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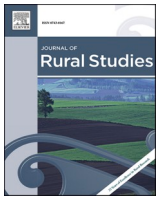

Beyond motivations: A framework unraveling the systemic barriers to organic farming adoption in northern Senegal

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ABSTRACT

Developing organic farming is among the most popular policy options for protecting soil, water, and biodiversity while improving incomes for agricultural producers around the World. Despite its growing success, the adoption as well as the outcomes of organic agriculture remain particularly low in sub-Saharan Africa. In this paper, we propose a multidimensional framework based on farmers' perceived motivations to evaluate the factors enabling or hindering the adoption of organic agriculture, including attitude (the subjective evaluation of a behaviour), ability (the cognitive and technical capacity to perform a behaviour), opportunity (the perceived social, economic, and ecological benefits of a behaviour), and legitimacy (formal and informal values and norms supporting a behaviour). We tested the framework on a sample of around 300 organic and conventional small-scale farmers in a horticultural area in northern Senegal. We found that despite a highly positive attitude towards organic practices among both conventional and organic farmers, adoption remains extremely low, and many have abandoned them. Low perceived ability and a lack of opportunities appeared to be determinant drivers, including difficulties accessing available organic input, knowledge, and tools and lack of both a market and institutional support. Our results suggest that greater emphasis should be placed on creating favourable conditions at the food system level based on broad agroecological principles. This can be achieved, for example, by supporting grassroots farmer organizations, enacting appropriate environmental legislation, securing organic farmers' productive resources, and enhancing participatory organic certification and alternative food networks. Such efforts are likely to have a more significant impact than training and promotion targeting farmers who are already convinced.

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1. Introduction

Organic farming and other sustainable agriculture initiatives are increasingly recommended by international policies as a way of protecting soil, water, biodiversity, and human health. Most approaches in organic agriculture recommend the replacement of external chemical inputs with alternatives ranging from self-made to industrial organic products (Migliorini and Wezel 2017). Despite the availability of many practical solutions, their adoption remains limited in sub-Saharan Africa, particularly in the horticultural sectors, where the use of chemical inputs exceeds most recommendations (Giller, Witter et al. 2009; Meijer, Catacutan et al. 2015). Understanding the factors facilitating or hindering the adoption of organic agriculture among small-scale farmers is key to proposing adapted support measures. In sub-Saharan Africa, Research on farmer motivations is only just emerging, despite its importance for identifying appropriate policy measures (Meijer, Catacutan et al. 2015; Avane, Amfo et al. 2022; Lee and Gambiza 2022). Most approaches focus on distinguishing enablers of and barriers to adoption of organic agriculture among farmers. Particular attention has been given to the potential relationship between farmers' socio-economic

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characteristics (wealth, infrastructure, labour availability, etc.) and their attitudes or belief systems. Despite these interesting trends, little research has taken a more holistic approach, for example by studying farmer characteristics in combination with their perception of the broader ecological, social, and economic contexts. This has led to a strong focus on the farm level (such as technical aspects, farm characteristics, etc.) when, in fact, several major factors must be understood at a broader systemic level (Schoonhoven and Runhaar 2018). Putting these different levels into dialogue requires appropriate methodologies and is important to avoid confusion in policy action. Too many "naïve" interventions, most often led by international NGOs, remain limited to technical aspects at plot level and consider the potential of organic agriculture and other sustainable agriculture initiatives as given without taking into account broader criteria (Giller, Witter et al. 2009; Wezel, Brives et al. 2016). Conversely, other policy actions focus on changing the institutional background or technical support schemes without understanding farmers' socially and ecologically determined motivations (Moumouni, Baco et al. 2013). Our research builds on the current literature to propose a holistic theoretical framework that helps to identify and hierarchize factors hindering or enabling farmers' adoption of organic farming practices. Our framework is then tested in northern Senegal, in the horticultural area of Niayes, where multiple organic farming extension programmes have been carried out with very little success in inducing widespread adoption by farmers (Bottazzi and Boillat 2021).

2. Drivers of sustainable agriculture adoption in sub-Saharan Africa

In sub-Saharan Africa, a growing number of actors, including civil society organizations, farmers' movements, and international cooperation agencies are promoting sustainable agriculture initiatives as efficient solutions for adapting to climate change, supporting food sovereignty, and improving vulnerable farmers' livelihoods. However, some scientific evaluations of these NGO-led initiatives take a less enthusiastic view (Giller, Witter et al. 2009; Tittonell, Scopel et al. 2012; Dahlin and Rusinamhodzi 2019; Mugwanya 2019). Many of these initiatives remain limited to small-scale projects that represent "islands of success" (Gonzalez de Molina 2013) and frequently end in progressive or abrupt abandonment once the project is over. Too many one-size-fits-all programmes have attempted to attract attention from African farmers without acknowledging the heterogeneity of local or regional socio-ecological contexts (Tittonell, Scopel et al. 2012; Vanlauwe, Coyne et al. 2014). In view of these challenges, more recent studies on sub-Saharan African farmers' motivations have begun to focus on capturing one or more aspects hampering adoption. A review of this research points up some important gaps at different levels.

2.1. Household and farm characteristics

A first level that has attracted attention is the role of household or farm characteristics that were identified as key features influencing the adoption of sustainable agricultural practices by farmers in sub-Saharan Africa (Sietz and Van Dijk 2015). These so-called "internal drivers" include general aspects, such as technical specificities, the types of sustainable farming practices involved, farm size, or household composition (Coulibaly, Motelica-Heino et al. 2019; Jambo, Groot et al. 2019). Technical aspects are often mentioned in sub-Saharan Africa because of the difficult climatic conditions; they include soil type, access to productive assets, biomass, and pest management techniques. Sustainable farming practices such as soil rehabilitation, no tillage, self-made organic inputs, crop diversification, and alternance or planting fertilizing trees can be highly demanding in terms of knowledge, work, and tools and inevitably involve certain trade-offs, especially for farmers with little resources (Tittonell, Scopel et al. 2012). Household composition has also garnered attention specifically in sub-Saharan Africa, where family farms are common. It includes the number of people, their level of education and training, and their availability to participate in productive activities (Meijer, Catacutan et al. 2015). All these aspects influence a farmer's ability to perform a certain behaviour – alongside production infrastructure, access to loans, technical ability, and empirical knowledge about the agroecosystem context (Mutyasira, Hoag et al. 2018; Lee and Gambiza 2022). Despite their importance, little attention has been given to gender aspects in sub-Saharan Africa. Gender approaches underline the particular relationship between women, family care, soil fertility, and good food (the ecofeminist perspective) (Tsikata and Yaro 2014).

Crucial farm characteristics influence farmers' adoption. In sub-Saharan Africa, these include yields, farmers' wealth and incomes, and access to natural resources. (Corbeels et al., 2014; Jambo, Groot et al. 2019; Lee and Gambiza 2022). This has also been demonstrated in wealthy countries like Switzerland, where environmental beliefs are also mediated by 'survival' priorities (Gabel, Home et al. 2018). Access to sufficient land and natural resources such as irrigation water is important, although it is not always possible to determine whether it is positively or negatively correlated with adoption, as in some cases large land owners can be attracted more by the conventional market (Sietz and Van Dijk 2015, Mutyasira, Hoag et al. 2018). Similarly, poverty was described as both a driver and a spoiler of organic agriculture adoption in sub-Saharan Africa. This can be explained by the fact that organic agriculture has a potential to reduce input costs – through the use of fertilizers and pest treatments that farmers make themselves on the farm – and can therefore be attractive to the poorest producers (Cakirli Akyüz and Theuvsen 2020). Farmer adoption of organic agriculture can therefore be motivated by financial strategies of minimizing input costs and maximizing income (Riar, Mandloi et al. 2017). However, many trade-offs and synergies must be considered. Poor households often seek short-term benefits rather than longer-term yield increases based on agroecosystem preservation techniques. Other aspects such as livestock ownership and access to off-farm income were generally shown to be positive assets (Corbeels et al., 2014).

