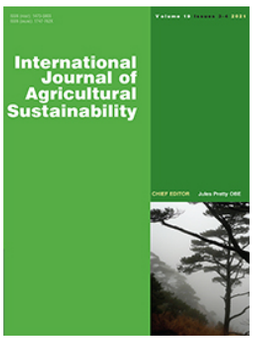

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Farmers' Organizations as innovation intermediaries for agroecological innovations in Burkina Faso

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ABSTRACT

Agroecology has been recognized as a paradigm that can offer multiple ecological and socio-economic benefits. In many developing countries, the promotion of agroecology is facilitated by intermediary organizations such as Farmers' Organizations (FOs). Detailed studies on how FOs support their farmers in the adoption of agroecology innovations are still scarce, and particularly there are limited studies on the roles of FOs in this realm in Africa. This paper addresses this gap by presenting a study on how FOs stimulate farmers' adoption of agroecological innovations in Burkina Faso. Three case studies of FOs were done to unravel the ways FOs support of farmers' adoption of agroecological innovations processes, using the lens of innovation intermediaries. The findings show that FOs fulfil both knowledge and innovation intermediation functions in the process of stimulating their farmers' adoption of agroecological innovations. By doing this, FOs act as a facilitator for the introduction and/or development of complementary agroecological innovations over longer periods of time. Future studies could look more deeply into how intermediation may contribute to broader transitions and how it connects with the political activities of FOs such as advocacy and lobbying.

KEYWORDS

Ecological principles; organic agriculture; agricultural innovation systems; innovation brokers; food systems transformation

Introduction

Current challenges of increasing food production while decreasing environmental problems call for alternative paradigms that can change the dominant model of high external input industrial agriculture. The paradigm of integrating ecology with agriculture, known as agroecology (Berthet et al., 2016; Van Hulst et al., 2020), aims to realize several environmental, economic and social benefits (see also Anderson et al., 2019a). These benefits are obtained by the application of ecological principles to agricultural production as the alternative to the use of agrochemicals and genetically modified germplasm (Haggar et al., 2020). Agroecology proposes practices that increase farmers' control over their productive resources and broader access to food grown in environmentally friendly ways (Altieri & Toledo, 2011; de Tourdonnet & Brives, 2018; Haggar et al., 2020; Mier y Terán Giménez Cacho et al., 2018). Proposed practices also allow optimal management of biodiversity of agroecosystems (D'Annolfo et al., 2021). Several authors (see e.g. Berthet et al., 2016; D'Annolfo et al., 2021; Gliessman et al., 2017; Röling & Jiggins, 1998) have noted that the development of such practices is highly knowledge-intensive, and this requires a combination of farmer's traditional knowledge with scientific knowledge.

The combination of knowledge sources is due to the specificity of agroecological innovations (de Tourdonnet & Brives, 2018). Agroecological innovations are defined in this study as all agricultural techniques integrating ecological principles (Uphoff, 2002) to optimize the management of agroecosystems (Altieri & Toledo, 2011). The integration of these principles

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also considers the social dimension of agriculture beyond only focusing on the technical and environmental ones (cf. Altieri & Toledo, 2011). Examples of ecologically-based agricultural techniques include intercropping, crop-rotations, compost, manure, agroforestry, biological control of pests and diseases by using natural enemies and biopesticides (Altieri & Toledo, 2011; Wezel & Silva, 2017). The combination of knowledge sources necessitates an active mobilization of diverse actors with multiple perspectives such as farmers, advisory services, agro-companies, etc (Berthet et al., 2016). Mobilizing these actors calls for organizations that act as a bridge to facilitate linkage creation between actors in agroecological innovation.

This bridge function is mostly performed by intermediary organizations, called 'innovation intermediaries' (see Klerkx et al., 2009) in the innovation studies literature. Howells (2006, p. 720) defines an innovation intermediary 'as an organization or body that act as agent or broker in any aspect of the innovation process between two or more parties'. Examples of innovation intermediaries in the agriculture sector include government agencies, private companies, NGOs, consultants, special programs (e.g. research consortia), and Farmers' Organizations (FOs)[1] (Cerf et al., 2017; Goldberger, 2008; Kilelu et al., 2011; Kilelu et al., 2017; Kivimaa et al., 2019; Westbrooke et al., 2018; Yang et al., 2014). According to Kilelu et al. (2013), innovation intermediaries perform many functions for agriculture development including organizing farmers to identify their needs and promoting platforms for information and knowledge sharing.

In the context of developing countries' agriculture, Bakhuijs (2013), reported the significant contributions of FOs in many agriculture innovation activities. The important role of FOs was reinforced by the withdrawal of the direct government intervention in agriculture development activities after the implementation of the structural adjustment reforms (between the 1980s and 1990s) promoted by the World Bank in many developing countries (Mercoiret et al., 2007). The considerable benefits of collective action of FOs which are broadly acknowledged by many policymakers and agriculture development actors (Verma et al., 2019). Many FOs started to be actively involved in agricultural development activities following the reduced role of governments imposed by the reforms (Blein & Coronel, 2013; Diagne & Pesche, 1995; Jacob & Lavigne Delville, 1994).

As intermediary organizations (cf. Esman & Uphoff, 1984), FOs have now become central in establishing partnerships with public and private agriculture development actors to better access to resources necessary for the provision of knowledge and innovation services (Chirwa et al., 2005; Gouët and Van Paassen, 2012; Luo et al., 2020; Reed & Hickey, 2016; Wennink & Heemskerk, 2006; Wynne-Jones et al., 2020). FOs provide these services to members by creating favorable conditions for production and utilization of agriculture knowledge and integrating members into agricultural innovation systems. FOs have been found to implement community-based extension approaches through the creation of joint learning at the individual and organization levels (Kiptot & Franzel, 2019). FOs can also contribute to the creation of innovation platforms so as to allow their members to participate in the co-production of technologies (Pretty et al., 2020). Besides participating in the knowledge generation, FOs can be very helpful in the creation of sustainable market access of its members' products (Gboko, 2020; Groot Kormelinck et al., 2019; Mangnus & Schoonhoven-Speijer, 2020; Ramirez et al., 2018). As Esman and Uphoff (1984) have indicated, FOs thus stimulate several different horizontal linkages (between farmers) and vertical linkages (with other organizations in the value chain and institutional system), and these linkages are often made in a complementary fashion (Kilelu et al., 2017).

Specifically, a number of studies have highlighted the core contributions of FOs in the development of agroecological innovations (Mier y Terán Giménez Cacho et al., 2018; Schiller et al., 2020a; Schiller et al., 2020b). This is by providing space for farmer-to-farmer (or *Campesino a Campesino*) knowledge exchanges and funding the construction of agroecology schools (Altieri & Toledo, 2011; Mier y Terán Giménez Cacho et al., 2018; Schiller et al., 2020a). FOs can also provide special marketing facilities (such as the organic certification) for products grown based on the integration of ecological principles (Mier y Terán Giménez Cacho et al., 2018; Schiller et al., 2020a; Home et al. (2017). Veltmeyer (2019) points out that FOs can be effective in defending small-scale farmers' right to access the land. Farmers' right is essential for food sovereignty (see Anderson, Bruil, Chappell, Kiss, & Pimbert, 2019a) promoted by transnational organizations defending agroecology, like La Vía Campesina (LVC) (Giraldo & Rosset, 2018).

While these previous studies have shown that FOs play roles in the agroecological innovation systems

(AeIS), more detailed studies on the way they support their farmers' interest in the adoption of these innovations are still scarce. Furthermore, though agroecology practices, movements, and transitions in Africa are gaining increasing attention (Ameur et al., 2020; Bakker et al., 2021; Bellwood-Howard & Ripoll, 2020; Bezner Kerr et al., 2018; Boillat et al., 2021; Bottazzi & Boillat, 2021; Gliessman, 2020; Kerr et al., 2018; Mousseau, 2015; Mugwanya, 2019; Peano et al., 2020; Pimbert & Moeller, 2018; Toillier et al., 2021), there are limited studies on the roles of FOs in this realm in the context of Africa and Burkina Faso in particular. Thus, the objective of this study is to fill the gap in the literature by answering the question of how do FOs stimulate their farmers' interest in the adoption of agroecological innovations in Burkina Faso.

