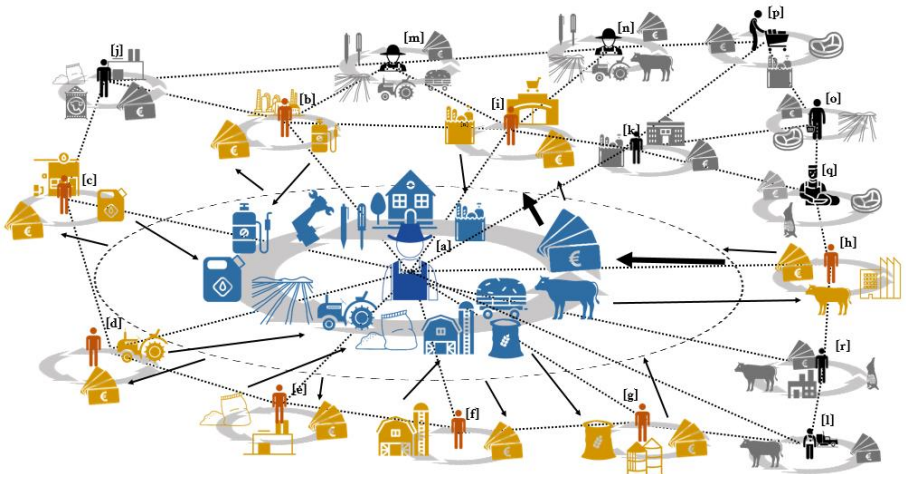

Figure 22 Visual representation of the network of impersonal relations a beef farmer is connected

The farmer (center, dark blue) [a] has by virtue of the private property rights access to certain resources (blue) and not to the resources (orange and gray) owned by other actors (red and black figures), and vice versa. Hence, the actors stand in relation to each other by a thick network of impersonal relations (dotted lines). In his economic

activities the farmer consumes and reproduces the resources available to him, yet to do so he chooses and is able to buy certain goods from some actors, and sell certain goods to others (red figures). In the presented example, the farmer spends money on pesticides from a biochemical company [b], fuel from the local gas station [c], a new tractor from the local dealer [d], fertilizers from another biochemical company [e], the construction of a stable from the construction company [f], and food staples from the local supermarket [i]. With these bought goods and with the other resources available to him, he produces wheat and cattle which he sells to the grain storage company [g], and meat processing company [h]. This doesn't take away that other trades could have been considered by the farmer in this cycle, such as buying feed from the feed company [i] instead of producing it, or sell to a cattle trader [l] or slaughterhouse [r] who may offer different terms for the beef, or the other local supermarket chain [k] or with other farmers [m] and [n], or with a non-farming land owner [o]. The picture moreover hints at the possibility of a cooperation between the farmer, the slaughterhouse [r] and the butcher [q] to set up short-chain circuit to sell meat to potential customers [o] and [p].

We observe therefore that by choosing to produce for the market rather than for themselves, the social nature of their activities only intensifies, as their economic security now is not merely a technical matter of efficiently organizing the resources available to them granted by this system of impersonal relations, but now also depends on the terms of trade that other owners of commodities would be willing to accept. Our framework, however, also suggests that personal social relations may form or have formed between these formally independent resource owners, influencing their production- and exchange-related activities. With the different types and quantities of commodities these farmers require for production, come different commercial actors, with different attitudes and expectations. Farmers thus also operate in different commercial networks, in which they exposed to different ideas, and are offered different terms of trade, on which basis they strategize. Throughout we also find that personal relationships between specific actors may enable them to give up their exclusive rights on certain resources, and gain access to certain resources without having to buy them, and hence can expand their resource base. All of these elements our framework suggests may be consequential to the farmers' willingness and capacity to pursue agroecological principles and were therefore traced empirically.

7.2.3. Method of presentation

Given this social complexity, we've presented the material as follows. First, we look at the ability and willingness of farmers to remain independent from input markets, second, we will look at the ability and willingness of farmers in this context to expand their resource base through the establishment of arrangements with specific actors (banks, state agencies, other farmers, friendly neighbors and customers), and in the third section we will look at influence more or less relational sale channels farmers depend on influence their self-understanding and situated behavior. In our analysis of

farmers answers, the concepts put forward by our framework are found to be readily applicable. Given the complexity of the situation, we made concept diagrams (Figures 23, 26, and 27) and network visualizations (Figures 24, 25, 28, 29) to keep track of the different aspects of the considered situations and how it relates to the analytical framework developed

7.3. Results

7.3.1. Dependence on input markets

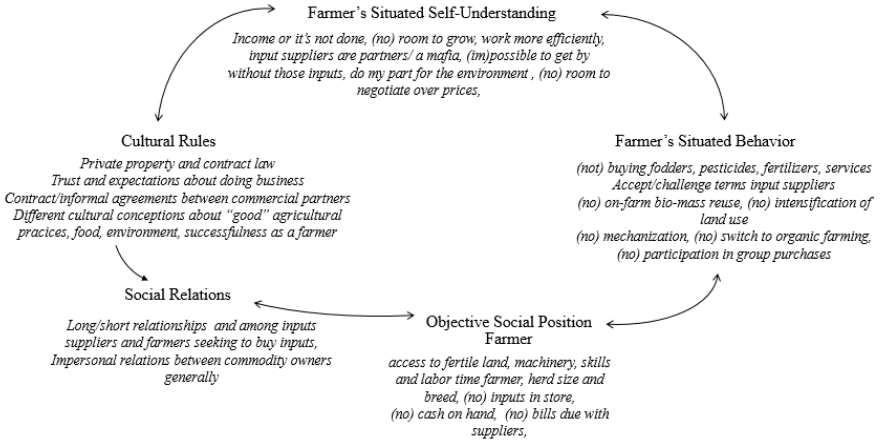

Figure 23 Concept diagram to relate conceptual framework to observed dependence of beef farmers on input markets

None of the interviewed farmers are subsistence farmers, as they have intentionally organized their life and the resources available to them in such a way that they can generate enough revenue, in particular but far from exclusively through the sale of certain agricultural commodities, to cover the costs of another productive cycle, which includes those associated with the material reproduction of themselves. They therefore all depend on markets, albeit to a markedly different degree. The degree to which farmers rely on agro-inputs such as feeds, fertilizers, pesticides, seeds and medicines is directly linked to farmers ability and willingness to pursue agroecological principles addressing the techno-productive and ecological dimensions of farming. And we also find that some farmers try to avoid having to buy services from other people as well, by doing it as much as possible yourself.

> *We actually do everything ourselves. I do the paperwork, I do have an accountant for the tax papers, but he really doesn't need to spend a lot of hours on it. And my husband, he does everything himself, he does. If something is broken, he always fixes it himself, so we never need third parties. And we also follow a lot of continued training, and we do a lot to keep up with the times. That way we keep our capital more. Same with machines, they are all well maintained and greased. (CND2)*

In the interviews, farmers indeed mention a whole list of practices (see Annex 3 for details on the frequency of such practices) that reduce direct costs. Some farmers

say this is a conscious decision on their part to install an agroecological system and become independent from certain commercial actors.

> *We began to ask ourselves questions about the way livestock farming was being done here in in Flanders and in Europe. We fatten our pigs, our animals, we milk our cows, by giving them those concentrates from South America, North America. There, they burn down the rainforest to put soy on it, which is then collected and loaded on trucks, then to the ports. At some point, you start thinking, "what are we doing? This is just not right." (ODS1)*

> *By using your own manure to make organic matter to fertilize the soil, you build independence, independence from the fertilizer industry, and yet improve your soil in a healthy way ... and there the other livestock also fit in, because we use residual flows in diverse ways: cattle don't eat pumpkins, but pigs love them. (ODD2)*

More commonly, we hear farmers justify their practices limiting their dependence on such inputs to be motivated by economic necessity, rather than out of any great moral commitments.

> *[the maintenance of soil life] that is very important from an economic point of view, you know, that farmyard manure, it increases the soil organic matter, yes, but I'm not going to say that I do it from an environmental perspective. I take the economic perspective, we are not going to be hypocritical about that (CND7)*

Many of these strategies to become independent from input markets require, however, a whole set of resources, in particular land, equipment and a skilled labor. While many farmers seek to expand their resource base in others ways than building up savings over time (see next section), farmers are often confronted with the limitations of their resource base. Rather than questioning the rules of private property and contract that impose these limitations, however, farmers instead prove more than willing to compromise their commitments on market independence, if they perceive these threaten the long-term viability of their operation, and hence their economic well-being.

> *I would like to move much more to a mixed farm set-up, but for that I have too little land, so I need to find more land. I would like to close many cycles, because now a lot of manure goes to other farmers, organic farmers, because you cannot dispose of it in nature reserves. And I would like to actually grow my cereals and beets myself, and I would like to expand my products that I can offer to my customers, and maybe have chickens, and maybe dairy, and have* [...] *vegetables on the farm. (ODD1)*

> *We have to buy extra fodder, quite a lot actually. Organic cows eat as much as regular cows, but your land does not yield that much, that's normal. You shouldn't put yourself in the situation of not having enough feed, you can see that in your cows too. Ultimately, everything must be economically correct. (ODD11)*

However, many farmers aren't bothered by a commitment to market independence, and seem little troubled to be involved in input markets. In fact a more commonly held opinion on the market question among the interviewed farmers,

including some organic farmers we interviewed, is that one should take advantages of trades offered by input suppliers, as their products allow the farmer to vastly overcome the techno-productive limitations of a more self-sufficient setup. Buying quality feed and straw may allow farmers for instance to rear and fatten cattle on a much faster and on a much greater scale than they would conceivably be able to achieve with on-farm produced fodder. And to save labor farmers chose to buy and operate fossil-fueled big machinery, rather than doing everything by hand.

> *If you do not dare to invest in your animals, that is something that strikes me enormously, that some colleagues don't dare to give concentrates, because it is expensive, but without it, you can hardly get fine results (CND10)*

> *We have to buy big machines for the farm. I bought myself that Weiman, why? Because I need to get the job done on one person's income. Sure, my father, who lives here, he gets up once in a while at night to see if there is no calving, and I will spread straw by hand sometimes. But all of that is no longer of today. It all has to go so fast. You 've got to accomplish ever more with one worker, because my wife she works off the farm; so we have to invest in machines, and yes those machines drive on fuel, and they need to be filled. There's no way around it, you have to keep up, and you're driving backwards in my opinion otherwise. (CND4)*

And by buying commercial hybrids, fertilizers and pesticides they can attain crop yields without the work and skill that careful management of nutrient streams and functional biodiversity would require. This also explains an organic farmers reluctance to sow, harvest and reproduce, open-pollinated crop varieties, and instead buy and plant commercial hybrids.

> *[My income is not such] that I can afford those little fantasies, and also, it must be practically feasible, I always give that example of the cauliflower. If I put a Mechelen cauliflower, a local, open-pollinated variety, that is a very beautiful little cauliflower, a very tasty cauliflower, but if I plant a thousand of those, I have go through them twenty times to harvest them, right? Because they are very diverse. If I then have to calculate my labor cost, yes, they will have to be pricy cauliflowers. While if I put a hybrid, I walk through there three times and they are all sold. That is the difference. (ODD5)*

The dependence on markets goes, however, much further than buying agro-inputs. As machines are expensive but crucial labor saving assets, farmers frequently lease machines or hire people to do the job for them. This also saves them time to educate themselves about all kinds of biophysical processes and dynamics occurring on their farm themselves

> *I do not use any pesticides. Our contractor does everything, and he has all the machines and equipment, all new, all legally in order, so we aren't involved in any of those things (CND13)*

Moreover, farmers rely on a whole set of services offered by people with specialized skills and resources (mechanical engineers, veterinarians, nutritionists, accountants, harvesters, sprayers, drivers). While there are of course costs attached to

relying on these bought goods and services, many farmers appear to have made the calculation that it is in their interest to deepen their dependence on these, so that they can specialize on certain productive activities. What we thus observe is that not only does the system of impersonal relations constituted by the shared notion of property rights in this context explains the unequal access to resources farmers have to resources and hence their ability to pursue agroecological principles, but also that such a system also gives rise to a social division of labor, as individual actors decide to specialize and trade.

We observe that farmers typically buy commodities through arrangements which differ markedly from the text-book competitive market definition. In fact, they mostly engage in so-called "relational" markets, in which more personal relationships have arisen among buyers, among sellers, and among buyers and sellers of the same commodity. We will now analyze this more qualitative side of market dependence, and how it influences the capacity and willingness of farmers to engage in the pursuit of agroecological practices. For most agricultural inputs (straw, forage, non-mixed concentrate components, calves, veterinary services, manual labor), farmers say there are ample suppliers, theoretically allowing farmers to pick and choose the most advantageous deals to them, and this ability is said to suffice as a sufficient deterrent against overpricing to such suppliers. Nonetheless, farmers regularly work with the same people to obtain these goods and services, for convenience sake, rather than out of necessity. Some farmers don't like to bicker over prices and prefer to build up a more amicable relationship with their suppliers based on mutual trust.

> *Three years ago we had a trader who also came to do Caesarean sections, but we then looked into that business marketwise, and saw that he was a lot more expensive than the rest. So in the end we approached him about it, and we now work since two years with another trader and veterinarian. (CND1)*

> *For the straw we now have someone who is very good, he knows very well what we want, but we are actually not that incredibly difficult on this point. And sure, he also knows that we prefer to pay 25 euros more per ton for very good straw, than just be focusing on price. We are by nature not people who will be shaving prices anyway. (ODD4)*

Such statements indicate that while such trades are a practical activity between two people, they are mediated by potential offers from other commodity owners. For a number of more sophisticated inputs (pesticides, pharmaceuticals, pre-mixed concentrates, commercial hybrid seeds, and planting material) there are but a few supplying companies around, however. As many farmers we interviewed need these specific commodities, conventional farmers find themselves forced to rely on these particular companies, which is regularly communicated as a form of commercial un-freedom. Moreover, some of these farmers say the co-ordination among a limited number of companies, and in so doing establishing personal relations, has led to a situation in which these companies come to dictate the prices and terms of trade in a way that is advantageous to them.

Price fixing is not allowed, but everyone knows that they [the feed producers] *have set up an association, everyone knows that the association is there to make price agreements, so if I go to* [this large seed and feed company] *tomorrow, and they say one hundred euros, then I go to the competitor, who will say: ninety-nine and a half, or a hundred and a half. They have agreed that they will not go under that price, because they want to keep profits high.* […] *There is no fair competition anymore in the animal feed companies, as it used to be in the past, I have been a representative myself, did the job myself, so I know what I am talking about! (CDD5)*

Reactions from farmers differ: nine farmers say they regularly change or threaten to change to go to input suppliers, whereas seven others farmers say they prefer building up an enduring relationship with commercial partners based on mutual trust, arguing the small price differences gained by changing suppliers don't outweigh the hassle and the costs of establishing a new working relationship.

In terms of suppliers, sure, you are partly stuck. I 'm saying that now with regard to the vegetables, you have two or three suppliers of plants, it's clear, you don't have much choice, so you are going to buy there. As to the feeds, the same story, there is not that much difference between one and the other, Just that you might decide, instead of buying those proteins you are going to grow it yourself, now you also know, even you are going to grow protein, soy for example, as you read in [agricultural press], is not feasible for the amount you need, so you remain partly dependent on your suppliers, you can play them off against each other, but you cannot every time you have a need for feeds start calling around for prices. You need to trust one of them for a time. The same for feed, medicines, veterinary, you can't be around shopping all the time. And in the end, you will hardly get a better deal. (CND7)

Farmers acknowledge, however, that lasting relationship can become very problematic, if the farmer is short on means of payment, but also requires these inputs right away. As farmers have nowhere else to go at that point, input supplier can take advantage of this situation, potentially leading to exorbitant prices, indebtedness to a supplier, long-term bondage, and possibly financial ruin of the farmer.

You shouldn't be afraid to work with major players, but you should take care of one thing, namely that you are not financially dependent on them. The moment you don't get by, go to your bank, and not to your feed supplier. If you have a credit line open there, you're finished.. In my case, every time an invoice arrives, the day after: it is paid, if you do so, you are not dependent. If you don't like anymore what they deliver, you can quit right away. I also change regularly, I ask different prices, if I am happy, then I will not change quickly, but make sure that you can keep going. (CND3)

We thus notice again an interaction between the social position of the farmer as it is continuously defined by the impersonal relations on the one hand, and personal relations on the other hand, through the situated understanding and productive and commercial behavior of the actors involved. The potential effect of personal relations between farmers on the terms of trade for inputs become evident when farmers engage in group purchases, as it allows farmers to obtain certain inputs more cheaply. To the frustration of a farmer engaged in such an initiative, other farmers appear very

reluctant to engage in group purchases, speculating farmers don't want to take the risk blowing up long-term personal relationships with inputs suppliers.

Lastly we note that for a number of organic farmers, this question of power between input suppliers and farmers appears not to apply to them, because they've organized their resources in such a way that they don't need the goods and services offered by these commercial actors. Importantly, they note that conventional farmers failure, has not only to do with their objective situation (not owning a farm that can generate sufficient income without these pesticides), but also with the direct cultural influence input suppliers have as important sources of information with regard to how one ought to farm. According to farmers, these salespersons have their own agenda and the information they give can't be trusted. The economic interest of these companies and sales representatives lies in increasing their sales, and some farmers speculate it is these actors that put the idea in other farmers' head to expand and intensify production.

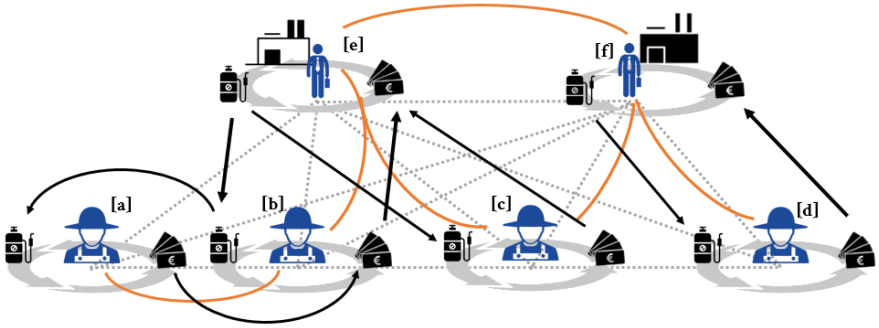

Figure 24 Diagrammatic representation of the personal (orange full lines), and impersonal social relations (grey dashed lines) underlying the marketing behavior of farmers vis-à-vis input suppliers (in this case, pesticides). a] and [b] represent farmers purchasing in group pesticides from supplier [e]. [c] represents a farmer with who pits two input suppliers [e] and [f] against each other who regularly coordinate activities, and [d] represents a farmer who deals with only one input supplier on a recurrent basis.

> *A lot of money is made in agriculture, but not by the farmer. and as a farmer you have to be very careful, you are actually a consumer, you must consider yourself like that, and you are bombarded by advertising, and everyone says "I have the best of the best, and you must have that, because then you will be able to produce a lot." but in fact, the person who comes to sell it to you has only one thing in mind: to make money. (ODS1)*

As such we observe that the establishment of personal relations with commercial partners influences in a direct material way, through the terms of trade, the objective situation of the farmers, but also in a cultural way, namely in how farmers perceive their situation. Figure 24 is an attempt to visually summarize the different social

relations underlying the different modes of marketing behavior between farmers and input suppliers we covered in this subsection.

7.3.2. Expanding the resource base without markets

In the previous subsection, we observed that farmers either reluctantly or willingly become dependent on inputs and services bought on the market as they perceive their own resource base constituted by the cultural rules of private property and contract law, to be insufficient to subsist on in a satisfying way. Nonetheless, we observe that farmers note a number of ways to expand their resource base other than saving up

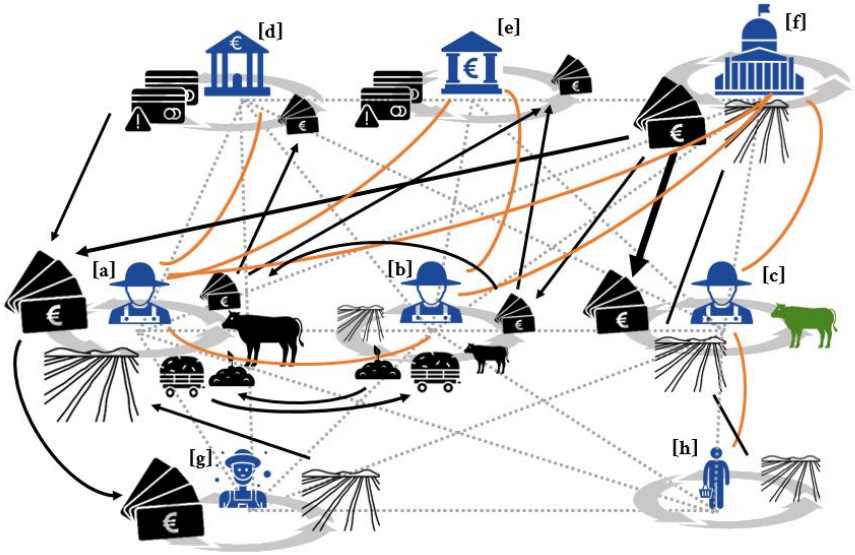

Figure 25 Diagrammatic representation of personal (orange full lines), and impersonal social relations (grey dashed lines) underlying some of economic arrangements discussed in this section between and among farmers [a, b, c and g], and banks [d and e], the government [f], and citizen-consumers owning resources of interest [h]. [a] represents a large farmer with good access to credit, able to buy land from retiring farmer [g]. [b] represents a small farmer with a loan in repayment, and who has an arrangement with farmer [a] to exchange manure for forage for a limited monetary compensation. [c] represents an organic farmer who has a land use agreement with a governmental organization [f] and a local non-farming neighbor [h]. All farmers get government subsidies [f] to a varying degree

money to acquire assets slowly, worth investigating further: (i) borrow money from banks; (ii) take state subsidies and physical resources supplied by state agencies and nature organizations; (iii) share resources including skills and information with other farmers; and (iv) make certain arrangements with neighboring citizens. In our analysis of these economic arrangements, we note the influence of personal and impersonal social relations that are constructed and reproduced on farmers' willingness and

capacity to initiate or severe such arrangements (see figure 25). As in the previous section, we will find that the different analytical moments outlined in the analytical framework are of significance to explain the accounts farmers give about their actions and perspective (figure 26).

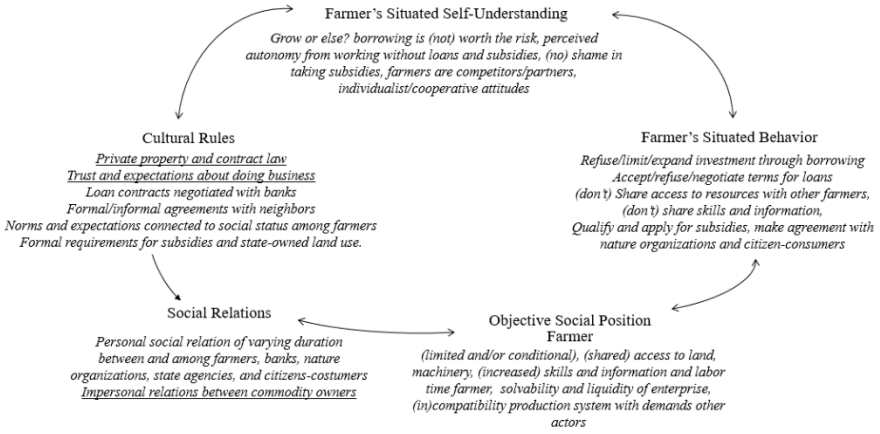

Figure 26 Concept diagram to relate conceptual framework to observed willingness and ability of farmers to source resources through non-market channels

7.3.2.1. Borrowing from bank

While the majority of these farmers were raised on a farm and therefore already were entitled to a share of their parents' farm, succession rights (which are subsumed under our proposed concept of property and contract law) require farmers to buy out their siblings' share of the farm. As saving up enormous sums of money by working elsewhere is deemed by most farmers a too slow of an option, borrowing money from banks is in the eyes of many farmers a necessary aspect of farming in Flanders.

> *Total financial independence? When you start a farming business, the bank is always a major player, it is like that for everyone. (CDD1)*

> *We cannot live well without the bank. We actually have quite a lot of loans, yes. Otherwise it takes a long time before you can move forward. Yes, that's impossible. We'd wish we could do without, but no. (CDS3)*

As such farmers establish with a bank, by accepting to borrow money from banks, and by the same token by accepting to extend credit to farmers, a personal relation is established between the farmer and bank, in which farmers get immediate access to more resources, in exchange for banks getting a legal claim over a certain amount of money over the years, or otherwise, over the productive assets owned by the farmer. While such an arrangement is deemed necessary by most farmers, farmers do acknowledge that there are significant downsides to borrowing: if an investment goes awry and farmers fail to service the debt, farmers are at the mercy of the creditor who

may take over control over the company by forcing the liquidation of assets, or imposing austerity in order to service and repay the debts

> *You must always stay boss. They* [the banks] *offered* [my son] *a loan for a stable, and he had to pay it off in ten years. Ten years! That was impossible, and I said, "if you [the son] have to do that, I will not let it happen* […] *then he'll be broke."* […] *I said, fifteen years or it doesn't go through, and eventually they gave in anyway. I have several colleagues whose children just went bankrupt because they had to pay off* [their debts] *in too short a time. (CND13)*

Some farmers, however, consciously limit their exposure to banks by only working with their own resources, but which forces them to produce on a very small scale, but also leaves them some peace of mind.

> *I am really independent. I don't eat out of the bank's hand. I have no debts with the banks.* […] *If I can't afford it* [a new barn], *I don't build it. It's as simple as that. I have always relied on the principle that I love farming, and I would very much like to keep doing that, but if I have to or want to stop for some reason, I am able to stop. I don't have much, but what's there is mine. And every night I sleep very well, I know others... (ODD5)*

Such an attitude towards borrowing, however, was rare among the interviewed farmers, and more often we came across a more moderate position in which farmers try to limit the size of their investments that they want to debt-finance. One organic farmer, notes, borrowing money may sometimes be the right thing to do even if one seeks to set up a system that is less dependent on buying services and inputs.

> *Every company has debts, long-term costs must be financed with long-term debt, and short-term costs must be financed with short-term money. Buying fodder with a loan is stupid, but so is buying a tractor with your own money. For that you have to go to the banks. (ODD1)*

The agency of farmers in this context, however, also articulates itself in terms of farmers' ability to negotiate the terms of the loans they get from the banks. Farmers say for instance that is important to make a good pitch to the banks. Reportedly, organic beef farmers may be at a disadvantage here as Flemish banks have little experience with investing in such projects.

> *You must make a pitch for yourself and your farm as best as you can, so that the bank has confidence in you, because certainly in organic, they do not know it very well, and they look at it with suspicion, it is difficult for an organic farmer to get financial means, (OND1)*

Furthermore, farmers also say that banks offered better terms after that they threatened to go to other banks. So, even though loans are interpersonal contracts, they are determined not only by the actions of the prospective creditor and debtor, but by the offers of other members of society looking for or offering loans. Farmers with an already profitable business or a whole of collateral to offer, indeed mentioned that this better position allows them to get a better deal from banks. This differential access

to credit plays a role in explaining why poorer farmers tend to be outbid by larger farmers in their search for access to land through land ownership.

> *O, there is land, sure, but there are two or three very large dairy farmers out there, and two more incredibly large beef cattle farmers, really giants, forget it, we cannot deal with that. (ODD4)*

In other words, we notice an interaction between the personal relations farmers may or may not be able to establish with banks, and the social positions of farmers within the system of impersonal relations. And not only does this interaction reinforces inequalities in resource access, it also gives rise to a speculative dynamic, in which even larger farmers perceive it absolutely necessary to borrow large amounts of money to buy expensive assets such as land, machinery and housing, as this is the only way they can expand production fast enough to avoid losing the competition for scarce resource such as land with other farmers in the future, further driving up land prices.

> [my vision is to] ... *double in numbers* [of livestock], *as these days, when they come get your animals with a truck and a driver, it makes a big difference whether they can take one, or they can take ten. And the cost price, you need to drop your cost price. So you need to be able to produce more cheaply.* […] *Normally we will get enough money, they [the bank representatives] do investigate your proposals of course. You should not be borrowing five hundred thousand euros to buy three tractors, sure, you have to be reasonable, and then they will examine why you need that for.* […] *The way I see it,* we still have to grow, I think that within five years, only the larger companies will remain. (CND2)

If we connect the dots then, it would appear that while access to credit may enable farmers to become less dependent on input markets (by for instance acquiring land to grow their own fodder, before they have the savings for them), in an intensively farmed and urbanizing region where land is only becoming scarcer, the credit system is also a social structure that accelerates scale-enlargement by farmers, drives up land prices, and thus exerts further pressure on farmers to mechanize, specialize and simplify production systems.

7.3.2.2. Direct arrangements with nature organizations and state agencies

Another way through which some of the interview farmers have gained more access to resources is by working out arrangement with government agencies, independent nature conservation associations. These organizations often hold significant amounts of semi-natural grassland and forest that needs to be managed in very extensively, which creates important opportunities for some beef farmers with a more extensive production system and a marketing strategy adapted to it.

> *I was able to start a business model for beef farming without inheriting the business and without having land. That is unique, they say you cannot farm if you do not inherit the farm from your dad. And certainly not if you are land-bound, because of the land*

tax. The idea of that collaboration with [nature organization and state agency] *has allowed me to farm on more than a hundred hectares, which is gigantic of course, and that is a very nice model, such a collaboration leads to a win-win situation that allows me to farm, and them to have to manage less land* […] *From an agricultural point of view, these natural areas have many disadvantages, you have to use them in a professional and intelligent way to benefit from them. And that is of course one reason why the farmer does not want to use the biodiversity, because that biodiversity has such negative effects on your technical results of a farm. If your business income depends entirely on your volume, then there is a hugely negative relationship between biodiversity in your grasslands versus income and that you can only solve it, by a company like mine, or by subsidies (ODD1)*

Yet, farmers with an intensive production system, or whose owned or leased land was reassigned in the past and have to deal with loss in productive capacity, have often little good to say about such arrangements or the actors associated with them.

that is all very nice for someone who is ecologically predisposed, to watch and do, but otherwise, […] *You can only put two livestock units on it, from May to October, you can't do more with than that,* […] *Look, they have their point of view on agriculture, and we have ours. It will never work, like I say: ecology and economy don't go together* […] *We've got to work for our money, and the greens, they just get money from the government, and it's the taxpayers who pay for it. (CND6)*

Farmers also frequently note the important role various CAP subsidies in sustaining themselves economically, yet these in the end voluntary state support programs are also said to limit their production choices. In other words, the personal relationship between the agricultural department constituted by their agreement to accept these subsidies in exchange for fulfilling the requirements of the scheme, mediates their access to resources farmers. In many instances, these schemes have motivated to farmers to pursue agroecological principles, with some of the interviewed farmers seeing these as an economic opportunity, whereas others see it as being forced into it, and now having to deal with the social stigma that is apparently attached to taking subsidies in the farmer communities, and the fear of being so dependent on the government.

I have sown some grass clover, I have to say it is under the influence of subsidies that I did that, because it is a bit of a squeeze, normally we try to get maximum yields, and for that you need a reasonable nitrogen dose and that requires fewer leguminous plants. But those subsidies made it attractive. (CND3)

The law says that along that [brook] *you have to keep that much distance, yes, then that is what you should actually do. Because if you do not stick to that and they take samples again and it is not good again, then they will scale back allowances even further, and they will do that until ... until you cannot do otherwise. On some plots so to say you are not allowed to spray 20 meters from the sides, yes, what are you going to do. If they catch you, you will pay even more, but that is not what we want. (CNS3)*

This [subsidies] *is important, but we would rather not have it, but it is not self-evident from a social point of view. I sometimes compare myself to an unemployed*

person, a man on the dole should do nothing, well, we still are supposed to tend our business... But if subsidies were to disappear, it would be completely over. (CND7)

As such, we may conclude there are both economic and cultural and at times contradictory drivers to subsidy uptake, emanating from the direct social networks farmers are in, and the broader social system of impersonal relations. It is important to note here, that current government subsidy schemes are not perceived unanimously perceives as imposing agroecological practices by farmers. In fact we found even small organic farmers vehemently arguing for the abolishment of the whole subsidy system, as it would mainly promote big farmers..

I'm glad I got some, it's not much for a small business, but it's there. Personally, my vision on it is that they can as well do away with all subsidies for everyone. That would be best for everyone. […] *Most subsidies go to the big companies, causing land prices to go up, making the final product price extremely low, so that they do not have to be profitable. I know companies here in [the village], which receive 75,000 to 100,000 grants a year. And then you may sell your milk at a loss, if you still have a fair income. So abolish that, then those land prices will return to normal, then fertilizer sales will not be a problem, those large companies will fade away, and then the price will be right again. But, well, I am not in control of the policy. (ODD5)*

7.3.2.3. Share resources and skills among farmers

Another way to expand the resource base a farmer has to work is to pool and share material resources and with other farmers. As such they give up some of the exclusive use and trade rights over resources that comes with their position in the system of impersonal relations, to get access to the resources of other farmers through an often informal but enduring agreement, thus establishing a personal relationships between them. The most commons forms of cooperation of this kind among the farmers we interviewed were about the exchange of manure and fodder, but they also include small transportation jobs, cultivation here and there, temporary use of land, *etc.* (see Annex 4, principle 10 for frequencies of specific arrangements). Such forms of farmer co-operation often occur on a rather transactional basis, but they often appear to have been facilitated by a mutual sense of trust, friendship or family bonds. Such arrangements are usually between two persons, however, more complex arrangements also exist in which multiple farmers are exchanging goods and services to each other on a regular basis. Co-operations between farmers for resources can go further than reciprocal arrangements, but even include co-ownership of resources. One farmer, for instance, fused his farm with his neighbor's farm, as they saw mutual economic benefits in that.

[I] *merged with* [a farmer] *of the goat farm, because he was short on grass and I had too much grass and I was short of machines. We actually merged, now almost six years ago and we have grown into the company that it is today. He also had a slow start with goats, didn't come from an agricultural background and yes… He could do things that I couldn't and he had resources that I didn't have and vice versa, so um... that's why. So we started a company. (ODD3)*

Whereas this is evidence of farmers being able and willing to share resources, we also interviewed many farmers who were puzzled or even annoyed by the idea of working together with other farmers. As one farmer put it pointedly:

Farmers don't work together, farmers cut each other off! (CDD5).

Whereas the actually existing co-operation between farmers noted above disproves this claim, it is backed up by other farmers noting their own unwillingness or inability to share resources with other farmers. Perceived benefits of sharing material resources such as machinery didn't outweigh the perceived lack of control or access they may have over these assets, and the conflicts among farmers it may lead to. In other cases, farmers told us that they were definitely wish they could work with other farmers, but that they trust the neighboring farmers.