2.2. Motivational factors

A second and important set of factors can be qualified as "intrinsic" or "attitudinal" and comprises the subjective perception of a behaviour, deep beliefs, and other cultural aspects such as the environmental or human values associated with the behaviour (Meijer, Catacutan et al. 2015). Intrinsic motivations are those motivations that are directly driven by the perceived inherent value of a behaviour. They are considered crucial in guaranteeing the continuity of a behaviour despite the end of a supporting programme or other contextual changes. Several researchers have started to explore the role of intrinsic motivations related to sustainable agriculture adoption in sub-Saharan Africa and have mostly found them to be equally important as external factors (Meijer, Catacutan et al. 2015; Lalani, Dorward et al. 2016; Mutyasira, Hoag et al. 2018; Mellon-Bedi, Descheemaeker et al. 2020). Using a holistic framework based on first-hand data from 246 farms in Malawi and Tanzania, Jambo et al. (2019) evaluate the relative importance of farmers' features (including autonomy, competences, and connectedness) compared to motivational criteria (extrinsic and intrinsic). These authors found an equivalent importance and a continuum between intrinsic and extrinsic motivations and point to the relevance of farmers' autonomy in shaping their decision according to their own evaluation criteria. Similar studies in sub-Saharan Africa underlined the importance of combining socio-economic farm features and external drivers with motivational factors such as attitude, personal satisfaction, and eco-instrumental motivations. They all found an equivalent importance of intrinsic factors depending on the geographical, social, and institutional contexts (Lalani, Dorward et al. 2016; Coulibaly, Motelica-Heino et al. 2019; Mellon-Bedi, Descheemaeker et al. 2020). A few studies also make reference to cultural drivers in conservation agriculture, such as

religious and other cultural beliefs (Buchmann, Prehsler et al. 2009). They invite us to step back from utilitarianist approaches and to integrate other types of rationalities, such as the importance of moral and ethical values in farmers' motivations. In other regions, sustainable agriculture was associated with a higher degree of life satisfaction, especially for more recently-converted farmers, along with higher income, profitability, satisfaction at work, social recognition, and good health (Mzoughi 2014; Timmermann and Felix 2015). These latter aspects have been quite neglected in sub-Saharan Africa, where programmes are often limited to a "basic needs" perspective.

2.3. Regional and institutional factors

A third level of concerns includes elements that do not directly depend on farm characteristics and farmers' explicit intentions, such as biophysical regional aspects (climate, rainfall, etc.) (Lee and Gambiza 2022), national and international policies (trade policies, subsidies, etc.) (Bendjebbar and Fouilleux 2022), local norms and institutional settings (organic certification, etc.) (Fouilleux and Loconto 2017), or economic context (customer preference, market channels, etc.) (Ndah et al., 2014; Ndah et al., 2015). Research on the role of institutional contextual drivers in Europe has shown that motivation for compliance with environmental regulations, farmers' awareness of rules, and the perceived legitimacy of these rules according to the type of farmer play important roles in organic agriculture adoption (Winter and May, 2001, Schoonhoven and Runhaar 2018). In sub-Saharan Africa, research on adoption mechanisms has mainly focused on the role of technical support (such as extension services provided by NGOs or the state) due to the region's historical dependence on international cooperation and state-centred agricultural extension (Moumouni, Baco et al. 2013; Mellon-Bedi, Descheemaeker et al. 2020). Aspects related to the effects of norms and institutional settings, such as organic certification mechanisms or price regulation policies, remain clearly underdeveloped in sub-Saharan Africa (Oya et al., 2018; Cakirli Akyüz and Theuvsen 2020). At intercommunity levels, synergies among farmers based on strong organizational settings, farmer-to-famer knowledge exchange, communalization of means of production, solidarity networks, peers' recognition, and social legitimacy might play an important role although they remain largely understudied in sub-Saharan Africa.

3. Theoretical framework

3.1. Toward a holistic framework that includes farmers' motivations concerning organic agriculture

The concept of motivation can be defined as a hypothetical construct used to describe the internal and/or external forces that engender the initiation, direction, intensity, and persistence of a behaviour (Carré and Fenouillet 2008). Scholars from agrarian sociology and psychology refer to it to understand factors leading to land users adopting innovative practices. Psychology has long established the distinction between intrinsic and extrinsic motivations: Intrinsic motivations are defined as motivations generated from the inherent beliefs of a person without the need for an external incentive, while extrinsic motivations are driven by external factors such as financial compensation or peer recognition (De Young 1985). Intrinsic motivations are often considered more important behavioural drivers than extrinsic ones, as they are more likely to lead to autonomy of the subject and maintenance of a behaviour over time. At least three main schools of thought have influenced the conceptual basis of motivation theory in the field of agrarian change: (1) rational choice theory (RCT) (Boudon 2003); (2) the theory of planned behaviour (TPB) (Ajzen 1991); and (3) self-determination theory (SDT) (Ryan and Deci 2000).

RCT is probably the most influential school of thought in multiple fields, from neoclassical economy to agronomic and environmental studies, although it is not always explicitly mentioned (Boudon 2003). It postulates that individuals always seek to maximize the utility of their action and develop strategies based on freely available information to take the best decision according to their interests. Classical agronomy has been (implicitly and explicitly) influenced by this approach in viewing farmers as rational agents whose main objective is to improve yields and profits. However, RCT has been criticized for being too reductive, by omitting cultural and psychological aspects and ignoring that individuals do not always have the necessary information to take decisions and, most often, act according to subjective and affective principles, thereby responding to forms of rationality that may go against their economic interests.

The theory of planned behaviour (TPB) was developed to overcome the limits of RCT by including more constructivist aspects of actors' rationalities, such as their subjective beliefs (attitude), socially constructed norms (subjective norm), and their perceived capacity to perform a given behaviour (perceived behavioural control) (Ajzen 1991, 2012). Although TPB became one of the most popular approaches to measuring pro-environmental behaviour, it has also been criticized for its reductionism and the lack of contextual, emotional, and cultural aspects, among others (Ajzen 1991; Meijer, Catacutan et al. 2015; Conner 2020).

Self-determination theory (SDT) (Ryan and Deci 2000) complements both RCT and TBP by further insisting on the importance of the above-mentioned aspects in evaluating the performance of a given behaviour. It emphasizes the idea that people who are intrinsically motivated in their actions enjoy life more and are therefore also more performant. According to SDT, the performance of a behaviour depends on the agent's competence, their degree of autonomy, and their connection with other people who provide support and recognition (relatedness). Extrinsic and intrinsic motivations are not disconnected from each other but rather interact during a so-called "internalization process", where what is extrinsically motivating can progressively become internalized.