Focusing on Burkina case studies is interesting because of the longtime involvement of FOs in the promotion of agroecological innovations. This started during the extensive droughts of the 70s and 80s and increased in the last decade with the advent of organic farming practices (Bancé, 2013; Roose et al., 1999). The involvement of FOs in agroecological innovations in the context of Burkina was due to their important functions in the country's agriculture development activities traced back during the independence period (Konate, 2013; LAMY, 2005). The next section presents a conceptual framework to analyze the innovation intermediaries' functions of FOs for agroecological innovations. Then follow the sections describing the research methods applied and the results obtained three selected cases of FOs. The last section discusses the key points from the results and concludes by pointing out implications of these results for policy, practice, and areas for further research.

A conceptual framework for analyzing the innovation intermediaries' functions performed by FOs In supporting farmers' adoption of agroecological innovations

Over the past decades, there has been an evolution of systemic thinking in agriculture innovation literature (Klerkx et al., 2012) characterized by a shift from technology-oriented to more holistic approaches such as the approach of agricultural innovation systems (AIS). According to Klerkx et al. (2012), the AIS approach is essentially about multi-actor interactions and structures (such as institutions, infrastructures, policies) to support innovation. The AIS approach, influenced by the 'national systems of innovation' perspective of Lundvall (1992), was first used by the World Bank to understand the complexity of agriculture innovation processes by focusing on the way different actors interact, share, exchange and use knowledge (World Bank, 2007). The AIS approach has been used widely to analyze agricultural innovation and diagnose enablers and barriers, and the related approach of 'technological innovation systems' was used by Schiller et al. (2020a) to describe the development of innovations based on ecological principles, which could thus be seen as an 'agroecological innovation system' (AeIS).

Components of AeIS include individuals, organizations, and institutions which can be grouped into five innovation domains following the categorization of AIS components of Rajalahti et al. (2008); Arnold and Bell (2001). These include the research domain, the enterprise and demand domains, the support structures, and the intermediary domains. *The research domain* primarily involves public and private research organizations producing codified and tacit knowledge. The *enterprise domain* involves agro companies, NGOs, FOs, and farmers using and producing codified and tacit knowledge. *The demand domain* primarily involves consumers of domestic and international markets as well as policy and quality assessment actors (e.g. certification agencies). *The support structures* are organizations and institutions (mostly NGOs, networks of traders, and FOs) in charge of the provision of necessary resources to stimulate agroecological innovations. *The intermediary domain* involves organizations whose activity is to broker access to knowledge and innovation services from one actor of the domain to another, and thus playing the functions of innovation intermediaries (cf Howells, 2006).

The literature identifies two broad functions of innovation intermediaries in supporting innovations i.e. the knowledge intermediation function which includes supplying information and facilitating farmers' learning process; and the innovation intermediation function which entails providing inputs, scoping market opportunities, managing networks of various actors, and, monitoring the innovation process (Kilelu et al., 2011; Yang et al., 2014). These functions are played by actors such as NGOs, national extension agencies, and FOs in many developing countries (see the above introduction section for further examples of innovation intermediaries). For the case of FOs (which is the type of innovation

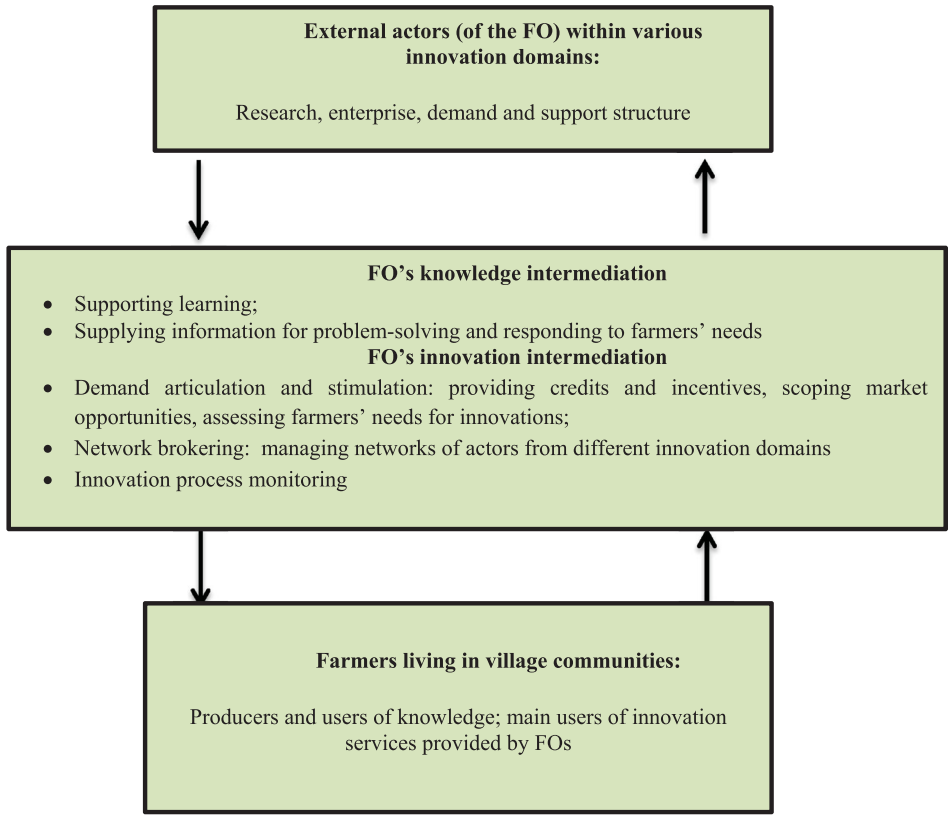

Figure 1. A conceptual framework to analyze the possible innovation intermediaries' functions of FOs in supporting farmers' adoption of agroecological innovations. **Source**: Own elaboration based on Yang et al. (2014); Kilelu et al. (2011); Arnold and Bell (2001).

intermediary central to this study), Yang et al.'s (2014) study shows how FOs fulfil the above-listed functions to support innovation processes. These functions have informed the framework presented in Figure 1 to understand the functions of FOs as innovation intermediaries in supporting farmers' adoption of agroecological innovations.

Research methods

A case-study approach (Yin, 2009) was chosen as appropriate to understand the innovation intermediation functions of FOs to answer the 'how question' addressed in this study. Three FOs case studies were selected according to their goal of the promotion of agroecological innovations in Burkina Faso. These include the promotion of agroecological innovations for enhancing the productivity of commercial crops concerning the *Union Nationale des Producteurs du Coton du Burkina Faso*-UNPCB; the promotion of agroecological innovations for improving the resilience of subsistence farmers regarding the *Association Inter-zones pour le Développement en Milieu Rural*-AIDMR; and the promotion of agroecological innovations for enhancing the productivity of commercial crops and the resilience of subsistence farmers concerning the *Union des Groupements pour la Commercialisation en commun des produits agricoles de la Boucle du Mouhoun*-UGCPA.

An overview of the three selected FOs case studies

The FO for the first case study (i.e. UNPCB) was established in 1998 as an FO in charge of the development of the cotton value chain by providing necessary economic (credits-inputs and marketing) and technical services to their members. The establishment of UNPCB was the result of long process involving the *Société des Fibres Textiles*-SOFITEX (a parastatal cotton agro-company, owned by the Burkinabè government, the French Geocoton group, and the UNPCB), international donors (such as the World Bank, and the '*Agence Française de Développement*,

AFD'), and the former local cotton FOs called '*Groupements Villageois*' and the new '*Groupement De Producteurs de Coton,* GPCs'. Initially established for the development of conventional cotton (by focusing on the use of synthetic inputs), UNPCB started to get involved in the promotion of practices aligned with agroecology (by introducing the conservation and organic agriculture techniques to their members but without using this wording) to better improve cotton's productivity. UNPCB, thus, mainly focuses on the technical dimension of agroecology by promoting the minimum tillage and the substitution of synthetic inputs with the ecological ones (concerning the organic cotton) and/or the combination of both synthetic and ecological inputs.