't is each his own stuff, and um, why? You own certain machines, and you need them exactly that day, and you need them both exactly that day, that mower too, when are you going to mow, when the sun is there, and the weather is dry, whose machine is it then. In the end you can say yes it is cheaper to share, but think, the gear will last also half the time, so you buy it alone. I wouldn't buy machines with someone else, no. (CND7)

I do not want that. It can also cause conflict. I'm quite chaotic, maybe not that caring with my material, and then you have those colleagues for whom it really all has to be perfectly tended, […] *and if something is broken, you know, that's human, isn't it? You understand. I have already experienced that, then yes, for sure, every person is different, I am quite chaotic and nonchalant, and then there are people who are driven crazy, if it is not as they would do it. (ODS1)*

That is almost impossible to do here, it is a difficult area [...] *[because of the lack of] simple human honesty, in this area it is difficult, I do not know how that works in other regions, but here it is difficult. (CND8)*

This failure to co-operate with each other in spite of the mutual benefits that reciprocal and cooperative arrangements might bring, is a source of frustration to some farmers. Some farmers speculate this must have something to do with the specific individualistic subculture of (conventional) farmers in the neighborhood, citing formal and informal co-operations among farmers are much more common in neighboring provinces or countries, and also among organic farmers

In the Netherlands that is completely accepted, and in Germany too, I did an internship there, it was normal there too. So I went to my neighbor [here in Belgium], *and I said "chap, you don't happen to have a cart, because I would have to move manure?" Then he was like "why don't you do it this way or that way?" So, that was not possible,* […] *He may also say right away that he did not want to do that, or he may have thought he could make money out of it, I don't know, but I thought that was a strange way of doing things, you see what I mean, but with organic farmers, that's completely different ... (ODD6)*

One farmers explains, however, that this lack of co-operation should be traced back to how Flemish farmers tend to perceive their own material interests, leading them prefer the long-term benefits of the economic demise of their colleague, over the short-term mutual gains of sharing resources with each other.

> *Sometimes it's a little bit each for themselves. I've already come back from what I first thought. It's not as easy as I imagined. It's everyone for themselves. There are all sorts of attitudes. Some see a setback that someone else encounters as an opportunity. Like, someone died in the neighborhood, a farmer had suddenly died, three days later they already asked the widow if she had any land to sell. He wasn't even buried yet, than you say to yourself, you know, […] it exists and more than you think. Yes weird. We would say, "oh dear those people, they are in quite a bit of misery there". But then someone else thinks, "yes! This is the moment now, to be able to snack on something" People are weird. (112 - ODS1)*

The ability of farmers to produce profitably does not only depend on how much material resources they can mobilize of their own, but also on skill. To develop such skills, farmers on the one hand can rely on what they learned from their own experiences working at their parents' farm, through their formal education, *etc.* This baggage enables them to engage in certain production methods, and must therefore be part of the resources they can depend upon. Educating oneself by gaining knowledge from all kinds of sources of information is therefore a crucial part of farming economically successfully. Given that farmers build up this knowledge, they are potentially also key sources for other farmers to advance themselves, and farmers acknowledge that they should and often can rely on other farmers formally to get ahead.

> *Well, we shouldn't all be inventing hot water all over again, we have a knowledge network with farmers that you come into contact with yourself, but Bioforum, for example, has a very large knowledge network, and they organize these organic farm networks, (ODD4)*

> [exchanging knowledge with farmers] *we certainly do, via social media mainly nowadays, we have groups through WhatsApp and those kind of things, if you come across a problem, you may just ask, has anyone had to deal with that problem, it might be a flu or the kind, or fertility, we do that kind of exchange. (CND5)*

Farmers note, however, that exchanging knowledge does take time and efforts from farmers.

> *Yes I try as much as possible ... but time is a limiting factor. Sure, I try to include knowledge and training activities. It's a disadvantage being a mixed farm. That you have to know a lot of different things and follow several company networks and things... (ODD8)*

> *It is difficult to get farmers out, those young farmers you don't see them no more, they are all on the internet, you can find everything there. I'm in an agricultural committee which has been set up two hundred years ago in order to inform the farmers if something new came out, something newsworthy, some presentation, and new*

techniques, but do we still need that today? […] *The young generation no longer leaves the home. They don't have time, they have to milk two hundred cows, they don't have to anymore, and that's the life they have been choosing, but, yes, if that is life... (CDS1)*

Farmers sometimes believe they have relatively little to learn from each other, either because their production system is so much different or they are more ahead in optimizing their production system. Moreover, some farmers note that the information they get from other farmers is not always reliable. They suspect farmers to lie about their results out of pride, and this is for some reportedly a reason to keep information for themselves.

There is some sharing of information, but in my opinion, farmers are not always honest with each other, for example, about the pricing, If the potatoes are an expensive year, then apparently they were all so smart to produce for the free market, and if it is a bad year for potatoes, then they all apparently had the foresight of getting a contract. The same for the animals, Someone will say, "gosh I sell my cows for so much, and my bulls for so much!". But there is so much lying going around among the farmers, mainly just for the image, not wanting losing face, so I will not mention any subject with them anymore, except to a very few people, but not to a great extent. (CND8)

Farmers indeed report that many farmers are rather reluctant to share knowledge, which they believe is rather selfish and short-sighted. The reason behind this according to some farmers is they find it unfair that other farmers are taking a free ride on the knowledge they have put time and resources in to acquire, and don't want to see other farmers become successful with it.

[Exchanging knowledge] *with other farmers is sometimes a difficult one, because many farmers do not want to share it with others. They are very quirky and very self-centered. So farmers don't like to talk to each other about such a thing. Which is a shame because we would be much stronger if we did. But when you try that you very often bump into walls. In agriculture. For what reason ... I'm guessing about it. Don't like to see the sunlight shine on someone else or what? But I find it very sad. (CDD4)*

So even though farmers don't give up directly their access to knowledge by sharing it with other farmers and these exchanges may even increase their own knowledge, though it may take some of their time, there is a tendency of farmers to deny each other knowledge, either because of a perception of justice or personal pride, or indeed because of the long-term effects sharing of information with neighboring farmers may have on their own access to scarce resources such as land, and their ability to secure sales. Possibly this gives to a reportedly common understanding among farmers not to bother each other if they can avoid it.

What we take away from this subsection is that farmers at times perceive a personal benefit from working together by sharing resources and knowledge. Nonetheless, we noted also that there is an unwillingness to share, because of a lack of trust among farmers, or because the other farmer doesn't feel like they have anything to gain from collaborating with each other and prefer not to give another farmer an advantage. In other words, the way farmers perceive their own social

position within a system of impersonal relations limits the establishment of potentially favorable personal social relations between farmers, resulting in a situation where farmers exclude each other for their resources, closing off production possibilities, among which less market dependent ones.

7.3.2.4. Arrangements with neighboring citizens for resources

For the sake of completeness, we also note that a number of farmers were able expand their resource base through arrangements with neighboring citizens (see Annex 4 principle 10 for an overview). In four cases for instance, farmers gained access to more land by being allowed to mow or graze animals on the land owned by a neighboring non-farmer. Yet such forms of cooperation also include small unpaid services to farmers by helping out here and there on the farm, to even taking a share in the farm, or the land holding allowing the farm to more easily invest.

> [one of the strong points of] *the company is certainly the legal structure, the co-operative and how the capital is divided and housed in that [land] foundation. That provides a very durable, a solid basis to be able to work in a sustainable way. and the connection with the customers, the commitment that the customers have within the company. Actually, not all customers are shareholders, and not all shareholders are customers, actually that is a bit loose ... but it does work! For example last winter our greenhouse collapsed, and then we have also been able to finance this with the help of those same people or other people who decided to become shareholders. That surely is a strength (ODD6)*

There indeed appears to be a section of consumer-citizens in this context wishing and able to support (certain) farmers activities economically, and indeed do so, resulting in the formation of personal relations between citizen-consumers and individual farmers. These also effect also the terms of trade farmers may hope to get when seeking to sell certain goods of services to these same actors.

7.3.3. Constructing favorable sale channels

As elaborated in section 7.3.1, the farmers interviewed rely to a significant extent on bought inputs to farm, which requires them to acquire means of payment in some way. Whereas the interviewed may depend to varying degrees on other sources of revenue, all of them depend also on the revenues from selling their products. At the end of that section, however, we also showed that farmers market dependence for inputs has a qualitative character of some relevance, indicating the role personal relations may play in the terms of trade farmers can get for the inputs they buy, and in fact the choice of buying these inputs in the first place. We find that similar dynamic plays out in the sale of agricultural producers, yet it is according to farmers a far more important for farmers, as the real challenge of market-based farming is not turning money into inputs, but rather turning outputs back into money.

> *The suppliers are not the problem, in conventional farming too. As long as farmers get paid enough for their product, they can buy whatever they want. I think it is above*

all your [product] price and your sales that you need to be in control of. From there you are freer to go the way you want. You need decent wages and a decent income. (ODD7)

As the farmer has often little or no direct use of the products they fashion themselves, all of the work and resources put into production are a waste if the farmer fails to find a buyer for these product. From the producers' perspective, however, it is imperative that this buyer is willing to accept terms that allow them to cover the production costs, including their own livelihood. In the short term then, the criteria of consequence in production are therefore not what farmers personally feel about the quality of agricultural goods, but rather how their product compares to others in the eyes of the expectation of potential buyers. Over the longer term, however, farmers are able to contemplate what kinds of commodities they would rather produce by reorganizing their resources, and for which they would be able to find customers that accept prices that will to cover their production costs.

I always recommend, look before you start production, what the demand is for it. So if you don't know where to take it, you shouldn't produce it. You must know that in advance and then problems will be fewer, […] *if you say for example, I am going to take a different breed than Belgian Blue, and you switch to Hereford, then you must know in advance who will buy that meat. (OND1)*

From the accounts of farmers we can derive that their prospective buyers are, just like farmers are when it comes to buying inputs, not merely interested in the price of the product as it compares to others, but also weigh and compare the particular use-values it provides to them compared to other differently priced products, the convenience in obtaining them, and sometimes even in the personal relationship they may have with the particular farmer. What we shall see, however, is that whatever moral commitments these prospective buyers may have, whether it are producers or traders, or final customers, they are under a very similar structural constraints as farmers.

If your boss can no longer make a profit on you, then that's bad news, He will say, boy, look for another job hey, you do not contribute to the well-being of my business. So, people who do business with me, need to be able to earn a profit... Why else would they come back to see me? Not just because they like my eyes, perhaps my wife's, but definitely not mine. You understand, you need to get rid of your stuff, and those that take it, always come with the intention of making a profit behind you. That is a reality we shouldn't lose sight of, (CDD5)

In this subsection we will focus on the material conditions and cultural rules influencing both these short-term considerations (on what terms already produced goods are sold), and the long-term considerations (what goods farmers end up producing). We will first analyze the situation of farmers selling life cattle to actors involved in wholesale beef chain, after which we will explore the situation of farmers seeking to sell beef directly to final customers through various economic arrangements with other actors . As in the previous sections, we will find that the

different moments outlined in the analytical framework are of significance to explain the accounts farmers give about their actions and perspectives on these issues (figure 27).

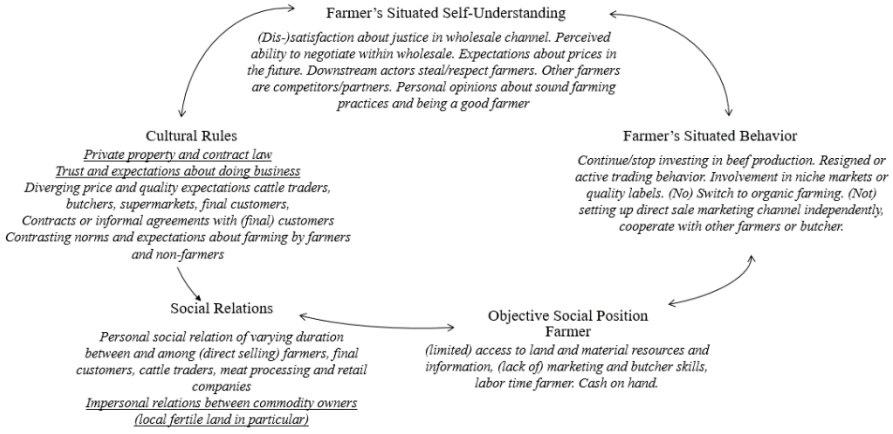

Figure 27 Concept diagram to relate conceptual framework to observed willingness and ability of farmers to construct market channels more favorable to agroecology

7.3.3.1. Selling life cattle

Many farmers in our sample have organized or found the material resources they own organized in such a way that they can produce a large bulk of agricultural products. As they have no direct use for these products, they are compelled to sell these. Farmers argue that at that point, you have little choice but to work with large food processing and distributing companies or via a trader in this context. The reason being that these companies are the only economic actors buying on a relatively reliable basis agricultural commodities in large quantities. Working with these actors also has advantages reportedly, as it allows farmers to focus their efforts on optimizing the scale, rate, and efficiency of the production of unprocessed commodities. The alternative, namely processing and distributing agricultural commodities to final customers by themselves, is regularly presented by whole-selling farmers as unfeasible given their individual resources and skills or from a personal point of view desirable. As we shall find in the next section, a considerable amount of time and resources has to secure these large number of small purchases by final customers, which cannot be spent in physical production.

> *You have to be realistic. In the past there were farms with just ten cows, ten calves, ten births, and you did every year about eight sales. That can still be done with sales to private individuals, but* […] *in today's day and age, you have companies that turn around yearly two hundred calves. That's two hundred to sell each year, what farmer can place 200 cows every year? You could do that, but then you would be on the road all day (CDD5)*

I do and do not believe in that, if you can combine that, and a beef farm, if you process it yourself, and can sell it yourself, I am convinced that it is fine, but the problem is that you should be able to combine it. […] *One plus one could be three, but you have to be careful that if you add a half to a half that you don't end up with zero. We do have the examples. If you have not seen a calving, because you are cutting up your meat, you won't get by. I truly believe in it, but it must be practically feasible. (CND3)*

Much depends on the size of your company and the volumes you produce. We actually have considerable volumes, and then you also have to appeal to major players, certainly in organic farming, those larger players also want it to be worthwhile. (OND1)

However, while whole-sale chains may enable farms to secure the sale of their products at low costs, it also constrains farmer's production options as they have to cater to the preferences of these larger companies. For conventional but even for organic vegetables this tends towards products which are well-conserving and of visually immaculate quality. For cattle, standards are set in such a way that a choice for Belgian Blue cattle brought up with high quality concentrate feeds is rewarded. Moreover, traders also have a tendency to promote the production of larger and larger quantities, which provides farmers with an additional incentive to expand production.

Why does the farmer keep using that breed? Because of the traders, the consumer is asking for that. I always believe that you should shoot less at the farmer and more at yourself as a consumer. […] *Suppose that I have too many cows and that I cannot get them dropped off locally, then I might as well push them into the river, so to speak. Nobody wants those cows. The trade has no interest in Angus meat. The demand is for Belgian Blue, Belgian Blue, and there is a whole system for that, the merchants, the whole trade, the markets, everything. It's all focused on Belgian Blue, and now it starts to take little by little an interest in Blonde d'Aquitaine now.* […] *there are now a few more farmers who are interested in those breeds, so sometimes you will find one. But actually from the system…* […] *you need as little fat as possible and as thick as possible muscle. So it is somewhere understandable that conventional farmers do what they do, because of the demand, and they have the certainty of a sale (ODD7)*

While whole-selling beef farmers have accepted to produce cattle that meet these expectations, according to farmers, the declining cattle prices together with rising costs, have made it hard for them to make a living over the years. As they observe that retail prices for beef are steady or rising, they believe that through the monopolization of meat processing and retailing activities, a limited number of companies take advantage of farmers as they have nowhere else to go with their product, and have to accept any price that is offered.

When you hear what the butchers still have to pay the wholesalers for one kilo. That is not less than two years ago. But we get half a euro less, sure, so where did that part go? To the wholesalers for sure, they are still making a profit. (CND5)

For everything that leaves here, you only receive what they want to give. You are in the position that if you say no, you cannot get it at that price, then they say good, then we will go next door, that's fine (CND14)

Farmers often also point to the role of the largest farmers' union which is said to benefit from this situation as parts of the organization are invested in these agro-industrial activities.

> *Everything is monopolized: the farmers' union takes over everything, whether in the mechanization, or in the feed factory, or in the marketing, or in the processing, they are everywhere, they monopolize everything. So what can you do about it?* […] *The factories may come to see you: look, this year, for those beans, there was too much production, so we are going to take one euro off. You must not argue about what they say. Enough beans, so see next year you don't put beans. (CND6)*

Others are more reserved about making such statements, arguing that downstream-processers too have costs and need to be remunerated for that.

> *Our vegetables go for thirty francs a kilo, yes, but in the shop it is fifty francs. It still is a cauliflower, but it is now in a bag, it has been processed. The same goes for the meat, it's gone and slaughtered, brought in the shop, and then it is so much the kilo. I do not know if there is much margin behind us, and who takes that, you can say, it's the supermarkets, but we do need them to in the chain. I couldn't say where the problem exactly is. (CND7)*

A part of the dissatisfaction of beef farmers also arises not only by the fact that the prices are on the low side, but that there is also insecurity about the prices. In some sectors like vegetable for industrial processing, veal, *etc.* farmers work by season and can get a contract, which makes it easier for them to calculate the risks and make informed production and investment decisions. For cattle trading, animals are bought on the spot, as such it is a similar situation to the day trading that happens in the fresh vegetable and fruit sector. As such they say they bear the brunt the risks resulting from price fluctuations as well as those resulting of physical production, without being remunerated for it adequately.

> *If you put vegetables, you have your plot of vegetables, your cauliflowers, you plant those, you harvest those and you know roughly where you will end up. But you can't don't have an idea at all with the market for animals (CND7)*

> *We bear the risks to raise all those animals, and you have to wait and see how much they want to give! (CND14)*

Some farmers, (among them larger farmers often with some personal experience in cattle trading), argued that cattle farmers have little right to complain about low prices, because it is part of the game, in which farmers made their bets to keep on producing cattle based on the expectation that prices would be high. Following this logic, there is nothing unjust about the whole situation as farmers knew fully well that other farmers had the right to continue and even expand production as well. To them, current low prices are but temporary and due to overproduction, and it is fair game for downstream economic actors to exploit the situation, which moreover will and should drive out farmers out of the production of cattle. From this vantage point, farmers are free to speculate, and instead of complaining they should consider moving on to

produce different commodities or retiring, which they note would surely improve their prospects. They argue moreover, that as the same "free market" principle applies to traders, retailers and butchers, to complain about fairness, as it is all part of the game there in as entrepreneurs.

> *Gosh, I can't even talk about the price. I may only ask, "when shall I be able to get rid of my product?" If they are ready to go in three weeks, and you ask a franc too much then they are off to buy at someone else's. But honestly, I would be like that too. If I can get my feed cheaper, then I shall find elsewhere for the same quality. There just is too much supply. (CND3)*

> *Business doesn't work like that, it is always supply and demand, and look at Champions League football, they are dealing with millions of euros, aren't they, and that referee, how many millions are not involved, is that fair now? No, it's not fair, and we want fair prices, but in the end of the day, we need to get rid of our product, at an as high a price as possible. So we're going to get bigger, and that's how we are going to survive, and earn a good living* […] *the weak must disappear, the stronger will survive. These are no longer family businesses nowadays. Those are industrial companies. (CND6)*

> *Well, it is the same principle again, amongst the cattle breeders, there are those who excel, and those whose will disappear. And amongst the traders too, some have knowledge of their trade, and business is good for them, and with others, it's absolutely miserable. It is a free market and a free profession, everyone is allowed to do it* […] *I was in a meeting about that problem with Veviba, and there were people from two supermarkets in an argument about some little details, and you sense the competition tensely. A farmer, may well say from his couch that it's all a mafia, who dominate us, but you must understand that if there is too much production, in anything, you'll have to drop you prices, whatever it that you sell if demand is low (CND9)*

If we consider this last quote in particular, farmers bring to our attention an important aspect about the market system constituted by these impersonal social relations that we have been describing. They consider that that not only farmers are in competition but so are retailers and food manufactures. They appear therefore under the same pressure to outbid their competitors, organize production economically efficiently, and get favorable deals for their inputs, namely the commodities offered by farmers. These economic pressures may therefore explain why they seek to drive down the cattle prices, to promote overproduction by farmers if they can, and to establish a steady and dependable supply, preferably in bulk to reduce transport and administrative costs. Importantly, not all farmers who share the understanding that it is economic competition that drives prices down, rather than monopoly power, say, however that this situation is a fair deal Flemish farmers, however. To their mind, they shouldn't be forced to compete against farmers, working under totally different price conditions and environmental and social standards, though this more the case for other agricultural commodities such as milk and grains. On the other hand, some farmers see opportunities in the opening up of these markets.

Whether the low product prices established in whole-sale trading are objectively speaking the result of the market power of a few (personal relations), or the power of the market itself (impersonal relations), they limit the control farmers have on technical decisions and moreover put pressure on the working conditions and standard of living of beef farmers at the time. Whole selling farmers feel pressured to scale up, mechanize, rationalize production in order to meet the expectations of the industry. Yet, they are also faced with more stringent environmental regulation and subsidy reductions, increasing the costs and time they have to spend in production. Many farmers note however that they are upset by the - in their eyes - unfounded criticisms on the sector's. These are believed not only to depress demand and thus further pushing down prices, but they also make them feel unappreciated by their fellow countrymen and –women. Given these conflicting demands put on farmers, but without seeing a clear solution, quite a few conventional whole-selling farmers let us know they feel left behind by or angry at other actors (agro-industrial and retail capital, non-farmers generally, environmentalists, politicians and policy makers.

> *The worse the economic situation is, the less time and money people will spend on their animals to produce a high-quality product, and so a worse lies in the shops. Somebody should reflect on that, because it can't continue like this… The more the retail keeps pushing down the price, the less high-quality the product that will be produced. All needs to go faster. There is media attention for the problem, and that keeps me hopeful, but people nowadays they don't think about that stuff (CND12)*

> *As long as they are campaigning against meat consumption, the price is not going to go up anymore. the media is destroying everything today. Here everything is strictly controlled. I understand there has been bad practices in the slaughterhouses, and at the farm level too, we need to get better. I always say, the weak have to vanish and the strong will become stronger, but it's unfair that the media destroys everything that is locally produced, but doesn't look at what comes in from abroad (CND6)*

> *We in Belgium have the best meat there is. How that our meat is controlled, I don't understand that such scandals can exist. They should certainly whirl all those rotten apples out. there are many in our sector that are doing very well, I am sure. otherwise you simply could not survive. (CND10)*

> *This way you can't keep it up. Also in terms of image, that's no fun if you open up the news and your sector is constantly being vilified, that's ... that's not nice. While you put all your energy into it, and make life out of it. Because yes, your animals, that is your life. (CND12)*

> *Sometimes you are a bit resigned, sometimes you just live your life, and hide a bit, and hope for the politicians to know better, and say to yourself: they are not going to let us bleed to death, are they, as they did to the coal miners at the time? (CND7)*

This social position helps to account for the stubborn refusal we at times spot from these farmers to contemplate and explore other business models, and rather choose to resist any change, as they don't feel there is anything wrong with what they are doing, and their frequent criticisms on organic farmers and environmentalists. It may also

help to account for whole-selling farmers who agree things need to change, but that their hands are tied, and instead point to the responsibility of other actors to deal with the problems associated with Flemish agriculture.

Whereas many farmers are dissatisfied with the terms of trade offered by wholesale traders, we observe farmers diverge in their reported trading behavior. Some being rather resigned to the situation and accepting the terms downstream actors have to offer, while others indicate to be rather active in seeking opportunities that may arise even in whole sale channels. Generally speaking, whole-selling farmers say they have little negotiation room to improve the prices and conditions offered by the whole-chain actors, rather they can either accept the prices, or be stuck with an animal, which they have no use for, and only costs them to maintain. However, just like we found for commercial relationships established for the buying of concentrates, seeds and pesticides, we do find farmers seeking to negotiate and look to put potential buyers in competition even in a bad market situation. This requires gathering information on whether there are better terms offered elsewhere from for instance other farmers (though this as we noted about knowledge sharing generally not always self-evident among farmers), and learning how to estimate the market value of their own product, by weighing the animals sold on the farm.

> *There are many places where only one cattle trader comes to the farmyard, you know.* […] *We have three who come regularly, and what we try to do, it doesn't work out every time, but when we have a lot of say ten animals, than I say, now, what would you give for that lot? And then another comes in and the bids can be compared. (CND7)*

> *You have to be sure of the value of your product, and check with colleagues what the prices are. Delivering with your own transportation means is an added value. Also, in the slaughterhouse you get an idea of the market, you can talk to colleagues. Some people I can have a frank and open conversation with. If I get reliable information from them, they will get reliable information from me. So, in that way, thanks to information, it will be harder to fool me. (CDD2)*

Again this ability to negotiate better deals does require some marketing experience, time and skill, and material resources (like owning means of transportation or an on-farm weigh beam). Furthermore, as just as we observed for input purchases, a minimum of financial liquidity is needed to be able to refuse and compare offers from different traders.

> *I think our strength, and I am not saying that to boast, but I think a person who needs cash immediately, is going to more easily give in on price. Me, I can wait a week or so. Take a fortnight, and they call back themselves, and propose to give a little more.* […] *We can keep our legs stiff.* […] *It is certainly no bragging, because things are going badly in agriculture, it is true, people who don't have any financial margin, I would not like to be in their shoes. (CND10)*

Another way to alleviate the power imbalances in the wholesale chain is to produce and market products of a rare quality which supermarkets and food manufacturers' value. The different structure of these markets allows the farmer to

negotiate better terms of trade. We also see a number of farmers looking for or having more fixed relationship with particular processers or supermarkets, by producing beef by standards set by private labels, or mutually agreed upon terms, and such are able to carve out a niche for themselves. We note, however, that the common agreements offered by the companies double down on the Belgian Blue as a breed choice and the use of expensive, sometimes even company-specific feeds.

> *People like us, we work on a label, so the traders know about the feed of the animals, and you stick a bit to the same buyer, and that results in somewhat higher prices, there is some difference, a better margin,* […] *Those people come here to have a look, what you feeds you give, from what companies, and you can follow up everything here, an identification book, so those people see that it is also being followed up, (CND10)*

Such arrangements for differentiated products associated with a price premium, doesn't necessarily impose input-intensive production methods on farmers, but may well define new commodity markets, favoring more agro-ecologically sound agricultural practices. Such is for the case for certified organic products have specifications which limit the use of chemical pesticides and artificial fertilizers. For organic beef, however, such value-chains didn't appear to be developed by the larger companies. If they do, however, a possible concern raised by an organic farmer producing vegetables for wholesale could become relevant, namely that these advantageous commercial arrangements could be destabilized by the entry of other farmers into these markets.

> [In] *niche markets with few players, we still have something to say, but the moment there would be an oversupply, all that could change at some point, and I fear that a bit. Then we are in the same boat again almost* […] *Up until today it has been generally quite good, so I think that pricing is reasonably good, but I think it is quite important that it can stay that way. And there is a threat, because nowadays there are quite a few new farmers coming up, organic farmers, not so much here, but that can sometimes put too much on the market and then we have a product that we have to get rid of, but well, that's characteristic of the market. (OND1)*

Farmers also frequently note, that instead of selling life cattle to traders, meat processing companies, there is also the possibility to pay for the slaughtering of the cattle in the slaughterhouse and have arrangements made with a local butcher, a local restaurant or supermarket or a specialty shop to buy the carcass. Nonetheless, it does require some more co-ordination on their part, and gives them less flexibility regarding product quality and timing than the sale to a trader would permit.

> *It sometimes happens that I sell some cows to the local butcher, which is also a form of a short chain, but that is not so easy, you actually have to be quite large as a farm to get a cow ready to deliver to a butcher every week. It actually has to be done every week, so that means fattening fifty cattle every year, and then on a weekly basis. That is impossible, but what I would like is that we could deliver once a month at the butcher's, now it is approximately every 2 to 3 months. (CND1)*

It must all be done very correctly, we can't bring an animal that is on the meager side, and the same goes for pigs too, we really have to deliver quality, but the advantage is that we have our money right away. (CND2)

The reasons such commercial partners would agree to do so, however, is because they can after processing it, re-sell at a higher price, because of the particular characteristics and imagery associated with the product, that they can communicate to their customers.

[The owners of the specialty store] *bring the story around the product. we also have a local butcher here, he also bought one here from us at the time around 2012 or '13, and he also told the story a bit, but you see, there is not really demand around here. People buying steaks at the local butcher's, they don't seem to bother whether it is a Belgian Blue or a West Flemish or any other breed, for them a steak is a steak. But those butchers who do tell the story about the farm and the animals, and who have clients who like to differentiate and taste the difference, sure, it's clear, but they have the clientele. (CNS2)*

Farmers note that butchers may not always be the most dependable business partners too, as they also confront farmers with lower prices the larger meat companies' offer, allowing them to get away with a lower price, and capturing most of the price premium connected with their product.

Sure, the butcher sometimes does more, he will put you in a magazine - like folder with pictures of the animals, grass, corn, fodder beet, a lot of own roughage -, and actually, he exploits that image commercially, […] *of course, they are crafty tradesmen too, and if a farmer turns up there with a carcass he can get at a cheaper price, he will sometimes process that too, under the same image. Well that bothers me enormously, as he misuses my name*

Such initiatives can also take place on a larger scale, where local farmers create a label for local products, which local retailers may agree to use in their marketing efforts in exchange for a better price. Such arrangements again are however not without similar controversies found at a smaller scale. Another more confrontational strategy to counter the power imbalances is to organize producers and decide to collectively limit production. However, just as was the case with organizing group purchases, many of these initiatives have failed, because of opportunistic behavior of individual farmers to secure a sale on their own.

[Cooperation with fellow farmers] *could be a strength of the farmer, but that doesn't work, you can't get them together. It's impossible, I've tried that. A supply management system for potatoes, I gave eleven meetings touring through Flanders, and even four in Wallonia, to get farmers together, and then agree on something, we are going to plant a little less. Because in the States, there is the United Potato Growers, they do that, they all grow ten percent less,* […] *on a voluntary basis, so that the potato price can go up again. But yes, you less, I less, and then there is one in the bunch that thinks: let them do, then I shall produce for myself an extra. - One hectare extra - one hectare, no directly one hundred hectares. Yes that is real, I am seriously disappointed with those farmers. (OND1)*

From this subsection, we take away that farmers can influence the terms of trade for life cattle by either negotiating individually or collectively. We noted, however again a number of limitations, arising from the impersonal relations defining the market system generally, namely farmers inability to process and sell large quantities themselves, compelling them to accept disadvantageous prices at some point, the competition between farmers resulting in an inability to negotiate higher prices, on a collective or individual basis (Figure 28).

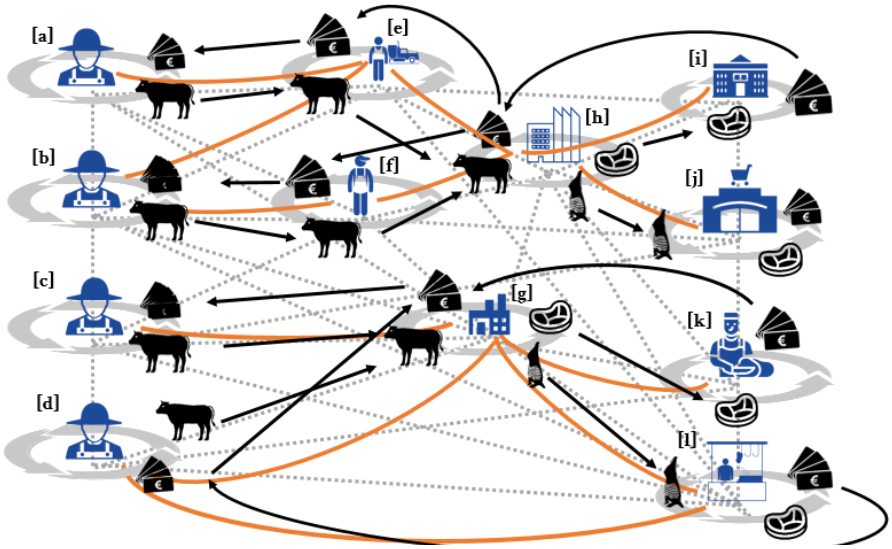

Figure 28 Diagrammatic representation of personal (orange full lines), and impersonal social relations (grey dashed lines) underlying some of economic arrangements discussed in this section between whole selling farmers [a, b, c, and d], cattle traders [e, f], slaughterhouse and meat processers [g and h], supermarkets [i and j], and butchers [k and l]. [a] represents a farmer selling their fattened cattle to one trader only,[b] represents a farmer supplying two cattle traders, [c] represents a farmer transporting and selling cattle directly to a meat processer, and [d] represents a farmer who made an arrangement with a local butcher to cut up and the carcass and sell the meat from a locally produced (premium) cow

7.3.3.2. Selling beef

Most organic and direct-selling farmers subscribe to the view that power imbalances in the whole chain make it impossible to get a fair price for their product, and that they therefore don't sell life cattle. They account to operate in a much more favorable price environment compared to wholesale, because they argue that they set the prices of their products to their own costs, rather than being dependent on the vagaries of the market, or being at the mercy of the industry.

Because of our direct sales here, we are not dependent on supermarkets and wholesalers who put pressure on those prices and everything. That has been one of the reasons why we started home sales. Also to no longer be dependent on anyone. We determine our price ourselves. (CDS2)

Dependence on sales partners. That is why I am in the short chain. If you are dependent on the auction, you are cheated, as a small company […] *They let you down, I once had to plow an entire hectare of savoy cabbages because they did not purchase. You do not like to do that. Plow under a clean product that you weren't able to find a customer for... (ODD5)*

However, their choice for direct selling appears also motivated by a recognition that while some farmers may be in a position to make a living by producing for wholesale, they were not, due to a lack of access to land.

I think the fact that we started selling at home is a bit of a guarantee that we can survive, because if you have to keep farming at the going prices it is very difficult. So I do think that's one of the ways to survive, let's put it this way. […] *If we didn't have that processing, we would have to grow much bigger in order to survive. And it's already hard to get hold of land, so we dealt with it that way. (CDS2)*

Short-chain marketing farmers, however, also give other reasons for being engaged in these initiatives. Others, however cite the joy and satisfaction they get from meeting customers.

Saturday is a great day for me, because I'm getting response, like, that is a good product, or that is a little less, or don't you have that or that. I think that is important. and also yes, just social contact, you know, if you have a small business, and work alone, these are quite lonely days, you leave home in the morning, you say goodbye to your wife, and in the evening you are back and you ask "hey how was your day", and there are days when you haven't seen a person […] *while if I have to drop off all that stuff at the wholesaler, then I don't even know if it's going to be eaten, right? (ODD5)*

But importantly, it allows them to produce in a way that is in accord with their own values, as it is only through direct selling that they can have margins which make it possible to a hold a different breed, produce without pesticides, or without imported feeds from abroad. Yet, the other dynamic may equally be true, as it are the expectations of the customers that provided the incentive to for instance diversify productions, or experiment with an alternative crop variety.