RCT, TBP, and SDT have inspired the development of motivational approaches, mainly in the fields of agrarian psychology and sociology, to provide a detailed analysis of what can lead land users to adopt a behaviour and to maintain and perform it over the long term (Kenter, O'Brien et al. 2015, Meijer, Catacutan et al. 2015, Sietz and Van Dijk 2015; Schoonhoven and Runhaar 2018, Jambo, Groot et al. 2019, Seufert, Austin et al. 2023). Some theorization efforts have proposed to "organize" or "classify" motivational factors into various categories. For example, Dessart et al. (2019) distinguish between (1) dispositional factors, such as personality, moral concern, or environmental concern, (2) social factors, such as norms, need for social approval, conformism, or need for social status, and (3) cognitive factors, such as farmer knowledge, perceived costs and benefits, perceived control of the behaviour, or perceived risks. Seufert et al. (2023) developed a theory of motivations in sustainable agriculture by combining TPB with the sustainable livelihoods framework (SLF). According to their approach, motivations concerning sustainable agriculture are the outcome of the combination of external factors (institutions, social networks, etc.), internal factors (livelihood characteristics), and several patterns of psychosocial motivations, such as attitudes, subjective norms, perceived behavioural control, or self-identity. An interesting holistic framework is proposed by Shoonhoven et al. (2018), who combine multiple dimensions including farmers' ability (skills, investment capacity, etc.), personal motivations (co-benefits, understanding of ecosystem, responsibility for future generation, etc.), demand (market and policy related aspects) and legitimation (norms and values, peer pressure, etc.). What they call the "onion model" locates the various factors at different distances from farmers' personal reality and subdivides these spheres into "direct" and "distal" contexts. This perspective invites us to consider farmers' motivations as a multidimensional construct of personal situation (subjective, structural, material, etc.) and perceived contexts at multiple levels (political, social, ecological etc.).

3.2. Proposition: a holistic motivation framework

Inspired above all by conceptual and empirical research in sub-Saharan Africa (Ndah et al., 2014; Meijer, Catacutan et al. 2015; Sietz and Van Dijk 2015, Lalani, Dorward et al. 2016; Coulibaly, Motelica-Heino et al. 2019; Jambo, Groot et al. 2019; Mellon-Bedi, Descheemaeker et al. 2020; Avane, Amfo et al. 2022; Lee and Gambiza 2022) and the above-mentioned theories (RCT, TPB, SDT), we propose a holistic framework to help us better understand what drives farmer motivations concerning the adoption of sustainable agriculture (Fig. 1). The framework is then tested in a case of organic farming adoption in a horticultural area of northern Senegal to evaluate its relevance for further similar studies. The framework is subdivided into 3 levels corresponding to what we call a motivational trend. Starting with the most obviously given contextual reality (socio-structural or contextual level), it then explores how these realities are perceived by the agent of the behaviour (perception level) and finally focuses on the characteristics of the behaviour or the behavioural intention (behavioural or practical level).

3.2.1. Level 1: socio-structural or contextual level

The socio-structural or contextual level encompasses both external and internal drivers. The former are not directly influenced by the agent of the behaviour. Examples include climate, national and international policies, market characteristics, territorial aspects, or the diffusion of new agroecological practices at broader scales. These drivers can be observed through participatory observation, field visits, and document review. Internal drivers mainly include the basic characteristics of farmers and farms that are not easily changed according to farmers' intentions. Examples include the people working on the farm and their age, gender relationships, or education, as well as farm size and main productive infrastructure, such as the amount of available land and other productive and natural resources. External and internal contextual drivers depend on each other according to physical dynamics and power-related coercive processes. For example, an agrarian reform can cause farmers to sell their land at market price and invest in other activities or migrate to urban centres. These processes can lead to the total abandonment of sustainable farming. Socio-structural parameters are therefore the products of a co-construction between external and internal factors that is shaped by asymmetric power relations and physical constraints.

3.2.2. Level 2: perception level

Deepening the motivational trends, contextual aspects are subject to perception by the agent of a given behaviour according to various dimensions of interest. Combining some of the above mentioned frameworks from the literature (Meijer, Catacutan et al. 2015; Lalani, Dorward et al. 2016; Schoonhoven and Runhaar 2018, Dessart, Barreiro-Hurlé et al. 2019; Jambo, Groot et al. 2019), it is possible to distinguish four dimensions along a continuum of progressive internalization: (1) Legitimacy, which comprises the perceived norms and values supporting the behaviour. These norms can be formal (written explicitly in laws and other regulations) or informal (emerging from interpersonal arrangements). (2) Opportunity, which refers to the indirect perceived benefits to be expected from the behaviour. It includes, for example, commercial income, the opportunity to meet new people, or a reduction in input costs thanks to subsidies. (3) Ability, which encompasses the cognitive and technical capacity to perform the behaviour, for example availability of the necessary knowledge, infrastructure, cost of labour, or cost of inputs. (4) Attitude, which refers to the subjective and inherent evaluation of the behaviour itself, for example in terms of environmental performance, moral appropriateness, or utilitarian benefits.

3.2.3. Level 3: behaviour or behavioural intention to adopt

Finally, our framework considers various configurations of behaviour and behavioural intention. The two are not causally linked, since behavioural intention is not necessarily followed by the behaviour itself. A farmer's positive, intermediate, or negative response can refer to different levels of adoption, ranging from recent adoption and maintenance to the absence of any clear intention or the complete rejection or abandonment of a behaviour. Farmers' behavioural intentions are not the product of strictly rational choices in an idealized world of transparent information but emerge from the above-mentioned constraining structures manifested in farmers' perceptions of the legitimacy, opportunity, ability, and attitude associated with the behaviour.

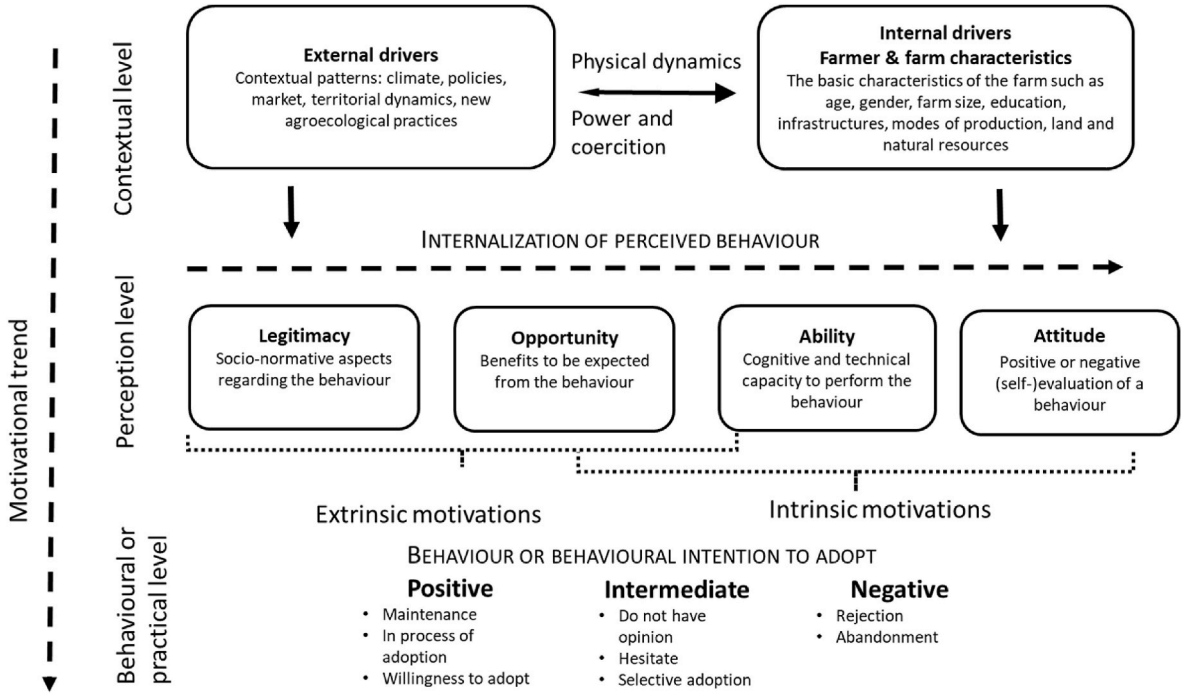

Fig. 1. Proposed holistic model to evaluate farmers' motivations concerning adoption of sustainable agriculture.