UNPCB is composed of about 325000 cotton farmers grouped into various GPCs, located in the village communities. One GPC has about 15–50 members self-selected by cotton farmers from the same village on the basis of a joint-liability (concerning the repayment of inputs-credits). Every GPC[2] has one treasurer, one secretary, and one president elected by the members of the group. These GPCs are further grouped into departmental and provincial cotton farmers' union.[3] The objective of this grouping is to better channel the economic and technical services from the national union (i.e. UNPCB) to the local farmers' groups (i.e. GPCs) levels. GPCs are composed of diverse types of farmers from various farm sizes, gender, and types of cotton grown (either conventional or organic cotton). For cotton farmers, joining the GPCs is the main possibility for accessing to credit-inputs and marketing services offered by the national union. At the national level, the UNPCB is structured as follows: a general assembly (a supreme decision-making body composed of one national president and three representatives of all the provincial cotton farmers' unions)[4]; a board of directors (which is the executive office of UNPCB composed with the national coordinator and twelve members elected by the general assembly); a legal and control office; and a multidisciplinary technical team (including the director of agriculture development unit and the technical advisors appointed at the departmental and provincial unions).

The FO for the second case study (i.e. AIDMR) was established in 1993 as an FO composed of groups of young farmers in charge of the promotion of ecologically-based techniques in the center and north regions. The establishment of AIDMR was facilitated through the technical and financial assistance of *Eau Vive* (an NGO). Most of the AIDMR's activities are primarily centered on the provision of agroecological technical training services to their members. Agroecological innovations are mainly promoted by AIDMR with the goal of improving the resilience of their members (mostly involved in subsistence farming) challenged with advanced soil degradation. The FO, therefore, focuses on the social (promotion of family farming, resilience, autonomy), technical, and environmental (preservation and restoration of members' soil fertility) dimensions of agroecology. AIDMR has the following structuration: one coordinator (the founder of the FO); one president (appointed by the coordinator of the FO); four endogenous advisors (who are also farmers living within the village communities); and about 700 subsistence farmers with an average farm size of less than 5 hectares. These farmers are grouped into 47 villages (composed of small-scale subsistence farmers of both gender) and every village group has a president chosen by the village members. Although there is no restriction for farmers to become members of the FO, AIDMR is highly encouraging prospective members to pay the annual contribution of 1000 CFA Franc.[5]

The FO for the third case study (i.e. UGCPA) was established in 1993 for the organization of collective marketing of cereals (maize, sorghum, millet) and cowpea surpluses in the Boucle du Mouhoun region through the technical and financial assistance of a Canadian development agency (*Agence canadienne de développement international*, ACDI). Following propositions from external partners and in line with its objective of supporting small-scale farming, UGCPA started the promotion of agroecological innovations with the goal of enhancing the productivity of commercial crops and the resilience of some of its members confronted with persistent soil degradation. This explains, the technical and (to some extent) environmental focus of agroecology of UGCPA. The technical dimension is mostly linked to the efficiency of ecological inputs (combined with the synthetic inputs or not), whereas the environmental dimension is connected to the soil preservation.

UGCPA is composed of about 2700 members (consisting of both small and large-scale farmers) growing subsistence and commercial (including conventional and organic) crops, grouped into 79 village groups (composed of farmers with various farm sizes and gender). Every village group has a president elected by the members from the same village. UGCPA is structured as follows: a general assembly (composed

Table 1. Data sources of the study

FO	Number of interviewees	Interview period and interviewees: 2015/2016 Informal interviews and formal semi-structured interviews	Interview period and interviewees: 2018 Formal semi-structured interviews	Observations	Document research
AIDMR: *Association Interzones pour le Développement en Milieu Rural*	21	• 1 administrator: the coordinator of the FO • 1 advisor • 1 main partner of the FO called *Terre et Humanisme*	• 2 Administrators: the president and the coordinator of the FO • 1 advisor • 15 farmers	Workshop and field visits	Reports on the FO's projects
UGCPA: *Union des Groupements pour la commercialisation en commun des produits agricoles de la Boucle du Mouhoun*	23	• 1 administrator: the coordinator of agriculture production unit • 3 advisors of the organic *hibiscus* program • 1 of the FO's partners called (*Fondation pour l'Agriculture et la Ruralité dans le Monde*)	• 2 administrators: the president and the coordinator of the agriculture production unit • 1 advisor of general agriculture activities • 15 farmers	As above	As above
UNPCB: *Union Nationale des Producteurs du Cotton du Burkina*	21	• 1 administrator: the national coordinator of the organic cotton program • 2 organic cotton advisors • 2 main partners of the organic cotton program: Catholic Relief Service and Helvetas	• 1 administrator: the provincial coordinator of the organic cotton in Banfora • 1 advisor of organic cotton in Banfora • 14 farmers	As above	As above

of one president and two representatives of every village group[6]); a board of directors (composed with cereals and hibiscus committees); and a technical team (with ten technical advisors in charge of the organization of training activities). Every farmer who joins the village groups is automatically considered a member of the national union. The main condition for the creation of village groups is the capacity of the village members to supply at least 20000 kilograms (i.e. 200 bags of 100 kilograms) of cereals during every farming season.

Data collection and analysis

Data were gathered (table 1) through informal and formal semi-structured interviews (with three FOs' administrators and advisors) conducted during three fieldworks periods conducted by the first author (i.e. 2015, 2016, and 2018). The interviews sought information on (i) the situation of FO's relations with various actors in the agroecological innovation domains'; (ii) types of the agroecological knowledge and innovations support services provided to farmers. These interviews helped to capture the overview of the type of innovation support services provided to (concerning partners) and received from (concerning farmers) the FOs. Document research (such as reports on the FO's projects), (participant and non-participant) observations, interviews with farmers, and some of the FOs' partners were also used to complement information obtained from the interviews.

The participant observation was conducted during field visits (between March and April 2018) to gain clear insights on the FOs' agroecological innovations support services. The non-participant observation was mostly conducted during participation (in November 2015) in an agroecology workshop organized by Inter-réseaux (an NGO) where a presentation was given of agroecological innovation services by the organizations of the three case studies. The purpose of using these multiple sources of data collection methods was to ensure the validity of the study by

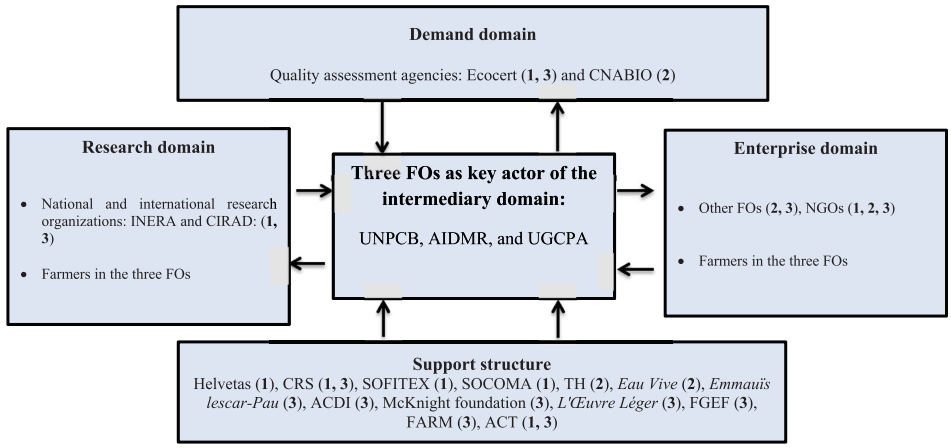

Figure 2. An illustration of FOs as a key intermediary domain actor for agroecological innovations in Burkina Faso. **Source:** Own analysis based on Arnold and Bell (2001).

means of triangulation (Yin, 2009). All the interviews (both written and recorded) were transcribed to identify FO's functions in the agroecological innovations processes. Transcripts were analyzed through coding guided by the concepts reviewed, i.e. the components of the agroecological innovation system and the innovation intermediation functions performed by FOs.

The analysis was conducted through the use of an actor-mechanism matrix (AMM) approach. An AMM is a tool developed by Bakhuijs (2013) to show the types of actors contributing to agriculture innovations in developing countries. AMM shows insights in both the structure (actor types) and functions of intermediaries (Bakhuijs, 2013) as it gives indications on what types of actors the farmer organizations can collaborate with to access different resources necessary for supporting farmers' innovation processes. Actor types can contribute to innovation through various support mechanisms they provide to FOs. Microsoft Excel was used to create matrices of FO's relations with different actors of the agroecological innovation domains as well as FO's knowledge and innovation support services provided to farmers. Examples of these services were further illustrated using photos (taken during the field visits) in the results section below.