Because we are in direct sales, it is important that we have as many different crops and vegetables from our own cultivation as possible, because the customers find that important. And so we now have a varied range of both meat and vegetables from our own cultivation. (ODD8)

That hassle with all those customers, sometimes it is just nice that you can concentrate on just being a farmer, finishing your product nicely and putting it in the fridge and a truck will come off, or you bring it yourself. (ODD6)

While direct selling appears to offer viable options to farmers with little available land, there are, however important demands on time, skills and resources to set up such a system, which may explain why not every farmer has switched to selling beef to customers. Moreover, based on the comments of farmers we find that these direct selling activities are not free from some of the social antagonisms we observed in the whole-sale chain, which raise doubts about whether such initiatives could indeed become the rule rather than the exception to the marketing of beef in Flanders.

The first challenge is finding a way to organize processing the product without mainstream processing companies. This ability of farmers to process their product themselves depends on commodity-specific legal and technical, training and skills, labor and investment requirements to set up such a processing unit. For fresh vegetables in relatively small amounts, this is relatively easy; for meat however, this appears to be a high bar for the relatively small meat processers that cattle farmers would be.

> *you also have to comply with everything, I don't know, but I think that those supermarkets make the laws, and now for the little men who have to follow and they cannot do that, yesterday been busy all day with what they call it again, damn it, every product must have a Sanitel* [Belgian food safety and tracing system] *sheet telling the contents, the allergens, in our case, what should we do with it, we need to contact a company that has a software to do that, which covers all products and then we can work again, but it costs thirty or forty euros a month again. (CDS1)*

And as a result many farmers resort to working together with a local butcher who packs their meat, rather than opening up a butchery of their own. The second practical challenge for direct selling is to organize the marketing activities, such making publicity, being involved in social media, making a sales pitch to potential customers in person, and setting up a system to complete the actual sale and distribution of the product. All of this is needed to secure and expand a customer base, which is willing to accept these presumably more fair prices, and moreover willing to come over to selling point.

> *Short chain, that's for a salesman and I am not a salesperson, then I have to build a shop and yes I already have a lot of investments and yes, you cannot do everything, can you? I think that's okay, but I didn't study before that. I studied agriculture. Otherwise I should have studied to become a butcher (CND12)*

> *So we have a short chain that we work on from continuously appealing to people through the newsletter because there are always many leaving again, you have to constantly recruit new customers. (ODD3)*

> *You have to see your animals every day, but that is also difficult because if you are dealing with markets and processing, clearly there is less time for that and you feel that in your management, then that is a frustrating factor, that you have less time for you animals. (ODD11)*

However, they are also required to produce in such a way that it convinces people to come over to farms and farmers' markets, rather than going to the supermarkets. After all, they too, are limited by their own budgets and time, and decide based on the information available to them whether their support for these alternative farmers is worth it. Yet, it appears that in Flanders there are such customers who indeed are willing to go through these efforts and also are willing to pay more for a product to farmers because it is locally produced, with few or little pesticides and fertilizers, it is of a different breed or variety. This dynamics provides the opportunity but also drives farmers to produce commodities providing a different use-value to customers than what is at offer in the supermarkets or the local butcheries.

> *well* [the presence of biodiversity] *is part of our image really* […] *yes that's our image, those cows walk in a natural reserve, we have natural meat, for us that is important of course, that is clear, that is our name.* […] *we also bet on customers who are interested in luxury products, so we bet on people who really want to eat a nice piece of meat that deserves its price, we also know that people no longer want a steak of two kilos, people want a small piece of meat that has a good taste, that is good, they eat less, but the quality must be excellent and then they also want to pay a little more for it, and we respond to that. (CDD5)*

> *You must have a different product. We have crossbreeding, between Holstein and Belgian Blue, that is a totally different kind of meat, and the people who come and say, you can't buy the same product anywhere else. That's "bingo!", because they will always come back, as you can't find that in the supermarket. And so we have many people who come exclusively to us for their meat (ODS1)*

As discussed in section 7.4.3.4, the support of customers may even extend beyond regularly buying a farmer's products at a price that allows the farm to continue to develop, such as offering land use rights to these farmers, helping out here and there on the farm or organize activities or paying for products in advance, or even taking a financial share in the farm, allowing the farmer the farmer to extend his/her resource base, and transferring some of the inevitable risks of production to their customers. Consequently the renewed relationship with customers enables these farmers to pursue agroecological principles, as these happen to be in line with the values of customers with some resources and time in the neighborhood. Moreover, gifts and shares to finance such initiatives may also come from citizens supportive who are supporters of the farm, even if they don't get any products from them.

There does appear to be a definite limit to the amount of money farmers may ask for their products, however, given that there seems to be a limited amount of customers that have an appetite for this more alternative beef, and beef generally, and a limit to the amount they wish to spend on those products. One farmer for instance, observes that her customers too are in fact under very similar structural constraints as farmers are:

> *That [income] is actually important for everyone, because for that some principles are thrown overboard, that's what's happening. We see for example people from the*

> *Voedselteams* [local food distribution network], *who come every Friday, they get organic vegetable packages that arrive here on Friday, and that is in curver boxes that is fifteen euros a box, and people trying to buy strictly organic … but then after a while, they see in* [the neighboring city*] on the conventional farmers' market they can have a vegetable package for three euros, so…* […] *for the money many principles are thrown overboard, not only with us, but actually with the consumers too. (CDD1)*

In other words, farmers note that even loyal customers are not immune to the attractions of lower prices offered by other direct selling farmers, or local butchers, as well as the convenience offered by supermarkets, even if their products don't provide the same unity as those offered by farmers. So while direct selling may provide them with the possibility of offering their product at any price they want, in reality direct selling farmers discover that they too are forced to take into account the marketing behavior of their competitors to secure sales.

> *We are now going to become organic certified, but you cannot afford to suddenly tell your customers: "we now have the label, so now it's two euros more for a kilo". there are going to be a lot of people saying: "that meat is not better". So, we have to be vigilant about that, (ODS1)*

> *Nowadays short chain is popular and everyone is trying to do that in a way. And the demand is increasing, but I have the feeling that we always have to compete with each other a bit. So we came up with vegetable packages, and then an initiative starts in* [nearby city] *that does self-picking, then our packages reduce, and then we start with the* [collective market initiative in the city], *then our subscriptions for packages reduce, because those customers come to the* [city market]. […] *you also have to find your place in the short-chain story (ODD6)*

> *I can't set my price much higher than anyone else. I don't really determine the price in direct sales either. Because I can say that cauliflower must cost so much to me, but if it only costs half as much at the neighbor's, so I do not set the price, it is important but I cannot control it.* (ODD5)

According to some farmers, direct selling farmers are perceived by supermarkets and the meat packing industry as a competitive threat, and as a result they engage in marketing campaigns to protect their customer base, by for instance by offering temporarily extremely low prices, in an attempt to squeeze direct selling farmers.

> *The people we try to do without also feel threatened, so if I try to get rid of my cattle trader, he will also try to* [oppose] *us, because they lose their income,* [...] *the supermarkets too, that will say a kilo minced meat, the second extra. They will try to lure our customers away, telling the customers that we are way too expensive. Sure they can give meat away, we can't. That meat is only part of the whole business, so they can say we are going to compete those farmers to pieces, that's what they will do. (CDD5)*

This social reality of competition moreover explains a number of antagonistic behaviors we've witnessed between direct selling farmers and other meat distributers, hampering the sharing of resources and information. Farmers, note for instance that they have experienced difficulties in establishing a friendly relation with butchers they

work together with for packing their meat, as butchers see these direct selling farmers as direct competitors. This may force them to find a butcher from further away.

> *The road that we take, we will no longer be able to combine with the sale to the butcher* [in our town], *because he is going to be mad, he will say boys, you are picking in on my customers. But you shouldn't look back, and be a bit more assertive, and above all be proud of the product you can deliver. (CDD2)*

In a similar vein, we find that direct selling farmers at times refuse to help each other out, as they perceive each other as competitors for the same customers. While generally speaking, we find organic farmers regularly working together even in marketing, there are clear signs that perceived competition for costumers may put a strain on collaborations among organic farmers for knowledge exchanging, sharing transport and investments and may even lead to active boycotts to protect their market from newcomers

> [I exchange knowledge] *less and less with colleagues. That's also because I used to give agricultural advice, and I was advising everyone but nothing ever came back. So then I also stop sharing information.* […] *I will more easily tell a bit more to a farmer from further away. But not in the area. I once told a guy who came to me to buy meat in detail how we all managed and processed, and today he does the same with the farm he started. So I actually taught him how to do it, and he used it against me, so I don't do that anymore.* (ODD3)

> *There used to be a few beef cattle organic farmers in the area, they are still there. I got in conflict with them. If you ask them, they might give a different explanation, but they tried to ruin my business. Probably because they didn't want any competition, but of course they won't say that* […] *They were fishing in a nice pond, I think, a pond that was very large with relatively few fishermen. And then another fisherman joined and the pond didn't get significantly bigger as they expected and that was a problem so let's drive him away.* […] *Yes, I can understand their feelings to a certain extent, but they played it dirty.* […] *And they also were badmouthing me to their customers: "that's bad meat, no good and you shouldn't go there" and all that.* (ODDX)

Furthermore, we find that organic farmers indeed believe that their products are to some extent substitutable in the eyes of their customers for conventional products. This threatens their customer base, which helps to explain why organic farmers make sure that the differences between organic farming and conventional farmers are guarded and underlined.

> *Why is it that people buy from me? What is the added value? Why am I doing this? And why don't I buy at the department store? Why is that farmer important and why do I make the effort to go to that farmer. You should be able to know that clearly. I don't know, only those people are so gullible, only I don't understand that well. But those are actually the farmers who deliver the bulk of their products to the department stores, indirectly, and then a bit on a farm, and then make people happy with it. I think that doesn't work in the long run. In time, their story will take water and customers will understand, "this is not real, this will stop".* (ODD6)

While there is more to the opposition of many of the interviewed organic farmers to the use of (bio-)pesticides and organic fertilizers, than simply economic motives, one farmer readily admits that conventionalization of organic vegetable farming would make it harder for them to capture the price premium customers are willing to pay for their products

> *I really want to avoid using those* [bio pesticides]. *I used to go to school in the Netherlands at the organic agricultural school, there in the polder in those large plots they simply used bt, that is bacillus* [thuringiensis], *that is a bacterium that can be used in the cabbages. At the time I didn't reflect about that, "why not?" But now I see the sector evolving, new farmers who switch over who are not so idealistic, but are more like, "Ah, organic farming, that looks like an interesting opportunity for my company" and then just look, "okay, what am I allowed to do" That's actually a bit of conventional farming, but then in an organic way. And so gradually dilute… Organic has been very clear so far and I wouldn't go to the consumer, it has to remain clear and I don't want those boundaries to blur, or copper use and things like that, for the consumer that can't be clear. (ODD6)*

Direct selling farmers are quite aware of the limitations of these alternative market-based arrangements that we have identified in this section. And they readily admit that they are still confronted with the limits of these business models to put agroecology into practice in this context, despite their efforts. While overall, they believe that their situation is fairer than in the whole-sale chain, even with direct selling it still is a hard way to make a living.

> *Even though we are a cooperative, and all those customers behind us, and our own pricing, it remains agriculture and you really have to engage with it, it's not that you can say that I work from eight to five and then you go home, so you have to do yourself a bit, in any case you are self-employed, and the wages are not too fat,* […] *we now ask one euro for a head of lettuce, for the shop that is one euro sixty, and then I see colleagues who drop it off at a wholesaler for sixty seventy eighty cents, because they want to get rid of it, we ask for an euro because we say we have to earn so much, but actually that is still not that we earn very much, but we sure cannot two euros for our lettuce, because then we will not get it sold, if I had to calculate my hours then we should have asked for two euros (ODD6)*

> *Of course that is not quite the case yet, we are working towards that. But if you see how many hours we have to work for which wages, then the burdens and benefits are not always in balance. So fair trade aspects, fair pricing, compared to conventional agriculture, we score well on this, but in proportion that is still far too low.* […] *The burdens and benefits are absolutely not equitably distributed at the moment, while we would prefer that, but that is a social problem that we cannot solve alone.* […] *The problem is that when it comes to agro-ecology and organic farming, we are actually quite advanced and have improved a lot in recent decades in techniques, but in terms of the economic model nothing changes, we are still working in a model invented in the 70s, hardly any changes have been made to it, it is not evolving sufficiently. And the agro-ecological movement is not picking this up as much as it should. They speak of a*

social movement, but those economic aspects and business models, for example, are rarely looked at. (ODD8)

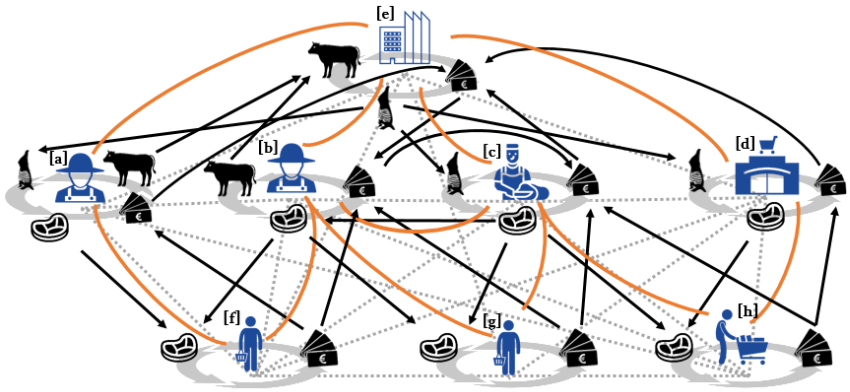

Figure 29 Diagrammatic representation of the personal (orange full line), and impersonal (grey dashed line) social relations underlying the marketing behavior of two direct selling farmers, one processing the carcass on the farm [a], the other [b] working together with a butcher [c], and a neighboring supermarket [d]. They all depend on a slaughterhouse [e] to process life cattle into carcasses.

To summarize this section, we found that the direct selling marketing model may allow smallholders to continue farming, and even opens up the space to engage in practices more in line with agroecological principles, because of the existence a customer base willing to pay for such products. Still, due to the competitive behavior of farmers, supermarkets, butcheries, this room for maneuver is squeezed as customers too are not indifferent to lower prices for comparable products. The fragility and failure of these alternative market arrangements to guarantee good living standards for the actors involves, can thus be explained by the fact that these actors still have the right to abstain from selling or buying and seek a better trade elsewhere. They are also compelled to do so because of their own social position that limits the resources they have access to. We thus observe here again an interaction between the system of impersonal relations and the establishment of farmer and agroecology-friendly systems of personal relations (Figure 29).

7.4. Discussion

7.4.1. Market dependence and agroecology on Flemish beef farms

As our framework outlines and we indeed found empirically in this context, the constitutive rules of markets (private property and contract law) define to a great extent the resources farmers have access to, and hence the room for maneuver that they have to pursue agroecological principles. Yet, even though these rules and the

impersonal relations between actors they give rise to are social-historically specific, farmers present them as an uncontestable state of affairs, and reproduce these rather uncritically through their productive activities. Moreover, as farmers perceive the social condition that these relations impose on them to farm, namely continued income generation, as one beyond their control, it serves for the interviewed beef farmers as a sufficient justification to compromise on agroecological principles, even though some farmers would wish it were otherwise.

Importantly, however, we found that the specific social position these farmers occupy within this social system is shaped by farmers' actions, as farmers mobilize the resources available to them to actively negotiate and change their social position vis-à-vis other actors, in terms of acquiring more or different kinds of resources, and by establishing personal relations with these actors. Owners of commodities are "free" to consume, invest, or sell their property for buying new goods and services as they please (though use and trading rights are not absolute). As such the very nature of this social system empowers farmers to break out or change commercial relationships they deem undesirable. Paradoxically then, this system of impersonal relations between commodity owners is both a limitation to put agroecology into practice, but also as the very condition for these individual farmers to pursue principles to some extent if they so desire as it is a prerequisite for their freedom of decision. Furthermore, this concern for economic security doesn't condemn farmers to exhibit income maximizing behavior. We noticed that farmers may sacrifice some of their resources and time to pursue other goals than income generation, and none of the farmers we interviewed said they took up farming to get rich quickly. Quite on the contrary, if they did, they would have chosen to spend their resources and efforts elsewhere. The limitations of this freedom are, however, evident: farmers are not free to pick and choose a production model, as they are constrained by their own material conditions, which they partly inherited and created through past actions, but also by the expectations of potential commercial partners who are under similar structural constraints within this same social system. The high land prices in this region are a quite objective barrier which denies most sections of the Flemish population to take up (beef) farming as agricultural commodity producers, even if they have the desire and skill to do so. Moreover, even quite resourceful farmers still are forced on bank loans, state subsidies, and hence work within the constraints of other economic actors' expectations.

Our analysis shows that this economic system constituted by these social relations may lock farms out of agroecologically sound agricultural practices, but also that there is a considerable, albeit limited, amount of "air" available that allows or drives farmers to put agroecology into practice. In the next two subsections we will elaborate on both the nature of the lock-in and the limited air in this system, after which we will conclude with a discussion on possible routes of actions forward.

Social Structural Lock-in

The terms on which agri-food companies accept to trade commodities play a great role in determining the agricultural practices of whole-selling farmers. While we observe that farmers have formally the right to refuse these terms, farmers accept to trade on these terms because partnership with wholesale value chain actors allows them to gain an income by producing and marketing high volumes if prices are relatively low, and farmers perceive no realistic or desirable alternatives.

The material interests of the different actors involved in wholesale trading leave their trace on what can acceptably be construed as a quality agricultural product in the wholesale circuit. Though we lack first-hand accounts from input suppliers, traders, butchers, *etc.*, to investigate why and how they are able to influence the terms of trade, the fact that current terms of trade drive increased dependence of farmers on large companies and banks, comes as no surprise, if one analyzes the material interests of these companies, and understands that these also influence the trading behavior of these companies. As actors who own and/or work in upstream economic activities, have made over the years vast investments in both a material and social infrastructure to produce and market agricultural inputs, they have an interest in promoting forms of agriculture that would be highly dependent on their inputs and services. Likewise, the interests of downstream actors lie in promoting forms of agriculture that provide a secure stable flow of widely distributable agricultural commodities, that are cheap to process and distribute, which can either be offered at a cheap price further in the chain, or are of a dependable quality that is easy to communicate to customers (such as “no (chemical) pesticides”, “local specialty”). Moreover, they have an interest in supplanting other commercial competitors such as small-scale butchers and direct selling farmers to ensure an ever greater share of the effective demand for goods and services in Flanders.

The political economic nature of different constructions of product quality is therefore evident. The definitions of these terms is the product of a negotiation with different economic actors (suppliers, processors, retailers, banks, governmental agencies, citizen-consumers) each with its own material interests that do not necessarily align with farmers, and with resources that far exceed those of farmers. Current terms of trade that conventional wholesale farmers accept, drive them (and importantly allow them) to engage in production methods that depend on inputs supplied only by large companies, and on major investments, driving them to accept terms for loans by banks. Indeed, the credit system plays an ambiguous role in the pursuit of agroecological principles in this context. Whereas access to credit may enable farmers to become less dependent on input markets (by for instance acquiring land to grow their own fodder, before they have the savings for them), at the aggregated level, there is an indication that in this intensively farmed and urbanizing region where land is only becoming scarcer, the credit system is also a social structure that accelerates scale-enlargement by farmers, drives up land prices, and thus exerts further pressure on farmers to mechanize, specialize and simplify production systems.

The dependency of farmers' livelihoods on governments and agro-industrial companies limits the scope of practices that can be reasonably employed by them, and hence one can indeed observe that beef production, like other agricultural sectors, has become a "conferred activity", namely that its prospects are mostly reliant upon a range of arrangements between regulators and economic actors distant from farm production itself (Marsden, Munton, Ward, & Whatmore, 1996).

Our analysis of farmer's views also confirms that there is a cultural "lock-in" of Flemish beef systems into intensive production systems (Stassart & Jamar, 2008), as we registered indeed a cultural and cognitive bias of certain conventional beef farmers to accept rather industrialist notions of "good practice" and "quality". However, by linked these notions to material interests of actors involved in the wholesale circuit, we provide a social structural basis for these productivist notions. As material interests are defined by social relations that are continuously reproduced in the economic activities of these actors, including farmers, we thus provide a more profound explanation of the stability of these productivist notions of quality locking many beef farmers into arguably non-agroecological farming practices.

Air in the system?

Nonetheless, even in conventional beef production for wholesale markets, farmers are able to negotiate, depending on their own resources and skills, the terms of trade on an individual basis, although they can't really fundamentally challenge the powerful social position of these companies overall. Collective solutions among farmers (like sharing information or material resources, or by engaging in group purchases) appear an even more potent strategy to do so. However, these are hampered by opportunistic and habit-driven individualistic behavior of individual farmers. Some farmers seek to explain this behavior on psychological or cultural grounds, echoing sociological analyses of non-cooperative behavior by farmers in other contexts. Chiffoleau (2009) for instance highlight that knowledge sharing can be symbolically costly, which leads farmers to prefer to engage in dialog with peers whom they consider to have a similar social status. And Emery (2015) note that the existence of individualist subculture amongst farmers, may lead farmers to prefer and continue their habit of solving their economic problems on their own. Our reading of the data, would, however, also suggest that independently of this psychological reflexes and cultural background which effectively narrow the range of strategies between which farmers are likely to choose, farmers are competitors, as they seek to secure purchases of the same scarce resources such as land, and sales to the same customers. Empirical studies of farmer behavior throughout the world reveal moreover that this individualistic behavior of farmers is not specific to Western farmers (Chibber, 2013; Emery, 2015; Rothmayer, 2016). This suggest that this individualism is rooted - but not determined - by the common material conditions farmers across the world face as commodity producers, which allow and motivate them to act as independent entrepreneurs and find ways to run other farmers out of business. In other words, individualism has institutional roots, and is likely, as Tilzey (2017) also note, a key

component of the material reproduction of capitalist social relations. However, this economic system of independent commodity producers, is flexible enough to allow farmers to build consensual relationships with each other. Some farmers indeed recognize that their material interests may align to some extent, which gives rise to more cooperative attitudes and practices among farmers. As game theorists and evolutionary biologists have known for quite a while (Axelrod & Hamilton, 1981), even self-interested competing individuals may choose rationally to co-operate. It strikes many farmers, however, that agro-food companies in the region have realized that better than the Flemish farmers community. Belgium has, however, also a long history of farmers' cooperatives, starting in the late 19th century (Gijselinckx & Bussels, 2012). A number of these organizations that emerged out of this history are nowadays key players in the Belgian beef supply chain nowadays. These are now however, accused by a number of the interviewed farmers of driving the push to scale enlargement and industrialization. As such we would highlight, as do other authors (De Herde, Baret, & Maréchal, 2020; Lucas, Gasselin, Thomas, & Vaquié, 2014), that there is no bidirectional relationship between farmer cooperatives and agroecology. The improved position of farmers through cooperation may well serve to double down on industrialization and scale-enlargement of the sector at large in order to gain a competitive advantage within world markets, rather than to construct a locally embedded and ecologically integrated food system

We also interviewed farmers who have been able, for a variety of reasons - inheritance, by working elsewhere, through state subsidies, by having access to land and resources owned by other actors, or by carefully building up capital themselves over the years - to accumulate enough skills and resources to produce in a way which is effectively less dependent on loans, on concentrates and chemical inputs, and relies more on local social networks and resources. As such, we have examples of farms clearly representing agroecological business models in this context. The presence of an affluent and concerned customer base in Flanders, to which production risks can be transferred in a CSA-model, or from whom a price premium for quality products can be expected, shows even in historically intensively farmed regions such as Flanders, business models that count on the value-added of their products are possible which indeed are more attuned to agroecological principles. Many agroecologists have drawn from this the conclusion that a wide-scale construction of market environments friendly to agroecology from the bottom up, is feasible, or would be if encouraged by government policies which allow for the establishment of agroecological systems even in highly urbanized and intensively farmed regions (FAO & INRA, 2018; Karl Falkenberg, 2016; Mier y Terán *et al.*, 2018).

As far as the bottom-up aspect of the construction of alternative food networks is concerned, we are skeptical this is can be the case, as our analysis reveals many mainstreaming influences that undermine the unbridled replication and even their continued reproduction (David Goodman *et al.*, 2011). What our analysis suggest, however, is that these destabilizing mechanisms are endogenous to alternative market

food networks, namely they arise from the interplay of the impersonal and personal social relations out of which they are constituted and which connect them with "not so alternative" market networks. This can help explain why agroecology-friendly market environments, despite decades of grassroots efforts, have failed to become the norm. As these alternative market-based food initiatives do not upend the dependency of farmers or consumers on markets, farmers and consumers remain stuck in what remain essentially the same antagonistic yet co-dependent buyer-seller relationships as in other market environments. The terms of trade for local organic beef sold at the farm are not independent from the prices offered by his colleague a few kilometers away, nor from the prices for certified organic steak in the supermarket, nor from the prices for conventional Belgian Blue steak in the same fridge as well as for the steaks produced and imported from Ireland and Argentina. Other actors too, the customers and citizens supporting local direct selling farmers, but also supermarkets, butchers and investors, face qualitatively similar structural constraints, which forces these actors, even if they have the best intentions, to comply with the logic this system imposes on them. Moreover, in so doing they reproduce their own chains, figuratively and literally speaking.

The constitution of these alternative food networks that are more favorable to agroecological production methods, are also continuously undermined by the competitive dynamics from actors apparently within these networks. We noted for instance the unwillingness of some organic farmers to co-operate and share resources with each other in fear of losing customers. This leads either to a failure to co-operate and trade, or to disputes undermining the trust and thus direct social coordination of production among farmers through reciprocal and redistributive arrangements. In our study, farmers indicate that there also have arisen disputes with downstream partners on which they rely on to process and distribute their product, over the distribution of the price premium that can be gained from selling food of an alternative quality. Just as more specialized empirical analyses have shown (Blättel-Mink, Boddenberg, Gunkel, Schmitz, & Vaessen, 2017), we also highlight that despite the relative ability to do without certain inputs or source them through non-market channels (cheap deals, or outright gifts by customers, and subsidies from the state), they still have to trade with non-alternative actors for all kinds of commodities that cannot be reasonably produced at a small-scale (machinery, tools, building materials, *etc.*). Most significantly, they have to be able to compete with the offers of other farmers for the scarce land in the region. Whereas some of these initiatives have certainly been able to call on the good-will and resources of their customers, charity has its limits, as these customers also rely mostly on the sale of their labor power (wages) to sustain their livelihoods, hence make comprises if their economic situation compels them to buy cheaper food elsewhere. Historically, such mechanisms based on social motives have proven to be the downfall of small-scale communal systems globally, and are likely to impede the spreading of these initiatives.

As these farmers moreover come to depend on the alternativeness of their product to socially reproduce, we traced empirically an exclusionary dynamic, namely direct selling farmers seeking to draw up entry-barriers to preserve their privileged position in the market. Marsden's observation (1999) that "alternativeness" may become a component of value and therefore a commodity to protect and exploit to protect the interests of particular producers and consumers, rather than becoming the standard for all, rings clearly in this context. Rather than the conventionalization of organic beef farming in this context, we spot instead a tendency towards "radicalization of the niche" as a business strategy among these farmers. From a food system transition perspective, this move allows these farmers to continue to play the role of pioneers and exert pressure on the more mainstream understandings of what constitutes quality food and good agricultural practices (von Oelreich & Milestad, 2016). As such, they can continue to be part of a broader political project to move food systems towards the agroecological ideal. However, because these farming systems rely on their image of being on the fringe for their own social reproduction, this hinders by definition their unbridled replication. 'Alternativeness' is framed in such a way that it makes it very costly or impossible for larger farmers and large-scale distributers to co-opt. The competition for the spending of customers with a limited appetite and purse, puts 'alternative' and 'not so alternative' marketers at loggerheads in a continuous marketing war over what constitutes "quality food". The focus on valorization of alternativeness also has the effect of doubling down on their marketing efforts, rather than challenging the idea that food should be treated as a commodity, let alone the fact that it is. The spreading of such alternative initiatives is however likely to be more and more contested as "alternative" and not so "alternative" direct selling battle it out on what constitutes food quality (David Goodman *et al.*, 2011). The strong competition for land and the lower access to credit leads to a structural disadvantage of small-scale low-input beef production systems in Flanders. Given the resources actors with an interest in promoting intensive production in Flanders have access to, and these actors include many beef farmers, it is unlikely that low-input beef production and associated notions of quality will replace the mainstream notions. However, given that the notion of alternative can never be fully appropriated by large-scale food manufacturers and distributers, it is likely that the conditions to produce and market beef in an alternative way will remain there. Hence, it is more than likely that these different notions of quality will continue to coexist rather than coalesce around a shared notion of quality. Given the balance of power, notions compatible with large-scale production and distribution will remain the most consequential however for most beef farmers.

Arrangements with governmental bodies and independent nature organizations, but also subsidies for organic farming and agro-environmental measures regularly come up as crucial mechanism through which even resource poor farmers succeed in taking up farming in an agroecological way. Conventional farmers too also frequently note the important role various CAP subsidies in sustaining them economically, and because of the requirements tied to these subsidies take up arguably more

agroecological agricultural practices. Governmental policy is extremely complex, however, and there are multiple ways that the policy environment may in fact motivate less agroecological behavior, for instance by disproportionately subsidizing larger farmers indirectly denying smaller farmers to acquire land, and restrictions in the use of on-farm manure resulting in more fertilizer usage. As the policy environment wasn't systematically discussed with farmers in the interviews, it is, however, impossible for us to make an in-depth assessment of the influence of policy on agroecological behavior. Of potential interest to such a further investigation, however, is that our exploration of the presented framework revealed there to be both economic and cultural drivers to subsidy uptake. The personal relationship between various governmental bodies and the farmer, which is constituted by their agreement to accept subsidies in exchange for fulfilling the requirements of the scheme, mediates the access to resources farmers have in addition to private property relations. As such farmers come to understand their participation in these mostly voluntary state support programs as a trade-off between alleviating their need for cash, and limiting their production choices. In many instances, these schemes have motivated to farmers to pursue agroecological principles, with some of the interviewed farmers seeing these as an economic opportunity, whereas others see it as being forced into by economic necessity. The social stigma that is apparently attached to taking subsidies in the farmer communities, and the fear of being so dependent on the government also appears to play a role in farmers understanding of these objective social relations. In the context of a "state-led" agroecological transition we would offer this certainly as an issue worth exploring further in research,

7.4.2. Reflections on market dependence and agroecological theory

Market dependence of farmers has been central in many political agroecological characterizations of farm diversity. We observe, however, that market dependence is most commonly understood in agroecological literature as a *relative* inability of farmers to participate in reproduce themselves as farmers without buying goods and services. This narrow view on market dependence, advanced most notably by Van der Ploeg (1990, p. 262-268), focuses therefore on both the wish and ability of farmers to abstain from market exchange. This understanding of market dependence is fruitful, as it allows categorize farmers based on their choice or desire to become independent from markets ('the peasant way') or rather to deepen their market dependence ('the entrepreneurial way'). Our own analysis also confirms that agroecologists are right in focusing on this aspect of market dependence. Indeed, also in this context, we found that the *intensification of commodification* (*cfr.* Bernstein 1977) clearly is associated, with severe technical changes in production, and also in the way the actual room for maneuver to put agroecological principles is perceived. And it also goes together with a market restructuring of commercial networks, and hence power relations within the food chain.

We present a view that understands market dependence as an immanent social condition of the contemporary economic system which all farmers are embedded in What our framework thus brings to the attention, is that the perceptions and material conditions of farmers are socially mediated by market dependence in a much more general but very significant way. That is that all these farmers, independent of their specific commercial networks, their views and aspirations, face a similar objective reality: the need to obtain means of payments by selling their products or services in order to remain active in agricultural production. By formulating this social condition moreover as structured by the constitutive cultural rules of the market, and as objective social property relations between individuals, we were able to understand market dependence of farmers as a necessary part of farmers' social life emanating from the economic system that farmers are born in and are compelled to participate in by habit and by economic necessity. Our understanding of market dependence of farmer livelihoods is therefore more comprehensive, as it not only focuses on the relative ability and willingness of individual farmers to fulfill most of their needs without markets, but also on the fact that a similar logic is imposed on agricultural production that is beyond the control of the farmer, once monetization of at least some aspects of the reproductive cycle of a farming household, becomes practically unavoidable for farmers, We thus draw attention to the historical specificity of this way of organizing agricultural production, and denaturalize it, by observing how it is socially constructed, which is a critical step in changing this situation.

To use a metaphor: Imagine a group of hikers that fell into a wild mountain river, after the bride underneath them collapsed. After some time, we find them considerably further downstream, though also very much dispersed along the river. Now say, we are asked to explain why these hikers are so far from the trail, albeit to different degrees. Certainly, it would be worthwhile to consider the different characteristics and trajectories of these individual hikers: some may have taken swimming classes in the past, some may believe they had to swim back where they fell in, whereas others might believe it is better to float with the stream, and an one may have been so unfortunate of hitting a rock along the way. However, we instead preferred to focus first on the river's pull, as this seemed to be a factor constraining all these hikers movement. Now, if we are then asked how these people should move upstream, rather than pointing to the group of hikers bravely swimming against the current, we'd suggest they all need to get out of the water and walk instead.

This conception of market dependence emphasizes thus first that capitalist dynamics don't stop at the farm gate, however bravely a farmer may try to remain independent from markets. From this perspective, it is deeply problematic to present such farmers as outside of this system. As Vivek Chibber (2013, p. 101-129). argues not all elements of social reproduction need to be commodified for capitalist social relations to be operative, and it may in fact generate many varieties of power relations, including interpersonal domination, other than a capitalist class owning all the means of production exploiting a working class having only their labor power to sell. The

universalization of capitalism doesn't require the erasure of all pre-capitalist forms of life, nor the commodification of all aspects of human life. Only those forms and aspects that are an obstacle to its continued reproduction Family farming is indeed a unit of social reproduction in which the access to the means of production is not mediated through a capitalist. Yet, it is an absolute mistake to see this as a non-capitalist form of production in current society, or for that matter by definition a form a form of resistance against capitalism, as we find proponents of "repeasantization" doing (Calvário, 2017; Gliessman, 2014; van der Ploeg, 2010b). Such a view could easily be repudiated by the just as problematic and functionalistic view that family farming remains significant because it is a politically expedient way to produce cheap food without having to directly suppress labor conditions (Griffin, Rahman, & Ickowitz, 2002).