4. Empirical test of the proposed framework in sub-Saharan Africa, namely in Senegal

4.1. Study area

To test this framework, we applied it to about 300 small farms in northern Senegal. Our research was carried out in the Niayes region, a 5–30 km wide coastal strip along the Atlantic coast between the cities of Dakar and Saint-Louis (Fig. 2). This region accounts for about 70% of Senegal's horticultural production, thanks to particularly good climatic conditions and to the presence of fresh groundwater in interdune basins (Touré Fall and Fall 2001). Our study focuses on Thiès Region in the southern part of Niayes (Fig. 2). The study area includes the two municipalities of Diender and Kayar, which have around 28,000 and 20,000 inhabitants, respectively. Agricultural activities in the area concentrate on interdune basins, called *niayes*. Basins located between coastal dunes have sandy soils, and those between older continental dunes have peaty soils that can be waterlogged during the rainy season. Cultivation in the *niayes* occurs during the dry season, with irrigation water pumped from the Nappe des Sables Quaternaires (NSQ) groundwater reservoir found at 0–15 m depth in a relatively permeable stratum that lies upon a marly and marly-limy substratum from the Eocene, which is relatively impermeable. The NSQ is a mostly renewable water source that depends on local seasonal rainfall.

The current horticultural system in Niayes developed during the colonial time, in the 19th and early 20th centuries, and was mainly dedicated to feeding the growing city of Dakar. In the 1930s, migration from the peanut basin further south was organized to increase the workforce. The main horticultural crop was potato, complemented with rainfed crops (millet, peanut, and cowpea) grown on the upper slopes of the dunes. Irrigation was mainly done using small wells in depressions, called *céanes*, and remains an option in some area today, despite a marked reduction in water availability. With the severe drought of 1970–1980, horticulture became more difficult in the loamy and sandy soils, and many people started investing in fruit cultivation and poultry. The drought also promoted the development of motorized irrigation and new labour arrangements such as sharecropping and wage labour. Increasing in-migration from the peanut basin led to the expansion of capitalist agriculture (Fare, Dufumier et al. 2017). Intensive use of chemical inputs was introduced together with the green revolution in the 1960s and 1970s, mainly by French research cooperation programmes, which ignored the fact that local farmers did not take adequate safety measures. It was not until recently that the authorities recognized the associated risks for humans, animals, and ecosystems (Hardin 2019), despite the publication of a report in the 1990s that detailed farmers' misuse of chemical products and its consequences for human and environmental health (German and Thiam 1993). Back in the 1980s, facing these risks, the national NGO ENDA-PRONAT (for *Environnement Developpement Action pour la Protection Naturelle des Terroirs*) launched an awareness-raising programme to support small-scale farmers in learning about the health and environmental risks associated with the misuse of chemical products (Bottazzi et al., 2021). For decades, ENDA-PRONAT continued their educational programme, using various instruments ranging from farmer field schools to a theatre forum. Despite these initiatives, the use and misuse of chemical products is still extremely high in the area. To increase their impact, ENDA-PRONAT pioneered the co-creation and support of local farmer organizations and helped to found the National Federation of Organic Producers (FENAB, for *Fédération Nationale pour l'Agriculture Biologique*) in 2008. These alliances have promoted several programmes to support small-scale farmers in transitioning to more sustainable practices, mainly by replacing chemical inputs with self-made local organic treatments and fertilizers, such as *neem* (*Azadirachta indica*, also known as *margousier* in French), *bantamaré* (*Cassia occidentalis*) and *poftan* (*Colatropis procera*). Other supporting initiatives helped farmers access credit, secure their land, and market their products through alternative value chains. Despite many years of support, very few farmers have maintained organic practices. A recent study identified 61 commercial

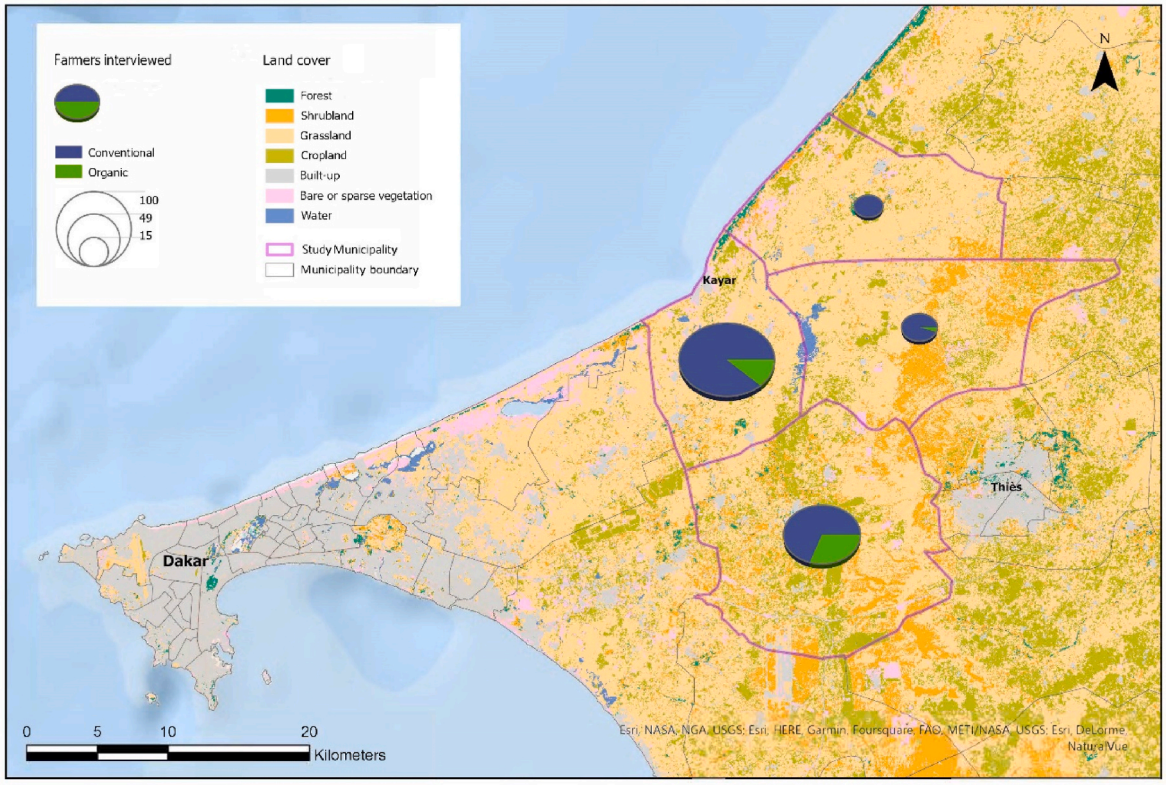

Fig. 2. Study area, with land covers and numbers and types of farmers interviewed.

pesticide products used in the area, containing more than 20 different types of active ingredients (Gaillard 2022). As we will see in the results section, many farmers initially engaged or expressed their interest in organic farming through their local organization but then progressively or suddenly abandoned it. At this point, it is relevant to mention that small-scale producers in the area are under pressure from multiple sources. Water availability has declined substantially due to excessive drilling for urban use and to climate change. In addition, land degradation, urban sprawl, excessive use of chemical input and related contaminations, lack of biomass, pest invasions, unfavourable prices on local and national markets, and price volatility are among the most cited factors contributing to the deterioration of agroecosystem resilience in the area (Touré Fall and Fall 2001, Fare, Dufumier et al. 2017; Camara, Bourgeois et al. 2019; Boillat and Bottazzi 2020, Diouf, Diongue et al. 2020).