Results

FOs as a key intermediary domain actor for agroecological innovations

The results of the study revealed the active involvement of FOs in connecting various innovation domain actors (Figure 2) in order to facilitate their farmers' adoption of ecologically-based agricultural techniques, through many 'vertical' and horizontal linkages' (Esman & Uphoff, 1984; Kilelu et al., 2017). The adoption of these techniques (by farmers in all three FO) is essential in achieving FO's goals of the promotion of agroecological innovations. Such goals include the enhancement of commercial crops' productivity (the case of the *Union Nationale des Producteurs du Coton du Burkina Faso*-UNPCB), or the improvement of subsistence farmers' resilience (the case of the *Association Inter-zones pour le Développement en Milieu Rural*-AIDMR), or the enhancement of both commercial crops' productivity and subsistence farmers' resilience (the case of the *Union des Groupements pour la commercialisation en commun des produits agricoles de la Boucle du Mouhoun*-UGCPA).

Overall, all three FOs, regardless of their goals, have collaborated with actors of the support structure (mostly NGOs) to get access to resources needed for the creation of agroecological innovation conditions. These include the reception of training facilities (to foster knowledge generation) and input funding to stimulate farmers' adoption of agroecological innovations. For example, Helvetas (an NGO) supported UNPCB to introduce organic cotton techniques. This was by providing technical (i.e. training FO's advisors on the technical requirement of organic cotton farming) and economic (such as subsidizing biopesticides and access to premium) assistance to the FO. Helvetas' introduction of organic cotton to UNPCB was mainly due to its key role in the development of (conventional) cotton value chain. Besides Helvetas,

the Catholic Relief Service-CRS (an NGO) also assisted UNPCB in the development of organic cotton. While Helvetas' assistance started after contacting the UNPCB, CRS' assistance rather came from the FO's side through its application to a call for a project targeting the improvement of rural livelihood.

Similar to UNPCB, AIDMR and UGCPA also received NGOs' support to engage in the promotion of agroecological innovations. Examples include the reception of funding from NGOs like *Terre et Humanisme* and *L'Œuvre Léger* (which provided Faidherbia seedlings and bio-gas materials to UGCPA to improve their knowledge of agroecological techniques and spread the use of Faidherbia seedlings to AIDMR and UGCPA respectively. The connection with NGOs (in all the three FOs) was mainly established through the commitment of the top leadership of the FOs which include the national presidents and some national coordinators (concerning the UNPCB and AIDMR cases). It is the task of these leaders to channel the information and resources received from NGOs to their corresponding local farmers' groups. Furthermore, the results also revealed the contribution of an actor other than NGOs in supporting the innovation process. One of the examples witnessed was the involvement of an agro company called SOFITEX (*Société Burkinabè des Fibres Textiles*) in the provision of processing facilities for organic cotton to UNPCB. SOFITEX (which is one of the key partners of UNPCB since its establishment) is providing a special ginning factory to process harvested organic cotton separated from that of the cotton conventional one. This separation is mainly due to the need to avoid the contamination of organic cotton with pesticide residues present in conventional cotton.

FOs also established relationships with actors of the research domain in the agroecological knowledge generation process. This is by developing technical recommendations and information sharing (between FOs and some partners, and between farmers within the FO). The establishment of these relations was conducted by the involvement of the technical team who were previously briefed (by the national leadership, i.e. the presidents of the FOs) about the FOs' engagement in the process. For example, INERA (*Institut de l'Environnement et de Recherche Agricole du Burkina Faso*), which is the main Burkinabè research organization, provided technical assistance for the development of ecologically-based cotton pests and diseases management techniques and the development of improved sorghum seeds to UNPCB and UGCPA respectively. This was by training the FOs' advisors and providing space and researchers to conduct trials and experimentations (both in the station and on-farm). Another example of actor collaborating with FOs in this domain is the involvement of CIRAD (*Centre de cooperation internationale en recherche agronomique pour le développement*) in helping FO like UGCPA to implement an agro environmental policy funded by an NGO called FARM-(*Fondation pour l'agriculture et la ruralité dans le monde*). CIRAD provided technical assistance in the selection and communication of recommended ecologically-based agricultural techniques. Last but not least actor in this domain is the farmers themselves since most of the promoted techniques were developed based on the improvement of existing practices.

Farmers are also contributing to the knowledge generation process by sharing information with other members, i.e. horizontal linkages. Farmers can share information about their practices during group meetings organized in the FO (concerning AIDMR) or through informal communication with other members living in the same village. The group meetings were most of the time organized by the FO's coordinator at their agroecological training center. Moreover, Figure 2 also indicates the establishment of FOs relations with other FO (within the enterprise domain) in the agroecological innovations development process. This was the case of the collaboration between UGCPA with FOs such as FEPABE (*Fédération Professionnelle des Agriculteurs du Burkina Faso*) and FNGN (*Fédération Nationale des Groupements NAAM*) in the participative breeding of sorghum seeds project.[7] This was also the case of AIDMR's collaboration with an FO called Beo-neere in building an agroecological innovations catalog. The catalog was built during a workshop organized by the coordinator (through the financial assistance of *Terre et Humanisne*) to serve as a training tool for AIDMR's members as well as non-members farmers (e.g. those present in the village communities or from FOs like *Beo-neere*). Farmers are using the acquired knowledge to improve their agriculture production for more household sustenance and/or profits for commercial products such as cotton, hibiscus, and cereal surpluses. Some of these products are quality-controlled (see the second section of the results) before reaching the final consumers.

It becomes clear from these results that FOs are the key intermediary domain actor for the development

Table 2. Innovation intermediaries' functions performed by three FOs to foster farmers' adoption of agroecological innovations

	UNPCB	AIDMR	UGCPA
Knowledge intermediation			
1. Supporting learning	Provided technical training on organic cotton technology	Organized group training of ecologically-based techniques	Provided technical training on organic *hibiscus* technology; Organized group meetings to show (through the use of video) the environmental issues related to the use of pesticides and the recommended ecologically-based agricultural techniques
2. Supplying information for problem-solving and responding to farmers' needs	Organized farmers-advisors exchanges on issues encountered in the organic cotton farming	Facilitated farmers-advisors exchange sessions at the beginning of the rainy season	Conducted a participative selection of sorghum varieties
Innovation intermediation			
3. Demand articulation and stimulation	Provided credits-inputs for organic cotton; Explored opportunities of organic certified cotton rotation crops (sesame, soybean); Discussed farmers' needs	Provided inputs subsidies; Assessed and discussed farmers' needs	Searched for market opportunities of organic *hibiscus* and provided credits-inputs to farmers concerned; Provided inputs credits and subsidies (e.g. bio-gas materials and Faidherbia seedlings obtained from supportive partners); Assessed farmers' needs
4. Network brokering	Established relationships with wholesalers (exporters) of other organic products such as sesame, soybean, and shea nut	Integrated the platform of civil society actors promoting market legislation of products grown based on ecological principles	Communicated (to attract potential supportive partners) farming issues encountered by farmers in the area of the FOs' operation to the participants of the peasant innovation fair
5. Innovation process monitoring	Managed the certification of organic products	Started the collective certification (under the participatory guarantee system) of fruits collected from the training center and the nearby village farms	Managed the certification of organic *hibiscus*

Source: Own analysis based on information obtained from FOs' interviews

of agroecological innovations. This is demonstrated by their engagement in multiple relationships with other actors of the innovation domain to ensure the flow of knowledge and innovation services for triggering the agroecological innovations processes. These relationships are usually established at the top leadership levels of the three FOs and are mostly organized around their broader goal of the promotion of agroecological innovations. While all the three FOs are engaged in the collaboration with the support structure' actors, the number of actors (in all the four innovation domains) collaborating with FOs is much higher for those involved in the promotion of commercial crops (i.e. UNPCB and UGCPA). This could be explained by the fact that these FOs were already familiar (even before getting involved in the intensive promotion of agroecology) with the establishment of multiples collaborations in searching for market opportunities of their farmers' products. Furthermore, it can be noted from the above results that, the NGOs constitute the main external actors' type supporting the most the FO's development of agroecological innovations.

The knowledge and innovation intermediation functions of FOs to stimulate their farmers' adoption of agroecological innovations

The results of the study indicate that all the three FOs (i.e. UNPCB, AIDMR, and UGCPA) performed both knowledge and innovation intermediation functions (Table 2) to stimulate farmers' adoption of agroecological innovations. The knowledge intermediation functions involve the provision of farmers' learning facilities by employing several methods. These include the organization of group training (at the FO's location), field demonstrations (at the selected farms), and individual exchanges between farmers and FOs' advisors. Group training is organized as formal group meetings during which the FOs'

advisors[8] explain and exchange with farmers on topics connected to the organic agriculture technology (the cases of UNPCB and UGCPA) or on more general topics related to the ecologically-based agricultural techniques (as observed with AIDMR and UGCPA). In the case of AIDMR, the group meetings are considered (by the FO's coordinator and advisors) as an important occasion for farmers' sharing experiences of successful ecological practices. The frequency of group meetings is either yearly-based (concerning the UNPCB due to certification requirement), or during the implementation of new agriculture development projects.