By insisting on the significance of a plurality and heterogeneity of economic forms co-habiting with capitalism, we find that proponents of the "peasant way", replicate some of the dualistic thinking of structural Marxism, that ironically Friedmann and Mcmichael (Friedmann & Mcmichael, 1989), were wont to break with in the first place (Tilzey, 2019). Namely the idea that workers - as opposed to capitalists - stand outside of capitalism, while they are in fact very much part of this system including their struggle for higher wages and better working conditions. Supporters of food sovereignty indeed tend to frame the existence of long-standing relationships between large international corporations and states, the neoliberal food regime" as a top-down and systemic entity that constrains and subordinates the peasantry, yet remains external to the inner dynamics of the latter's existence In turn, 'the peasantry' is conceived as a unitary concept constructed in opposition to capital, the agent that will shape alternatives to the corporate food regime (Henderson, 2018). While we appreciate that political theorists sympathetic to the agroecological movement seek to integrate the insights of critical political economy (De Schutter, 2019; Gliessman, Friedmann, & Howard, 2019; van der Ploeg, 2020), we would draw attention to the fact that that Marx did not set out in *Kapital* (Marx, 1867) to critique particular individuals or organizations in a capitalist society, but rather the social forms that productions relations take in capitalist society (abstract social labor, capital, land, money capital), that particular individuals (the wage worker, the capitalist, the landlord, the banker, respectively) for contingent reasons happen to personify because of their social position in the capitalist system. As such it fundamentally demands from agroecologists a shift from critiquing actions and ideas of specific actors to the critique of the social forms of capitalism and the structural imperatives that it imposes on people, which do appear to be beyond the apparent control of individual economic actors or even the national state. By virtue of our concept of impersonal social relations, we come to appreciate that power under capitalism, once it is established, is primarily exerted, 'economically', not politically - though it fundamentally relies on the state upholding property rights (Tilzey, 2019), and thus comes to take a form of domination with no apparent determinate locus that can't be capture in adequately in terms of political confrontations between (Postone, 2017). Nonetheless, this abstract

form of social domination greatly constrains what and how goods and services tend to be produced and distributed, and also the types of trades and cooperation that actors will tend to accept. The existence of such a economic system with such powers allows us to explain why certain personal social relations between actors came in to being, why some of these may have given rise to perceived exploitative or beneficial terms of trade for farmers, and importantly, why they came into existence in the first place.

Political agroecology, on the other hand sees power in contemporary food systems mostly as one exercised from one group of people over another, who may then organize to resist it. It therefore echoes a traditional Marxist interpretive framework in social domination is understood primarily in terms of class domination and exploitation (Postone, 2017). Our analysis reveals this theorization of power to be problematic on two accounts: (i) it can be shown to be partial empirically as it fails scrutinize the power dynamics between farmers, and (ii) it is limited in scope as it fails to capture the abstract social domination over producers operative in capitalist societies generally, or in more conventional terms, the power of the market itself. First, our analysis indeed draws attention towards is that one should not only scrutinize corporate and financial capitalists, and the global institutions that protect their interests, contributing to a structural lock-in of contemporary food system in industrial production, but also "the relentless micro-capitalism of petty commodity producers" observable in the countryside (Jansen, 2015), in which farmers knowingly and willingly compete for land, deny other farmers access to resources or information, cut corners and produce "externalities" for competitive advantage, borrow wherever they can, and see advantages in deepening their involvement within the international social division of labor of the capitalist economic system. In other words, agroecological political theorists presents capitalism primarily as a mode of (unequal) distribution rather than as a mode of production, it insists on the existence and construction of more fair markets, rather than questioning market dependence in general. Power in capitalist food systems is primarily understood in terms of market power, resulting in the enrichment of certain chain actors at the expense of the farmer (De Schutter, 2019; van der Ploeg, 2020). Whereas the farmers we interviewed certainly echo such an agroecological analysis of power in food systems, farmers also mention the structural imperatives imposed on all economic actors embedded in this system, no matter how concentrated power in these value chains may be. The issue for agroecological theory, however, is that this kind of power, "the power of the market", cannot be captured in a meaningful way in terms of concrete relations, between persons or organizations, and hence by focusing only on market power, political organizing is reduced to constructing more equitable markets and moralizing about what constitutes a "fair" price. Rather than merely seeking to contain the social antagonisms that arise from private control over resources, a "transformative" politics would put into question why actors have private control over resources in the first place.

This broadened conception of market dependence not only problematizes but also contributes to agroecological theory and practice, however. By having a better understanding of how "real" markets function (Bernstein & Oya, 2014), agroecologists may better anticipate competitive dynamics within alternative market-based food networks, and strategize to make them less fragile. Furthermore, agroecologists may find opportunities to construct alternative markets in the competitive behavior of upstream and downstream suppliers. Third, it may motivate agroecological theorists to interrogate the liberal assumption of private property as the necessary condition for self-realization or human emancipation, to articulate a post-capitalist vision for society, and a politics to get there.

Our discussion of agroecological perspectives so far has focused on the more radical strains of agroecology, for the good reason that there is a substantive political economic theory to critique and improve. Yet our analysis doesn't leave common conceptions in the more widely accepted food system transition literature unscathed. Quite on the contrary, precisely because there is no systematic attempt made in this literature to critique capitalist social relations *per se*, our ability to trace the causal influence of a capitalist economic system through empirical analysis of farmer's accounts on their actions and lifeworld is all the more devastating. Indeed the understanding of all farmers being embedded and participating in capitalist economic system fundamentally challenges prevalent ideal-typical constructions in the food system transition literature characterizations of Belgian food systems (Dedeurwaerdere *et al.*, 2017; Freibauer *et al.*, 2011; Hubeau *et al.*, 2019; Stassart & Jamar, 2008; Vanloqueren & Baret, 2009). In this – what is perceived to be more reformist - literature stream it has indeed become commonplace to characterize and explain the coexistence of a diverse agricultural systems within a region in terms of agroecological-minded actors (the small, organic, local farmer and her environmentally conscious allies, against the productivist, short-sighted, hubristic, global corporations and their lackeys), along with the systems they supposedly have created for themselves ("the niche" and "the regime"), with an untheorized but causally effective macro-political economic backdrop "landscape". The boundaries of these systems of actors and practices are, however, notoriously fuzzy and slippery and lack explanatory power from a critical realist perspective (Sorrell, 2018). Based on our examination of farmer behavior we find indeed that the concepts of "niche" and "regime" lack a material basis, as practices and attitudes of these farmers don't conform to clear coherent ideal-types, and the social networks and cultural norms influencing their behavior are clearly overlapping. By contrast, the idea of an economic system in which both alternative and not so alternative farmers are all embedded in, structuring their behavior and tending to result in predictable farm development patterns, appears be much more plausible.

7.1. Conclusion and perspectives

In a very recent, publication, Gasselin *et al.* (2021, p. 309) find that for methodological and political reasons, ideal-typical representations of farm diversity[6] are often needed to understand the enormous diversity of practices, discourses and positions of actors and to facilitate transformative action. They readily admit, however, that such archetypes necessarily lead to certain abstractions, privileging certain aspects of farming systems over others, and therefore also go together with a normative orientation, as it inevitably leads one to make a judgment about what to focus on in order to separate different systems from one another. This, however, also inevitably leads to empirically problematic dualisms. Agroecological characterizations of actors, farming systems, beliefs, or practices are riddled by such dualisms: "Peasant or family farming" versus "entrepreneurial or capitalist agriculture" (van der Ploeg, 2013a), the peasant movement versus corporate-state regime (Rosset & Martínez-Torres, 2012), neo-productivism versus food sovereignty, niche versus regime (Levidow *et al.*, 2014), alternative versus non-alternative markets (Mier y Terán *et al.*, 2018). Each of these dualisms have been problematized by critical, but sympathetic scholars (Castellanos-Navarrete & Jansen, 2016; Edelman, 2011; Henderson, 2016; Jansen, 2015; Sorrell, 2018). In this chapter, we presented also wide ranging and lengthy material that further substantiates such critiques. However, rather, than merely criticizing certain characterizations because they lack descriptive validity, we have advanced an alternative – *i. e.* a non-archetypical way of understanding this observed diversity. We aspired as it were, to construct a theory like the one Charles Darwin did in his day to explain the existence of the many species inhabiting the Earth. That is by postulating a number of very simple mechanisms, and in so doing constructing a scientific theory which allows at once for structural determination, contingency, and individual goal-driven behavior (Foster, 2000). In other words, we aspired to construct a more general theory of evolution of farming systems under capitalism to come to grips with the diversity of beef farming systems that we observed throughout our research.

In this chapter, we set out to explain the market dependence of the beef farmers in terms of their objective social positions within systems of social relations between other economic actors, the cultural rules that constitute them, and the situated self-understanding of the actors involved. We found that each of these moments indeed played in our analysis, and we sought to make sure that our presentation of the

[6] Gasselin *et al.* (2021, p. 15) count among these archetypical representations the regimes described by Wiskerke and van der Ploeg (2004), McMichael, 2009), *référentiels* as described by Muller (1990) and Gisclard and Allaire (2012), farming styles (van der Ploeg, 2010 ; 2012), agricultural systems (Plumecocq *et al.*, 2018), food systems (Sobal *et al.*, 1998 ; Fournier et Touzard, 2014), and social-techical systems as described by Geels (2010) and Darnhofer (2015)

evidence also bear that out, Nonetheless, despite this attention to the agency and cultural context, the outcome does echo a historical materialist or Marxian political economy approach to farmer behavior. Indeed, our analysis of the particular pursuits of agroecological principles by the interviewed Flemish beef farmers, but also the ongoing processes of rural change in Flanders, explains these in terms of the more broader social antagonisms of a capitalist system, and showing how these antagonisms are consequential for the implementation of agroecological insights and how these are reproduced by both alternatively and not so alternatively-minded family farmers. This is because the adopted theory on human behavior explicitly allows for an independent structural moment, and hence to trace the existence of a global economic system (but defined in social terms) motivating social behavior. This stands in contrast to approaches that subsume these drivers under the category of an ideology or a discourse, like "market culture", "modernism", "consumerism", "productivism", "imperialism", "extractivism" or "individualism"), actor-oriented approaches which tend to conflate these drivers with the values or goals of individuals ("entrepreneurial", "capitalist", "invididualist" farmers), and to methodological individualist and behaviorist approaches which believe these to be part of the immutable nature of the human subject ("Homo oeconomicus").

We readily admit, however, that our analysis is not complete. The causal influence of hegemonic and counterhegemonic discourses on farmer behavior came, for instance, insufficiently into the picture. Our analysis was certainly sensitive to it, as we noted elements of it (e.g. the social stigma to taking subsidies, productivist notions brought in by the famer's commercial network, individualist attitudes cultivated by the industry), but it neglected to theorize these further, in part because of data availability, in part due to time constraints. In reading Fairclough *et al.* (2002) article on the need for but also the theoretical possibility to include this semiotic moment in in critical realist informed research on human behavior, we are, however, heartened that this gap can be addressed with further analysis and theorization, rather than that it signifies a refutation of the conception of human agency that we put forward in this chapter. Likewise, our emphasis on the causal influence of a capitalist economic system on farmer behavior, mustn't be taken as a trivialization of causal influence of gendered, (domestic in particular) social relations and cultural rules to explain observed farmer behavior. Quite on the contrary, we believe that by outlining a layered approach to social structures, it may in fact encourage and allow the flexible integration of other critical perspectives which are already well developed in the agroecological literature (Oteros-Rozas, Ravera, & García-Llorente, 2019) into the analysis of alternative and not so alternative market-based food systems.

PART IV
DISCUSSION

Chapter 8
General Discussion

General Discussion

8.1. Recalling the research questions and objectives

This research explores the relevance of agroecology to Flemish beef farming. The impetus of this research came from the observation that livestock systems in Flanders are under multiple societal criticisms and economic pressures, and agroecology was being proposed by numerous stakeholders as an alternative development pathway for these systems. As there was a poor scientific understanding of what agroecology actually entails for these systems and their challenges, we sought to fill this knowledge gap, by analyzing the actions and perspectives of a diverse group of beef farmers. We hypothesized that this would lead to an empirically grounded theory on the relevance of agroecology in the context of beef farming in Flanders. In this chapter, we review the effectiveness of our approach by summarizing our findings regarding the three research questions that guided this research:

- PRACTICE: What actions can and do these beef farmers take to put agroecology into practice?
- ACTOR: What is the role of the farmers' agency in the application of agroecological insights?
- SYSTEM: What social-material processes and conditions contribute or limit the application of agroecological insights at these farms?

We then consider the methodological innovations and perspectives we made along the way, and present in section 8.5 a wider societal reflection on how to advance agroecology as a practice, science and policy for sustainable food systems in this context. But first, we reflect on the scale, scope and aims that we were able to cover in this research with the chosen methods of data gathering and analysis.

8.2. Methodological reflections

8.2.1. Exploratory nature of our research

"un ouvrage n'est jamais achevé . . . mais abandonné" - Paul Valéry

All three of the research objectives are exploratory in nature rather than confirmatory. In other words, our research aimed at identifying new hypotheses, rather than testing existing ones. This stemmed from the initial observation that agroecology is a concept missing a clear delineation and program, particularly in the context of beef farming in Flanders. Due to the large range of themes addressed by agroecology, we chose to use methods that would generate rich data and would allow us to explore if, how and why agroecology materializes on Flemish beef farms. This choice, however, confined us to a medium-sized sample, which given the observed structural diversity of beef farms in Flanders, couldn't be both representative of the beef farming population, and efficient in mapping out the full scope of agroecological

practices in this context. With the followed theoretical sampling approach, we sought to maximize our chances to be effective in the latter, at the expense of the former consideration. Given the unrepresentativeness of our sample therefore, our results should not be interpreted as a balanced cross-cut of the application of agroecological insights on Flemish beef farms. We were, however, able to make some inferences about the state of affairs and future of the sector more generally, thanks to our exploratory analysis of farm census data and the structured questionnaires we gathered ourselves. This made us very aware of the fact that both organic and direct selling activities are rare in the broader beef farming population. Our focus on professional and therefore larger farmers was unintended, likely a side-effect from the Snowball sampling, as farmers gave us contacts to mostly professional farmers. One could argue - perhaps even along with the farmers we interviewed – that part-time or retired farmers are of lower interest to our investigation, as they play a smaller role in shaping the future of the sector than professional farmers might.

In this research, we sought to provide a global analysis of the different aspects of farm functioning in relation to agroecology, rather than seeking to systematically and holistically analyze a particular practice of agroecological interest, *e. g.* the installment of agroforestry systems (*cfr.* Borremans *et al.* 2019). This allowed us to be very comprehensive in our exploration of the relevance of agroecology as a practice on beef farms, as we could identify many more practices of potential interest. It had the drawback that no detailed information on the nature and context of each of these practices was gathered on a systematic basis. We also recognize that other concepts identified in this dissertation could have benefited from a more advanced exploration. For instance, the distinction between control and adaptive animal health management is a matter that deserves further scrutiny. We are also well aware that we develop a particular framing of agroecology, it is a comprehensive one but it is not the only valid characterization of the agroecological perspective. Nonetheless, it is the product of a sincere effort to synthesize ideas and experiences shared by self-identifying agroecologists, to trace how and why these ideas materialize or fail to materialize in the context of beef farming in Flanders. We sought to be comprehensive in elaborating multiple dimensions addressed in the agroecological literature, still, some themes were barely covered in this dissertation (cultural heritage, animal rights, gender relations, democratic governance, *etc.*). These shortcomings of our investigation are indicative not of a lack of personal interest to explore these dimensions of livestock farming systems, but rather of the high demands on resources, time and competence that interdisciplinary research requires.

In agreement with most critical scholarship in agri-food studies, we believe that farmer behavior must be explained by drawing attention to the broader social and cultural milieu in which farmers make their decision, rather than in crude behaviorist and rationalist terms (Higgins, 2006). Yet, the data we gathered on the social context of these farmers is limited to the accounts these farmers gave themselves of their situation. This didn't keep us from making inferences about the functioning of beef

value chains in Flanders, and indeed the general functioning of contemporary food systems. This requires a clarification from our part.

Informed by critical realist philosophy (Danermark *et al.* 2019), we believe that a fundamental task of social science is to make generalizing claims, by setting out to explain social phenomena in terms of the causal mechanisms that produce them. This as opposed to taking record of the particular values, views and biographies of the interviewed individuals in all its complexity and detail, an *idiographic approach*, or trying to deduct general laws by developing and empirically testing abstract theoretical models, *a nomothetic approach*. The latter is the empirical realist illusion which conflates the real with the actual domain, the former is the task of the historian in particular. While either approach would find the gathered data lacking to make substantial inferences, we found these data to be extremely fertile material to develop and explore theories to explain farmer behavior in terms of their social context. By exploring a holistic understanding of agroecology as a practice, we ended up gathering data on themes that explicitly aimed at understanding the diverse relationships farmers may have with other social actors (commercial and financial autonomy, rural fabric, producer-consumer ties, knowledge exchange, and social equity). As such, we have an empirical set of data on how each of these farmers stand in relation to their wider social context. Furthermore, farmers continuously account for their actions by referring to the wider historical social context in which past decisions have been taken. These accounts taken together present us with an extremely rich picture of the broader context in which these farmers operate, even if contradictory, partial and incomplete. The analysis that emerged foregrounds, the causal influence on their behavior. of material conditions, as they find them already existing or produce them through their activities. This materialist starting point is far from an arbitrary one, as both farmers and social theorists like Marx have argued (Foster 2000, p. 114-115). And scientifically, it was a productive one, moreover, as it allowed us to understand farmer behavior within the totality of a global economic system, and not just in terms of the local discourses, norms or traditions, or biophysical conditions.

The presented analysis of the gathered data on these farmers' social behavior is, however, far from a complete one. The research process presented in the methodology chapter suggests a continuous revisiting of the data to describe and explain the phenomena observed. At some point, however, this process has to stop and come to a conclusion. More analyses have been conducted on the data body than those developed in these pages, and we suggest that more complete, profound, and insightful readings of the observed facts and relations be established with further data analyses. Like in any empirical investigation, it wasn't possible to cover all mechanisms and conditions that give rise to a certain phenomenon in equal detail. Yet, it's precisely because of the comprehensive understanding of human behavior that we lay out in chapter 7, that we are sensitive to the limitations of the presented analysis. And it's precisely because we detect venues to integrate other critical sociological analytical lenses (critical discourse analysis, psychoanalysis, intersectionality, political

geography, to name a few) in an empirically applicable theory to explain agroecological farmer behavior, that we would be eager to do so ourselves. To summarize this methodological contemplation: like a work of art, exploratory empirical research is never finished, but abandoned (Yanai & Lecher, 2020).

8.2.2. The role of critical realism and literature

From early on, critical realist philosophy has been a key component supporting our research activities. It proved useful to anticipate some of the shortcomings and strengths of the different methods, and the development of our mixed method approach. This approach, as we shall argue in the second section of this chapter, allowed us to successfully address the research questions. Critical realist meta-theory was useful throughout this research project, as it provided a basis from which to assess the validity of inferences we made, based on the at times contradictory or incomplete empirical evidence. In the development of the scoring system, for instance, it helped us to appreciate the pitfalls that came along using coded practices as a proxy for assessing the presence or absence of agroecological practices. Critical Realism was key in developing concepts to describe and account for the phenomena we had observed. Our preference for the concept POA for instance, rather than strategy, and farming models underlying farmers' actions, rather than farm designs, is based on the analytical distinction between actions and the intentions or reasons behind such actions. Likewise it led us to appreciate Cognitive Maps for what they were, that as hermeneutical enablers, rather than as actual representations of farmers' causal beliefs, or blue-prints to model systems dynamics. Furthermore, by understanding reality as differentiated, consisting of an empirical, actual and a real domain, critical realist writings motivated us to not only describe actual events with empirical observations, but also seek to explain why these events we witnessed happened in the first place. We did so by the critical realist mode of inference, namely retroduction. That is by hypothesizing the existence of mechanisms and entities that, if they existed, would explain what we had observed. In other words, rather than simply reporting on the accounts farmers' gave about their behavior, we sought to dig deeper and identify the mechanisms that led farmers to give such an account of their actions in the first place. We were arguably successful in doing so by drawing extensively on academic literature and, of course, on our own personal experiences as citizens, customers, researchers, employees living in Belgium, and the reported experiences of other researchers we were aware of, and possible concepts that could explain the patterns we had observed, as part of the totality of our lived experiences. In this retroductive endeavor, we were also able to build on explicitly critical realist inspired social theorists, like Douglas Porpora, William A. Jackson, Howard Richards and Margaret Archer.

8.2.3. Role of the researcher

The more rigorous and plausible explanation critical realism provides for the very possibility of fruitful scientific work compared to positivism or interpretivism, is one

way to account for the followed methodological approach. Yet it can also be explained on the basis of my own personal commitments and capacities as a researcher. I have always had a great curiosity in establishing how the world works, which can certainly explain why I have a great respect for natural scientific work, even if the abstractions scientists provide, turn out at times to be very partial and socially inconsiderate. From a very young age, I also developed a sensitivity for natural life, and I took up a particular interest in watching (rare) birds in Europe. Confronted with, however, the historical decline of many bird species throughout Europe, and the land use changes that I witnessed with my own eyes, I early on deduced that the disappearance of birdlife couldn't be separated from the functioning of the economic systems that humans had set up. Both my environmental concerns as my interest in the sciences likely explain why I chose to study bio-science engineering in Ghent, and my motivation to become engaged as a Ph. D. student at ILVO on the topic of agroecology. Rather than applying and deepening my understanding of biophysical processes, however, I took the chance to develop also further my understanding of how the "social world" functioned, and quite consciously with the motive to change it, though not necessarily with the means and ends agroecologists had in mind.

I had no formal education, however in traditional social science research methodology, nor in the social sciences or in philosophy of science, but I was eager to implement this vision of a realist, consciously normative and socially engaged, social science. This led me with openness to experiment with different methods, to learn what certain lenses let me see and not see and entertain certain concepts that had become out of fashion to describe the phenomena I was observing. The absence of such an education, likely contributed to the methodological and conceptual originality of my work, as I was more likely to wander of the downtrodden paths. However, it also fed into an uneasiness about what constitutes credible and valid scientific work; This led to exploring critical realism early on in the research to ground the investigation philosophically and give my work more methodological rigor, while still being able to pursue transformative scientific goals. Faced with an abundance of methods for data gathering and analysis, I was for instance well aware that many journals, research units in the agricultural sciences consider quantitative methods as the only methods that provide evidence on which to make reliable inferences/conclusions on any subject. Yet such methods would confine the scope of questions I would be able to answer in my research. Likewise, the conceptual lenses I sought to operationalize were influenced by my desire to provide an analysis of the current social challenges that speaks and seek to improve not only the realities of Flemish beef farmers, but indeed, of all working people in contemporary society. Having an approach that extensively uses qualitative data, and is heavily informed by "normative" or "political" literature rather than on "facts and numbers" is socially handicapping, however. One indeed risks to get brushed aside by objectivists claiming that findings arrived in such a way are unscientific and mere opinion. Yet, this was risk worth taking, as early on in my research I found myself strongly agreeing with Max Horkheimer's insight that a scientific project that disavows all values (excluding

the value of value-neutrality), cannot offer society anything meaningful or critical and in fact may unreflectively promote the power of the few (Gunderson, 2014, p. 25).

Throughout my research I have sought to be transparent, explicit and reflexive about motives driving my investigations, by being outspoken about my views and I also endeavored to put my analyses into working documents, presentations, to share these with my supervisors, the diverse interdisciplinary team at ILVO, and at UCL. Whereas I indeed hold certain convictions I would be very reluctant to give up (commitments like philosophical materialism, realism, secular humanism, *etc.*), I have not shied away from confrontations with other researchers, and have grappled throughout my research with evidence and literature I came into contact with that challenged the beliefs I held thus far. My hope is that the validity of the presented work is received in this same spirit, namely through critical and sincere dialogue, in mutual recognition and humanity.

8.3. Scientific findings

8.3.1. Exploring agroecology as a practice

The first research objective was to identify the actions Flemish beef farmers take to put agroecology into practice.

This objective was important because the fuzziness of the phrase agroecology needed to be reduced in order to make a proper assessment of its relevance in this context. In this research, a comprehensive and holistic understanding of agroecology as a practice was put forward and explored. The study area was not confined to farms on the fringe, but included farms which are often snubbed as places where agroecological principles aren't pursued at all. Furthermore, the scope of agroecology as a practice was not reduced to a particular innovation, as we sought to understand how a mental model that clearly sees the interconnections between the agricultural practices, social movements, and research, may manifest itself materially in farmers' practices. The combination of a qualitative semi-structured data gathering method and an initially open-ended analysis led to the discovery of many practices through which farmers can pursue an array of agroecological principles. In so doing, the many ways beef farmers still and already today put agroecology into practice were uncovered. This is far from an exhaustive listing of the practices these interviewed farmers actually engage that could be related to the pursuit of agroecological principles, let alone the beef farming population as whole. Nonetheless, our work represents a significant probe into this question. Most notably, our study indicates is that farmers can and do take actions to operationalize not only technical but also social dimensions of agroecology. There is a tendency to reduce agroecology at the farm level to the agronomic sphere, and reserve the social dimensions of agroecology to particular actors such as policy makers and NGO's. By skipping the farm level as a legitimate level of social analysis, one disregards, the many ways farmers may create favorable social conditions to adopt agroecologically sound agricultural practices.

The formulation of 36 different Pathways of Action (POA) revealed many questions and contradictions concerning the boundaries of agroecology as a practice in this context. Namely about the compatibility of control measures in an agroecological animal health management model (P1), about the open nature of most beef farming systems in terms of nutrient flows (P2), about the appropriate scales for installing species diversity (P3), about the place of nature conservation for its own sake within agroecology (P4), about the compatibility of efficiency, substitution and low-output measures within an agroecological approach to reduce inputs (P5), about the substitutability of natural for social capital (P6), about farmers' ambiguous role in the commoditization of agriculture and the reproduction of agro-industrial and financial capital (P7, P8), about the origins of farmers' knowledge (P9), about the necessity of local economic activities to maintain the social fabric (P10), about the role of often informal, reciprocal and redistributive arrangements in sustaining agroecological food systems (P11), about the role of large retailers in supplying local food (P12), and about the political strategy to reform rather than resist and work around regime institutions (P13). The translation of principles into POAs by farmers, may be very different in situations which markedly differ in terms of social organization of agriculture (for example tribal or communal systems), physiological nature of the particular product concerned, pedoclimatic conditions, or cultural traditions. Yet given the prevalence of social organization form of (family labor based) commodity production in the 21st century, modern production, processing and distribution technologies and hegemonic and counterhegemonic environmental discourses across the globe, we wouldn't be surprise that these POAs are applicable in other agricultural sectors and regions, and that the questions raised by such conceptualization, may be pertinent in other contexts.

These ambiguities were further explored in chapter 5, as we turned this descriptive framework could be transformed into an analytical framework to compare sets of practices of farmers. Three farming models underlying their diverse pursuits of agroecological principles were identified: one farming model represents seven conventional farmers who name a bare minimum of practices contributing to agroecology, and two models representing farmers that do integrate elements of agroecology. Conceptually, the second farming model, which represents nine direct selling farmers, eight of them organic, corresponds with a low-input, low-capital, but knowledge intensive model, embedded within alternative commercial and social network, which actively seeks to become independent from regime institutions. The third farming model represents five mostly whole-selling conventional beef farmers that find advantages within the mainstream market environment. It overlaps with a number of practices related to the techno-productive dimension of agroecology with the second model, as far as these maintain or increase productivity, and are compatible with the expectations of value-chain actors. The remaining half of the farmers is found in the continuum between these models, indicating that these models are combinable in practice to some extent, and that not all farmers go as far as the most emblematic instances of these models.

Our observations based on accounts of farmers confronted by this particular set of practices, and viewed through the lens of identified POAs, may in our view reveal some traits characteristic of an agroecological perspective generally on farming systems. Like other conceptual approaches to multifunctionality (Renting *et al.*, 2009), agroecology takes in interest in practices maintain natural, social and cultural capital. Yet what distinguishes agroecology (or at the very least the perspective we put forward in this dissertation) is that it ties these dimensions to the advancement of the political position of farmers and to a lesser extent consumers in the agro-food systems. We find that this more political dimension compelled and allowed us to distinguish between ways of technically and socially organizing production, processing, distribution and consumption that work around the mainstream, and those that are more conforming (Levidow, 2015). We indeed observe differences between the input reduction strategies that the two identified sustainable farming models are following, though what are termed "Redesign" practices (Rosset & Altieri, 1997), may not be as alternative as often considered in the context of beef farming in Flanders. Likewise, we find that knowledge exchange among farmers is not particularly characteristic of alternative farmers. We found that other distinctions do hold up, however, such as sets of practices related to so-called high-input systems that are heavily commodified and dependent on agro-industrial and financial enterprises, and those low-input systems that are more self-sufficient (van der Ploeg, 2013b) and depend on more reciprocal and solidarity-based market arrangements (Mier y Terán *et al.*, 2018; Sabourin & Djama, 2009). Our data indicates also a split between alternative and more mainstream sustainable farming models in their different approaches to animal drug use reduction. This distinction between an adaptive or a control model (Napel *et al.*, 2006), is rarely brought up in the literature associated with agroecology (likely because of the emphasis on cropping rather than livestock systems), and arguably deserves more attention from researchers.

Whereas our sample is far from representative of the Flemish beef farming population, the mere existence of these observed coordinates reveals the subsistence and perhaps emergence of a numerous ways to produce beef in this context. This diversity discredits binary characterizations of existing farming systems as either conforming completely to a conventional "industrial farming" model or to an "organic farming" model. Insofar as the sum of POAs indicators can scale the agroecological nature of the systems considered, we see organic direct selling beef farmers on one end of the spectrum, and conventional whole-selling farmers on the other, yet in between these extremes there is a continuum where these *a priori* categorizations cease to be helpful. Concepts put forward in the literature to distinguish different sustainable development, such as "Sustainable Intensification" and "Peasant Farming" could indeed describe to some extent the different models we identified based on a data-driven classification of our cases. Our empirical analysis of farmers' sets of practices suggests that these concepts are not merely academic construction, but have indeed some descriptive validity in this context. But still, none of the interviewed farmers represented these models in a pure state. In fact, our results

indicate that many farmers don't go very far in either approach, or are situated in between these farming models. In fact, the ability of farmers to blend practices fitting both or either one of these models, may actually explain some of the controversies surrounding the definition and delimitation of agroecologically managed farming systems. Without going into the legitimacy of the concerns surrounding the co-optation of agroecology by powerful institutions (Holt-Giménez & Altieri, 2013; Norder *et al.*, 2016), we would suggest that disputes on the definition of agroecology as a practice may stem from the overlap in management principles and indeed actual farming practices of the different farming models being proposed. As Brédart & Stassart (2017) point out, farmers are on their own trajectory of combining various practices fitting their situation and their judgment. The sets of practices they end up constructing therefore resist ideal-typical classification. The sets of practices they end up constructing therefore resist ideal-typical classification. As an alternative we suggest that an adequate explanation, and therefore characterization of farm diversity needs to take the dynamism, continuity and unevenness of actual of individual farmers pursuits of agroecological principles as a starting point and examine the mechanisms that give rise to this fact.

8.3.2. Exploring farmers as agents for agroecology

The second main goal of this dissertation was to explore the role of farmers in implementing agroecology.

The application of Cognitive Mapping (CMing) invited us to consider how farmers themselves are part of these various processes that sustain a farming system as a whole, and thus help us come to grips with farmer agency as a causal force in its own right in shaping the development of farming systems. Both aggregated and individual CMs (albeit to a lesser extent) represent farm functioning as a tight connectivity of production and marketing activities to generate not only income but also satisfaction, feeding back into further investment to improve production conditions in a variety of ways or improve marketing arrangements directly. The centrality of income in the overwhelming majority of the CMs drawn by farmers suggest that income generation is understood by farmers as a necessary condition to continue farming. Further analysis of the interview transcripts also show that farmers across the board, present the need to generate an income, quite understandably, as an uncontestable state of affairs. This acceptance or resignation of farmers, however, is consequential for the room farmers perceive to have to put agroecology into practice on their farm. The constitutive rules of the social system there in (property and contract law), define objectively to a great extent the resources available resources to them, and as they accept this situation, it becomes a sufficient justification for farmers to compromise on agroecological principles, even if they wish it were otherwise. They tend to adhere therefore to the dictum, as Bertolt Brecht put it famously,*"Erst kommt das Fressen, dann kommt die Moral"*. The acceptance of this situation, however, isn't all negative for the implementation of agroecological principles, however, as by accepting an

economic rationale, farmers also tend to work 'efficiently' by economizing on inputs, recycling, maintain soil fertility and animal health *etc.* Still, while farmers across the board have accepted this structural limitation, they can act upon this reality differently, and this is also reflected in their CMs. Clustering of farmers based on their CMs indicated the existence of farmers who appear to be more business-minded versus those foregrounding their quality of life, farmers who are more focused on production and other more on marketing-minded, farmers who are more investment-minded, and others who look to get by with little inputs and capital investment. The identification of distinct clusters conforms with other recent empirical findings (Beingessner & Fletcher, 2020), suggesting that farmers may position themselves differently towards the dominant agri-food system, with some farmers resigned to or even promoting going standards of production and consumption, others withdrawing from intensive production and actively constructing alternative channels around other, potentially contradictory notions of quality. There clearly is room for maneuver in this system, even though in the short term, the criteria of consequence in production are not what farmers personally feel about the quality of their goods and acitivities, but rather whether their products meet the expectations of potential customers in such a way that can afford the bills. Over the longer term, values held by farmers do play a role in the kind of commodities they are producing, and hence the commercial relationships they form. Consequently, when there is a contradiction between the expectations and desires of farmers, and those of their customers, this may lead to farmers suppressing or changing their own values, or it may alternatively lead them to seek out customers that do align with his/her preferences, insofar as farmers believe these customers exist and their material conditions allow them to produce commodities meeting these customers' expectations.

While some interviewed farmers take pride in being able or at least trying to produce without certain inputs, other farmers believe their dependence on an external inputs like pesticides, fertilizers, concentrates and fossil fuel are a necessary evil to get by, whereas others believe these inputs are the very means through which they can get ahead in life. Likewise, we find that few farmers hold great commitments to become independent from banks, as it is perceived as the only way they can take over a farm, or stay economically viable in the long-term in this context. And, while many whole selling farmers don't like it that they are dependent on large agro-industrial companies, they may take little action to change this situation. Whether it is by design or by accident, a string of decisions made over the course of a farmers' career may contribute to either build up the conditions for pursuing agroecological principles to an ever greater extent, or they can destroy these. By lending great amounts of money to build a new stable for young cattle, a farmer commits to the production of certain commodities and forecloses other courses of action for years to come. Given that economically viable alternative initiatives have been started by a number of organic farmers with far less resources, it would suggest that conventional farmers often didn't consider technological trajectories more in line with agroecology to be part of an economically viable business model. There is therefore also something to be said for

the idea that it truly is not a merely a lack of means which keeps conventional farmers from implementing agroecological principles, but a lack of imagination and willingness to contemplate alternatives. As such, this empirical investigation sides with other analyses that have criticized one-sided essentialist constructions of "small farmers", "peasants", "family farmers" as the protagonists of an agroecological transition (Bernstein, 2014; Castellanos-Navarrete & Jansen, 2016; Edelman, 2014).