4.2. Methods

The data used in this article were derived from a cross-sectional survey of organic and conventional horticultural producers. The survey was conducted from December 2021 to March 2022 in the agro-ecological zone of Niayes in Senegal. The area was selected for its high concentration of pesticide and fertilizer substitution programmes led by the above-mentioned NGOs and farmer organizations. Researchers with a background in social sciences started with a two-month qualitative and explorative analysis, conducting around 40 interviews with local stakeholders. The data and information obtained played a key role in the development of the heuristic framework and the related survey. A team of experienced numerators, supervised by the authors of this paper, conducted the survey in villages in the municipalities of Keur Moussa, Kayar, Diender, Mont Rolland, and Notto Gouye Diama (Fig. 2). Interviewees were determined in a multistage sampling procedure. The sampling methods were based on lists of producers affiliated with two local farmer organizations, FAPD (for *Fédération des AgroPasteurs de Diender*) and Woobin (for *Wooté BooloIndi Natangué*). These lists were completed with the help of other national and regional organizations, such as FENAB, the Organization of Horticulturalists of Niayes (AUMN, for *Association des Unions Maraîchères des Niayes*) as well as ENDAPRONAT. Initially, 94 organic producers were identified a priori from the lists; given their relatively limited number, these were all included in the sample. In a second step, the conventional producers were randomly sampled in the same study areas from a new list of producers established via informer interviews. This resulted in a total sample of 308 producers. During the interviews, 42 out of 94 organic producers selected from the lists said they had abandoned organic farming and reverted to using chemical inputs, amounting to an abandonment rate of 44.7% since their enrolment in the NGO-led organic scheme in 2015. As a result, our sample ended up including 52 organic producers (20 certified organic and 32 non-certified) and 256 conventional producers. To ensure comparability of results, we only interviewed farmers who were mostly involved in vegetable production and systematically excluded those engaging exclusively in arboriculture and rainfed cereal production. A structured, standardized questionnaire was used to obtain information on the socio-economic characteristics of producers, farm characteristics, producers' motivations, and constraints. For the questions on motivations and constraints, respondents reported their response to each statement concerning their position on organic agriculture using a predefined five-point Likert scale ranging from 1 (very negative) to 5 (very positive).

4.2.1. Categorization of organic and conventional producers for analysis

Producers were interviewed according to the category (organic or conventional) to which they were considered to belong based on our lists. For the subsequent analysis, the data collected were segmented according to subjective criteria assessed in the questionnaire: We operationalized organic producers as those who stated that, since their early adoption of organic farming, they had stopped using chemicals for (1) phytosanitary treatment, (2) treatment in case of infestation, or (3) fertilization. Producers who reported having used chemical inputs for any of these three purposes were coded as conventional. Due to time constraints, it was not feasible to cross-check whether all 32 non-certified organic farmers really complied with the criteria of organic agriculture. Acknowledging this limitation, our study seeks to estimate differences between organic and conventional farmers based on perceived motivations rather than observable practices.

4.2.2. Data analysis

In our heuristic framework, we identified four dimensions that can motivate the adoption of organic agriculture. As each of these four dimensions is characterized by a set of variables, we used explorative factor analysis (EFA) to identify their underlying relationships. For this purpose, we merged attitude and opportunity on the one hand and ability and legitimacy on the other hand as they were most likely to be co-dependent. EFA identifies latent or unobserved variables that explain the largest proportion of variance shared among two or more observed variables (Field 2013). Before EFA, all missing responses and "don't know/no" responses were suppressed. Moreover, responses that resulted in low intercorrelation ($r < 0.3$) were suppressed following the procedure used in other similar studies (Mellon-Bedi, Descheemaeker et al. 2020). We did not detect any extreme correlation ($r > 0.8$) in the data set. The data were also appropriate for EFA for each of the four motivation dimensions, with a good Kaiser–Meyer–Olkin index (KMO >0.69) obtained for both *attitude-opportunity* (0.781) and *ability-legitimacy* (0.730). The analysis showed significance of Barlett's test for *attitude-opportunity* (χ^2 (153) = 847.37, $P < 0.05$) and *ability-legitimacy* (χ^2 (105) = 528.175, $P < 0.05$). To interpret the motivational factors, we used the Varimax rotation since we expected the factors to be uncorrelated. We calculated Cronbach's alpha to determine the degree of cohesion within each factor and did a mean difference test to compare the derived factors of motivations between organic and conventional producers (Park, Mishra et al. 2014). We used parallel analysis to confirm the number of factors of motivations that had to be extracted (Kabacoff 2022). For each dimension, factors with loadings <0.5 were retained. The four dimensions were calculated as averages that were weighted by the coefficients of the factor loadings.

Finally, we ran a binary logistic regression model (Maddala 1983) to examine the effects of motivational factors on farmers' decisions to adopt organic agricultural practices. Several studies have used probit, logit, or bivariate probit models to examine the effects of socio-economic factors on farmers' decisions to adopt agricultural technologies (Andvig 2001). The advantage of the logit model over other models is that it enables analysis of categorial dependent variables (Nkamleu and Kielland 2006).

We assumed that a respondent farmer, i, faces two choices, thus $s = 1, 2$ (Nkamleu and Kielland 2006). To examine how factors of motivation and socio-economic factors (Z) influence farmers' decision to adopt organic practices, the choice probability was defined by the binary logistic regression model (1). To estimate the model, we used the maximum likelihood method. In our analysis, we used organic as the reference category. The parameters, β_i, were estimated using the models below (1, 2). The value of regression coefficients $\beta_1 \ldots \beta_p$ indicate the relationship between Z and the logit of Y.

Several socio-economic variables have been shown to influence farmers' adoption of agricultural technologies in Niayes. In our model, we considered the respondent's age, gender, and level of education, as well as household size, training in agriculture, membership in an organization, non-agricultural income, size of land used, number of workers from household, number of wage workers, rainfed agriculture, and irrigation technologies, which corresponds to the external and internal contextual drivers in our proposed framework. We included the four derived factors of motivations as independent variables in the analysis. We took a marginal effect (dy/dx) approach to ensure easy

interpretation of the coefficients because odds ratios and relative risks can be misleading and do not provide a sense of the magnitude (Hilbe 2009). The entire analysis was conducted with SPSS version 21. Factor analysis was conducted using the SPSS dimension reduction commands. Visualization of Likert scores was conducted using the tools of MS Excel, and the logit was estimated using the "logit" package of STATA (Filmer and Pritchett 2001).

4.3. Results

4.3.1. Characterizing organic farmers

Table 1 presents the main descriptive characteristics of farmers and farms. Clear differences between conventional and organic farmers appear with regard to several aspects: Organic farmers are 15 years older on average and include a ten times higher proportion of women. Moreover, almost 70% of organic farmers have received training in agriculture, compared to only ~30% of conventional farmers. Organic farmers are also more likely to be members of a farmer organization or an NGO. They depend more on non-agricultural income for their basic livelihood and generally rely on family rather than external wage labour. This latter aspect is most probably due to financial limitations, but may also be influenced by an informal norm restricting the use of wage labourers (Bottazzi et al., 2020; Marfurt, Haller et al. 2023; Marfurt, Haller et al. 2023). Their productive infrastructures indicate a smaller productive capacity compared to that of average conventional farmers. Organic farmers have access to ~1 ha less land and clearly lack irrigation infrastructure, which makes them dependent on rainfed agriculture. According to our descriptive statistics, the most common vegetables produced by our respondents were cabbage, onion, bitter aubergine, sweet aubergine, chilli pepper, tomato, and *kandia* (okra). Few differences appeared between conventional and organic farmers. We did not measure their yields and agricultural incomes in absolute terms (as such data are usually very difficult to collect in these areas). However, according to supplementary informal interviews, organic farmers in the area usually practice low-intensity agriculture and have low productivity due to numerous constraints (poor access to organic fertilizers and irrigation material, many plant diseases). Overall, based on these descriptive characteristics, we can already postulate that organic farmers who managed to maintain organic practices in the study area occupy a small niche and represent the most vulnerable farmers, namely older women and men with little financial and productive assets. The following analyses confirm and deepen this assessment.