Moreover, group meetings can also be conducted with the aim of sensitizing members about environmental issues connected to the high use of pesticides as observed with UGCPA. This was through the use of a video for communicating the risks of pesticides, as shown by the following quote from the coordinator of the agriculture production unit: '*through video, farmers now understood the dangerousness of certain* (synthetic) *products which can harm the environment and human health*'. Group training is most of the time complemented with field demonstrations to show the applicability of various techniques discussed during various meetings. This can be through conducting on-farm experimentations of various ecological fertilization techniques (i.e. the application of compost, manure, or both in the selected farms) as was the case with UNPCB or the demonstration of compost pile techniques, which is conducted in all the three FOs. In the case of AIDMR, field demonstrations are conducted in the FO's training center and/or in the selected farms belonging to the president of the various village groups.

The compost pile technique is an aerobic method of decomposition of a mixture of manure, crops residues such as cereal straw), and water. This mixture is later transferred (twice to thrice within two months) into another pile to ensure the oxygen flow needed for compost production. Compost pile is increasingly promoted by these FOs due to its limited requirement in labor compared to compost pits, which were previously adopted techniques by many FOs' members. Compost pile is also promoted due to its efficiency in the management of soil fertility as explained by one advisor of AIDMR in the following quote: '*So we made a comparison between compost pits and the new one* (i.e. compost pile)*, and we saw that the new one is the best* (in terms of increasing soil fertility)'. Figure 3 shows an example of a place prepared by one member of AIDMR to demonstrate the aerobic compost-making technique to other members living in the same village.

Figure 3. An example of a place prepared by one member of AIDMR to demonstrate the aerobic compost-making technique (left).

The last learning method employed by the FOs studied is the promotion of individual exchanges between farmers and advisors. In the case of UNPCB for example, farmers-advisors exchanges take place when organic farmers identify unknown issues (e.g. damage caused by new pests) in their farms. It is the task of the advisor to seek ecological solutions to the identified problems because of the certification requirements. In the case of AIDMR, farmers-advisors exchanges usually take place at the beginning of the farming season, during which interested farmers approach FO' advisors to express their needs for advice on techniques such as compost pile and *zaï* (which consists of digging and filling pits with compost and/or manure) techniques to restore soil fertility as this is the common problems faced by AIDMR' farmers. Advisors can provide an immediate solution to farmers' needs by using available training materials such as pictures (obtained from an NGO called *Eau Vive*) showing the recommended disposition of *zaï* following an equilateral triangle shape

Figure 4. A training material used by one AIDMR' advisor for showing the recommended *zaï* pits disposition (right).

(see Figure 4). They can also invite these farmers to join the field demonstrations usually organized at the beginning of the farming season.

The results in Table 2 also indicate that FOs perform wider innovation intermediaries' functions beyond facilitating farmers' access to agroecological knowledge. These functions cover most of the innovation intermediation functions summarized in Figure 1: demand articulation/stimulation, network brokerage, and innovation process monitoring. Demand articulation focuses on the provision of economic (such as supplying credits, inputs, and marketing facilities) and technical (e.g. through various communications between advisors and farmers as stated in the previous paragraphs) services to activate farmers' needs for agroecological innovations. For example, UNPCB provides organic inputs in credits to farmers interested in growing organic cotton. Inputs include organic cotton seeds and commercial biopesticides called Batik (*Bacillus thuringiensis*), which have to be paid back upon selling organic cotton. Besides inputs, UNPCB also supported the construction of stores (see Figure 5) in the organic farmers' villages through the financial assistance of the Catholic Relief Service-CRS (one of the key organic cotton partners of UNPCB) as part of the provision of organic premiums. All these services are

Figure 5. An organic cotton store built with the support of the Catholic Relief Service.

reaching farmers (grouped into GPCs) through the intermediation activities by their provincial and departmental unions which are those directly connected to the national union.

Furthermore, the search for market opportunities (by the national coordinator of the union and the provincial coordinator of the organic cotton program) of the organic cotton rotation crops such as sesame and soybean has also contributed to increasing the farmers' demand for organic cotton farming techniques. The commercialization of rotation crops thus contributes to the diversification of farmers' revenue as illustrated by this quote from an organic cotton advisor in Banfora, '*rotation crops such as sesame kept maintaining the income source of farmers depending on the market environment*'. Like UNPCB, AIDMR and UGCPA also provide inputs either in the form of credits (the case of UGCPA), or subsidies to stimulate farmers' adoption of agroecological innovations. The provision of these subsidies in the two FOs largely depends on the assistance of external partners. Most of the subsidies are provided by the partners, as part of their objective of strengthening farmers' interest in the production of compost. A typical example of subsidies was the distribution of materials like wheelbarrows and shovels (which are used for the collection and transportation of manure) by AIDMR (through funding obtained from *Terre et Humanisme*) to their farmers. Most of the farmers in AIDMR and UGCPA were selected for the subsidies according to their contribution to the membership fees (which serve in funding some of the operation cost of FOs' activities).

Network brokerage (Table 2), which is the common function observed with all three FOs, is mostly performed by FOs to get access to innovation support services from different actors (as shown in the first section of the results) and to search for market opportunities. Concerning the latter, the presidents of the national unions (and in some cases the provincial coordinator of the organic cotton program) are those in charge of price negotiation and establishment of market agreements with international buyers (e.g. Victoria's Secret for organic cotton in UNPCB) or wholesalers (mostly the case of organic hibiscus in UGCPA), who in their turn sell the products to exporters like Olam Burkina Faso. The products are sold in kilograms, the 2018 prices used by UNPCB and UGCPA were 335 CFA Franc for organic cotton and 1000 CFA Franc for organic hibiscus. These products are firstly certified to ensure the absence of synthetic inputs. Certification, therefore, enables the FOs to monitor their farmers' adoption of agroecological innovations.

Certification is conducted by a third-party organization such as Ecocert concerning UNPCB and UGCPA. It is the task of Ecocert to select and visit the sample of farms to be certified following its predefined standards of organic products. Moreover, the results of the study also reveal the implication of AIDMR in the certification process despite being primarily focused on the improvement of farmers' subsistence crops. This is due to the recent involvement of the FO in the creation of a network of actors promoting ecological products (targeting the domestic market), called CNABIO (*Conseil National de l'Agriculture Biologique*). Unlike the two other FOs, AIDMR is mostly certifying their products (i.e. the collected and processed mango and shea nut) under the participatory guarantee system where the FO (as well as other members of CNABIO), is also involved in the process of certification. Certified products are usually sold during exhibitions and workshops jointly organized by the members of CNABIO.

It can be observed from the above results that all the three FOs, regardless of how they choose to promote agroecological innovations, realized the importance of performing the two main innovation intermediaries' functions. FOs' knowledge intermediation usually follows the classic extension method of technology dissemination (by organizing group training and field demonstrations), but also include farmers' participation in the knowledge generation process since the FO in one of the case study (i.e. AIDMR) is also encouraging the promotion of farmer to farmer knowledge exchanges. FOs innovation intermediation embraces the performance of broader innovation support services by connecting and collaborating with different types of actors. These connections are essential for the continuity of FOs' provision of the technical and economic services necessary for stimulating their farmers' adoption of agroecological innovations.

Discussions and conclusion

The goal of this study was to provide empirical evidence on the role of FOs in agroecology in Africa, which is still limited, and more broadly contribute to literature on FOs as innovation intermediaries and facilitating actors in agroecology transitions. We will now discuss key results and contrast them to the extant literature on the topic. Also, we will provide some implications for policy.