8.3.3. Exploring social systems for agroecology

The third aim of this dissertation was to identify the mechanisms arising from the social context that enable or constrain farmers to put agrology into practice.

The prominence of income generation in the cognitive maps of most farmers, as well as the returning comments of farmers suggesting that rather than moral objections or agreements with principles, income figured as the prime reason why certain actions were considered necessary or impossible to take. This led us to further investigate this common constraint set to farmers' behavior. Through extensive literature review we became aware that the explanation of farmer behavior is a challenging task, which many scholars and traditions have grappled with, each with its observable shortcomings. Rather, than simply criticizing existing approaches, we developed an original analytical framework to overcome perceived shortcomings, such as recognizing both market power and the power of the market, recognizing role of different objective material conditions as well as cultural beliefs of actors, and by recognizing agency throughout the value chain for or against agroecology. In particular, we felt it was incumbent upon us to address a shortcoming in the political analyses of many prominent agroecology associated social theorists (De Schutter, 2019; Guzmán & Woodgate, 2013; Holt-Giménez & Altieri, 2013; van der Ploeg, 2020). Namely that an analysis of power in contemporary food systems cannot limit itself to scrutinizing the actions of corporate and financial capitalist enterprises, and the global institutions that protect their interests, but it must also involve a critique of "the relentless micro-capitalism of petty commodity producers" that preceded it and is still going on (Jansen, 2015). As such we outline in our a research an alternative to explaining (the lack of) food system transitions in moralistic and particularistic terms of good and bad actors (the "peasant" versus the "World Bank" and the "corporations", and the systems they supposedly have created for themselves ("the niche" and "the regime"). This alternative is motivated by a belief informed by the accounts farmers gave that a more accurate explanation of rural change could be provided and had to be provided in terms of the more general social antagonisms of a capitalist system, which was also sensitive to particular relationships, personal predispositions and resources of individual actors.

Out of an iterative interrogation of our data and the literature we encountered, we postulated the existence of a system of impersonal social relations of production all farmers embedded in, as well as the existence of particular systems of personal social relations of production. We hypothesized that these sets of social relations variably

enable and constrain farmers' willingness and ability to put agroecology into practice as they define the resources and skills available to them. Whereas this framework presents but a first and provisional attempt to abstract theorization of farmer behavior, our empirical exploration of this framework based on our data, is likely indicative of its salience to advance agroecology as a theory of sustainable food systems.

The constitutive rules of markets (private property and contract law) define to a great extent the resources farmers have access to, and hence the room for maneuver that they have to pursue agroecological principles. Farmers are by these rules formally free to consume, invest sell or consume their property as they play, however the limitations of this freedom are evident. Farmers are not free to pick and choose a production, as they are constrained by their own material conditions, which they partly inherited, and partly created through past actions, but are also determined by the expectations of potential commercial partners, themselves under similar social structural constraints. Consequently, farmers have to rely on other actors, most commonly on a bank to get a loan, and governmental agencies for subsidies and potentially land, and hence work within the constraints of their expectations.

Our analysis confirms that there is a lock-in of beef production into intensive production methods (Stassart & Jamar, 2008), yet goes further as we show how apparent cultural preferences and cognitive biases of commercial actors involved in the whole sale beef chain, are the result of the continued reproduction of a set of social relations between these actors. We find that the terms of trade that conventional wholesale farmers accept, as they perceive no realistic or desirable alternatives, drive them (and importantly allow them) to engage in production methods that depend heavily on inputs supplied only by large companies, and on major investments, driving them to accept terms for loans by banks. The political economic nature of different constructions of product quality is evident: the material interests of different actors leave their trace on what can acceptably be construed as a quality agricultural product in the wholesale circuit. We derive from farmers accounts that actors who own and/or work in upstream economic activities, have made over the years vast investments in both a material and social infrastructure to produce and market agricultural inputs. It follows that they have a material interest in promoting forms of agriculture that would be highly dependent on their inputs and services. Likewise, the interests of downstream actors lie in promoting forms of agriculture that provide a secure stable flow of widely distributable agricultural commodities, that are cheap to process and distribute, which can either be offered at a cheap price further in the chain, or are of a dependable quality that is easy to communicate to customers (such as "no (chemical) pesticides", "local specialty"). Moreover, they have an interest in supplanting other commercial competitors such as small-scale butchers and direct selling farmers to ensure an ever greater share of the effective demand for goods and services in Flanders. The dependency of farmers' livelihoods on agro-industrial companies limits the scope of practices that can be reasonably employed by them, and hence one can indeed observe that beef production, like other agricultural sectors, has

become a "conferred activity, namely that its prospects are mostly reliant upon a range of arrangements between regulators and economic actors distant from farm production itself (Marsden *et al.*, 1996).

Nonetheless, our exploration also draws attention to the fact that whole-selling beef farmers are able to negotiate, depending on their own resources and skills, the terms of trade on an individual basis. These are, however, insufficient to fundamentally challenge the powerful social position of these companies overall. The potential of collective bargaining by farmers, our data would suggests appears to be limited due risk-averse and opportunistic trading behavior of farmers. As, we noted earlier, that an individualist subculture among farmers indeed appears to effectively narrow the range of strategies between which farmers are likely to choose, but based on our analysis we find that an unwillingness to share and co-operate with other farmers is connected to the material conditions of farmers as petty commodity producers as they compete for scarce resources, particularly land, and customers. Importantly, this economic system is also flexible enough to allow the formation of more consensual relationships among farmers, whose recognize their individual interests align sufficiently, as evidenced by the reciprocal and redistributive arrangements that many interviewed farmers had with other farmers. That the industrialization of agriculture in Flanders was accompanied by the rise of farmer cooperatives in this region reminds us however, that the improved position of farmers through cooperation also be used to double down on industrialization and scale-enlargement of agricultural activities in order to gain a competitive advantage within world markets, rather than to construct a locally embedded and ecologically integrated food system (De Herde *et al.*, 2020; Lucas *et al.*, 2014).

As our comparative assessment of sets of practices has shown, we interviewed farmers who produce in a way which is effectively less dependent on loans, on concentrates and chemical inputs, and relies more on local social networks and resources. Whereas numerous factors contributed to the ability and willingness of farmers to do so, in our analysis we highlight in particular the role of an affluent and concerned customer base in Flanders, to which production risks can be transferred or from whom a price premium for quality products can be expected. As such we find that even in historically intensively farmed regions such as Flanders, it is possible for farmers to set up viable business models that allow to put agroecological principles into practice. Many agroecologists have drawn from this the conclusion that a wide-scale construction of market environments friendly to agroecology from the bottom up, is feasible, or would be if encouraged by government policies which allow for the establishment of agroecological systems even in highly urbanized and intensively farmed regions (FAO & INRA, 2018; Karl Falkenberg, 2016; Mier y Terán *et al.*, 2018). Our investigation problematizes this hypothesis to some extent as we identified various mechanisms that continuously destabilize these alternative market environments. These therefore help to explain why such alternative market environments, despite decades of grassroots efforts, have failed to become the norm.

Our investigation reveals that alternative marketing environments are continuously destabilized by the impersonal relations out of which they are partly constituted by. This is evidenced by the unwillingness of some organic farmers to co-operate and share material resources, knowledge and information with each other in fear of losing customers to each other, by disputes farmers apparently had had with downstream partners on which they rely on to process and distribute their product, by the restraint direct-selling farmers exercise when setting their prices in fear of losing customers to other meat distributers, as well as their difficulty in acquiring land in the presence of better financed conventional farmers in the neighborhood. Furthermore, we find that direct selling farmers, and organic direct selling farmers in particular, depend heavily on the recognition of their product as alternative and hence meriting a higher price and/or missing out on the convenience provided by supermarkets. This we find, leads to an exclusionary dynamic in which these farmers seek to draw up entry-barriers to preserve their privileged position in the market, by defining 'Alternativeness' is framed in such a way that it makes it very costly or impossible for larger farmers and large-scale distributers to co-opt. This dependence on their image of being on the fringe, however, also a reason to doubt the unbridled replicability of these models. Yet, as the notion of 'alternativeness' can never be fully appropriated by large-scale food manufacturers and distributers, it's likely that different notions of quality beef will continue to coexist in Flanders, with nonetheless notions compatible with large-scale production and distribution remaining by far the most consequential for beef farmer's production choices.

Without any direct control over agricultural means of production, non-farming local citizens find (and due to the legal restrictions) even land owners find it difficult to make their preferences for agroecologically sound agricultural practices felt through their consumption choices (except for rare cases in which they choose to participate in production through financing in a cooperative set-up). Flanders is a relatively affluent society in which a good proportion reportedly are willing to pay more for less intensively produced animal products, indicating the possibility of a consumer-led approaches to agroecological transitions in this context. Whereas analyzing the agency of citizen-consumers in this context was beyond the scope of this study, based on farmers' views, we believe the transformative potential of consumer politics can easily be overstated. Their access to resources is defined by these very social relations mediating farmers' access to resources. As such there are serious social structural constraints on their effective consumption choices and how they tend to perceive themselves, particularly for the poorer sections of the working class, leading them regularly to choose for more convenient or cheaper options.

8.4. Methodological innovations and perspectives

In order to answer these three research questions, we developed new methods of data gathering and analysis as well as conceptual frameworks, which arguably

represent major methodological and conceptual contributions to key challenges to the study of contemporary food systems.

1. Conceptualizing agroecology as a practice

In this research we have assessed the agroecological nature of farmers' practices by determining whether their actions were in line with a comprehensive list of agroecological principles, and then categorizing these practices under different POAs, an original concept of this research. The application of this approach demonstrate it as a promising methodology to explore how agroecology is translated in practice by farmers in a specific context, that strikes a delicate balance of being inclusive and sensitive to the need to contextualize agroecology, but also of accommodating various normative framings within the agroecological literature. For exploratory research, we found that the concept of POA has two major practical advantages. As each POA is tied to only one principle explicitly, the range of practices to consider for each POA is confined, simplifying a grounded analysis of practices. The other analytical advantage of POA, in contrast to the concept like strategy, "way of acting", or "référentiel", is that it separates the actions of farmers from the individual views of farmers and their social context, and to handle the explanation of observed (non-) agroecological behavior separately. In so doing, we avoid some of the major methodological limitations of Weberian approaches (*cfr.* A. M. Dumont *et al.* 2020), that seek to determine whether farmers are driven by motivations and perceptions that aligned with agroecological principles[1].

2. Assessing the implementation of agroecology as a practice.

In chapter 5, we demonstrated that the conceptual frameworks of 36 POAs developed in chapter 4, can also be turned into an analytical framework to assess the implementation of agroecological practices by individual farmers. There is an urgent

[1] While intuitively promising, we found a Weberian approach to agroecology as a practice flawed for three reasons. First, by linking agroecology as a practice to actors' perceptions and motivations agroecology as a practice is inadvertently stripped from its material history and confines its current reach to that of the self-identifying agroecological community. Agroecology takes great inspiration from "proto-agroecological" systems and the associated practices that existed long before the notion of agroecology existed (van der Ploeg *et al.*, 2019). The actors operating these systems were or are likely motivated by ideologies bearing little resemblance to the modern or post-modern notions like social justice and food sovereignty, that reportedly motivate agroecological activists and researchers today. Second, it too generously assumes that actors can give an account of the motivations and perceptions driving their practices, and too optimistically assumes that these can be easily revealed in an interview format. And thirdly, by emphasizing the values and meanings of actors, rather than the mediating role of social structures, the absence of agroecology as a practice is problematically framed as an attitudinal problem, as opposed to a structural one.

need for tools that can verify the promise of agroecological practices (HLPE, 2019). While our research interests for this study lie in establishing the presence of the means of agroecology, *i. e.* agroecological practices, on our case study farms, rather than their effectiveness in meeting certain agroecological ends, this study's methodological contribution to such an assessment does not escape us. After all, the identification of systems managed more along agroecological lines is prerequisite to studying the performance of such systems. A more systematic assessment of the presence of means of agroecology at each studied case is still lacking, our study may well have laid the foundation for such assessment tool. Other methods of data gathering such as a structured questionnaires, could be developed to trace in a more systematic way the actions taken by farmers, which will lead to a more accurate characterization of sets of practices.

3. Classifying Farming systems

In this dissertation we developed a number of methods to characterize the diversity of beef farming systems in Flanders at several points in our analysis to reach our objectives: the construction of a structural typology based on expert interviews and multivariate analyses of farm census in chapter 3, the identification of farming models through the development of a scoring system and application of an archetypal analysis algorithm in chapter 5, the clustering of farmers by comparing their cognitive maps a quantitative distance measure in chapter 6. Whereas the methodologies to construct these classifications are rather different, our perspective on using such methodologies was similar, and worth spelling out. In our view there are structural mechanisms at work determining farm development, yet there is also room for diverse goal-oriented behavior by farmers and contingency (from the weather patterns to genetic mutation). Together these create an enormously diverse landscape of farming systems, practices, and beliefs in a specific context which cannot be adequately captured in ideal-types. Nonetheless as methods to explore this actually existing diversity, classification schemes are extremely valuable, as long as they are used reflectively and critically. That is by being aware of the normative judgment that underlie in variable and model selection, and of the distinction between empirical traces like indicator scores, and actual characteristic of farming systems. Rather than trying to perfect or prove the descriptive validity of classification schemes, our approach is outcome-oriented and allows us to appreciate the possibilities of innovative methodologies like the ones put forward in this dissertation in that regard.

4. Cognitive Mapping

One of the outcomes of this dissertation is an in-depth reflection on the effectiveness of CMing as method to study farm functioning in its complexity and its diverse forms. CM are best interpreted as communication tools for the respondent farmers to construct an image of their farm, rather than complete or accurate representations of their beliefs. CMs may disclose what aspects farmers are working on, and what they are working towards, and help theorize how these aspects fit together as a whole. They therefore help us to consider the material impact of farmers'

views being constitutive of farm functioning, as they translate into actions that reconfigure the farm and its environment, giving the farm as a whole dynamism and purpose. While the applied CMing method showed a limited capability of classifying farmers based on their beliefs about farming, it did provide systemic representations constructed by farmers on varying /the range of connection between different aspects of farming. Whereas we would stipulate that CMing may not necessarily be the most efficient method to explore these dynamics, we do believe CMing can be effective in informing further interdisciplinary and holistic analyses of farmers' decision making and of the actual functioning of these systems

5. Explaining farmer behavior and food systems dynamics

By explaining individual farmer behavior in terms of emerging properties of a global social system, based on a coherent behavioral theory that is sensitive to the particular situation of each farmers, it doesn't escape us that we made a sizeable contribution to the food system transition literature. In an editorial of the Journal of Rural Studies, Lamine *et al.* (2019) highlight that one of the key conceptual challenges of the field is to connect the different modes of explanation in the field, which Scoones *et al.* (2018) schematically call the 'structural', 'systemic', and 'enabling' conceptual approaches. Because each of these lenses tend to be operationalized at different levels and spatial-temporal scales of analysis, there is persistent difficulty for researchers to connect the dots between empirical case studies of farmer behavior and their local social networks, and the macro-level theorizations of a global food system. Scoones *et al.* (2018) argue that different approaches can complement each other, as they cover each other's blind spots, and bring different pieces of the puzzle to explain and enact transformation of food systems. In the course of constructing our own framework to understand observed farmer behavior within the totality of a global food system, however, it became apparent to us that underlying these different conceptual approaches are markedly different social ontologies (Elder-Vass, 2008; Geras, 1988; Porpora, 1989; Sorrell, 2018). Rather than resolving the perceived inadequacies of the separate conceptual frameworks, we observe that the combination of frameworks instead leads to a multi-paced conception of food system developed, namely, one that holds to a rather deterministic structuralist account at the macro-level, one that subscribes to a more flexible systems account at the meso-level, and one that explores a post-structural account at the micro-level. And by unfortunate consequence, it also feeds into a politics that believes that at the local level everything is possible, while at the global level everything is determined (cfr. Tilzey, 2019). Rather than continuously making *ad hoc* combinations of frameworks when the situation appears to demand it, it would seem more efficient to rework existing scientific insights along a single rigorous social ontology. While the theorization of farmer behavior within the totality of the contemporary global food system as it is developed and applied in this dissertation, has its limitations, both due to lack of data and a lack of time, it is our contention that the analytical framework outlined in chapter 7 has great potential in this endeavor.

6. The integration of literature in exploratory empirical research

In this research, we took a more open a more pluralistic stance to existing theory, hoping that as the empirical evidence came in, a theory would emerge out of a continued dialogue between incoming gathered data and the literature we came across through research. In section 2.4, we highlighted that a number of publications outlining the possibility of an informed grounded theory as a method of data gathering and analysis, consistent with a critical realist philosophy, motivated us to experiment with a critical realist informed grounded theory approach that we saw emerging. Considering the successes of our research, we can say that such an approach was not merely wishful thinking on our part. We certainly be open to further explore the possibilities of a critical realist informed grounded theory approach in future research.

8.5. Societal reflections

8.5.1. Advancing agroecology as a practice for sustainable food systems

Farming is inherently a social-political activity

In this thesis we explored agroecology as a practice at the farm level from a comprehensive and holistic perspective. This approach led us to conclude that farmers are not merely technical managers, but social agents that interact with their social context, and hence create in part the conditions limiting and enabling effective agroecologically sound agricultural practices, while also addressing or failing to address social dimensions of food systems that are dear to the agroecological movement. Our analysis hence affirms that farmers are political agents to be carefully considered in any transition towards sustainable food systems. We therefore are critical towards a conception of agroecological or sustainable farming practices that doesn't consider the real and potential direct influence of farmers' actions on society at large. For a large part of the agroecological community this is self-evident, as they are actively engaged in enlisting farmers (if they are not farmers themselves) in activities that go well beyond the improvement of the environmental and economic performance of their own farm, though this remains an important element. Indeed farmers are called upon to share and develop knowledge with other farmers, build a community, construct more just economic arrangements, and oppose all kinds of social domination. Our study confirms that this is not just an aspiration in this context, as Flemish beef farmers already, albeit to varying degree, engage in such actions. An avenue we would encourage farmers and farmers' organizations to explore further.

The mobilization of farmers to construct an agroecological food system is particularly pressing in the re-skilling of the agricultural labor force. We found that many farmers often see no other option but to adopt production methods antithetical to agroecological principles listed by scientists. The continued and extensive use of agro-chemicals and pesticides over decades has not only increased farmers' dependence on the market. It has also led to a considerable de-skilling of agricultural

labor (*cfr*. Liodakis 1997), since the knowledge and skills required to engage in low-input practices has been lost, contributing to a warped self-understanding from some conventional farmers, implying that no other ways of farming are possible. While the creation of agro-ecologically knowledgeable farming population is likely to require large-scale state-financed investments in training programs (see section 8.5.3), grass-root farmer movements have shown to have an important role in disseminating and developing knowledge and practices that allow to break the dependence of agriculture on chemical inputs to some extent (Mier y Terán *et al.*, 2018).

A Marxian outlook on transformative politics

In conceptualizing agroecology as a practice that includes these social dimensions, it also falls upon us to consider what the agroecological social movement may take away from this dissertation. Agroecology being a transformational body of thought simultaneously tries to understand and deconstruct the societal relations from which it evolves. In a way, although far less coherent and systematic, it shows some affinities with Marxian political economy which argues that the immanent tendencies of the capitalist mode of production undermine the very material conditions of sustainable human development, (Burkett, 2009; Kenis & Lievens, 2015). We used that explanatory framework to shed light on the pursuit of agroecological principles by the interviewed Flemish beef farmers and to evaluate whether agroecology as a practice represents a coherent intellectual and political program that may move us beyond current societal relations. Based on extensive literature research and the accounts farmers gave about their social reality, we believe the transformative nature of agroecology as a body of thought remains largely aspirational, even though it contains strains of radicalism which are promising in that regard.

Beyond a Manichean world-view

There is certainly a lot of anti-capitalist rhetoric to be found in the agroecological literature, which at least suggests many agroecologists hold on to the notion that a widespread and persistent tendency influencing human behavior is at work. What capitalism actually is, however, is either not articulated at all, or else problematically assumed to be some form of global conspiracy of corporations and governments seeking control over food production and the poor. Many supporters of food sovereignty frame capitalism in terms of a neoliberal food regime, as a top-down and systemic entity that constrains and subordinates the peasantry, yet remains external to the inner dynamics of the latter's existence (Henderson, 2018). Like other contemporary anti-capitalist movements (Postone, 2006), they try to understand the abstract and dynamic social domination of capital with a concretistic theory of domination in which specific individuals and organizations dominate through their practices and beliefs the rest of the population. While this externalization of the enemy may be a politically useful discursive strategy to mobilize farmers by enlisting them in a heroic struggle against the regime (see further, our discussion on agrarian populism), it neglects to scrutinize the many ways farmers often willingly contribute

to the reproduction of the very social system that hampers the implementation of agroecological principles.

Beyond Family farming

Our analysis of the gathered data informed by the lenses of Marxian political economy problematizes the widely held assumption by agroecologists that family farming (Gliessman, 2014), or in political economic terms, family-labor based agricultural commodity production, is a conducive social organization form to put agroecology into practice. As our analysis of the evidence suggests, farmers are very much part of a the capitalist system as it is conceptualized in Marxian political economy. They depend on it for their own economic security, they pursue their own goals within it, and in so doing they reproduce quite uncritically the cultural rules and social relations that constitute it. While it is true that they may be able to carve out a space in this system for themselves to produce in a way that is more in line with their values, these spaces are limited in part because of the very capitalist dynamics that they help set in motion through their productive and marketing behavior. At the farm level then, we find that it is hard to speak of an authentic transformational act by any of the interviewed farmers, *i. e.* one that fundamentally challenges the existing social-political frame of the system. Rather, they work within the limits of their environment, continuously making compromises, combining different strategies, rather than conforming to an ideal type. Being engaged in family farming, rather than working or owning a corporate farm, hardly represents in and of itself a form of resistance to capitalism. Such a view could be repudiated by the just as problematic and functionalistic view that family farming remains significant because it is a politically expedient way to produce cheap food without having to directly suppress labor conditions, as market forces will take care of that (Griffin *et al.*, 2002).

As family farming doesn't represent a break with the capitalist mode of production, one may indeed question, given the history of capitalist agriculture, which supplanted the arguably agroecological agricultural systems of pre-capitalist societies, whether it is indeed a conducive and stable social organization form in the long term for agroecological practices. Neither most of the interviewed farmers, nor most agroecologists seem to grapple with this question, as both are preoccupied with exploring the possibilities within the limits of the family-owned business. This is not a cognitive limitation specific to farmers or agroecologists, however, but a broader ideological phenomenon of capitalist societies in which capitalist social relations have this peculiar quality of naturalizing themselves through the social practice of market exchange, while also alienating humans from each other, their own activities, and from themselves (Eagleton, 1991; White, 2013). Agroecology, as far as we have encountered it therefore fails to articulate avenues out of this system, let alone ones that are appealing enough for farmers to risk their livelihood for.

Towards a post-capitalist alternative

Alternative but widely applicable social organization forms of agricultural production need to be developed and put in place, for agroecologically sound agricultural practices to take hold in the long term. Historically, food systems based on reciprocal and redistributive social arrangements did not have the immanent tendency towards speed up and expansion, as the capitalist social order that arose out of them (Empson, 2014; Mazoyer & Roudart, 2006; Moore, 2015; Polanyi, 1944; Worster, 1990). Some of the systems managed by farmers we interviewed, the CSA's in particular, represent a substantial reversal of the commodification of food, which political economic analysis itself would suggest lies at the basis of the industrialization of agriculture. There is an inherent risk for these initiatives to become mere safe spaces and play grounds for dissatisfied customers and farmers who can afford it (Blättel-Mink *et al.*, 2017). However, the deliberative character of the decision making within CSA's make these initiatives also potential living labs in which a broad-based de-commodification agenda can be outlined and experimented with. A key challenge in that regard is whether and how it is possible in practice to avoid the rise of new forms of direct domination that characterized the non-market based systems of the past (feudalism, state socialism). In other words, whereas non-market-based food systems have certainly existed (feudal and tribal systems) and experimented with on a larger scale (state socialist systems), it remains a question whether they can be reinvented along more democratic lines. Yet, it is in this context perhaps important to note that markets may well have a place even in a post-capitalist social order. It is not market *per se* that have to be objected to but rather the fact that capitalist social relations (notably global private property relations) have come to determine the scope of what is marketed and how. According to Morozov (2019), in markedly altered social conditions, markets may well be of use to become aware of the different needs of individuals and hence inform production and distribution decisions, yet other (digital?) social feedback infrastructure may even be more effective.

Beyond essentialism

While our study demonstrates that some farmers may have the room for maneuver to put multiple principles into practice and also are willing to do so, it is clear that the interests and viewpoints of family farmers do not necessarily align with agroecological principles (Castellanos-Navarrete & Jansen, 2016). Whereas we acknowledge that the category 'peasant' may be usefully applied in progressive struggles to create a political identity for rural people to construct a united opposition to the capitalist state, capitalist factions, or the capitalist economic system generally (see further), it doesn't follow that family farmers, nor for that matter, landless workers, are because of their social position natural allies of the progressive movements. Historical evidence shows, the peasant appears a rather poor substitute for the worker in socialist politics as the historical class subject, which was arguably a flawed essentialist construction to begin with (Bernstein, 2001). As the category of the peasantry is a lumping together of social groups with very different social

positions (indigenous tribes, landless workers, subsistence farmers, small and not so small family-owned businesses with or without land ownership), one may wonder whether this unitary conception of its political base won't harm the agroecological movement in the long-term, as it scathes over actually existing internal class, generational and gender tensions within its ranks that cannot simply be dispensed with in a performative act of unity (Bernstein, 2014).

Against the populist temptation?

We stipulate however, that agrarian populist discourses typically associated with political agroecology have a role to play in food system transitions in this context, as they may mobilize farmers towards agroecological ends, while also weaken right-wing forms of populism in the countryside (Meek, 2014; van der Ploeg, 2020). By emphasizing common interests of farmers against a common enemy "the regime", they raise a form of group consciousness which runs counter to individualist subjectivities that appear an obstacle to farmers for working together, such as sharing and developing resources, information and skills, and by collectively negotiating better terms of trade with downstream and upstream actors. They therefore may also contribute to constructing a more co-operative culture among farmers, which would indeed open up more possibilities for farmers to source their inputs locally, manage diversity, and process and distribute more locally, and take pride in their work. The overlaps between agrarian populism and right-wing populism (notions such as rootedness, tradition, stewardship and autonomy, *etc.*) are part of the appeal of these discourses, yet they are also what makes the operationalization of agrarian populist discourse in anti-capitalist movements a gamble. Class analysis remain therefore crucial to avoid the degeneration of rural movements into reactionary ones (Borras, 2020). Such class consciousness is also likely to challenge agrarian movements to not content themselves with an improved economic position of farmers within the capitalist system, and hence avoid the conservative reflex that worker, trade union and farmer cooperative movements in this region can be accused of in the past, and so lose their transformative potential.

8.5.2. Advancing agroecology as a science for sustainable food systems

Agroecology represents another instance of a cautious "*rapprochement*" of science and the environmental movement which since the 1960s has already had an uneasy relationship with modern science, but found a soft spot for ecological science (Worster 1994, p. 340). For many *'the ecological world view'* suggests that as the world is based upon systemic processes and relationships, our values and actions should be consistent with such a systemic reality (Hay, 2002). If ecology seemed to have that intrinsic quality to be able to fuse modern scientific reason with environmentalist ethics, and agroecology was expected to become a similar supporting and substantiating sustainable agriculture by borrowing concepts and methodologies of ecology. Faced with the sweeping and, at times, devastating

transformation of agriculture across the globe, many – scientists, farmers, citizens alike – have turned to agroecological science, expecting it to deliver nothing less than an agro-food system in a lasting harmony with its biotic environment. However, as is evident from the wealth of agroecological publications (Mason *et al.*, 2021), a scientific, as opposed to a popular, ecological view on agriculture doesn't necessarily lead into an expansion of scientific inquiry into the social sciences, nor does it require a questioning of the productivist aims of agricultural research (*cfr.* Tittonell 2014), nor does it imply a new ethic towards Nature (*e. g.* Botelho *et al.* 2016) (Hay 2002, p. 61). In fact, history shows that ecological science is rather ambivalent to its social ends. Ecology may as well be used to support the status quo than be the cause of social reform, for it can readily be employed as an informant of technological and bureaucratic intervention in order to facilitate continued growth with a minimum of environmental backlash. An insight more politically-oriented agroecologists will surely share (Baltazar *et al.*, 2017; Giraldo & Rosset, 2017; Holt-Giménez & Altieri, 2013; Levidow *et al.*, 2014).

Whereas much of contemporary agricultural scientific research may fail to pass this high bar, it is our view that scientists should not spoil this fragile moment. In an age of widespread ideological confusion, resignation and indifference about environmental and social degradation, engaged and reflexive scientists are badly needed. Whereas important research efforts are put into the further development and dissemination of 'sustainable technologies', our analysis suggests that the lacking application of agroecologically sound agricultural practices isn't solely due to a lack of scientific knowledge or underdevelopment of these technologies, but rather is rooted in the continued reproduction of identifiable widespread social structures and associated cultural norms,. Hence, we would invite researchers to explore this social dimension of farming more fully, and start developing theories on how farmers, and other actors can modify this social context in such a way that is conducive to the implementation of the techno-productive and ecological dimensions. This requires, as other scholars have noted (Castellanos-Navarrete & Jansen, 2016), agroecologists to seriously engage with methodologies and theories developed by critical social fields such as agrarian political economy, political ecology, agri-food studies, and rural sociology. In our own work, we have found that Critical Realism could provide a philosophical underpinning to guide such critical interdisciplinary work. A shared, pluralistic attitude which recognizes that different methodologies and concepts may be more appropriate to different scientific domains, may already go along way (Olsson & Jerneck, 2018). Such a conceptually open approach, we suggest may also allow for continuous critical examination and formulation of action principles in the light of new and old experiences. In that sense we are encouraged by the fact that principles are continuously re-assessed and re-negotiated by the different actors involved in the agroecological community, and as such are taken as our best guidelines to date at best, rather than as unquestionable axioms to be religiously followed. As such, we hope that this dynamic continues, so that agroecological theory and practice may move dialectically forward in the future.

Lastly, the relationship between agroecological science and social movements has to be *mutually* critical in order to be constructive. The current entente of agroecological research with rural and social justice movements has certainly been fruitful to advance both scientific and farmer knowledge, and indeed effective politics. Moreover, it has challenged both social and natural scientists to become more conscious about their own biases, methodological prejudices and complacency on social and environmental justice matters, and on human emancipation. However, in order to set a research agenda that goes beyond the immediate self-perceived interests of the individuals and organizations involved, it is imperative that agroecologists also scrutinize the viewpoints and actions of peasants and affiliated social movements as well. Otherwise, we fear that agroecology 's potential of becoming a full-grown theory of and for sustainable food systems will be limited. To our mind, of key concern is the development of a research agenda that explores in pluralistic fashion both conceptually and in practice widely applicable social organizational forms, as an alternative to the promotion of family labor based petty commodity production under capitalism. An agenda that addresses both the environmental and democratic concerns typically promoted by self-identified agroecologists.

8.5.3. Advancing agroecology as a policy for sustainable food systems

Agroecology represents a fundamental shift from 'ready-to-use' to 'custom-made' production systems (FAO 2017). It therefore challenges not only conventional ways of farming but also conventional ways of governing food systems. It implies a shift from centralized agricultural policy making based on statistical cost-benefit assessments of similar technologies across contexts to a considerably more dynamic, tailored, and participatory approach to the design and management of sustainable food systems instead (Duru, Therond, & Fares, 2015). Such approach however, is unlikely to be successful if the social context in which Flemish beef farmers now have to make decisions doesn't change substantially.

Based on the accounts of a medium-sized but diverse group of Flemish beef farmers we surmise that due to a lack of resources and unhelpful cultural but particularly economic incentives farmers get from their environment, the capacity and willingness of Flemish beef farmers to put agroecology into practice is very limited. Without a countervailing force, particularly in times of extreme economic inequality, the current economic system farmers are embedded in and reproduce, is unlikely to drive agroecologically-sound behavior nor for that matter will it lead to rational, equitable, or democratic outcomes in any meaningful sense of these words, neither in terms of the allocation and use of agricultural means of production, nor in terms of the distribution of agricultural products among the population (*cfr.* Liodakis 2010; Kallis *et al.* 2013; Pirgmaier 2017). In the context of beef farming in Flanders, public policy has already shown that it can be such a counteracting force. In the wake of changing public opinion, public policy has sought to curb the excesses of

industrialized forms of agriculture, and has been able to change the standards for socially acceptable farming practices, thus creating new economic opportunities for farmers more in line with agroecology. The farmers we interviewed also made it clear that public policy was consequential in their decision making. While of course caught up in wider geopolitical contradictions of the global economic system, governments are uniquely positioned, due to their redistributive capabilities, to create the broad social conditions of an agro-ecologically sound agriculture in the short term (Guthman, 2004). If policy makers indeed wish to drastically change the capacity and willingness of beef farmers to put agroecology into practice, public policy should interrogate existing systems of control over economic assets (land, agricultural inputs, intellectual property rights, buildings, processing units, infrastructure, education), and aim to coordinate at different governance levels (municipal, regional, national, international) the needs and productive capacities of farming and non-farming citizens in an equitable and if feasible participatory manner. Farmers are under legitimate pressure to reduce chemical and energy use, replenish soil, and cut greenhouse gases, yet it would be unfair to leave them without the resources to make such changes. Both existing and new farms could benefit from a just transition in which policies support them to overcome barriers to land, capital, and begin to restructure the system from which unequal barriers grow (Blättel-Mink *et al.*, 2017). The implementation of more ecologically integrated ecosystems, will require an appropriately skilled, knowledgeable and likely larger agricultural workforce with sufficient means to develop and implement contextually-appropriate technologies in collaboration with researchers and developers of other economic sectors. In this, we can find arguments in favor of putting substantial public resources into creating these requirements. It was beyond the scope of this investigation to make a systematic assessment of the contradictory ways current policy influences farmers willingness and capacity to pursue agroecological principles, and therefore propose specific instruments that might be most effective in this context. We would refer here to recent reporting EU-funded research (*e. g*. Zilans *et al.* 2019).