Table 1
Characteristics of the households/farms surveyed.

	Conventional Farmers	Organic Farmers
Number of cases	256	52
Age[a]	42.7 (14.2)	57.5 (11.2)[I]
household size (number of people)[a]	14.5 (6.6)	16.1 (7.8)[I]
Years in agriculture[a]	18 (13)	26 (12)
Size of accessible land (ha)[a]	3.48 (11.8)	2.49 (2.56)
Size of cultivated land (ha)[a]	1.64 (1.92)	1.6 (1.59)
Number of workers[a]	3.7 (2.7)	3.2 (2.2)
Agricultural training (yes)	31.30%	69.20%[II]
Proportion of non-agricultural income in total income[b]	22.0%	38.0%[II]
Member of an organization (yes)[b]	19.1%	48.1%[II]
Proportion of women[b]	5.9%	46.2%[II]
Received school education (yes)[b]	94.1%	84.6%[II]
Proportion of wage workers[b]	34.0%	7.7%[II]
Rainfed agriculture[b]	21.1%	55.8%[II]
Irrigation with well[b]	46.9%	21.2%[II]
Irrigation with drill[b]	37.9%	15.4%[II]
Irrigation with drip[b]	50.0%	13.7%[II]

[a] Mean and standard deviation.
[b] Percentage of total in each group.
I The Chi-square statistic is significant at the 0.05 level.
II The mean test statistic is significant at the 0.05 level.

4.3.2. Overview of farmers' perceptions of organic farming

Fig. 3 provides the percentage frequency of response categories related to the different motivational items. Both groups of farmers expressed a generally positive attitude regarding organic agriculture, although, as expected, organic farmers are generally more positive. However, sub-variables such as aesthetic quality, water conservation, and, more sharply, pest resistance and yields were the most controversial. Among all motivational variables, ability to perform the behaviour was the least positive set of variables in both groups of farmers. Most farmers felt they still lacked sufficient knowledge, proper soil, access to water, labour, organic material, tools, and the capacity to produce their own organic treatments. Related to opportunities, differences between organic and conventional farmers are more significant, underlining the "niche" opportunity for the few organic farmers who managed to subsist in the area. This is true for all opportunity variables, such as meeting new people, building a trustful social network, customer engagement, getting organizational support, and benefiting from premium market access and higher prices for products. Perceived legitimacy appears to differ qualitatively between the two categories of farmers. As our survey focused not on abandonment but rather on adoption criteria, we added an open question to capture the main reasons of those conventional farmers who had abandoned organic farming before the interview (42 in total) for their choice. Among these farmers, 95% were men, and 74% stated they did not belong to any local producer organization. The most general reason for abandoning organic agriculture was its "lack of profitability". This was composed of a combination of difficult market access, unfair price competition between organic and conventional products, difficult production capacity subject to pest attacks, and a longer maturation time. Finally, many formerly organic producers complained about a lack of support and supervision from NGOs and other extension services. These arguments correspond to the most negative variables in Fig. 3 included in farmers' ability and perceived opportunity with regard to organic farming. They are rated more negatively by conventional than by organic producers.

4.3.3. Estimating the relative weight of motivational variables

To estimate the relative weight of motivational variables and to avoid co-linearity, we ran two distinct explorative factor analyses (EFAs) as detailed in the methods: one combining opportunity and attitude, and one combining legitimacy and ability. Table 2 shows the factor loadings for opportunity (Factor 1) and attitude (Factor 2). Opportunity is represented by access to the market, customer engagement, social trust, fair prices, and self-consumption. Attitude is represented by the ecosystem conservation, moral and ethical values, preservation of human health, and soil enrichment. Table 3 shows factor loadings for extrinsic motivations. Here, too, two factors appear quite clearly: legitimacy (Factor 1) and ability (Factor 2). Legitimacy is represented by the perceived support that various local and national organizations provide to organic farmers. Ability is represented by access to sufficient tools and organic inputs.

The analysis shown in Fig. 4 confirms that all farmers were generally positive about organic agriculture, especially when it comes to subjective attitude and opportunities (intrinsic motivations). However, some tendencies indicate that dynamics differ between the two groups of farmers. Ability is close to the average and quite similar in both groups, showing that both organic and conventional farmers are critical of this aspect. By contrast, organic farmers expressed a clearly positive view in terms of opportunity and legitimacy, while conventional farmers tended to remain quite neutral regarding these aspects (although the variability is high). The biggest difference between the two groups concerns the legitimacy of organic practices, where each group clearly favoured their own practices. Overall, however, the differences in perceptions are fairly small.

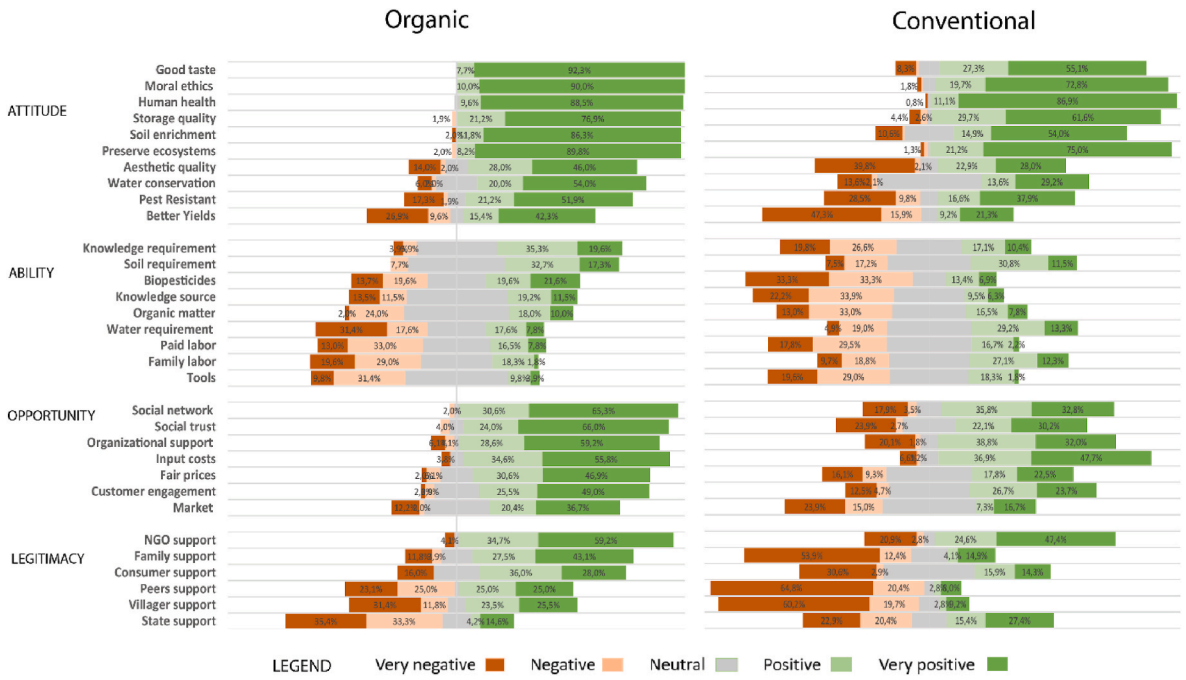

Fig. 3. Percentage frequency of response categories (from very negative to very positive) related to the different motivational items describing farmers' motivations for adopting organic agriculture. Farmers were asked to rank each item in each general category of variables (attitude, ability, opportunity, legitimacy).

Table 2
Factor loadings of the items contributing to attitude and opportunity.