The results demonstrate the contribution of FOs as the main intermediary actor facilitating the agroecological innovation process in Burkina Faso. This is illustrated by their establishment of multiple relationships with various actors of the agroecological innovation domains, and this is consistent with the earlier results of (Yang et al., 2014) who studied intermediation roles of FO in China. However, contrary to the Yang et al.'s (2014) results, the FOs in this study are mostly engaged in 'many-to-many' relationships. This can be due to the knowledge-intensive characteristic of agroecological innovations. As in many other developing countries (cf. Altieri & Toledo, 2011; Mier y Terán Giménez Cacho et al., 2018; Schiller et al., 2020a), the agroecological innovation actors in Burkina Faso are also dominated by the presence of many NGOs. These NGOs provide resources (such as technical knowledge and funds) to FOs in line with their wider objective of supporting small-scale farmers confronted with the increasing economic and ecological challenges. FOs, in their turn, organize the management of resources (obtained from NGOs as well as other innovation domain actors) to provide support services necessary to the stimulation of farmers' adoption of agroecological innovations. This corresponds with the argumentation of Bakhuijs (2013) on the contribution of innovation intermediaries' in bringing resources from many sources to many farmers, and findings elsewhere that intermediaries operate in a wider 'ecology' with other organizations that also provide intermediary roles (Kivimaa et al., 2019). In this case, the NGOs in a sense act as a knowledge intermediary to the FOs (following Goldberger, 2008), who subsequently translate it to farmers.

FOs thus bring resources to farmers by translating acquired knowledge into technical recommendations and providing other economic services, and connected farmers to different service providers (e.g. trainers, certifiers (cf. Gboko, 2020)) and each other (peer learning groups). This confirms the observations of Yang et al. (2014) regarding the multi-functionality of FOs in bringing compatibility between technical and economic dimensions of farming, and those of Kilelu et al. (2017) that these are both horizontal and vertical linkages. However, it could be noted from this study that some FOs (namely those promoting subsistence crops) are more engaged in facilitating participatory and joint learning (Kiptot & Franzel, 2019) through the organization of multiple interactions with farmers than others (i.e. those promoting commercial crops). This is due to the experiential characteristic of agroecological innovations which are usually developed through the consideration of farmers' knowledge (Altieri & Toledo, 2011; D'Annolfo et al., 2021). The economic services provided to farmers include credits, incentives, and marketing facilities. While credits and incentives are provided to stimulate farmers' interest towards specific agroecological innovations (e.g. organic cotton techniques and/or compost); marketing facilities are provided for helping both the FOs (for increasing the economies of scale) and their farmers in getting the overall benefits of the promoted innovations. This resonates with what other studies on innovation intermediaries (Bakhuijs, 2013; Howells, 2006) concluded on the importance of commercialization functions of intermediaries, as these support FOs to obtain the overall benefits from their products and innovations.

In conclusion, this study has provided insights into the innovation intermediaries' functions of FOs in supporting farmers' adoption of agroecological innovations. These are reflected from their fulfillment of two broad innovation intermediaries' functions identified in the literature i.e. the knowledge and innovation intermediations which may contribute to what has been called 'transformative agroecology learning' (Anderson et al., 2019b). Though earlier work has found that technical and economic functions of FOs, as well as horizontal and vertical intermediation, are complementary (Kilelu et al., 2017; Kiptot & Franzel, 2019; Yang et al., 2014), this study has deepened knowledge on this and argues that these may contribute to a broader transition since they can address several barriers in the agroecological innovation system (as per Schiller et al., 2020a). Here the FOs act as a facilitator for the introduction and/or development of complementary agroecological innovations over longer periods of time as they get more and more involved in the promotion of these innovations according to the evolution of their partnership with external partners. In the context of Burkina Faso, the FOs' development of these innovations is related to the continuity of their active performance of many agriculture development activities. It can also be noted that they do this with different foci and agroecology paradigms in mind, some of which (especially the one promoting mainly subsistence crops) may be more divergent from the mainstream conventional systems than others.

This study also has limitations, in the sense that it has looked at knowledge and innovation intermediation functions, and not centrally focused on lobbying and other change agency roles of FO which also contribute to agroecology transitions (Anderson et al., 2019a; Mangnus & Schoonhoven-Speijer, 2020; Mier y Terán Giménez Cacho et al., 2018). Future research regarding the farmers' adoption of agroecological innovations could thus examine the overall farmers' adoption situations and unraveling all key factors that influence their adoption of agroecological innovations and how this may transform agri-food systems. Thus, future research may look into how transformative the contribution of FO is, also in view of their focus and espoused agroecology paradigm, and what is the scope of transformation, as stimulating certain agro-ecological practices does not necessarily lead to a full-blown transformation (as per Schiller et al., 2020b).

In terms of policy recommendations, although FOs are considered as an important actor in the development of agroecological innovations, they still depend on the support provided by external funding sources (namely NGOs) and their donors to better stimulate their members' adoption of agroecological innovations, which may call for increased investment in agroecology (cf. Pimbert & Moeller, 2018). Additional support from national policy actors could therefore contribute to reducing the FOs' dependence on NGOs for the development of agroecological innovations, though this will require a coherent agroecological transformation policy (as per Anderson et al., 2019a; Schiller et al., 2020b). This support could be by subsidizing the access to agroecological inputs and setting specific policy incentives for agriculture products grown based on agroecological principles (e.g. public food procurement programs). Furthermore, increasing the promotion of farmer-to-farmer exchanges (at the level of the FOs) could also improve the farmers' access to agroecological knowledge and thus stimulate their adoption of agroecological innovations.

Notes

1. FOs (including unions, association, and groups with different structuration levels) can be defined as membership organizations contributing to fulfill farmers' agriculture development activities through collective action (Tanguy et al., 2008).
2. The GPCs are those in charge of the organization of cotton primary marketing activities (i.e. the collection and storage of cotton grain). The GPCs are receiving rebates from SOFITEX according to the tonnage of cotton supplied. These rebates constitute the main income source of the GPCs and the other unions of the UNPCB.
3. There are about 26 departmental and 280 provincial unions across the country. And both the departmental and provincial unions also have a president elected by their members.
4. All the general assembly members are among the large-scale cotton farmers of the country (with an average farm size of 100 ha).
5. CFA Franc is the currency used by many West African francophone countries.
6. All the members of the general assembly and board of directors are involved in large-scale farming with an average farm size of 25 ha.
7. This project was initially funded by the French Global Environmental Facility to experiment for the experimentation of participative sorghum selection, and later continued their activities with the support received from McKnight foundation. UGCPA started to train their farmers to become expert in the production and marketing of *Kapelga, Gnossiconi* and *Flagnon* sorghum varieties.
8. Advisors are either agricultural technicians appointed (by the national union technical team) in provinces (mostly the case of UNPCB and to some extent UGCPA) or some highly skilled farmers living within the village communities (concerning AIDMR and UGCPA).

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Data availability

The data collected and analyzed for this study can be shared upon request.

Declarations

All the participants to the study were informed about the purpose of the study and gave informed oral consent to participate in the study. All the interviewees participated on a voluntary basis and discussion was held (at the end the interviews) to share our understanding on what will be reported in the study.

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References

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. https://doi.org/10.1080/03066150.2011.582947

Ameur, F., Amichi, H., & Leauthaud, C. (2020). Agroecology In north African irrigated plains? Mapping promising practices and characterizing farmers' underlying logics. *Regional Environmental Change*, *20*(4), 1–17. https://doi.org/10.1007/s10113-020-01719-1.

Anderson, C. R., Bruil, J., Chappell, M. J., Kiss, C., & Pimbert, M. P. (2019a). From transition to domains of transformation: Getting to sustainable and just food systems through agroecology. *Sustainability*, *11*(*19*), 5272. http://doi.org/10.3390/su11195272

Anderson, C. R., Maughan, C., & Pimbert, M. P. (2019b). Transformative agroecology learning In Europe: Building consciousness, skills and collective capacity for food sovereignty. *Agriculture and Human Values*, *36*(3), 531–547. https://doi.org/10.1007/s10460-018-9894-0

Arnold, E., & Bell, M. (Eds.) (2001). Some New ideas about research for development. In *Partnerships at the leading edge: A danish vision for knowledge, research and development. Report of the Commission on development-related research funded by danida* (pp. 279–319). Ministry of Foreign Affairs/Danida.

Bakhuijs, E. (2013). *The intermediary role of farmer organizations: Stimulating innovation In developing countries* (Master's thesis), Utrecht University, The Netherlands. Retrieved August 01, 2016, from https://dspace.library.uu.nl/handle/1874/276939.

Bakker, T., Dugué, P., & de Tourdonnet, S. (2021). Assessing the effects of farmer field schools on farmers' trajectories of change In practices. *Agronomy for Sustainable Development*, *41*(2), 1–15. https://doi.org/10.1007/s13593-021-00667-2.