Our endorsement of far-reaching government interventions as a strategy to realize this agroecological vision may appear somewhat unexpected in the light of previous sections where our analysis provides arguments for more consistent post-capitalist policies and visions, and also a research agenda that supports such projects. Yet the proposed reforms should not be understood as reforms for reforms' sake. They are articulated in the expectation that the enactment or even just the struggle for such reforms may set in motion a process that would lead to a genuine transformation of the global food system. Such expectations may be too optimistic. We are adamant however, that any serious agroecological movement, namely one that isn't satisfied with local initiatives here and there, has a duty to analyze how government regulation currently affects the implementation of agroecology, how government policy can possibly be influenced, and what policies might conceivably promote agroecology. This last recommendation, evidently, is also one that we would direct to ourselves, without downplaying the fundamental insights on the actual functioning of

contemporary food systems that this exploratory farm- and farmer-centered empirical inquiry already put forward.

8.6. Conclusion

The dissertation explored the relevance of agroecology as a body of thought in the context of beef farming in Flanders. We did so by unraveling how agroecological principles materialized in the actions of a diverse group of Flemish beef farmers. Our empirical investigation revealed that at the surface level, agroecology is present in the diverse practices, viewpoints, and social systems we observed. Hence, we find there is some descriptive validity to common agroecological concepts such as "input-substitution", "peasant vs. industrial farming", "productivism", "sustainable intensification", "alternative markets", "corporate-state regime". As we dug deeper however, we found that these conceptual distinctions ceased to explain the observed practices and perspectives, and this led us to doubt their relevance more broadly. Not that there are no scientifically and politically valid distinctions to be made at all. Rather it is a question of whether these are helpful in containing or even overcoming the very real social antagonisms underlying the degradation of the social and environmental conditions in the Flemish context and globally. Agroecology as a body of thought needs to be transformed, in order to be fully transformative. For all its identified flaws, however, we cannot help but notice that our critical dialogue with agroecology has only invigorated our desire to engage with this question.

Bibliographical References

Bibliographical References

Abolafia, M. 1998. Markets as cultures: An ethnographic approach. *The Sociological Review*, *46*(1_suppl), 69–85.

Akimowicz, M., Cummings, H., & Landman, K. 2016. Green lights in the Greenbelt? A qualitative analysis of farm investment decision-making in peri-urban Southern Ontario. *Land Use Policy*, *55*, 24–36.

Alary, V., Tillard, S., Messad, C., & Taché, E. 2002. Approche de la diversité des systèmes d ' élevage laitiers à la Réunion. *Revue d'Elevage et de Médecine Vétérinaire Des Pays Tropicaux*, *55*(4), 285–297.

Alonso-Fradejas, A., Borras, S. M., Holmes, T., Holt-Giménez, E., & Robbins, M. J. 2015. Food sovereignty: convergence and contradictions, conditions and challenges. *Third World Quarterly*, *36*(3), 431–448.

Altieri, M. A. 1995. *Agroecology: the science of sustainable agriculture.* Intermediate Technology Publications Ltd., London.

Altieri, M. A., Letourneau, D. K., & Davis, J. R. 1983. Developing sustainable agroecosystems. *Bioscience*, *33*(1), 45–49.

Altieri, M. A., & Nicholls, C. I. 2005. *Agroecology and the search for a truly sustainable agriculture* (First Edition). Mexico D. F., Mexico: United Nations Environmental Programme, Environmental Training Network for Latin America and the Caribbean. Mexico D.F.

Altieri, M. A., Nicholls, C. I., & Montalba, R. 2017. Technological approaches to sustainable agriculture at a crossroads: An agroecological perspective. *Sustainability*, *9*(3), 1–13.

Altieri, M. A., & Toledo, V. M. 2011. The agroecological revolution in Latin America: Rescuing nature, ensuring food sovereignty and empowering peasants. *Journal of Peasant Studies*, *38*(3), 587–612.

Andersen, E., Elbersen, B., Godeschalk, F., & Verhoog, D. 2007. Farm management indicators and farm typologies as a basis for assessments in a changing policy environment. *Journal of Environmental Management*, *82*(3), 353–362.

Anderson, C. R., Bruil, J., Chappell, M. J., Kiss, C., & Pimbert, M., eds. 2021. *Agroecology Now! Transformations Towards More Just and Sustainable Food Systems*. Palgrave Macmillan, Cham.

Anderson, C. R., & Maughan, C. 2021. "The Innovation Imperative": The Struggle Over Agroecology in the International Food Policy Arena. *Frontiers in Sustainable Food Systems*, 5, 33.

Archer, M. S. 2003. *Structure, agency and the internal conversation*. Cambridge University Press, Cambridge.

Archer, M. S., Bhaskar, R., Collier, A., Lawson, T., & Norrie, A., eds. 1998. *Critical realism: essential readings*. Routledge, London.

Arrignon, J. 1987. *Agro-écologie des zones arides et sub-humides*. Maisonneuve & Larose, Paris.

Axelrod, R., & Hamilton, W. D. 1981. The evolution of co-operation. *Science*, *211*(4489), 1390–1396.

Bachhofer, M., & Wildenberg, M. 2011. FCMappers − Disconnecting the missing link. http://www.fcmappers.net/joomla/index.php. Accessed June 26, 2018.

Baltazar, S., Lambert, M., Lewuillon, M., Louah, L., Maughan, N., Richelle, L., … Visser, M. 2017. Can we avoid extractivism while doing research in agroecology? A critical view on co-optation and institutionalization of agroecology. Abstracts of Talks and Posters of First Agroecology Europe Forum. Lyon.

Beingessner, N., & Fletcher, A. J. 2020. "Going local": farmers' perspectives on local food systems in rural Canada. *Agriculture and Human Values*, *37*(1), 129–145.

Bell, M. M., & Bellon, S. 2018. Generalization without universalization: Towards an agroecology theory. *Agroecology and Sustainable Food Systems*, *42*(6), 605–611.

Bennett, M. A. 2013. Design of a socio-technical change management process: A critical realist perspective. *International Conference on Engineering Education and Research*. Marrakesh.

Bensin, B. M. 1928. *Agroecological characteristics description and classification of the local corn varieties chorotypes*.

Bensin, B. M. 1930. Possibilities for international cooperation in agroecological investigations. *Int. Rev. Agr. Mo. Bull. Agr. Sci. Pract*, *21*, 277–284.

Bernstein, H. 1977. Notes on Capital and Peasantry. *Review of African Political Economy*, *4*(10), 60–73.

Bernstein, H. 2001. "The Peasantry" in Global Capitalism: Who, Where and Why. *Socialist Register*, *37*, 25–51.

Bernstein, H. 2010. *Class dynamics of agrarian change*. Kumarian Press, Sterling, VA.

Bernstein, H. 2014. Food sovereignty via the 'peasant way': a sceptical view. *Journal of Peasant Studies*, *41*(6), 1031–1063.

Bernstein, H., & Oya, C. 2014. Rural futures - How much should markets rule? IIED Working Paper. London.

Bhaskar, R., Danermark, B., & Price, L. 2018. *Interdisciplinarity and Wellbeing: A Critical Realist General Theory of Interdisciplinarity*. Routledge, Abingdon.

Bijttebier, J., Strubbe, M., Schotte, L., Delanote, L., Jamart, A., Kempen, I., & Marchand, F. 2016. *Bio in Beeld: Succesfactoren voor een geslaagde bedrijfsvoering*. 1-48. Instituut voor Landbouw-, Visserij- en Voedingsonderzoek, Merelbeke.

Blättel-Mink, B., Boddenberg, M., Gunkel, L., Schmitz, S., & Vaessen, F. 2017. Beyond the market—New practices of supply in times of crisis: The example community-supported agriculture. *International Journal of Consumer Studies*, *41*(4), 415–421.

Bonaudo, T., Bendahan, A. B., Sabatier, R., Ryschawy, J., Bellon, S., Leger, F., … Tichit, M. 2014. Agroecological principles for the redesign of integrated crop-livestock systems. *European Journal of Agronomy*, *57*, 43–51.

Borras, S. M. 2020. Agrarian social movements: The absurdly difficult but not impossible agenda of defeating right-wing populism and exploring a socialist future. *Journal of Agrarian Change*, *20*(1), 3–36.

Borremans, L., Visser, M., & Wauters, E. 2019. *The development of agroforestry systems in Flanders. A farming systems research approach to social,*

institutional and economic inquiry. Ph. D. Dissertation. Université Libre de Bruxelles, Brussels.

Bosma, C., Glenk, K., & Novo, P. 2017. How do individuals and groups perceive wetland functioning? Fuzzy cognitive mapping of wetland perceptions in Uganda. *Land Use Policy*, *60*, 181–196.

Botelho, M. I. V., Cardoso, I. M., & Otsuki, K. 2016. "I made a pact with God, with nature, and with myself": exploring deep agroecology. *Agroecology and Sustainable Food Systems*, *40*(2), 116–131.

Botreau, R., Farruggia, A., Martin, B., Pomiès, D., & Dumont, B. 2014. Towards an agroecological assessment of dairy systems: Proposal for a set of criteria suited to mountain farming. *Animal*, *8*(8), 1349–1360.

Braeckman, P. 2017. *Groeihormonen in de veeteelt : een opgelost probleem of een actuele zaak ?* Master thesis. Universiteit Gent, Gent.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D. J., Newig, J., … Von Wehrden, H. 2013. A review of transdisciplinary research in sustainability science. *Ecological Economics*, 92, 1–15.

Brédart, D., & Stassart, P. M. 2017. When farmers learn through dialog with their practices: A proposal for a theory of action for agricultural trajectories. *Journal of Rural Studies*, *53*, 1–13.

Brouwers, J., De Geest, C., Peeters, B., Struyf, I., Vancraeynest, L., Vander Putten, E., … Van Steertegem, M. 2017. *Systeembalans 2017: Milieu-uitdagingen voor het energie-, mobiliteits- en voedingssysteem in Vlaanderen*. Milieurapport Vlaanderen. Vlaamse Milieumaatschappij, Aalst.

Brym, Z. T., & Reeve, J. R. 2016. Agroecological principles from a bibliographic analysis of the term agroecology. In *Sustainable Agriculture Reviews*, ed. E. Lichtfouse, *19*, 203–231. Springer, Cham.

Buchanan, J. 2013. *An integral approach to agroecological research*. Ph. D. Dissertation. University of Wisconsin.

Burch, D., & Lawrence, G. 2009. Towards a third food regime: Behind the transformation. *Agriculture and Human Values*, *26*(4), 267–279.

Burkett, P. 2009. *Ecological Marxism and Ecological Economics*. Haymarket Books, Chicago, IL.

Buttel, F. H. 2003. Envisioning the Future Development of Farming in the USA: Agroecology Between Extinction and Multifunctionality? *New Directions in Agroecology Research and Education*. CRC Press, Boca Raton, FL.

Calvário, R. 2017. Food sovereignty and new peasantries: on re-peasantization and counter-hegemonic contestations in the Basque territory. *Journal of Peasant Studies*, *44*(2), 402–420.

Campbell, B. M., Beare, D. J., Bennett, E. M., Hall-Spencer, J. M., Ingram, J. S. I., Jaramillo, F., … Shindell, D. 2017. Agriculture production as a major driver of the earth system exceeding planetary boundaries. *Ecology and Society*, *22*(4).

Caron, P., Reig, E., Roep, D., Hediger, W., Le Cotty, T., Barthélemy, D., … Sabourin, E. 2008. Multifunctionality: Refocusing a spreading, loose and fashionable concept for looking at sustainability? *International Journal of Agricultural Resources, Governance and Ecology*, *7*(4–5), 301–318.

Castellanos-Navarrete, A., & Jansen, K. 2016. Is Oil Palm Expansion a Challenge to Agroecology? Smallholders Practising Industrial Farming in Mexico. *Journal of Agrarian Change*, *18*(1), 132–155.

Chantre, E., & Cardona, A. 2014. Trajectories of French Field Crop Farmers Moving Toward Sustainable Farming Practices: Change, Learning, and Links with the Advisory Services. *Agroecology and Sustainable Food Systems*, *38*(5), 573–602.

Charmaz, K. 2008. Grounded Theory as an emergent method. In *Handbook of Emergent Methods*, eds. S. N. Hesse-Biber & P. Leavy, *37*, 155–172. The Guildford Press, New York, NY.

Chayanov, A.V. 1966. The theory of peasant economy, eds. D. Thorner, B. Kerblay & R.E.F. Smith. Richard Irwin for the American Economic Association, Homewood, IL.

Chibber, V. 2013. *Post-Colonial Theory and the spectre of capital*. Verso Books, London.

Chiffoleau, Y. 2009. From politics to co-operation: the dynamics of embeddedness in alternative food supply chains. *Sociologia ruralis*, *49*(3), 218-235.

Christen, B., Kjeldsen, C., Dalgaard, T., & Martin-ortega, J. 2015. Can fuzzy cognitive mapping help in agricultural policy design and communication? *Land Use Policy*, *45*, 64–75.

CIDSE. 2018. *The principles of agroecology - Towards just, resilient and sustainable Food Systems*. CIDSE Task Force on agroecology, Brussels. https://www.cidse.org/publications/just-food/food-and-climate/the-principles-of-agroecology.html. Accessed September 8, 2019.

Colman, D., & Young, T. 1989. *Principles of agricultural economics: markets and prices in less developed countries*. Cambridge University Press, Cambridge.

Conway, G. R. 1987. The properties of agroecosystems. *Agricultural Systems*, *24*(2), 95–117.

Coopman, P., & Grenade, F. 2018. *Le baromètre des agricultures familales 2018*. SOS Faim, Îles de Paix et Autre Terre, Huy.

Corbin, J., & Strauss, A. 2014. *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications, Thousand Oaks, CA.

Cox, G. W., Atkins, M. D., & others. 1979. *Agricultural ecology: an analysis of world food production systems.* W. H. Freeman and Company, San Francisco, CA.

Crivits, M. 2016. *Exploring Discursive Representation: Flemish Agriculture as a Case*. Ph. D. Dissertation, Universiteit Gent.

Crivits, M., de Krom, M. P. M. M., Dessein, J., & Block, T. 2018. Discursive representation within the institutional void: The Rise and Fall of a Governance Network on Sustainable Food in Belgium. *Sociologia Ruralis*, *58*(3), 475–499.

Cutler, A., & Breiman, L. 1994. Archetypal analysis. *Technometrics*, *36*(4), 338–347.

D'Annolfo, R., Gemmill-Herren, B., Graeub, B., & Garibaldi, L. A. 2017. A review of social and economic performance of agroecology. *International Journal of Agricultural Sustainability*, *15*(6), 632–644.

Daeseleire, E., De Graef, E., Rasschaert, G., De Mulder, T., Van den Meersche, T., Van Coillie, E., … Heyndrickx, M. 2016. Antibiotic use and resistance in animals: Belgian initiatives. *Drug Testing and Analysis*, *8*(5–6), 549–555.

Dalgaard, T., Hutchings, N. J., & Porter, J. R. 2003. Agroecology, scaling and interdisciplinarity. *Agriculture, Ecosystems and Environment*, *100*(1–3), 39–51.

Danermark, B., Ekström, M., & Karlsson, J. C. 2019. *Explaining society: Critical realism in the social sciences* (Second Ed.). Routledge, London.

Darnhofer, I., Lamine, C., Strauss, A., & Navarrete, M. 2016. The resilience of family farms: Towards a relational approach. *Journal of Rural Studies*, *44*, 111–122.

de Almeida, R. A., Hernandez, D. G., & Collado, A. C. 2014. The'new'agrarian question in Andalucia: processes of repeasantization at times of agrifood empires. *Revista NERA*, *17*(24), 9–36.

De Cock, L., Dessein, J., & de Krom, M. P. 2016. Understanding the development of organic agriculture in Flanders (Belgium): A discourse analytical approach. *NJAS - Wageningen Journal of Life Sciences*, *79*, 1–10.

De Herde, V., Baret, P. V., & Maréchal, K. 2020. Coexistence of cooperative models as structural answer to lock-ins in diversification pathways: The Case of the Walloon Dairy Sector. *Frontiers in Sustainable Food Systems*, 4, 584542.

De Schutter, O. 2009. International trade in agriculture and the right to food. Dialogue on Globalization. *Occasional Papers*, 46. Friedrich Ebert Stichtung, Geneva.

De Schutter, O. 2010. Report submitted by the Special Rapporteur on the right to food. UN General Assembly. Human Rights Council Sixteenth Session, Agenda item 3 A/HRC/ 16/49.

De Schutter, O. 2019. The Political Economy Approach to Food Systems Reform. *IDS Bulletin*, *50*(2), 13–27.

De Wilde, D. 2016. *Een geschiedenis van de biologische landbouw in Vlaanderen aan de hand van de absolute pionier : de Vereniging voor Ecologisch Leven en Tuinieren van 1973 tot 1995*. Master thesis, Universiteit Gent.

Debruyne, L., Triste, L., & Marchand, F. 2017. *Levenslang leren als antwoord op de complexe uitdagingen in landbouw*. Instituut voor Landbouw-, Visserij- en Voedingsonderzoek, Merelbeke.

Dedeurwaerdere, T., De Schutter, O., Hudon, M., Mathijs, E., Annaert, B., Avermaete, T., … Vivero, J. L. 2017. The Governance Features of Social Enterprise and Social Network Activities of Collective Food Buying Groups. *Ecological Economics*, *140*(1), 123–135.

Demolder, H., Schneiders, A., Spanhove, T., Maes, D., Landuyt, W. Van, & Adriaens, T. .2014.. Hoofdstuk 4 - Toestand biodiversiteit. In *Natuurrapport - Toestand en trend van ecosystemen en ecosysteemdiensten in Vlaanderen*, eds. Stevens, M. *et al.* Instituut voor Natuur- en Bosonderzoek, Brussels.

Ditzler, L., Klerkx, L., Chan-dentoni, J., Posthumus, H., Krupnik, T. J., López, S., … Groot, J. C. J. 2018. Affordances of agricultural systems analysis tools : A review and framework to enhance tool design and implementation. *Agricultural Systems*, *164*(164), 20–30.

Dryzek, J. S. 2013. *The politics of the earth: Environmental discourses*. Oxford University Press, Oxford.

Dumont, A. M., Gasselin, P., & Baret, P. V. 2020. Transitions in agriculture: Three frameworks highlighting coexistence between a new agroecological configuration and an old, organic and conventional configuration of vegetable production in Wallonia (Belgium). *Geoforum*, *108*, 98–109.

Dumont, A. M., Vanloqueren, G., Stassart, P. M., & Baret, P. V. 2016. Clarifying the socioeconomic dimensions of agroecology: between principles and practices. *Agroecology and Sustainable Food Systems*, *40*(1), 24–47.

Dumont, B., & Bernués, A. 2014. Editorial: Agroecology for producing goods and services in sustainable animal farming systems. *Animal*, *8*(08), 1201–1203.

Dumont, B., Fortun-Lamothe, L., Jouven, M., Thomas, M., & Tichit, M. 2013. Prospects from agroecology and industrial ecology for animal production in the 21st century. *Animal*, *7*(6), 1028–1043.

Duru, M., Therond, O., & Fares, M. 2015. Designing agroecological transitions; A review. *Agronomy for Sustainable Development*, *35*(4), 1237–1257.

Duru, M., Therond, O., Martin, G., Martin-Clouaire, R., Magne, M. A., Justes, E., … Sarthou, J. P. 2015. How to implement biodiversity-based agriculture to

enhance ecosystem services: a review. *Agronomy for Sustainable Development*, *35*(4), 1259–1281.

Eagleton, T. 1991. *Ideology – An introduction*. Verso, London.

EC. 2008. Commission Regulation (EC) No 1242/2008 of 8 December 2008 establishing a Community typology for agricultural holdings. *Official Journal of the European Union*, *L 335*(13.12.2008), 3–24.

EC. 2020. A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system *Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions.* COM 381 final (20.5.2020).

Edelman, M. 2011. The new Peasantries: Struggles for Autonomy and Sustainability in an Era of Empire and Globalization - Review. *Human Ecology*, *39*(1), 111–113.

Edelman, M. 2014. Food sovereignty: forgotten genealogies and future regulatory challenges. *Journal of Peasant Studies*, *41*(6), 959–978.

Ehrbar, H. G. 2001. Critical realist arguments in Marx's Capital: From Hegel to Bhaskar. In *Marxism and Critical Realism*, eds. Brown, A., Fleetwood, S & Roberts, J. M. Routledge, London.

Elder-Vass, D. 2008. Searching for realism , structure and agency in Actor Network Theory. *British Journal of Sociology*, *59*(3), 455–473.

Emery, S. B. 2015. Independence and individualism: conflated values in farmer cooperation? *Agriculture and Human Values*, *32*(1), 47–61.

Empson, M. 2014. *Land and labour: Marxism, ecology and human history*. Bookmarks Publications, London.

Eugster, M. J. A., & Leisch, F. 2009. From Spider-Man to Hero - Archetypal Analysis in R . *Journal of Statistical Software*, *30*(8).

Ewel, J. J. 1999. Natural systems as models for the design of sustainable systems of land use. *Agroforestry Systems*, *45*(1/3), 1–21.

Fairclough, N., Jessop, B., & Sayer, A. 2002. Critical realism and semiosis. *Alethia*, 2–10.

Fairweather, J., & Hunt, L. M. 2011. Can farmers map their farm system? Causal mapping and the sustainability of sheep/beef farms in New Zealand. *Agriculture and Human Values*, *28*(1), 55–66.

FAO. 2014. *Final Report for the International Symposium on Agroecology for Food Security and Nutrition*. Food and Agriculture Organization of the United Nations. Rome.

FAO. 2017. The future of food and agriculture: trends and challenges. In *The future of food and agriculture: trends and challenges*. Food and Agriculture Organization of the United Nations. Rome.

FAO. 2019. *Tape Tool for Agroecology Performance Evaluation Process of Development and Tape*. Food and Agriculture Organization of the United Nations. Rome.

FAO, & INRA. 2018. *Constructing markets for agroecology - An analysis of diverse options for marketing products from agroecology*. Loconto, A., Jimenez, A. & Vandecandelaere, E. Rome.

Feola, G., & Binder, C. R. 2010. Towards an improved understanding of farmers' behaviour: The integrative agent-centred (IAC) framework. *Ecological Economics*, *69*(12), 2323–2333.

Fernandez, M., Goodall, K., Olson, M., & Méndez, V. E. 2013. Agroecology and alternative agri-food movements in the United States: Toward a sustainable agri-food system. *Agroecology and Sustainable Food Systems*, *37*(1), 115–126.

Filippitzi, M. E., Callens, B., Pardon, B., Persoons, D., & Dewulf, J. 2014. Antimicrobial use in pigs, broilers and veal calves in Belgium. *Vlaams Diergeneeskundig Tijdschrift*, *83*(5), 215–224.

Foster, J. B. 2000. *Marx's Ecology - Materialism and Nature*. Monthly Review Press, New York, NY.

Francis, C., Lieblein, G., Gliessman, S. R., Breland, T. A., Creamer, N., Harwood, R., … Poincelot, R. 2003. Agroecology : The ecology of food systems. *Journal of Sustainable Agriculture*, *22*(3), 99–118.

Freibauer, A., Mathijs, E., Brunori, G., Damianova, Z., Faroult, E., i Gomis, J. G., … Treyer, S. 2011. Sustainable Food Consumption and Production in a

Resource-constrained World Summary Findings of the EU SCAR Third Foresight Exercise. *EuroChoices*, *10*(2), 38–43.

Friedmann, H. 2005. From colonialism to green capitalism: Social movements and emergence of food regimes. *Research in Rural Sociology and Development*, *11*, 227.

Friedmann, H., & Mcmichael, P. 1989. Agriculture and the state system - The rise and decline of national agricultures, 1870 to the present. *Sociologia Ruralis*, *29*(2), 93–117.

Fuchs, D., & Kalfagianni, A. 2010. The causes and consequences of private food governance. *Business and Politics*, *12*(3).

Funtowicz, S., & Ravetz, J. 2003. Post-normal science. In *Internet Encyclopaedia of Ecological Economics*, 443–447.

Gallardo-López, F., Hernández-Chontal, M. A., Cisneros-Saguilán, P., & Linares-Gabriel, A. 2018. Development of the concept of agroecology in Europe: A review. *Sustainability*, *10*(4), 1–23.

Garini, C. S., Vanwindekens, F. M., Scholberg, J. M. S., Wezel, A., & Groot, J. C. J. 2017. Drivers of adoption of agroecological practices for winegrowers and influence from policies in the province of Trento, Italy. *Land Use Policy*, *68*, 200–211.

Gasselin, P., Lardon, S., Cerdan, C., Loudiyi, S., & Sautier, D. 2021. *Coexistence et confrontation des modèles agricoles et alimentaires*. Éditions Quæ, Versailles.

Geels, F. W., & Schot, J. 2007. Typology of sociotechnical transition pathways. *Research Policy*, *36*(3), 399–417.

Geras, N. 1988. Ex-Marxism Without Substance: Being A Real Reply to Laclau and Mouffe. *New Left Review*, (169), 34–61.

Gert, B. 1990. Rationality , Human Nature , and Lists. *Ethics*, *100*(2), 279–300.

Gibon, A., Sibbald, A. R., Flamant, J. C., Lhoste, P., Revilla, R., Rubino, R., & Sørensen, J. T. 1999. Livestock farming systems research in Europe and its potential contribution for managing towards sustainability in livestock farming. *Livestock Production Science*, *61*(2–3), 121–137.

Gijselinckx, C., & Bussels, M. 2012. Support for Farmers' Cooperatives; Country Report Belgium. Wageningen UR, Wageningen.

Giraldo, O. F., & Rosset, P. M. 2017. Agroecology as a territory in dispute: between institutionality and social movements. *Journal of Peasant Studies*, *45*(3), 545-564.

Glaser, B. G., Strauss, A. L., & Strutzel, E. 1968. The discovery of grounded theory; strategies for qualitative research. *Nursing Research*, *17*(4), 364.

Gliessman, S. R. 2007. *Agroecology: the ecology of sustainable food systems* (2nd Edit.). CRC Press. Boca Ratón.

Gliessman, S. R. 2013. Agroecology: Growing the roots of resistance. *Agroecology and Sustainable Food Systems*, *37*(1), 19–31.

Gliessman, S. R. 2014. The International Year of Family Farming. *Agroecology and Sustainable Food Systems*, *38*(5), 503–504.

Gliessman, S. R., Engles, E., & Krieger, R. 1998. *Agroecology: ecological processes in sustainable agriculture*. CRC Press, Boca Raton, FL.

Gliessman, S. R., Friedmann, H., & Howard, P. H. 2019. Agroecology and food sovereignty. *IDS Bulletin*, *50*(2), 91–110.

Goodman, D. 1999. Agro-food studies in the "age of ecology": Nature, corporeality, bio-politics. *Sociologia Ruralis*, *39*(1), 17–38.

Goodman, David, Dupuis, E. M., & Goodman, M. K. 2011. *Alternative Food Networks Knowledge practice and politics*.

Granovetter, M. 1985. Economic action and social structure : the problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510.

Griffin, K., Rahman, A., & Ickowitz, A. 2002. Poverty and the Distribution of Land. *Journal of Agrarian Change*, *2*(3), 279–330.

Guiomar, N., Godinho, S., Pinto-Correia, T., Almeida, M., Bartolini, F., Bezák, P., … Wästfelt, A. 2018. Typology and distribution of small farms in Europe: Towards a better picture. *Land Use Policy*, *75*, 784–798.

Gunderson, R. 2014. *Nature, sociology and the Frankfurt School*. Ph. D. Dissertation, Michigan State University.

Guthman, J. 2000. Raising organic : An agro-ecological assessment of grower practices in California. *Agriculture and Human Values*, *17*, 257–266.

Guthman, J. 2004. *Agrarian dreams: The paradox of organic farming in California*. Univ of California Press, Berkely and Los Angeles, CA.

Guzmán, E. S., & Woodgate, G. 2013. Agroecology: Foundations in agrarian social thought and sociological theory. *Agroecology and Sustainable Food Systems*, *37*(1), 32–44.

Harvey, D. 2010. *A Companion to Marx's Capital*. Verso, London.

Hay, P. R. 2002. *Main currents in Western environmental thought*. University of New South Wales Press, Sydney.

Henderson, T. P. 2016. Food Sovereignty and the Via Campesina in Mexico and Ecuador : Class Dynamics , Struggles for Autonomy and the Politics of Resistance. *Agrarian Change*, *18*, 1–276.

Henderson, T. P. 2018. The Class Dynamics ofFood Sovereignty in Mexico and Ecuador. *Agrarian Change*, *18*(1), 3–21.

Hermans, F., Horlings, I., Beers, P. J., & Mommaas, H. 2010. The contested redefinition of a sustainable countryside: Revisiting frouws' rurality discourses. *Sociologia Ruralis*, *50*(1), 46–63.

Higgins, V. 2006. Re-figuring the problem of farmer agency in agri-food studies: A translation approach. *Agriculture and Human Values*, *23*(1), 51–62.

Hill, S. B., & MacRae, R. J. 1996. Conceptual framework for the transition from conventional to sustainable agriculture. *Journal of Sustainable Agriculture*, *7*(1), 81–87.

HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Hodgkinson, G. P., Maule, A. J., & Bown, N. J. 2004. Causal Cognitive Mapping in the Organizational Strategy Field: A Comparison of Alternative Elicitation Procedures. *Organizational Research Methods*, *7*(1), 3–26.

Holling, C. S. 1996. Engineering resilience versus ecological resilience. In *Engineering within Ecological Constraints*, ed. P.C. Schulze, 31–43. The National Academies Press, Washington, D. C.

Holt-Giménez, E., & Altieri, M. A. 2013. Agroecology, food sovereignty, and the new green revolution. *Agroecology and Sustainable Food Systems*, *37*(1), 90–102.

Holt-Giménez, E., & Shattuck, A. 2011. Food crises, food regimes and food movements: Rumblings of reform or tides of transformation? *Journal of Peasant Studies*, *38*(1), 109–144.

Hubeau, M., Vanderplanken, K., Vandermoere, F., Rogge, E., Van Huylenbroeck, G., & Marchand, F. 2019. Sharing is caring: The role of culture in the transformative capacity and continuation of agri-food networks. *Environmental Innovation and Societal Transitions*, *33*(April), 127–139.

IPES-Food. 2019. Towards a Common Food Policy for the European Union: The policy reform and realignment required to build sustainable food systems in Europe. International Panel of Experts on Sustainable Food Systems, Brussels.

Iraizoz, B., Gorton, M., & Davidova, S. 2007. Segmenting farms for analysing agricultural trajectories: A case study of the Navarra region in Spain. *Agricultural Systems*, *93*(1–3), 143–169.

Jackson, M. C. 2001. Critical systems thinking and practice. *European Journal of Operational Research*, *128*(2), 233–244.

Jackson, W. A. 2007. On the Social Structure of Markets. *Cambridge Journal of Economics*, *31*(2), 235–253. https://doi.org/10.2753/sor1061-0154420644

Jansen, K. 2009. Implicit sociology, interdisciplinarity and systems theories in agricultural science. *Sociologia Ruralis*, *49*(2), 172–188.

Jansen, K. 2015. The debate on food sovereignty theory: agrarian capitalism, dispossession and agroecology. *Journal of Peasant Studies*, *42*(1), 213–232.

Jones, N. a., Ross, H., Lynam, T., Perez, P., & Leitch, A. 2011. Mental Model an Interdisciplinary Synthesis of Theory and Methods. *Ecology and Society*, *16*(1), 46–46.

Kallis, G., Gómez-Baggethun, E., & Zografos, C. 2013. To value or not to value? That is not the question. *Ecological Economics*, *94*, 97–105.

Karl Falkenberg. 2016. Sustainability Now! A European Vision for Sustainability. European Political Strategy Centre. Strategic Notes, 18.

Kenis, A., & Lievens, M. 2015. *The limits of the Green Economy: From re-inventing capitalism to re-politicising the present*. Routledge, London.

Kerkvliet, B. J. T. 2009. Everyday politics in peasant societies (and ours). *Journal of Peasant Studies*, *36*(1), 227–243.

Keulemans, W., Avermaete, T., Claes, J., De Tavernier, J., Geeraerd, A., Govers, G., … Vanpaemel, G. 2015. Voedselproductie en voedselzekerheid: De onvolmaakte waarheid. Visietekst werkgroep Metaforum, 14. Leuven.

Khumairoh, U., Groot, J. C. J., & Lantinga, E. A. 2012. Complex agro-ecosystems for food security in a changing climate. *Ecology and Evolution*, *2*(7), 1696–1704.

Klerkx, L., Mierlo, B. Van, & Leeuwis, C. 2012. Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. In *Farming Systems Research into the 21st Century: The New Dynamic*, eds. I. Darnhofer, Ika, Gibbon, D., Dedieu, B., 457–483. Springer Netherlands, Dordrecht.

Köbrich, C., Rehman, T., & Khan, M. 2003. Typification of farming systems for constructing representative farm models: Two illustrations of the application of multi-variate analyses in Chile and Pakistan. *Agricultural Systems*, *76*(1), 141–157.

Kok, K. P. W., Loeber, A. M. C., & Grin, J. 2021. Politics of complexity : Conceptualizing agency , power and powering in the transitional dynamics of complex adaptive systems. *Research Policy*, *50*, 104183.

Koutsouris, A. 2012. Facilitating Agricultural Innovation Systems: A critical realist approach. *Studies in Agricultural Economics*, *114*(2), 64–70.

Krippner, G., Granovetter, M., Block, F., Biggart, N., Beamish, T., Hsing, Y., … Riain, S. O. 2004. Polanyi Symposium : a conversation on embeddedness. *Socio-Economic Review*, (2), 109–135.

Lacoste, M., Lawes, R., Ducourtieux, O., & Flower, K. 2017. Methods to Study Agricultural Systems. In *Sustainable Agriculture Reviews*, ed. E. Lichtfouse, 115–148. Springer, Cham.

Lamine, C., Darnhofer, I., & Marsden, T. K. 2019. What enables just sustainability transitions in agrifood systems? An exploration of conceptual approaches using international comparative case studies. *Journal of Rural Studies*, *68*, 144–146.

Landais, E. 1998. Modelling farm diversity: New approaches to typology building in France. *Agricultural Systems*, *58*(4), 505–527.

Landert, J., Pfeifer, C., Carolus, J., & Al., E. 2019. Report 3.1 on environmental, economic and social performance of current AEFS, and comparison to conventional baseline. Uniseco Project Deliverable. FiBL, Geneva.

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., … Thomas, C. J. 2012. Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science*, *7*(SUPPL. 1), 25–43.

Langfield-Smith, K., & Wirth, A. 1992. Measuring differences between cognitive maps. *Journal of the Operational Research Society*, *43*(12), 1135–1150.

Lebacq, T. 2015. *La durabilité des exploitations laitières en Wallonie: analyse de la diversité et voies de transition*. 1–282. Ph. D. Dissertation, Université catholique de Louvain-la-Neuve.

Levidow, L. 2015. European transitions towards a corporate-environmental food regime: Agroecological incorporation or contestation? *Journal of Rural Studies*, *40*, 76–89.