Attitude and opportunity	*Factor 1 Opportunity*	*Factor 2 Attitude*
Access to market	**0.793**	0.077
Customer engagement	**0.750**	−0.055
Social trust	**0.635**	0.001
Fair prices	**0.596**	0.261
Self-consumption	**0.574**	0.176
Ecosystem conservation	0.123	**0.735**
Morals and ethics	0.001	**0.733**
Human health	0.028	**0.569**
Soil enrichment	0.261	**0.524**
Storage quality	0.067	0.448
Organizational support	0.120	0.086
Social network	0.481	0.040
Good taste	0.365	0.185
Better yields	0.105	0.105
Aesthetic quality	0.052	−0.062
Pest resistance	−0.075	−0.150
Input costs	−0.034	0.370
Eigen value	9.009	4.562
Proportion of variance	0.501	0.253
Cronbach's alpha	0.941	0.827

Factor loadings >0.5 are highlighted in bold.

Table 3
Factor loadings of the items contributing to ability and legitimacy.

Ability and Legitimacy	Factor 1 Legitimacy	Factor 2 Ability
Villager support	**0.812**	−0.077
Peer support	**0.801**	0.112
Neighbour support	**0.653**	−0.192
Family support	**0.652**	0.189
Tools	−0.071	**0.713**
Organic matter	0.041	**0.631**
Knowledge	0.424	0.459
Organic certification	0.059	0.037
Access to extension services	0.314	0.289
NGO support	0.164	0.018
Consumer support	0.485	−0.047
Soil requirements	0.097	0.244
Water requirement	−0.239	0.080
State support	0.031	−0.461
Biopesticides	0.298	0.319
Eigen value	5.360	4.952
Proportion of variance	0.357	0.330
Cronbach's alpha	0.872	0.855

Factor loadings >0.5 are highlighted in bold.

4.3.4. *Assessing the relative importance of motivational factors in farmers' behaviour*

Table 4 shows the result of the logistic regression model with $N = 282$. The pseudo R^2 value of equal 58.690% and LR chi^2(16) equal 156.46 with p value 0.000 show the model fits well to the data. The reference is organic farmers, which has value of 1. This result allows for testing the importance of contextual farm characteristics against motivational aspects.

The model confirms most tendencies observed in the above descriptive part. Organic farmers are more likely to be women (+10% interpreting the marginal effect dy/dx), elderly or retired (<1%), and active members of a farmer organization (+10%). Productive assets are also determinant. Organic farmers have less access to irrigation infrastructure and are therefore more dependent on rain. This also coincides with the fact that they do not rely solely on agriculture and depend more on non-agricultural income.

At the perception level, attitude, opportunity, and ability proved to be significant and positively correlated to organic farming, while legitimacy is not significant. This further confirms the usefulness of looking at socio-structural drivers in combination with farmers' perceptions and assessing the relative importance of intrinsic and extrinsic motivations. Although both organic and conventional farmers have a highly positive attitude towards the intrinsic value of organic farming, attitude remains a statistically significant difference in farmers' adoption. However, in our case this dimension is represented above all by the importance farmers attach to conserving ecosystems, as well as other moral and ethical values as revealed by the factor analysis. This emphasis contrast with more utilitarian aspects such as yields, and the resistance to pests, which are clearly seen as fundamental limitations in organic farming.

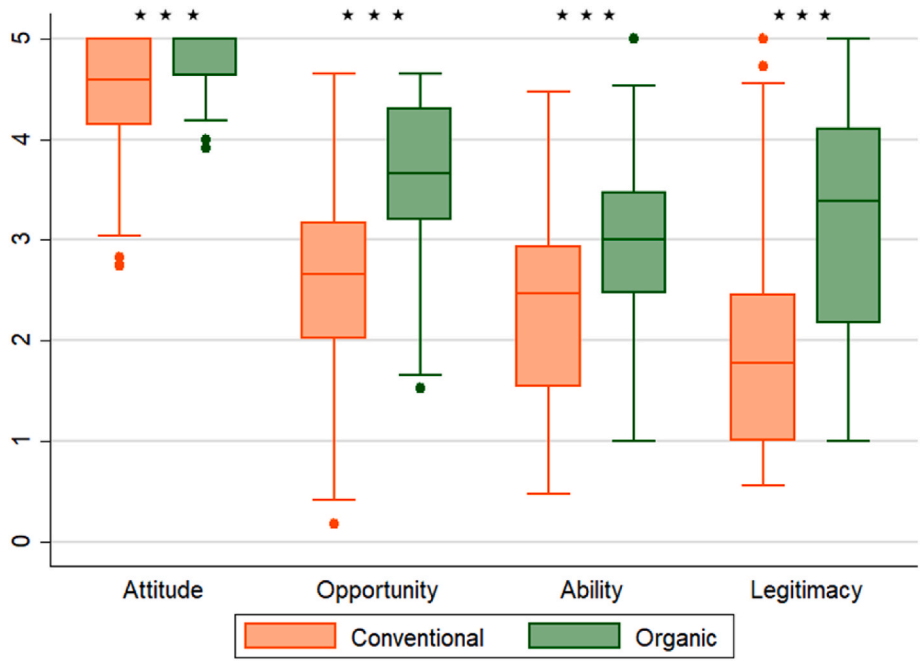

Fig. 4. Comparison of the different motivational dimensions related to organic agriculture among conventional and organic farmers based on factor loading. Means and standard deviations show the perceived differences between organic and conventional farmers in each of the four dimensions (attitude, opportunity, ability, legitimacy). Values on the vertical axis from 0 to 5 correspond to least to most favourable to organic farming. All comparisons were significant at $P < 0.05$.

Table 4
Results of logistic regression model and marginal effects of organic agriculture adoption combining internal farm characteristics and motivational items.

Organic farmer	Coef.	dy/dx	Std. Err.	z	P > z	[95% Conf. Interval]	
Age	0.051	0.003	0.020	2.470	0.013 **	0.011	0.091
Sex	1.787	0.112	0.716	2.490	0.013 **	0.383	3.191
Level of education	−0.501	−0.019	1.133	−0.440	0.658	−2.722	1.720
Household size	0.028	0.001	0.037	0.750	0.455	−0.045	0.101
Training in agriculture	0.474	0.030	0.629	0.750	0.451	−0.758	1.707
Membership in organization	**1.661**	**0.101**	**0.665**	**2.500**	**0.012** **	**0.358**	**2.964**
Non-agricultural income	**0.326**	**0.020**	**0.111**	**2.940**	**0.003** **	**0.109**	**0.543**
Size of land used	**0.287**	**0.018**	**0.131**	**2.200**	**0.028** **	**0.031**	**0.543**
Number of workers from household	−0.099	−0.005	0.099	−1.000	0.315	−0.293	0.094
Number of wage workers	**−2.007**	**−0.123**	**0.856**	**−2.350**	**0.019** **	**−3.685**	**−0.330**
Rainfed agriculture	**1.465**	**0.088**	**0.636**	**2.300**	**0.021** **	**0.218**	**2.711**
Water drill	−1.017	−0.061	0.719	−1.420	0.157	−2.426	0.391
Attitude	**1.871**	**0.111**	**0.881**	**2.120**	**0.034** **	**0.144**	**3.597**
Opportunity	**0.895**	**0.050**	**0.363**	**2.470**	**0.014** **	**0.184**	**1.606**
Ability	**0.877**	**0.050**	**0.338**	**2.590**	**0.009** **	**0.214**	**1.540**
Legitimacy	0.305	0.017	0.225	1.350	0.176	−0.137	0.747
Constant	−21.297		4.818	−4.420	0.000 ***	−30.739	−11.854