Bancé, S. (2013). *Caractérisation des dispositifs d'accompagnement des exploitations agricoles familiales vers l'intensification durable au Burkina Faso* (Master's thesis). Agrinovia, Université de Ouagadougou. Retrieved Avril 01, 2015, from https://afrique-ouest.cirad.fr/content/download/5570/48816/version/1/file/BANCE+Saydou+AGRINOVIA+2013-1.pdf

Bellwood-Howard, I., & Ripoll, S. (2020). Divergent understandings of agroecology In the era of the African Green revolution. *Outlook on Agriculture*, *49*(2), 103–110. https://doi.org/10.1177/0030727020930353

Berthet, E. T., Barnaud, C., Girard, N., Labatut, J., & Martin, G. (2016). How to foster agroecological innovations? A comparison of participatory design methods. *Journal of Environmental Planning and Management*, *59*(2), 280–301. https://doi.org/10.1080/09640568.2015.1009627

Bezner Kerr, R., Nyantakyi-Frimpong, H., Dakishoni, L., Lupafya, E., Shumba, L., Luginaah, I., & Snapp, S. S. (2018). Knowledge politics in participatory climate change adaptation research on agroecology in Malawi. *Renewable Agriculture and Food Systems*, *33*(*3*), 238–251. http://doi.org/10.1017/S1742170518000017

Blein, R., & Coronel, C. (2013). *Les organisations de producteurs en Afrique de l'ouest et du centre : attentes fortes, dures réalités. FARM (fondation pour l'agricultnure et la ruralité dans le monde).* (Vol. 8).

Boillat, S., Belmin, R., & Bottazzi, P. (2021). The agroecological transition In Senegal: Transnational links and uneven empowerment. *Agriculture and Human Values*, 1–20. https://doi.org/10.1007/s10460-021-10247-5

Bottazzi, P., & Boillat, S. (2021). Political agroecology In Senegal: Historicity and repertoires of collective actions of an emerging social movement. *Sustainability (Switzerland)*, *13* (11), 6352-1–20. https://doi.org/10.3390/su13116352

Cerf, M., Bail, L., Lusson, J. M., & Omon, B. (2017). Contrasting intermediation practices In various advisory service networks In the case of the French ecophyto plan. *The Journal of Agricultural Education and Extension*, *23*(3), 231–244. https://doi.org/10.1080/1389224X.2017.1320641

Chirwa, E., Dorward, A., Kachule, R., Kumwenda, I., Kydd, J., Poole, N., Poulton, C., & Stockbridge, M.. (2005, November). Walking tightropes: Supporting farmers organisations for market accessNatural resource. In *Natural Resource Perspective* (Vol. *99*). Overseas Development Institute. http://www.odi.org.uk/nrp/99.pdf

D'Annolfo, R., Gemmill-Herren, B., Amudavi, D., Shiraku, H. W., Piva, M., & Garibaldi, L. A. (2021). The effects of agroecological farming systems on smallholder livelihoods: A case study on push–pull system from western Kenya. *International Journal of Agricultural Sustainability*, *19*(1), 56–70. https://doi.org/10.1080/14735903.2020.1822639

de Tourdonnet, S. and Brives, S. (2018). Agroecological innovation: Mobilizing ecological processes In agrosystems. In J. M. Touzard, L. Temple, F. Goulet, Y. Chiffoleau, & G. Faure (Eds.), *Innovation and development in agricultural and food systems* (pp. 95–109). Quae.

Diagne, D., & Pesche, D. (1995). *Les organisations paysannes et rurales: Des acteurs du développement en Afrique sub-saharienne.* Réseau GAO, 82 p.

Esman, M. J., & Uphoff, N. T. (1984). *Local organizations intermediaries In Rural development*. Cornell University Press.

Gboko, K. C. (2020). *Évaluation des performances des services de conseil agricole intégrés aux programmes de certification du cacao des exportateurs en côte d'Ivoire* (Doctoral dissertation), Montpellier SupAgro, France. Retrieved Septembre 15, 2021, from https://www.researchgate.net/publication/351749005_Evaluation_des_performances_des_services_de_conseil_agricole_integres_aux_programmes_de_certification_du_cacao_des_exportateurs_en_Cote_d'Ivoire.

Giraldo, O. F., & Rosset, P. M. (2018). Agroecology as a territory In dispute: Between institutionality and social movements. *Journal of Peasant Studies*, *45*(3), 545–564. https://doi.org/10.1080/03066150.2017.1353496

Gliessman, S. (2020). Investing In agroecology In Africa. *Agroecology and Sustainable Food Systems*, *44*(10), 1253–1254. https://doi.org/10.1080/21683565.2020.1791486

Gliessman, S., Putnam, H., & Cohen, R. (2017). *Agroecology and participatory knowledge production and exchange as a basis for food system change: The case of the community agroecology network*. World Scientific.

Goldberger, J. R. (2008). Non-governmental organizations, strategic bridge building, and the "scientization" of organic agriculture In Kenya. *Agriculture and Human Values*, *25*(2), 271–289. https://doi.org/10.1007/s10460-007-9098-5

Gouët, C., & Van Paassen, A. (2012). Smallholder marketing cooperatives and smallholders 'market access: Lessons learned from the actors involved. *The Journal of Agricultural Education and Extension*, *18*(*4*), 369–385. http://doi.org/10.1080/1389224X.2012.691784

Groot Kormelinck, A., Bijman, J., & Trienekens, J. (2019). Characterizing producer organizations: The case of organic versus conventional vegetables In Uruguay. *Journal of Rural Studies*, *69*, 65–75. https://doi.org/10.1016/j.jrurstud.2019.04.012

Haggar, J., Nelson, V., Lamboll, R., & Rodenburg, J. (2020). Understanding and informing decisions on sustainable agricultural intensification in Sub-Saharan Africa. *International Journal of Agricultural Sustainability*, 1–10. https://doi.org/10.1080/14735903.2020.1818483

Home, R., Bouagnimbeck, H., Ugas, R., Arbenz, M., & Stolze, M. (2017). Participatory guarantee systems: Organic certification to empower farmers and strengthen communities. *Agroecology and Sustainable Food Systems*, *41*(5), 526–545. https://doi.org/10.1080/21683565.2017.1279702

Howells, J. (2006). Intermediation and the role of intermediaries In innovation. *Research Policy*, *35*(5), 715–728. https://doi.org/10.1016/j.respol.2006.03.005

Jacob, J.-P., & Lavigne Delville, P. H. (1994). *Les associations paysannes en afrique: Organisations et dynamiques*. APAD/Karthala.

Kerr, B., Nyantakyi-Frimpong, R., Dakishoni, H., Lupafya, L., Shumba, E., Luginaah, L., Snapp, I., & S, S. (2018). Knowledge politics In participatory climate change adaptation research on agroecology In Malawi. *Renewable Agriculture and Food Systems*, *33*(3), 238–251. https://doi.org/10.1017/S1742170518000017

Kilelu, C., Klerkx, L., & Leeuwis, C. (2013). Unravelling the role of innovation platforms In supporting co-evolution of innovation: Contributions and tensions In a smallholder dairy development programme. *Agricultural Systems*, *118*, 65–77. https://doi.org/10.1016/j.agsy.2013.03.003

Kilelu, C. W., Klerkx, L., & Leeuwis, C. (2017). Supporting smallholder commercialisation by enhancing integrated coordination In agrifood value chains: Experiences with dairy hubs In Kenya. *Experimental Agriculture*, *53*(2), 269–287. https://doi.org/10.1017/S0014479716000375

Kilelu, C. W., Klerkx, L., Leeuwis, C., & Hall, A. (2011). Beyond knowledge brokering: An exploratory study on innovation intermediaries In an evolving smallholder agricultural system In Kenya. *Knowledge Management for Development Journal*, *7*(1), 84–108. https://doi.org/10.1080/19474199.2011.593859

Kiptot, E., & Franzel, S. (2019). Stakeholder planning of the institutionalization of the volunteer farmer–trainer approach In dairy producer organizations In Kenya: Key steps and supporting mechanisms. *International Journal of Agricultural Sustainability*, *17*(1), 18–33. https://doi.org/10.1080/14735903.2018.1558581

Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries In sustainability transitions: A systematic review and a research agenda. *Research Policy*, *48*(4), 1062–1075. https://doi.org/10.1016/j.respol.2018.10.006

Klerkx, L., Hall, A., & Leeuwis, C. (2009). Strengthening agricultural innovation capacity: Are innovation brokers the answer? *International Journal of Agricultural Resources, Governance and Ecology*, *8*(31), 1–47. https://doi.org/10.1504/IJARGE.2009.032643

Klerkx, L., Mierlo, B. v., & Leeuwis, C. (2012). A.evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. In I. Darnhofer, D. Gibbon, & B. Dedieu (Eds.), *Farming systems research into the 21st century: The New dynamic* (pp. 457 –4483). Springer.