Levidow, L., Pimbert, M., & Vanloqueren, G. 2014. Agroecological Research: Conforming—or Transforming the Dominant Agro-Food Regime? *Agroecology and Sustainable Food Systems*, *38*(10), 1127–1155.

Liodakis, G. 1997. Technological Change in Agriculture: A Marxist Critique. *Sociologia Ruralis*, *37*(1), 61–78.

Liodakis, G. 2010. Political economy, capitalism and sustainable development. *Sustainability*, *2*(8), 2601–2616.

Long, N. 1997. Agency and Constraint, Perceptions and Practices. A Theoretical Position. *Images and Realities of Rural Life. Wageningen Perspectives on Rural Transformations*, 1–20.

Lucas, V., Gasselin, P., Thomas, F., & Vaquié, P.-F. 2015. Coopération agricole de production : quand l'activité agricole se distribue entre exploitation et action collective de proximité. In *L'agriculture En Famille : Travailler, Réinventer, Transmettre*, eds. P. Gasselin, Choisis, J.-P. , Petit, S. , Purseigle, F. & S. Zasser. 201-222. EDP Sciences, Les Ulis.

Machado, N. M. C. 2010. Karl Polanyi and the New Economic Sociology: Notes on the Concept of (Dis)embeddedness. *RCCS Annual Review*, *3*, 119–140.

Madry, W., Mena, Y., Roszkowska-Madra, B., Gozdowski, D., Hryniewski, R., & Castel, J. M. 2013. An overview of farming system typology methodologies and its use in the study of pasture-based farming system: A review. *Spanish Journal of Agricultural Research*, *11*(2), 316–326.

Makkar, H. P. S. 2018. Review: Feed demand landscape and implications of food-not feed strategy for food security and climate change. *Animal*, *12*(8), 1744–1754.

Malézieux, E. 2012. Designing cropping systems from nature. *Agronomy for Sustainable Development*, *32*(1), 15–29.

Markóczy, L., & Goldberg, J. 1995. A method for eliciting and comparing causal maps. *Journal of Management*, *21*(2), 305–333.

Marsden, T. 2013. From post-productionism to reflexive governance: Contested transitions in securing more sustainable food futures. *Journal of Rural Studies*, *29*, 123–134.

Marsden, T., Munton, R., Ward, N., & Whatmore, S. 1996. Agricultural geography and the political economy approach: a review. *Economic Geography*, *72*(4), 361–375.

Marsden, T., Murdoch, J., & Morgan, K. 1999. Sustainable agriculture, food supply chains and regional development: editorial introduction. *International Planning Studies*, 4(3), 295-301.

Marten, G. G. 1988. Productivity, stability, sustainability, equitability and autonomy as properties for agroecosystem assessment. *Agricultural Systems*, *26*(4), 291–316.

Martin, G., Moraine, M., Ryschawy, J., Magne, M.-A., Asai, M., Sarthou, J.-P., Duru, M. & Therond, O. 2016. Crop–livestock integration beyond the farm level: a review. *Agronomy for Sustainable Development*, *36*. 53.

Marx, K. 1867. C*apital: A Critique of Political Economy Vol. 1*. The Marx/Engels Internet Archive. http://www.marxists.org. Accessed at December 3, 2018.

Mason, R. E., White, A., Bucini, G., Anderzén, J., Méndez, V. E., & Merrill, S. C. 2021. The evolving landscape of agroecological research. *Agroecology and Sustainable Food Systems*, *45*(4), 551-591.

Mathevet, R., Etienne, M., Lynam, T., & Calvet, C. 2011. Water management in the Camargue biosphere reserve: Insights from comparative mental models analysis. *Ecology and Society*, *16*(1), 43.

Maxwell, J. A., & Mittapalli, K. 2010. Realism as a stance for mixed methods research. In *SAGE Handbook of Mixed Methods in Social and Behavioural Research*, eds. A. Tashakkori & Charles Teddlie, 145–167. Sage Publications, Thousand Oaks, CA.

Mazoyer, M., & Roudart, L. 2006. *A history of world agriculture: from the neolithic age to the current crisis*. NYU Press. New York, NY.

Mcevoy, P., & Richards, D. 2006. A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of Research in Nursing*, *11*(1), 66–78.

Mcmichael, P. 2013. Historicizing Food Sovereignty: a Food Regime Perspective. Conference on Food Sovereignty: A Critical Dialogue. September 14-15, 2013. Program in Agrarian Studies, Yale University, New Haven, CT.

McMichael, P. 2006. Global Development and The Corporate Food Regime. *Research in Rural Sociology and Development*, *11*, 265–299.

Meek, D. 2014. Agroecology and Radical Grassroots Movements' Evolving Moral Economies. *Environment and Society: Advances in Research*, *5*(1), 47–65.

Méndez, V. E., Bacon, C. M., & Cohen, R. 2013. Agroecology as a transdisciplinary, participatory, and action-oriented approach. *Agroecology and Sustainable Food Systems*, *37*(1), 3–18.

Merot, A., Ugaglia, A. A., Barbier, J., & Del'homme, B. 2019. Diversity of conversion strategies for organic vineyard. *Agronomy for Sustainable Development*, *39*, 16.

Meyer, S. B., & Lunnay, B. 2013. The application of abductive and retroductive inference for the design and analysis of theory-driven sociological research. *Sociological Research Online*, *18*(1), 12.

Micha, E., Fentonb, O., Dalyb, K., Kakonyic, G., Ezattib, G., Moloneyb, T., … Thornton. 2019. *Mapping the pathways towards farm-level sustainable intensification of agriculture: an exploratory network analysis of stakeholders' views*.

Mier y Terán, M. G. C., Giraldo, O. F., Aldasoro, M., Morales, H., Ferguson, B. G., Rosset, P., … Campos, C. 2018. Bringing agroecology to scale: key drivers and emblematic cases. *Agroecology and Sustainable Food Systems*, *42*(6), 637–665.

Migliorini, P., & Wezel, A. 2017. Converging and diverging principles and practices of organic agriculture regulations and agroecology. A review. *Agronomy for Sustainable Development*, *37*, 63.

Mingers, J., Mutch, A., & Willcocks, L. 2013. Critical realism in Information systems research. *MIS Quarterly*, *37*(X), 1–10.

Mirowski, P. 2018. The future(s) of open science. *Social Studies of Science*, *48*(2), 171–203.

Moliner, J., & Epifanio, I. 2019. Robust multivariate and functional archetypal analysis with application to financial time series analysis. *Physica A: Statistical Mechanics and Its Applications*, *519*, 195–208.

Monsieurs, S. 2018. *De relevantie van agro-ecologische principes voor Vlaamse rundveebedrijven : focus op biodiversiteitsaspecten.* Master thesis, Universiteit Antwerpen.

Moore, J. W. 2015. *Capitalism in the Web of Life*. Verso Books, Brooklyn, NY.

Morozov, E. 2019. Digital Socialism? *New Left Review*, (116/117), 33–68.

Mørup, M., & Hansen, L. K. 2012. Archetypal analysis for machine learning and data mining. *Neurocomputing*, *80*, 54–63.

Nakamura, K., Iwai, S., & Sawaragi, T. 1982. Decision Support Using Causation Knowledge Base. *IEEE Transactions on Systems, Man and Cybernetics*, *12*(6), 765–777.

Napel, J. ten, Bianchi, F., & Bestman, M. 2006. Utilising intrinsic robustness in agricultural production systems: Inventions for a sustainable development of agriculture. In *Inventions for a sustainable development of agriculture*, 1, 32–53. TransForum Agro & Groen, Wageningen.

Nicot, R., Bellon, S., Loconto, A., & Ollivier, G. 2018. *The European networks of research , education and training stakeholders in agroecology*. (July), 1–5.

Norder, L. A., Lamine, C., Bellon, S., & Brandenburg, A. 2016. Agroecology: Polysemy, Pluralism and Controversies. *Ambiente and Sociedade*, *19*(3), 1–20.

Nuijten, E. 2011. Combining research styles of the natural and social sciences in agricultural research. *NJAS - Wageningen Journal of Life Sciences*, *57*(3–4), 197–205.

Oberlack, C., Sietz, D., Bonanomi, E. B., De Bremond, A., Dell' Angelo, J., Eisenack, K., … Villamayor-Tomas, S. 2019. Archetype analysis in sustainability research: meanings, motivations, and evidence-based policy making. *Ecology and Society*, *24*(2).

Odum, E. P. 1964. The new ecology. *BioScience*, *14*(7), 14–16.

Odum, H. T. 1967. Energetics of world food production. *Problems of World Food Supply. President's Science Advisory Committee Report*, *3*, 55–94.

Oliver, C. 2012. Critical realist grounded theory: A new approach for social work research. *British Journal of Social Work*, *42*(2), 371–387.

Olsson, L., & Jerneck, A. 2018. Social fields and natural systems: Integrating knowledge about society and nature. *Ecology and Society*, *23*(3).

Oosterlynck, S. 2011. The political economy of state restructuring and the regional uneven transition to after-Fordism in Belgium. In *Contemporary Centrifugal Regionalism: Comparing Flanders and Northern Italy.*, ed. M. Huysseune,

83–94. Koninklijke Vlaamse Academie van België Voor Wetenschappen En Kunsten, Brussel.

Oteros-Rozas, E., Ravera, F., & García-Llorente, M. 2019. How does agroecology contribute to the transitions towards social-ecological sustainability? *Sustainability*, *11*(16), 1–13.

Özesmi, U., & Özesmi, S. L. 2004. Ecological models based on people's knowledge: A multi-step fuzzy cognitive mapping approach. *Ecological Modelling*, *176*(1–2), 43–64.

Pacilly, F. C. A., J. C. J. Groot, G. J. Hofstede, B. F. Schaap, and E. T. Lammerts van Bueren. 2016. Analysing potato late blight control as a social-ecological system using fuzzy cognitive mapping. *Agronomy for Sustainable Development*, 36, 35.

Pacini, G. C., Colucci, D., Baudron, F., Righi, E., Corbeels, M., Tittonell, P., & Stefanini, F. M. 2014. Combining multi-dimensional scaling and cluster analysis to describe the diversity of rural households. *Experimental Agriculture*, *50*(3), 376–397.

Papageorgiou, E. I., Markinos, A., & Gemptos, T. 2009. Application of fuzzy cognitive maps for cotton yield management in precision farming. *Expert Systems with Applications*, *36*(10), 12399–12413.

Peeters, A. 2010. Country pasture/forage resource profile for Belgium. Food and Agricultural Organization of the United Nations, Rome.

Pirgmaier, E. 2017. The Neoclassical Trojan Horse of Steady-State Economics. *Ecological Economics*, *133*, 52–61.

Platteau, J., Lambrechts, G., Roels, K., & Van Bogaert, T. 2018. Uitdagingen voor de Vlaamse Land- en Tuinbouw. Landbouwrapport 2018. Departement Landbouw en Visserij, Brussels.

Plumecocq, G., Debril, T., Duru, M., Magrini, M. B., Sarthou, J. P., & Therond, O. 2018. The plurality of values in sustainable agriculture models: Diverse lock-in and coevolution patterns. *Ecology and Society*, *23*(1).

Polanyi, K. 1944. *The great transformation*. New York, NY: Farrar & Rinehart.

Porpora, D. 1989. Four Concepts of Social Structure. In *Critical realism - Essential Readings* (pp. 339–355).

Porpora, D. 1993. Cultural Rules and Material Relations. *Sociological Theory*, *11*(2), 212–229.

Postone, M. 2006. History and helplessness: Mass mobilization and contemporary forms of anticapitalism. *Public Culture*, *18*(1), 93–110.

Postone, M. 2017. The current crisis and the anachronism of value. *Continental Thought & Theory: A Journal of Intellectual Freedom*, *1*(4), 38–54.

Potter, C., & Tilzey, M. 2005. Agricultural policy discourses in the European post-Fordist transition: Neoliberalism, neomercantilism and multifunctionality. *Progress in Human Geography*, *29*(5), 581–600.

Reisinger, A., & Clark, H. (2018). How much do direct livestock emissions actually contribute to global warming? *Global Change Biology*, *24*(4), 1749–1761.

Renting, H., Rossing, W. A. H., Groot, J. C. J., Van der Ploeg, J. D., Laurent, C., Perraud, D., … Van Ittersum, M. K. 2009. Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework. *Journal of Environmental Management*, *90*(SUPPL. 2), S112–S123.

Restrepo, M., Lelea, M., Christinck, A., Hülsebusch, C., & Kaufmann, B. 2014. Collaborative learning for fostering change in complex social-ecological systems: a transdisciplinary perspective on food and farming systems. *Knowledge Management for Development Journal*, *10*(3), 38–59.

Richards, H. 2018. On the intransitive objects of the social (or human) sciences. *Journal of Critical Realism*, *17*(1), 1–16.

Righi, E., Dogliotti, S., Stefanini, F. M., & Pacini, G. C. 2011. Capturing farm diversity at regional level to up-scale farm level impact assessment of sustainable development options. *Agriculture, Ecosystems and Environment*, *142*(1–2), 63–74.

Rivera-Ferre, M. G. 2018. The resignification process of Agroecology: Competing narratives from governments, civil society and intergovernmental organizations. *Agroecology and Sustainable Food Systems*, *42*(6), 666–685.

Rosset, P. M., & Altieri, M. A. 1997. Agroecology versus input substitution: A fundamental contradiction of sustainable agriculture. *Society and Natural Resources*, *10*(3), 283–295.

Rosset, P. M., Altieri, M. A., & others. 2017. *Agroecology: science and politics.* Fernwood Publishing, Black Point, NS.

Rosset, P. M., & Martínez-Torres, M. E. 2012. Rural social movements and agroecology: Context, theory, and process. *Ecology and Society*, *17*(3).

Rothmayer, J. C. 2016. An Ethnographically Inspired Study of Farming Families and Food Practices in the Northern Highlands of Ecuador - Implications for Food Sovereignty. Master thesis Wageningen UR.

Rubin, I. 1928. *Essays on Marx ' s Theory of Value*. Black and Rose Books Ltd., Montreal, Quebec.

Sabourin, E., & Djama, M. 2009. Pratiques paysannes de la multifonctionnalité Nordeste brésilien et Nouvelle-Calédonie. *Économie Rurale*, *273*(1), 120–133. https://doi.org/10.3406/ecoru.2003.5394

Schotte, L., Baret, P. V., & Marchand, F. *Two steps approach to enlarge agroecological knowledge in the Flemish bovine sector*. Unpublished working document.

Silici, L. 2014. Agroecology. What It Is And What It Has To Offer. IIED Issue Paper. IIED, London.

Smith, S. P., & Johnston, R. B. 2014. How critical realism clarifies validity issues in information systems theory-testing research. *Scandinavian Journal of Information Systems*, *26*(1), 5–28.

Sorrell, S. 2018. Explaining sociotechnical transitions: A critical realist perspective. *Research Policy*, *47*(7), 1267–1282.

Soussana, J.-F., Tichit, M., Lecomte, P., & Dumont, B. 2014. Agroecology: integration with livestock. Proceedings of the FAO International Symposium on Agroecology for Food Security and Nutrition -, 225–249.

Stassart, P. M., Baret, P. V., Grégoire, J.-C., Hance, T., Mormont, M., Reheul, D., & Stilmant, D. 2012. L'agroécologie : Trajectoire et potentiel pour une transition vers des systèmes alimentaires durables. In *Agroécologie Entre Pratiques et Sciences Sociales*, eds. D. Van Dam, Streith, M., Nizet, J. & Stassart, P. M., 25-51. Éducagri éditions, Dijon.

Stassart, P. M., Crivits, M., Hermesse, J., Tessier, L., Van Damme, J., & Dessein, J. 2018. The generative potential of tensions within Belgian agroecology. *Sustainability*, *10*(6).

Stassart, P. M., & Jamar, D. 2008. Steak up to the horns! The conventionalization of organic stock farming: Knowledge lock-in in the agrifood chain. *GeoJournal*, *73*(1), 31–44.

Statbel. 2013. Landbouwtellings/enquête-gegevens 1980-2013. FOD Economie - De Algemene Directie Statistiek -Statistics Belgium (AD Statistiek), Brussels.

Statbel. 2019a. Kerncijfers - Statistisch Overzicht van België 2019. De Algemene Directie Statistiek -Statistics Belgium (AD Statistiek), Brussels.

Statbel. 2019b. Kerncijfers landbouw 2019. De Algemene Directie Statistiek - Statistics Belgium (AD Statistiek), Brussels.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2020. Pathways of action followed by Flemish beef farmers – an integrative view on agroecology as a practice. *Agroecology and Sustainable Food Systems*, *45*(1), 111–133.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2021. Identifying the farming models underlying Flemish beef farmers ' practices from an agroecological perspective with archetypal analysis. *Agricultural Systems*, *187*, 103013.

Thornberg, R. 2012. Informed grounded theory Informed Grounded Theory. *Scandinavian Journal of Educational Research*, *3*(56), 243–259.

Tilzey, M. 2017. Reintegrating economy, society, and environment for cooperative futures: Polanyi, Marx, and food sovereignty. *Journal of Rural Studies*, *53*, 317–334.

Tilzey, M. 2019. Food Regimes, Capital, State, and Class: Friedmann and McMichael Revisited. *Sociologia Ruralis*, *59*(2), 230–254.

Timmermans, I., & Van Bellegem, L. 2019. *De biologische Landbouw in 2019*. Brussel.

Timmermans, S., & Tavory, I. 2012. Theory Construction in Qualitative Research. *Sociological Theory*, *30*(3), 167–186.

Tittonell, P. (2014). Ecological intensification of agriculture-sustainable by nature. *Current Opinion in Environmental Sustainability*, *8*, 53–61.

Tittonell, P., Bruzzone, O., Solano-Hernández, A., López-Ridaura, S., & Easdale, M. H. 2020. Functional farm household typologies through archetypal responses to disturbances. *Agricultural Systems*, *178*(November 2019), 102714.

Toffolini, Q., Cardona, A., Casagrande, M., Dedieu, B., Girard, N., & Ollion, E. 2018. Agroecology as farmers' situated ways of acting : a conceptual framework. *Agroecology and Sustainable Food Systems*, *43*(5), 514–545.

Tomich, T. P., Brodt, S., Ferris, H., Galt, R., Horwath, W. R., Kebreab, E., … Yang, L. 2011. Agroecology: A Review from a Global-Change Perspective. *Annual Review of Environment and Resources*, *36*(1), 193–222.

Tordjman, H. 2004. How to Study Markets ? An Institutionalist Point of View. *Revue d'économie Industrielle*, *107*(3), 19–36. https://doi.org/10.3406/rei.2004.3046

van der Ploeg, J. D. 1990. *Labor, markets and agricultural production.* Westview Press. Boulder, CO.

van der Ploeg, J. D. 1994. Styles of farming: an introductory note on concepts and methodology. *Endogenous Regional Development in Europe: Theory, Method and Practice*, eds. H. J.de Haan & van der Ploeg, J. D., 7–30. Van Assen, Gorcum.

van der Ploeg, J. D. 2010a. Farming styles research: the state of the art. Keynote Lecture for the Workshop on 'Historicising Farming Styles,' 21–23 October. Melk, Austria.

van der Ploeg, J. D. 2010b. The peasantries of the twenty-first century: The commoditisation debate revisited. *Journal of Peasant Studies*, *37*(1), 1–30.

van der Ploeg, J. D. 2011. The Drivers of Change : the Role of Peasants in the Creation of an Agro-Ecological Agriculture. *Agroecología*, *6*, 47–54.

van der Ploeg, J. D. 2013a. Peasant-driven agricultural growth and food sovereignty. *The Journal of Peasant Studies*, *6150*(6), 999–1030.

van der Ploeg, J. D. 2013b. *Peasants and the art of farming - A chayanovian manifesto*. Fernwood Publishing, Black Point, NS.

van der Ploeg, J. D. 2020. The Political Economy of Agroecology. *Journal of Peasant Studies*, *95*(1), 177–200.

van der Ploeg, J. D., Barjolle, D., Bruil, J., Brunori, G., Costa Madureira, L. M., Dessein, J., … Wezel, A. 2019. The economic potential of agroecology: Empirical evidence from Europe. *Journal of Rural Studies*, *71*, 46–61.

van der Ploeg, J. D., Laurent, C., Blondeau, F., & Bonnafous, P. 2009. Farm diversity, classification schemes and multifunctionality. *Journal of Environmental Management*, *90*(SUPPL. 2), S124–S131.

van Hemert, M., & Peeters, A. 2020. Agroecology initiatives in Belgium. In *Agroecology initiatives in Europe* (pp. 45–64). Agroecology Europe, Corbais.

Van Winsen, F., de Mey, Y., Lauwers, L., Van Passel, S., Vancauteren, M., & Wauters, E. 2013. Cognitive mapping: A method to elucidate and present farmers' risk perception. *Agricultural Systems*, *122*, 42–52.

Vandermeer, J., & Perfecto, I. 2013. Complex traditions: Intersecting theoretical frameworks in agroecological research. *Agroecology and Sustainable Food Systems*, *37*(1), 76–89.

Vanloqueren, G., & Baret, P. V. 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. *Research Policy*, *38*(6), 971–983.

Vanwindekens, F. M., Baret, P. V., & Stilmant, D. 2014. A new approach for comparing and categorizing farmers' systems of practice based on cognitive mapping and graph theory indicators. *Ecological Modelling*, *274*, 1–11.

Vanwindekens, F. M., Stilmant, D., & Baret, P. V. 2013. Development of a broadened cognitive mapping approach for analysing systems of practices in social – ecological systems. *Ecological Modelling2*, *250*(2013), 352–262.

Venkatesh, V., Brown, S., & Sullivan, Y. 2016. Guidelines for conducting mixed-methods research: An extension and illustration. *Journal of the Association for Information Systems*, *17*(7), 435–495.

Verleye, G., & Zadorina, K. 2017. *Imago van de landbouw(er) in Vlaanderen: imagometing 2017 in opdracht van VILT*. Universiteit Gent.

VMM. 2015. Verzurende en vermestende luchtverontreiniging in Vlaanderen – jaarrapport 2014. Vlaamse Milieumaatschappij, Brussels.

VMM. 2017. MIRA - Systeembalans 2017. Milieurapport Vlaanderen 2017. Vlaamse Milieumaatschappij, Brussels.

VMM. 2019. Nutriënten in oppervlaktewater in landbouwgebied, resultaten MAP-meetnet 2018-2019. Vlaamse Milieumaatschappij, Brussels.

von Oelreich, J., & Milestad, R. 2016. Sustainability transformations in the balance: exploring Swedish initiatives challenging the corporate food regime. *European Planning Studies*.

Vrints, G., & Deuninck, J. 2015. Rentabiliteits- en kostprijsanalyse vleesvee. Departement Landbouw en Visserij, Brussels.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. 2004. Resilience, Adaptability and Transformability in Social – ecological Systems. *Ecology and Society*, *9*(2), 5.

WCED. 1988. Our Common Future. Report of the World Commission on Environment and Development, New York, NY.

WEF. 2009. *New Vision for Agriculture. A global initiative of the World Economic Forum*. http://ofbf.org/uploads/AgResourceDirectory.pdf. Accessed on February 17, 2021.

Wezel, A., Bellon, S., Doré, T., Francis, C. A., Vallod, D., & David, C. 2009. Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainainable Development*, *29*, 503–515.

Wezel, A., Casagrande, M., Celette, F., Vian, J. F., Ferrer, A., & Peigné, J. 2014. Agroecological practices for sustainable agriculture. A review. *Agronomy for Sustainable Development*, *34*(1), 1–20.

Wezel, A., & Peeters, A. 2014. Agroecology and herbivore farming systems – principles and practices. *Options Méditerranéennes*, *109*(109), 753–768.

Wezel, A., & Soldat, V. 2009. A quantitative and qualitative historical analysis of the scientific discipline of agroecology. *International Journal of Agricultural Sustainability*, *7*(1), 3–18.

White, H. 2013. Materiality, Form, and Context: Marx contra Latour. *Victorian Studies*, *55*(4), 1–110.

Wilson, G. A. 2008. From "weak" to "strong" multifunctionality: Conceptualising farm-level multifunctional transitional pathways. *Journal of Rural Studies*, *24*(3), 367–383.

Wittman, H. 2009. Reworking the metabolic rift: La Vía Campesina, agrarian citizenship, and food sovereignty. *Journal of Peasant Studies*, *36*(4), 805–826.

World Forum for Food Sovereignty. 2007. Declaration of the Forum for Food Sovereignty. Nyéléni Village, Sélingué. https://nyeleni.org/IMG/pdf/DeclNyeleni-en.pdf Accessed on October, 2, 2020.

Worster, D. 1990. Transformations of the Earth: Toward an Agroecological Perspective in History. *The Journal of American History*, *76*(4), 1087–1106. https://doi.org/10.2307/2936586

Worster, D. 1994. *Nature's economy: a history of ecological ideas*. Cambridge University Press, Cambridge.

WWF. 2020. Rapport Planète Vivante - La Nature en Belgique. Szczodry O., Eggermont H., Paquet J-Y., Herremans M., Luyten S., WWF, Brussels.

Zachariadis, M., Scott, S., & Barrett, M. 2013. Methodological implications of critical realism for mixed-methods research. *MIS Quarterly*, *37*(3), 855–879.

Zanden, J. L. van. 1991. The first green revolution: the growth of production and productivity in European agriculture, 1870-1914. *The Economic History Review*, *44*(2), 215–239.

Zilans, A., Vanni, F., Povellato, A., & Al., E. 2019.. Report D5.1. Inventory of Market and Policy Incentives Supporting AEFS. UNISECO Project Deliverable. CREA, Arezzo.

Zinsstag, J., Schelling, E., Waltner-Toews, D., & Tanner, M. 2011. From "one medicine" to "one health" and systemic approaches to health and well-being. *Preventive Veterinary Medicine*, *101*(3–4), 148–156.

Annexes

Annexes

10.1. Annex 1: Interview Guide

This annex presents a translation of the interview guide used for most of the data collection of this research. The pilot interviews were conducted with a less elaborate interview guide to flexibly experiment with ways of introducing the research to the farmer, to explain the CMing, the sequence of the different interview parts (CMing before or after the discussion of principles).

1. Social Introduction

First let me introduce myself. I am Louis Tessier, 24 years old, born and raised in Ghent. I am an agricultural engineer by training and have been working as a PhD researcher at the social sciences unit of ILVO in Merelbeke since November last year. My research examines whether and how agro-ecological farming practices can be relevant for Flemish beef farmers. In agro-ecology, an attempt is made to approach agriculture in an ecological way, by mapping and understanding the different relationships between plants, soil, animals and humans, in order to see if we can use these insights to create a more sustainable design of the system. Consider, for example, growing grass-clover instead of soybean meal from Brazil, production for the local market, using natural enemies to suppress pests and diseases. Now that all sounds nice, but such practices aren't common here, and what I want to understand is why in some cases they do and in others they don't. For example, in terms of greenhouse gas emissions, it might be better to produce your own feed protein by growing your own clover than to have soy sourced from Brazil, but if your soil is not suitable, or it is too much work, or it does not fit in the animal diet, or one is not familiar with the cultivation, or the investment to switch is too expensive, and so on and so on, it is perfectly understandable that many beef farmers don't cultivate clover.There are countless ways in which farmers use their land and countless reasons why they do so. So it is this problem that I want to take a closer look at. Through interviews with various beef farmers, I hope to gain a better insight into the what, the how and the why of certain practices. My research focuses on identifying opportunities and brakes at the company level, so I hope to link back to you later to see if one or the other strategy could offer opportunities.

2. Informed Consent

Before I continue, I must formally ask you permission to continue with the interview and use the information I obtain. There are no risks associated with this study, your name and your company will not be identified in the results and publications of this study.

[hand over documents to give informed consent]

[recorder on]

3. Introductory Quesions

- To begin with, I would have liked to familiarize myself with your company. What do you say when you are asked what you are doing?
- What kind of cattle do you keep? Is this exclusively beef cattle? and is that then fattening cattle as well as raising heifers and keeping suckler cows?
- And is that meat for the wholesale trade or for local processing and sales?
- Do you also have other agriculture-related activities, such as arable farming, greenhouse cultivation or keeping poultry?
- How did the company come about?
- What do you think are the strengths of you and your company?
- What do you think are the weaker points of you and your company?
- What is your vision for you and your company? What do you want to do in five years? And what should you focus on to achieve that vision? Or if it's not all in your hands, what should be included?

4. Cognitive mapping

STEP 1: Explanation of the mapping process

What I would like to do with you now is try to visualize how different aspects of your business are connected. We are going to do this by making a kind of mind map. It is easiest to explain this with an example. Show example map (Figure 30). This is what they call a “cognitive map” that a fisherman has made of a lake in Turkey that he is fishing. He has selected a few terms that he considered important to describe this system, and between those terms that that person considered important, positive and negative arrows were drawn. A positive arrow indicates that when one term increases the other increases, but also that when one term decreases, the other decreases as well. For example, the fisherman saw a positive relationship between the water area and the fish population because if there were a larger water surface, there would also be more fish in the lake, and reverse also: even if there is less water surface, there would be less fish in it. A negative relationship indicates that an increase in one results is a decrease in the other. For example, if the water is more polluted, the fisherman thinks that this has a negative impact on his catch, or if the water were less polluted, his catch would be higher. There can also be double arrows drawn.

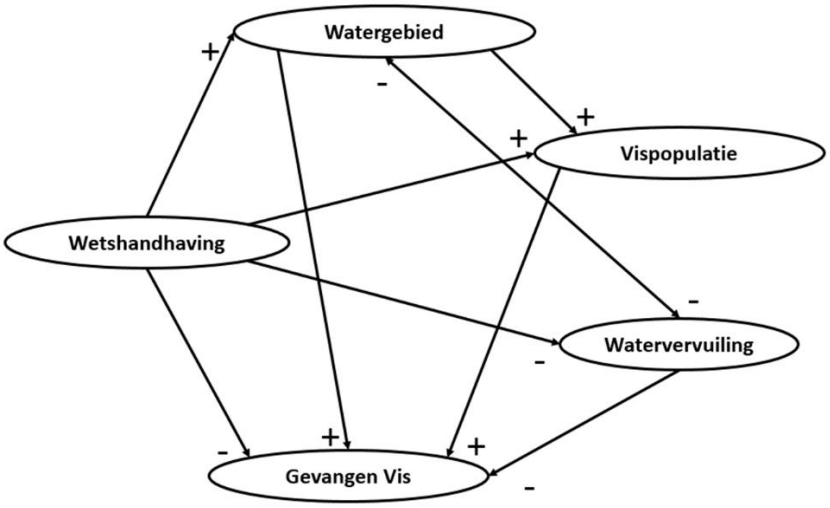

Figure 30 Example of CM used to explain the rules of CMing to farmers. Translation of map provided by Özesmi and Özesmi (2004).

STEP 2: Sorting

I'm going to give you cards with about 50 terms and then ask you to sort them into three stacks. A stack of terms that are very important to the running of the business and therefore should definitely be in the schedule, a stack that is moderately important, they play a role but more indirectly, and a stack where you need to take much less into account. If you think you are interpreting a term differently than I do, you can always clarify what you mean.

STEP 3: Mapping

Now the goal is to make a kind of mind map with these terms, like on this paper. Extract some concepts that are important to you to describe how the business works in the broad sense of the word today. Stick them anywhere on the sheet, and try to link them with a positive or negative arrow. Each time you add a term to the map, try to think: what does this term affect and what term affects it? You are not supposed to use all concepts, they may all have something to do with your company, so limit it to a maximum of twenty. Feel free to tell us why you are linking one to the other. There are no wrong answers in this process here, see it as a means of communicating several important connections you see.

Examples of remarks to help the farmer during the mapping process:

Does this term relate to another term that is already there? What if… decreases, what does that have an effect on, or what how can… decrease or increase? So if this is rising, is this going to fall / rise?

STEP 4: Follow-up questions

- Did you experience that something was missing in the glossary? what would that be, and how would you link it to the others?
- What are the main points of the cognitive map?
- What are you trying to maximize, what to minimize?
- Do you think this mapping process served you in any way?

5. Discussion of Principles

I am now going to present you with some agroecological principles. My questions to you are: What do you understand by this principle? How do you see this principle applied to your business? What actions do you take to realize this principle? Which factors play a role in this? What important effect does that have on the rest of the company? And if you think that the fulfillment of the principle is not entirely in your hands, do you still take actions that make a difference, even if only symbolically? How do you still see this principle applied? What are you trying to do to see that realized…

Read principle, and if deemed necessary explain with extra text.

1. Strengthen animal health in an integrated way
    a. So don't just use medication to solve a disease, and what's more, it's better to prevent than to cure.
2. Close nutrient cycles
    a. This concerns organic material, nitrogen, phosphorus, *etc.* So for example try to keep the nutrients on the farm there by avoiding losses or if something leaves the company to return it,
3. Maintain a high diversity of species and genetic variants over time and space
    a. This involves multiple crop types / varieties / mixtures, in rotation, in mixed culture, *etc.*, but also keeping multiple animal species and breeds.
4. Protect and use biodiversity (natural diversity above, on, in and around the field)
    a. So on the one hand, species on which production depends, such as earthworms and other soil organisms that break down dead material and make it available to plants, bees for pollination, *etc.* and on the other hand also species that use the agricultural landscape as a habitat, such as a buzzard, or a fox for example, or wild flowers and the like.
5. Reduce the use of external (chemical) inputs
    a. Like fuel, electricity, pesticides, fertilizers, this can be done by making more efficient use of inputs by using other inputs that can also perform this function, or by trying to fulfill this function with proprietary processes.
6. Increase the resilience and adaptability of the ecosystem against environmental pressures and shocks,
    a. for example, against drought, wetness, frost, invasive pests, external pollution
7. Strive for as much independence as possible from influential suppliers or customers.

    a. So avoid powerful players, eg by collaborating with other people or by just doing it yourself ...
8. Strive for greater financial independence and control over economic and technical decisions
    a. See that the bank does not dictate what you do and don't do ...
9. Exchange knowledge with different sources to find problems and solutions.
    a. The idea that we should not individually figure out the problems that arise ourselves, but that we can call on a knowledge network
10. Maintain the social network in the countryside
    a. Do you have a lot of contact with people in the neighborhood, how does the company play a role in this?
11. Collaborate with other producers and consumers.
    a. Producers: labor, land, capital, products, and the same for consumers
12. Create local food systems of production and consumption.
    a. Is what you produce also eaten here?
13. Equally distribute the burdens and benefits of food production
    a. Is everyone involved getting their rightful share of the pie?

6. Structured Questionnaire

I would now also like to request some indicators about the structure and management of the company. Normally, this survey should be completed fairly quickly

7. Snowball Sampling

> Do you know any other beef farmer, that we might contact and who might be interested in doing an interview with us as well? This might be a farmers who has a very similar way of going about farming as you do, or somebody who 's doing it totally differently than you.

10.2. Annex 2: cluster means

Table 21 Cluster means for activity indicator, with their respective labels and groups

Definition		Cluster	Cluster Means						
			D_ind	S_ind	RDC_ind	RSC_ind	VP_ind	FAT_ind	
0	0.1 DRDC	D_RDC1	0.47	0.03	0.25	0.02	0	0.11	451
		D_RDC2	0.46	0.01	0.4	0	0	0.03	458
		D_RDC3	0.69	0.01	0.15	0.01	0	0.04	272
		D_RDC4	0.59	0	0.24	0	0	0.02	894
		D_RDC5	0.52	0	0.32	0	0	0.02	1028
		RDC_D	0.34	0.01	0.51	0	0	0.06	114
	0.2 D	D	0.95	0	0.01	0	0	0.02	123
	0.3 VP	VP	0	0	0	0	0.99	0	193
	0.4 Other	RDC	0.01	0	0.93	0.01	0	0.03	92
		D_RDC_VP	0.51	0	0.26	0	0.15	0.04	27
		RDC_VP	0.02	0.01	0.59	0.02	0.25	0.05	7
1	1.1. DSRH	D_RDC_S_RSC	0.36	0.1	0.26	0.1	0	0.07	296
		D_RH_S_FAT	0.24	0.18	0.18	0.2	0	0.1	154
		D_S_RDC_RSC	0.39	0.18	0.13	0.11	0	0.07	227
		RSC_S_D_FAT_RDC	0.19	0.27	0.07	0.27	0	0.11	93
	1.2. DSRHFAT	D_FAT_RDC_S_RSC	0.29	0.14	0.15	0.11	0	0.23	392
		FAT_RSC_D_S_RDC	0.18	0.13	0.09	0.19	0	0.35	251
		FAT_S_D_RH	0.18	0.25	0.07	0.15	0	0.27	290
	1.3. Other	D_FAT_RDC	0.47	0.02	0.13	0.02	0	0.27	165
		D_RDC_FAT	0.34	0.01	0.29	0.01	0	0.28	197
		FAT_D_RDC	0.28	0.03	0.11	0.04	0	0.49	156
		FAT_RDC	0.01	0.02	0.32	0.03	0	0.61	60
		RDC_FAT	0.03	0.03	0.66	0.01	0.01	0.26	38
		D_RSC_FAT	0.4	0.02	0.08	0.32	0.01	0.1	79
		D_VP_FAT_RDC_S	0.36	0.08	0.12	0.04	0.2	0.18	7
		FAT_S_RH	0.01	0.29	0.21	0.08	0.01	0.35	86
		RDC_S_FAT	0.02	0.31	0.46	0.03	0.02	0.09	40
		RSC_RDC_S_FAT	0.01	0.08	0.38	0.46	0	0.06	26
		S_RDC_FAT	0	0.52	0.26	0.02	0.01	0.12	43
		S_RSC_RDC_FAT	0.01	0.36	0.22	0.23	0.01	0.13	68
		S_VP_FAT	0.02	0.49	0	0.03	0.3	0.13	17
		RDC_RSC_FAT	0.01	0.08	0.51	0.22	0	0.16	21
		FAT_VP	0.01	0.06	0.02	0.04	0.37	0.48	16
		S_RSC_VP	0.01	0.37	0	0.24	0.23	0.1	31
		VP_R	0.04	0.04	0.03	0.03	0.8	0.04	25

Table 22 Continuation Table 21

Definition		Cluster	Cluster Means						
			D_ind	S_ind	RDC_ind	RSC_ind	VP_ind	FAT_ind	
2	2.1. FAT	FAT	0	0.01	0	0.01	0	0.98	677
	2.2. FATRSC	FAT_RSC	0.01	0.04	0.01	0.26	0	0.69	210
		RSC_FAT_S	0.01	0.07	0.01	0.51	0	0.39	178
	2.3. RSC	RSC	0.01	0.02	0	0.88	0	0.08	178
	2.4. SRSC	RSC_S	0	0.29	0	0.57	0	0.07	358
		S	0	0.88	0	0.03	0	0.04	99
		S_RSC1	0	0.58	0	0.25	0	0.06	327
		S_RSC2	0	0.44	0	0.41	0	0.06	512
3	3.0 SRSCFAT	FAT_S_RSC1	0.01	0.27	0.01	0.08	0	0.59	308
		FAT_S_RSC2	0	0.27	0	0.23	0	0.44	647
		RSC_S_FAT	0	0.32	0	0.41	0	0.2	498
		S_FAT	0	0.56	0	0.07	0	0.22	203
		S_FAT_RSC1	0	0.32	0	0.31	0	0.32	707
		S_FAT_RSC2	0	0.4	0	0.16	0	0.36	612
		S_RSC_FAT	0	0.43	0	0.27	0	0.21	530

10.3. Annex 3: Scoring Table

Table 23 weights and frequencies of farmers classified by their membership of archetype of scored practices. Cut-off threshold set at 66.7 percent.

Scored practices	Cases	POA 1	POA 2	POA 3	POA 4	POA 5	None	A 1	A 2	A 3
Principle 1: Animal Health		CONTROL	BASIC ANIMAL HEALTH	ADAPTIVE	/	/	N= 16	N= 7	N= 9	N= 5
Vaccination	19		1				63%	57%	11%	80%
tolerate some disease	2			1			0%	14%	11%	0%
supplement minerals and vitamins	12		1				25%	29%	33%	60%
study occuring diseases	3		1				0%	0%	11%	40%
strive for high levels of production	2			-1			6%	0%	0%	20%
strawing stables	11		1				31%	14%	33%	40%
separate calves	8	1					25%	0%	0%	80%
selective breeding herd	9		1				19%	29%	11%	60%
secure nutrition	9	1					13%	29%	0%	100%
rotational grazing for animal health	2			1			0%	0%	22%	0%
robust breeds and crossbreeds	11			2			25%	14%	67%	0%
preventive medication	4	1					13%	14%	0%	20%
optimize climatic cond housing	10		1				25%	43%	22%	20%
no preventive medication	3			1			6%	0%	22%	0%
no natural calving	23			-1			56%	86%	33%	100%
nematicides grazing areas	1	1					6%	0%	0%	0%

natural repellents	1			1			0%	14%	0%	0%
lower stocking densities in stable	13		1				31%	14%	44%	60%
kill germs in stable	5	1					13%	0%	0%	60%
invest in good housing conditions	25		1				63%	71%	56%	100%
immediate treatment	4	1					6%	0%	11%	40%
feed nutritionally balanced out	7	1					19%	0%	0%	80%
extensive grazing	10			1			19%	0%	67%	20%
extensive feed	13			1			19%	0%	89%	40%
enough grazing opportunities for animals	6			1			6%	0%	56%	0%
diversity in grazing areas	16			1			25%	14%	89%	60%
collostrum!	15		1				31%	29%	44%	80%
early wheaning	8	1					19%	0%	11%	80%
closed herd	21		1				69%	57%	44%	40%
clean animals	11	1					38%	0%	33%	40%
awareness for disease	8		1				31%	0%	11%	40%
avoid contamination from outside	2	1					6%	0%	0%	20%
trust animals adapt to perils natural environment	2			1			6%	0%	11%	0%
safe stable environment	9	1					19%	29%	22%	40%
breed with tame animals in herd	4		1				6%	0%	22%	20%
alternative and light treatments	2			1			0%	0%	22%	0%
Principle 2: Nutrient Cycling		LOSS MITIGATION	INTERNAL CYCLING	EXTERNAL CYCLING	/	/				
selling straw	1		-2				6%	0%	0%	0%
dependence on off-farm straw	12		-2				25%	43%	44%	20%
storage facilities for manure and slurry	4	1					13%	14%	0%	20%
selling roughage	5		-2				19%	0%	22%	0%
dependence on off-farm roughage	13		-2				31%	29%	56%	20%

reduce stable emissions	16	1					38%	14%	56%	80%
less and timely tilling	14	1					38%	29%	78%	60%
no till cultivation	7	2					19%	14%	11%	40%
reduce losses during application fertilizer	16	1					38%	71%	33%	40%
recuperate field run-offs with trees	12	1					19%	0%	89%	20%
permanent soil cover	3	2					0%	0%	33%	0%
two-way exchange manure for straw with farmers	3			2			13%	14%	0%	0%
two-way exchange manure for fodder with farmers	5			2			19%	0%	22%	0%
no or little fertilizer on pastures	14	1					25%	14%	78%	40%
monitor and limit fertilizer dose on fields	18	1					50%	43%	22%	100%
re-use on-farm manure and slurry	31		1				75%	86%	89%	100%
no off-farm manure	11		2				31%	14%	33%	40%
no export manure	24		2				75%	43%	56%	80%
export manure	16		-2				50%	57%	33%	20%
dependence on off-farm manure	17		-2				56%	14%	56%	40%
maintain soil cover in winter	19	1					69%	0%	33%	100%
liming and mineral fertilizers	9		-1				25%	14%	33%	20%
field residues and mow margins for feed	7		1				19%	14%	22%	20%
reduce concentrate requirements	12		1				19%	0%	89%	20%
on-farm concentrates production	25		2				75%	29%	89%	60%
dependence on off-farm concentrates	24		-1				69%	71%	56%	60%
compost on-farm residues	5		1				6%	0%	44%	0%
application of concentrated N-fertilizers	13		-1				31%	43%	44%	20%
Principle 3: Planned Diversity		WITH SEPARATION	WITHOUT SEPARATION							
sow flower mixtures in field margins	3		1				0%	0%	33%	0%
bushes and trees around parcels	12		1				25%	0%	78%	20%
broad field margins with grass	4		1				13%	0%	11%	20%

somewhat to very intensive grassland management	21		-2				56%	43%	67%	60%
very intensive grassland management	15		-2				50%	43%	11%	60%
somewhat to very extensive grassland management	28		2				75%	29%	100%	100%
very extensive grassland management	12		2				19%	14%	67%	40%
short to long crop rotation over parcels	34	4					88%	100%	89%	100%
short crop rotation over parcels	8	-2					6%	86%	11%	0%
long crop rotation over parcels	7	2					19%	0%	0%	80%
polycultures (grass-clover, grain-legum mixtures, ...)	21		2				69%	14%	89%	20%
no arable farming	1	-2					0%	0%	11%	0%
intercropping of various vegetables	5		6				13%	0%	33%	0%
intercropping of trees (agroforestry)	3		3				0%	0%	33%	0%
own seed production and selection	1		2				6%	0%	0%	0%
multiple commercial hybrids used	5	1					19%	14%	11%	0%
commercial landraces and alternative grains	4		1				6%	0%	33%	0%
cover crops and green manures	17	2					63%	0%	22%	100%
species mixtures as green manures	8		1				25%	0%	0%	80%
off-farm animal genetic material	23		1				63%	86%	33%	80%
multiple animal species held separately	15	4					31%	29%	78%	20%
multiple animal breeds held together	11		2				19%	14%	67%	20%
multiple animal breeds held separately	3	2					0%	14%	11%	20%
monitor inbreeding	9		1				31%	14%	0%	60%
Principle 4: Associated Diversity		SOIL CONSERVATION	NATURE CONSERVATION	/	/	/				
pest control in stables	5		-1				13%	0%	0%	60%
no fly conrol in stables	1		1				0%	0%	11%	0%
no spraying of field margins	14		1				31%	57%	22%	60%
install broad field margin	4		1				13%	0%	11%	20%

bushes and trees around parcels	12		2				25%	0%	78%	20%
artificial pond	2		2				0%	0%	22%	0%
hospitable living environment around farm property	6		2				6%	14%	33%	20%
more intensive grassland managemtn	22		-2				63%	43%	67%	60%
very intensive grassland management	16		-2				56%	43%	11%	60%
nematicide treatment grasslands	1	-2					6%	0%	0%	0%
less intensive to extensive grassland management	21		2				38%	29%	100%	80%
extensive grassland management	18		2				31%	29%	100%	40%
reduced or no chemical pesticides	18		1				38%	29%	78%	60%
organic farming and no biopesticides	10		1				19%	0%	78%	0%
reduce soil disturbance	18	2					38%	29%	78%	60%
non-allelopathic crop protection methods	12		1				25%	0%	67%	40%
maintain soil cover	19	2					69%	0%	33%	100%
incorporate organic matter	35	2					94%	86%	100%	100%
sow flower mixtures	3		2				0%	0%	33%	0%
mainly grassland in management	3		2				0%	0%	33%	0%
late ploughing of green manure	1		1				6%	0%	0%	0%
intercropping with trees (agroforestry)	3	2	2				0%	0%	33%	0%
grass-clover in rotation	17		2				56%	0%	78%	20%
grain-legume meadow for feeding birds	2		1				6%	14%	0%	0%
avoid acidification from fertilizers and slurry	31	2					75%	86%	100%	80%
accept weeds and pests	5		2				13%	0%	33%	0%
P5: External Input Use		EFFICIENCY	SUBSTITUTION	REDESIGN	LOW-OUTPUT	TRANSFER				
mechanical crop protection methods	11		2				25%	0%	56%	40%
high diversity of crops	12			2			31%	0%	33%	80%

efficient use chemical pesticides	8	2					19%	29%	0%	60%
disease resistant commercial varieties	1		2				0%	0%	0%	20%
count on natural enemies in the environment	7			4			13%	0%	56%	0%
alternative pesticides	5		2				13%	0%	22%	20%
selective spraying of weeds in pastures	4	2					6%	14%	11%	20%
rotational grazing with sheep	1			2			0%	0%	11%	0%
no weed control in meadows	15				2		25%	29%	78%	40%
mow weeds in pastures	4		2				6%	0%	33%	0%
accept damage weeds and pests in fields	5				2		13%	0%	33%	0%
long grazing season, less mowing	4			2			0%	0%	44%	0%
fuel efficiency	15	2					38%	29%	56%	40%
no till cultivation	7			2			19%	14%	11%	40%
more efficient machinry	5	2					6%	0%	33%	20%
less and timely tilling	8	2					13%	29%	44%	0%
isolated water trays	1	1					6%	0%	0%	0%
economic and only neccesary driving	4	1					13%	0%	11%	20%
buy pre-pressed straw	1		1				6%	0%	0%	0%
alternative heat sources	6		2				6%	29%	22%	20%
on-farm wood production	1			1			0%	0%	11%	0%
substitute for other off-farm inputs	18		2				56%	14%	67%	40%
re-use on-farm manure, slurry and residues	32			2			75%	86%	100%	100%
maintain soil cover	19			1			69%	0%	33%	100%
legumes	21			2			63%	14%	89%	40%
accept lower quality feed	13				2		19%	0%	100%	20%
energy efficiency and easy savings	4	1					19%	0%	0%	20%
alternative electricity sources	18		2				38%	43%	56%	80%
on-farm straw production	12					-1	56%	43%	0%	0%
on-farm roughage production	25					-1	81%	29%	78%	60%
on-farm concentrates production	25					-1	75%	29%	89%	60%
dependence on off-farm straw	9					2	13%	29%	44%	20%
dependence on off-farm roughage	12					2	25%	29%	56%	20%
dependence on off-farm concentrates	24					2	69%	71%	56%	60%

P6: Ecological Resilience		AVOID	MITIGATE	AVOID & MITIGATE	COPE	/				
transfer risk	6				1		19%	14%	22%	0%
store feed	4				1		6%	14%	22%	0%
reduce stocking densities	20		2	2			44%	14%	100%	60%
reduce soil disturbance and compaction	18		2	2			38%	29%	78%	60%
mitigate soil disturbance and compaction	3		1	1			6%	0%	0%	40%
maintain soil cover	19		2	2			69%	0%	33%	100%
irrigation system	7		2	2			19%	14%	11%	40%
incorporate organic matter (no slurry)	31		2	2			75%	86%	89%	100%
improve draining fields	4		2	2			13%	14%	11%	0%
green manures and temporary grasslands in rotation	29		2	2			94%	14%	89%	100%
diversify income sources	22				1		69%	14%	67%	80%
diversified land use	21		2	2	1		50%	0%	89%	100%
bushes and trees	12		2	2			25%	0%	78%	20%
agroforestry	3		2	2			0%	0%	33%	0%
compensate soil mineral deficiencies	9		2	2			25%	14%	33%	20%
build in financial buffer	14				1		50%	0%	22%	80%
avoid high fertilizer doses	2		2	2			6%	0%	11%	0%
avoid contamination from outside	23	2		2			75%	57%	44%	60%
adequate housing	26		2	2			63%	86%	56%	100%
adapted plant species and breeds	14		2	2			31%	29%	78%	0%
P7: Commercial Autonomy		DO-IT-YOURSELF	CONTROL	ALTERNATIVE PARTNERS	/	/				
put commercial partners in competition	12		2				44%	0%	11%	80%

produce for spot markets	7		1				38%	0%	0%	20%
no room for maneuver to negotiate	8		-1				19%	29%	11%	40%
have a financial buffer to negotiate	11		2				38%	0%	11%	80%
gather market information short term	8		1				25%	0%	0%	80%
trusting and fixed relationships with suppliers	7		-1				13%	29%	0%	60%
contract-based production	12		-1				38%	29%	0%	80%
don't take commercial debt	9		1				38%	0%	11%	40%
on-farm concentrates production	25	2					75%	29%	89%	60%
deels eigen krachtvoer	13	-1					44%	29%	22%	40%
reduce services needed	9	1					25%	14%	0%	80%
own processing of agricultural products	10	2					25%	29%	44%	0%
no or very low use of fertilizers, pesticides and seeds	11	2					19%	0%	89%	0%
sporadic sale to consumers	8	1					25%	29%	0%	40%
regular sale to consumers	19	4					44%	29%	100%	20%
active in cattle trading	2	2					13%	0%	0%	0%
differentiate product for price difference in chain	9		1				19%	29%	33%	20%
co-operative processing	6			2			6%	0%	44%	20%
co-operative distribution	15			2			50%	0%	78%	0%
collective market power	9		2				19%	14%	33%	40%
anticipate long-term market cycles	2		1				6%	0%	0%	20%
alternative suppliers	7			2			25%	14%	22%	0%
alternative sale channels	22			2			63%	43%	67%	60%
P8: Financial Autonomy		INDEPENDENCE	BORROW ON OWN TERMS	MANAGE FINANCES	/	/				
strong dependence on land lord or bank	6	-2	-2				31%	14%	0%	0%
share investments	9	2					31%	0%	44%	0%
transfer financial risk to third party	6			1			19%	14%	22%	0%

diversify to reduce risk exposure	13			1			38%	0%	44%	60%
reduce investment needs	9	1					19%	29%	33%	20%
reduce investment costs	1	1					0%	0%	11%	0%
no lending	12	2					13%	29%	89%	0%
negotiate interest rates with bank	5		1				19%	14%	0%	20%
lend strategically	9		2				25%	0%	33%	40%
lend cautiously	11		1				31%	0%	33%	60%
know your numbers	8			3			25%	0%	22%	40%
find alternative financial sources	4	2					6%	0%	33%	0%
build in financial buffer	10			3			38%	0%	11%	60%
P9: Knowledge Exchange		SHARE KNOWLEDGE	BUILD KNOWLEDGE	/	/	/				
work as a consultant	2	4	1				6%	0%	11%	0%
sporadic informal exchange with colleagues	15	1	1				31%	14%	56%	80%
rely on own knowledge	5		2				19%	0%	22%	0%
regular informal exchange with colleagues	10	2	2				31%	14%	22%	40%
organize on-farm workshops	1	4	1				0%	0%	11%	0%
netwerken met vaste groepen	19	2	2				38%	29%	78%	80%
infovergaderingen lb	14	1	2				31%	86%	0%	60%
consultants	12		4				19%	14%	67%	40%
commercial partners	17		2				56%	29%	22%	80%
involved in participatory research projects	4	4	2				6%	0%	33%	0%
contact government research centers	2		2				0%	0%	22%	0%
visit other farms	4		2				13%	14%	11%	0%
monitoring own acitivities	12		4				31%	0%	33%	80%
gather documentation	8		2				0%	29%	44%	40%
follow courses	3		4				13%	0%	11%	0%
experiment at the farm	7		4				13%	0%	44%	20%

accept groups of farmers visiting	5	2	1				19%	14%	0%	20%
P10: Rural Social Fabric		RURAL SOCIAL LIFE	RURAL ECONOMY	/	/	/				
yearly on-farm festivities for customers	3		5				6%	14%	11%	0%
voluntary work local clubs	5	1					13%	14%	11%	20%
school visits	6	1					19%	14%	11%	20%
sale end-products from or to farmers	10		1				25%	0%	67%	0%
render services to farmers	23		1				69%	14%	89%	60%
plan production with farmers	3		1				6%	0%	22%	0%
organize processing with farmers	3		1				6%	0%	22%	0%
organize among farmers for market power	8		1				25%	0%	22%	40%
exchange manure with farmers	24		1				75%	43%	78%	40%
exchange machinry with other farmers	13		1				31%	0%	78%	20%
exchange land with other farmers	14		1				38%	29%	44%	40%
exchange knowledge with farmers	34		1				94%	86%	89%	100%
exchange fodder, feed and straw with farmers	22		1				56%	57%	78%	40%
exchange animals with farmers	8		1				19%	14%	22%	40%
personal local network	8	1					25%	0%	22%	40%
local publicity	9		3				25%	14%	22%	40%
involved in local municipal government	4	1					13%	0%	0%	40%
informal contacts with neighbours	10	1					19%	29%	33%	40%
hold open days	11	1					25%	43%	22%	40%
sporadic sale to consumers	8		5				25%	29%	0%	40%
regular sale to consumers	19		10				44%	29%	100%	20%
contact consument in grootwarenhuizen	1		5				6%	0%	0%	0%
cooperation with locals	7		5				13%	14%	33%	20%
care farm	5	1					19%	0%	11%	20%
agro-tourism	5		5				13%	0%	33%	0%

P10: Producer and Consumer Ties		EXCHANGE	RECIPROCITY	CO-OPERATION	/	/				
small co-operative for processing	3			2			6%	0%	22%	0%
buying or selling products colleagues	7	1					19%	0%	44%	0%
buying and selling of products colleagues	5		4				19%	0%	22%	0%
create collective yearly growing plan	2			2			0%	0%	22%	0%
co-ordinate growing plans with local farmers	1		4				6%	0%	0%	0%
local chain initiatives	2			2			6%	0%	11%	0%
involvement in political farmer organisations	3			2			6%	0%	11%	20%
group purchases and sales	3		4				6%	0%	0%	40%
reciprocal or simple exchange	7		2				19%	14%	33%	0%
one way exchange	15	1					50%	29%	33%	40%
informal reciprocity	8		4				13%	0%	56%	20%
co-ownership machinry	6			1			19%	0%	33%	0%
switching lands year-in year out	5		4				13%	29%	0%	20%
seasonal use land	6	1					19%	0%	33%	0%
seasonal leasing out land	1	1					0%	0%	0%	20%
informal reciprocal services among farmers	6		4				13%	0%	22%	40%
hired work and paid services from farmers	16	1					44%	14%	56%	60%
help out other farmers in emergencies	5		1				0%	0%	33%	40%
sell know-how	3	1					6%	0%	22%	0%
regular informal knowledge exchanges	10		4				31%	14%	22%	40%
informal exchange with colleagues	27		2				69%	86%	56%	100%
formal learning networks with fixed groups	19			1			38%	29%	78%	80%
fodder, feed, straw from or to particular farmer	10		4				31%	14%	44%	0%
buying or selling feed and straw on the spot	16	1					31%	43%	67%	40%
small farmer co-operative for distribution	8			1			19%	0%	56%	0%

sale to local farmer-run store	1	1					0%	0%	11%	0%
co-ownership and management of land	2			1			6%	0%	11%	0%
purchase or sale cattle among farmers	7	1					19%	14%	11%	40%
gifting of chicks neighbour farmer	1		1				0%	0%	11%	0%
sporadic sale to consumers	8		2				25%	29%	0%	40%
regular sale to consumers	19		4				44%	29%	100%	20%
customers supply inputs	2		1				0%	14%	0%	20%
customers or neighbours provide land	4		2				0%	0%	11%	0%
foundation for land	1			2			6%	0%	33%	0%
customers help out on farm	2		2				0%	0%	22%	0%
consumer-led network for distribution	3		2				6%	0%	22%	0%
co-financing by customers and symphatizers	3			2			0%	0%	33%	0%
P12: Local Food Systems		SELF-RELIANCE	LOCAL PARTNERS	/	/	/				
whole-sale of products	26	-4	-4				81%	86%	33%	100%
occasionally whole-sale	1	-1	-1				0%	0%	11%	0%
sporadic on-farm sale	8	2					25%	29%	0%	40%
regular direct sale on-farm and or wider neighboor	19	6					44%	29%	100%	20%
regular direct sale in wider neighbourhood	8	-2					19%	0%	56%	0%
local or regional sale via third parties	24		6				63%	43%	89%	60%
sale via regional third parties	4		-2				13%	14%	11%	0%
reduced need of concentrates	12	1					19%	0%	78%	40%
produce on-farm concentrates	25	2					75%	29%	89%	60%
partial-self-sufficiency concentrates	13	-1					44%	29%	22%	40%
locally sourced inputs	11		1				38%	14%	44%	0%

P13: Social Equity		WITHIN THE REGIME	AROUND THE REGIME	OUT OF AGRICULTURE	/	/				
subsidies	13	2					31%	14%	78%	0%
strong ties with nature conservation	4			1			13%	0%	22%	0%
diversity in mainstream commercial partners	3	2					6%	0%	11%	20%
diversity in alternative commercial partners	3		2				6%	0%	22%	0%
share risks	2		2				0%	0%	22%	0%
risk transfer	4	2					19%	14%	0%	0%
other remunerated farm-related acitiviteis	6			1			19%	0%	33%	0%
off-farm employment	9			1			25%	14%	22%	40%
no investment	6			1			19%	14%	22%	0%
negotiate higher price	8	2					31%	0%	0%	60%
keep on investing in production	13	2					38%	43%	11%	60%
involvement in chain initiatives	6	4					19%	0%	22%	20%
high value products	13	2					31%	29%	56%	20%
group purchases and sales	3	2					6%	0%	0%	40%
follow and anticipate market trends	7	2					19%	0%	0%	80%
on-farm concentrates production	25		2				75%	29%	89%	60%
own processing of agricultural products	10		2				25%	29%	44%	0%
zelf slachten	2		1				6%	0%	11%	0%
sporadic sale to consumers	8		1				25%	29%	0%	40%
regular sale to consumers	19		3				44%	29%	100%	20%
active in cattle trading	2	2					13%	0%	0%	0%
create demand for own product	6		1				19%	14%	11%	20%
collarbations with alternative channels	23		2				63%	43%	78%	60%
collective political action	4	2					13%	0%	11%	20%

10.4. Annex 4: Details on archetype analysis

Given the strong break in the scree-plot for the value 4, k appears as an appropriate value for k (Figure 31). Archetype Analysis is, however, very susceptible to outliers and may suffer from rotational ambiguity (Moliner & Epifanio, 2019; Mørup & Hansen, 2012), and we therefor compared the solutions the algorithm found by running it on different sets of scores obtained by slightly changing the weight matrix.

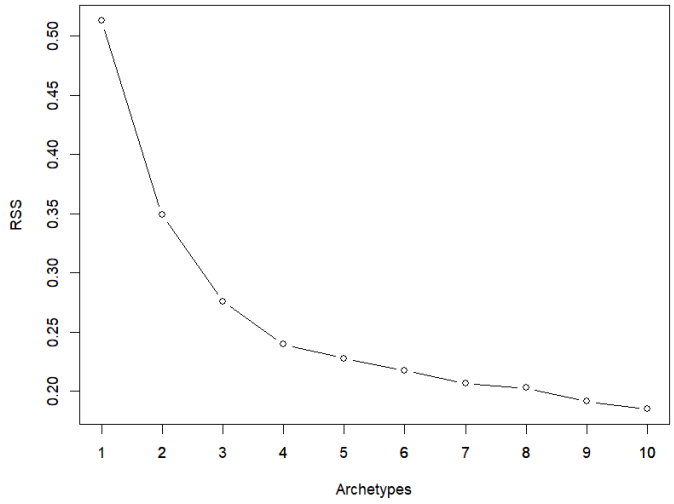

Figure 31 scree-plot, showing residual sum of squares corresponding with best solutions after 1000 iterations for different numbers of archetypes k.

As can be seen in figure 32, from the loadings of the individual cases to the archetypes identified we can derive that small changes result in rather different archetypes identified by the Archetypal Analysis algorithm. The first row of plots is created based on the scores as presented in this dissertation, the solutions in the second row are based on exactly the same weighing except for deducting -1 for the Loss Mitigation POA if farmers mentioned practices contributing to field nutrient leaching, for the third row, we made a, slight change where the practice quarantine is excluded from the avoid pathway, and co-finance models of land are categorized as a reciprocal rather than cooperative practice, fourth row, we gave the practice “robust breeds” a weight of one instead of 1, and in the fifth row we reduced the absolute weight of the practice “whole selling” for the Local Partners POA from -4 to -2.

We are in particular interested in the solutions for k=4, the weights matrix, as a way of sensitivity analysis. This for the reason that this value the scree-plot showed a strong bent in the curve. Looking at the solutions corresponding with k=4, however, we can see that slight changes in the weights leads the algorithm to go switch from a set of two archetypes represented by organic farmers, and two archetypes by conventional farmers, to a set of three archetypes represented by conventional

farmers, and one by organic farmers. We believe that the solution for k=4 isn't robust enough to characterize our data, as it hinges on changing the weight of one coded practice. Observe that the solutions for k=3 correspond with rather similar groupings in the face of these slight changes.

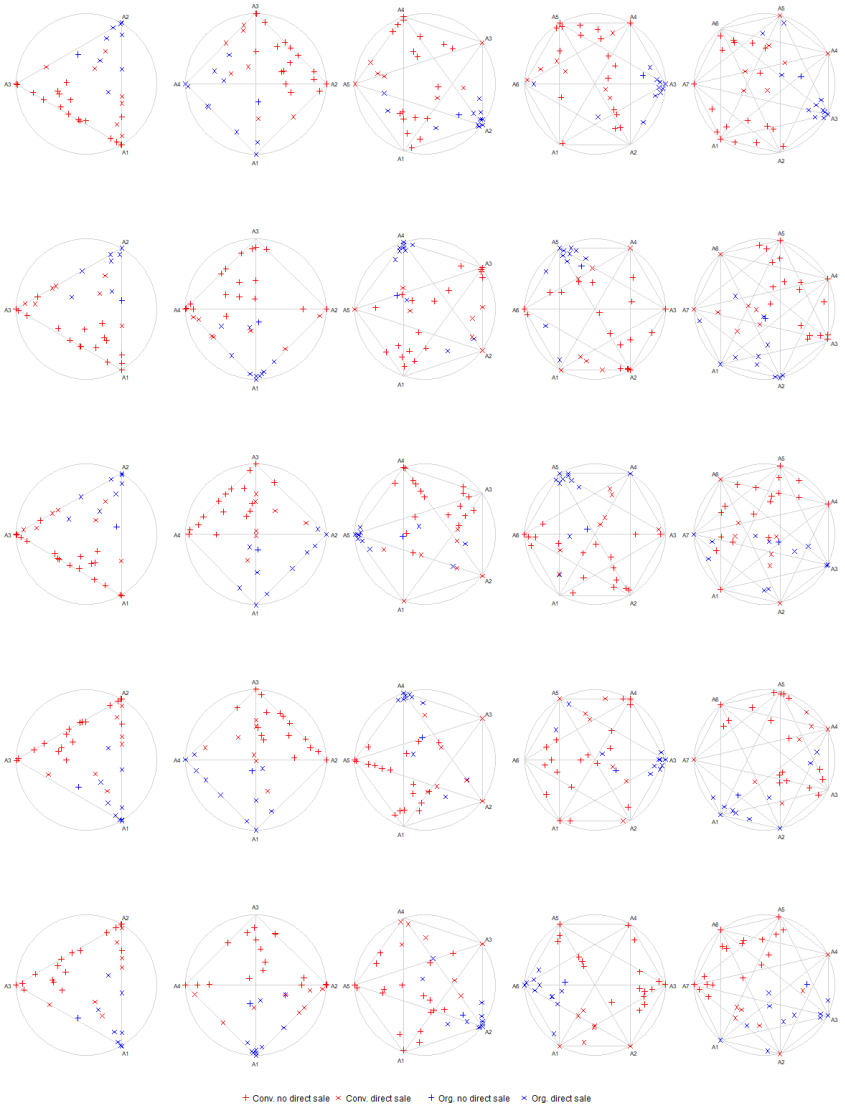

Figure 32 Simplex visualizations of optimal solutions of the Archetypal Analysis algorithm after 1000 iterations for k-values ranging 3 to 7 based on different scoring matrices.

List of Scientific Publications

Peer-reviewed articles in international scientific journals

Stassart, P. M., Crivits, M., Hermesse, J., Tessier, L., Van Damme, J., & Dessein, J. 2018. The generative potential of tensions within Belgian agroecology. *Sustainability*, *10*(6).

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2020. Pathways of action followed by Flemish beef farmers–an integrative view on agroecology as a practice. *Agroecology and Sustainable Food Systems*, 45:1. 111-131.

Tessier, L. Bijttebier, J., Marchand, F., & Baret, P. V. 2021. Identifying the farming models underlying Flemish beef farmers' practices from an agroecological perspective with Archetypal Analysis. *Agricultural Systems*, 187, 103013.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. Cognitive Mapping, Flemish beef farmers' perspectives and farm functioning: a critical methodological reflection. *Agriculture and Human Values.* (Accepted March 12, 2021)

Conference papers and abstracts for national and international conferences

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2017. A mixed-model approach to characterize the link between agroecological principles and beef farm functioning. Bam Book 6th Belgian Agroecology Meeting. Gembloux.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2018. A mixed method approach to characterize and explain agroecological practices on Flemish beef farms. 19th PhD Symposium Agricultural and Natural Resource Economics. Brussels

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2018. A mixed method approach to characterize and explain the pursuit of agroecological principles at Flemish beef farms. Proceedings of 13th European International Farming Systems Association Symposium, Farming systems: facing uncertainties and enhancing opportunities, 1-5 July, 2018, Chania, Crete.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. 2019. Agroecological practice on Flemish beef farms: a closer look at integrated animal health management. In Book of Abstracts of the 70th Annual Meeting of the

European Federation of Animal Science. Vol. 25. 25-29 August, 2019, Gent. p. 654.

Tessier, L., Bijttebier, J., Marchand, F., & Baret, P. V. The role of relational markets and farmer agency in the pursuit of agroecological principles at Flemish beef farms. Proceedings of 14th European International Farming Systems Association Symposium, Farming systems facing climate change and resource challenges. Postponed to 10-14 April, 2022, Euvora.

Master Thesis

Tessier, L.. 2016. Low-input dairy farms: definitions and sustainability assessments. Universiteit Gent.