Konate, S. (2013). Les organisations de producteurs en Afrique de l'ouest et du centre : attentes fortes, dures réalités : le cas du Burkina Faso. FARM (fondation pour l'agriculture et la ruralité dans le monde) working report.

LAMY, M.-H. (2005). *La reconnaissance du rôle du monde paysan dans le développement du Burkina Faso depuis son indépendance* (Master's thesis), Institut d'Etudes Politiques de Lyon, France. Retrieved Septembre 1, 2018, from http://doc.sciencespo-lyon.fr/Ressources/Documents/Etudiants/Memoires/Cyberdocs/MFE2005/lamy_mh/pdf/lamy_mh.pdf.

Lundvall, B. A. (1992). *National systems of innovation. Towards a theory of innovation and interactive learning*. Printer.

Luo, J., Han, H., Jia, F., & Dong, H. (2020). Agricultural Co-operatives In the western world: A bibliometric 1114 analysis. *Journal of Cleaner Production*, *273*, 122945-1–13. https://doi.org/10.1016/j.jclepro.2020.122945

Mangnus, E., & Schoonhoven-Speijer, M. (2020). Navigating dynamic contexts: African cooperatives as institutional bricoleurs. *International Journal of Agricultural Sustainability*, *18*(2), 99–112. https://doi.org/10.1080/14735903.2020.1718991

Mercoiret, M. R., Pesche, D., & Bosc, P. M. (2007). *Rural producers organizations for Pro-poor Sustainable agricultural development*. workshop proceedings Paris, France, 30-31 October 2006. The World Bank-CIRAD-IFAD-AUF.

Mier y Terán Giménez Cacho, M., 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. https://doi.org/10.1080/21683565.2018.1443313

Mousseau, F. (2015). The untold success story of agroecology In Africa. *Development (Basingstoke*, *58*(2-3), 341–345. https://doi.org/10.1057/s41301-016-0026-0

Mugwanya, N. (2019). Why agroecology is a dead end for Africa. *Outlook on Agriculture*, *48*(2), 113–116. https://doi.org/10.1177/0030727019854761

Peano, C., Massaglia, S., Ghisalberti, C., & Sottile, F. (2020). Pathways for the amplification of agroecology In African sustainable urban agriculture. *Sustainability (Switzerland)*, *12*(7), 2718. https://doi.org/10.3390/su12072718

Pimbert, M. P., & Moeller, N. I. (2018). Absent agroecology Aid: On UK agricultural development assistance since 2010. *Sustainability (Switzerland)*, *10*(2), 505. https://doi.org/10.3390/su10020505

Pretty, J., Attwood, S., Bawden, R., Van Den Berg, H., Bharucha, Z. P., Dixon, J., … Yang, P. (2020). Assessment of the growth In social groups for sustainable agriculture and land management. *Global Sustainability*, *3*, 1–16. https://doi.org/10.1017/sus.2020.19.

Rajalahti, R., Janssen, W., & Pehu, E. (2008). *Agricultural innovation systems: From diagnostics toward operational practices*. Agriculture & Rural Development Department, World Bank.

Ramirez, M., Clarke, I., & Klerkx, L. (2018). Analysing intermediary organisations and their influence on 1185 upgrading In emerging agricultural clusters. *Environment and Planning A: Economy and Space*, *50*(6), 1314–1335. https://doi.org/10.1177/0308518X17741316

Reed, G., & Hickey, G. M. (2016). Contrasting innovation networks In smallholder agricultural producer cooperatives: Insights from the niayes region of Senegal. *Journal of Co-Operative Organization and Management*, *4*(2), 97–107. https://doi.org/10.1016/j.jcom.2016.09.001

Röling, N. G., & Jiggins, J. (1998). The ecological knowledge systems. In N. G. Roling & M. A. E. Wagemakers (Eds.), *Facilitating sustainable agriculture: Participatory learning and adaptive management in times of environmental uncertainty* (pp. 283–311). Cambridge University Press.

Roose, E., Kabore, V., & Guenat, C. (1999). Zaï practice: A West African traditional rehabilitation system for semiarid degraded lands, a case study In Burkina Faso. *Arid Soil Research and Rehabilitation*, *13*(4), 343–355. https://doi.org/10.1080/089030699263230

Schiller, K., Godek, W., Klerkx, L., & Poortvliet, P. M. (2020b). Nicaragua's agroecological transition: Transformation or reconfiguration of the agri-food regime? *Agroecology and Sustainable Food Systems*, *44*(5), 611–628. https://doi.org/10.1080/21683565.2019.1667939

Schiller, K. J. F., Klerkx, L., Poortvliet, P. M., & Godek, W. (2020a). Exploring barriers to the agroecological transition In Nicaragua: A technological innovation systems approach. *Agroecology and Sustainable Food Systems*, *44*(1), 88–132. https://doi.org/10.1080/21683565.2019.1602097

Tanguy, B., Collion, M.-H., De Janvry, A., & Ron, P,SE. (2008). Do village organizations make a difference In African Rural development? A study for Senegal and Burkina Faso. *World Development*, *36*(11), 2188–2204. https://doi.org/10.1016/j.worlddev.2007.10.010

Toillier, A., & Bancé, S. (2021). *Coexistence et confrontation des modèles agricoles et alimentaires. Un nouveau paradigme du développement territorial ?*. In P. Gasselin, S. Lardon, C. Cerdan, S. Loudiyi, & D. Sautier (Eds.), *Coexistence et confrontation des modèles agricoles et alimentaires. Un nouveau paradigme du développement territorial ?* (pp. 133–150, Versailles: Editions). Nature et société.

Uphoff, N. (2002). *Agroecological innovations: Increasing food production with participatory development*. Routledge.

Van Hulst, F., Ellis, R., Prager, K., & Msika, J. (2020). Using co-constructed mental models to understand stakeholder perspectives on agro-ecology. *International Journal of Agricultural Sustainability*, *18*(2), 172–195. https://doi.org/10.1080/14735903.2020.1743553

Veltmeyer, H. (2019). Resistance, class struggle and social movements In Latin America: Contemporary dynamics. *Journal of Peasant Studies*, *46*(6), 1264–1285. https://doi.org/10.1080/03066150.2018.1493458

Verma, S., Sonkar, V. K., Kumar, A., & Roy, D. (2019). Are farmer producer organizations a boon to farmers? The evidence from bihar, India. *Agricultural Economics Research Review*, *32* (conf), 123–137. https://doi.org/10.5958/0974-0279.2019.00022.3

Wennink, B., & Heemskerk, W. (2006). *Farmers' organizations and agricultural innovation. Bulletin 374*. Royal Tropical Institute (KIT) Publishers.

Westbrooke, V., Guenther, M., Bewsell, D., & Greer, G. (2018). Meat processing company staff as innovation intermediaries: Developing a framework from New Zealand's red meat sector. *The Journal of Agricultural Education and Extension*, *24*(2), 123–135. https://doi.org/10.1080/1389224X.2018.1435419

Wezel, A., & Silva, E. (2017). Agroecology and agroecological cropping practices. In A. Wezel (Ed.), *Agroecological practices for Sustainable Agriculture: Principles, applications, and making the transition* (pp. 18–50). World Scientific.

World Bank. (2007). *Enhancing agricultural innovation: How to go beyond the strengthening of research systems* (pp. 1–188). World Bank.

Wynne-Jones, S., Hyland, J., Williams, P., & Chadwick, D. (2020). Collaboration for Sustainable intensification: The underpinning role of social sustainability. *Sociologia Ruralis*, *60*(1), 58–82. https://doi.org/10.1111/soru.12275

Yang, H., Klerkx, L., & Leeuwis, C. (2014). Functions and limitations of farmer cooperatives as innovation intermediaries: Findings from China. *Agricultural Systems*, *127*, 115–125. https://doi.org/10.1016/j.agsy.2014.02.005

Yin, R. K. (2009). *Case study research. Design and methods* (4th ed.). Sage.