***$P < 0.001$, **$P < 0.05$, and *$P < 0.1$. Organic farmer is taken as reference.
dy/dx: marginal effects.

5. Discussion

5.1. Structural determinants of farmers' adoption of organic practices

Our results highlight the importance of taking a holistic and multi-dimensional approach that examines both intrinsic and extrinsic factors to better identify the main drivers enabling or hindering the adoption of organic agriculture in sub-Saharan Africa (Meijer et al., 2015; Sietz and Van Dijk, 2015; Jambo, Groot et al. 2019). With our framework, we attempt to offer such an approach by combining farmers' subjective perceptions with socio-economic parameters. The latter – including farmers' social status (Oya 2007), wealth, gender, access to productive resources and assets, non-agricultural income, and hired or family workforce – play a determining role in the adoption of organic agriculture. In our case, most organic farmers who had maintained their organic practices had received support and training from NGOs and extensionists and were members in a farmer organization. This underlines the importance of strengthening these networks, particularly farmer organizations that provide institutional support and extension services while also contributing to small-scale farmers' empowerment (Ndah et al., 2014; Ndah et al., 2015; Jambo, Groot et al. 2019). It also shows that persevering organic farmers belong to a narrow social category consisting of mostly elderly or retired women and men who do not completely rely on agricultural income for their livelihood and who have access to less land and productive infrastructure than others. Although organic and conventional farmers cultivate similarly large areas of land – which might be due to the lower intensity and lower yields associated with rainfed practices – conventional farmers have greater means of production. Women clearly appear to be more attached to and involved in organic farming than men, a link which has also been

observed in other areas of Senegal (Sene and Gning 2022). Internationally, scholars have explained this link with women's greater interest in health and family care and their stronger involvement in NGO-led collective action (Siliprandi and Zuluaga 2014, Trevilla Espinal, Soto Pinto et al., 2021).

In addition, organic farming represents an alternative livelihood strategy to lower input costs, get access to external support, increase peer recognition, and tap potential resources from international cooperation and development support. "Social entrepreneur" farmers who depend on other sources of income such as family or NGO support can afford lower yields. Finally, it has been shown that for the most vulnerable groups, particularly women, agroecological farming (including organic agriculture) can become a "survival" activity which provides complementary income and a minimum of financial autonomy (Bezner Kerr, Hickey et al. 2019). This seems to be verified in our case, as the lack of irrigated land and difficult access to inputs appear to be a clear characteristic of organic farmers, especially for the women. The feminization of organic farming requires careful consideration, as it can lead to self-exploitation for women engaged in this sector. Research in Senegal has shown that these women frequently bear a heavy burden, juggling domestic care responsibilities alongside their production activities (Bottazzi et al., 2020; Sene and Gning 2022, Marfurt, Haller et al. 2023; Marfurt, Haller et al. 2023).

5.2. Beyond motivations

Like other studies in sub-Saharan Africa, we found extrinsic and intrinsic factors to be more or less equally important in determining farmers' decision to adopt organic agriculture (Meijer, Catacutan et al. 2015; Lalani, Dorward et al. 2016; Jambo, Groot et al. 2019; Mellon--Bedi, Descheemaeker et al. 2020). However, in our case, the two categories of factors work against each other. While farmers almost unanimously express a clearly positive attitude to organic farming, especially for ecological and utilitarian reasons (taste, health, soil and ecosystem protection, and ethical criteria), most of them are very critical regarding their own ability to perform the behaviour – a phenomenon that has been found elsewhere, too (Jambo, Groot et al. 2019). It is aptly illustrated by the interpretation of this conventional farmer from our study:

"The people [organic farmers] who reported to us had good results and I saw it. It is full of benefits; it's better for health, the product flows faster, it keeps longer, it is better for the consumer. I think organic is full of benefits. What is missing is market access and support. If I had this support, I would see myself converting entirely to organic." (A.Y_F_56 Conventional)

Our results contrast with studies where intrinsic motivations combine with other aspects such as yield, labour, and income (Lalani, Dorward et al. 2016). Lack of ability can be seen as the product of a progressive deterioration of contextual opportunities and support. Both groups of farmers felt that they lacked the necessary knowledge, inputs, natural assets, labour availability, and tools to engage in organic agriculture, a situation we can ironically summarized as "we want to, but we can't." In particular, all farmers said they lacked access to the basic natural resources needed to engage in organic agriculture. This issue is an expression of the more general conflict between small-scale farmers, who are the most likely to engage in agroecological intensification, and agribusinesses, who practice monoculture using large amounts of wage labour, underground water, and chemical inputs. Other research in the Niayes area has documented a progressive deterioration of the agroecosystem due to the "systemic dispossession" of small-scale farmers of their basic productive resources, namely biomass, water, and land (Boillat and Bottazzi, 2020). This causes small-scale producers to progressively sell their land to those who can afford to invest in water drills and to employ wage workers. These circumstances clearly hamper the development of sustainable agriculture, which requires increased resilience at least during the first years of conversion. At a broader regional scale, it can also be said that organic agriculture in Niayes has reached a tipping point. When too many producers in an area use chemical inputs, the remaining organic farmers are eventually forced to give up because of widespread air contamination across conventional and organic plots and low recognition of organic producers' efforts (low legitimacy) (Touré Fall and Fall 2001, Dugué, Kettela et al. 2017; Camara, Bourgeois et al. 2019; Diouf, Diongue et al. 2020). The lack of trained workforce clearly appears as a weakness and, along with the feminization of organic agriculture, is the result of a rural exodus and the transfer of an additional workload on the most vulnerable social categories (Bezner Kerr, Hickey et al. 2019; Bottazzi et al., 2020; Laske and Michel 2022).

Perceived opportunities show the sharpest differences between organic and conventional farmers. Overall, most farmers criticize the lack of income and lower yields generated by organic agriculture compared to conventional agriculture, which partly explains their reluctance to adopt organic practices (Corbeels et al., 2014). In several observed cases, farmers' maintenance of organic practices was found to be the product of a "niche effect", underlining the importance of social networks, organizational support, and broader institutional arrangements supportive of organic farming (Ndah et al., 2014). In our case, these effects were limited to a small group of farmers who remained connected to their supporting NGOs through various exchanges and the maintenance of an organic cooperative that sold their products in urban centres (Boillat, Bottazzi et al. 2023). This opportunity was only available to a small group of farmers, as "the demand for organic products in Senegal is too low to help develop the sector" (NGO representative, October 02, 2021). This aspect points to the fact that local and national organic markets are clearly not sufficiently developed compared to conventional or export-oriented markets. Small-scale producers in the area face unfair competition from semi-industrialized farms that flood local markets with cheap products they were unable to sell for export. In addition, the poor success of organic products is also partly due to unfavourable local "consumption habits", with people preferring cheap imported products to locally and ecologically grown ones (Fare, Dufumier et al. 2017; Boillat and Bottazzi 2020). These views contrast with the neoclassic argument that import-driven food systems can improve food security in Africa in contexts of low productive capacity (Knößlsdorfer and Qaim 2023). Cultural aspects and consumers' financial situation are other aspects to be carefully evaluated. People who value organic products mainly live in the large urban centres and belong to the upper class that has westernized preferences (Boillat, Bottazzi et al. 2023). Moreover, most farmers perceived a complete disinterest and lack of institutional support from the state and now also from NGOs, which amounts to a kind of "delegitimization" of organic agriculture in the area. Most farmers felt that people around them do not really care about organic farming (whether in the field or on the plate), leading to a perceived absence of formal as well as informal supporting norms or peer recognition. These institutional aspects have been identified as important drivers of (de)motivations (Winter and May, 2001). In this sense, our results confirm the need to increase communication about organic products and practices through consumer associations and the media, to develop fair value chains through participatory guarantee systems (PGS) and, more broadly, to continue providing technical and logistical support to farmers interested in taking up organic agriculture.

5.3. From farmer "sensitization" to agroecology-based food system transformation

The greatest challenge in scaling out organic agriculture is therefore not to convince already convinced farmers about the inherent value of these practices, but to generate spaces of resilience for these farmers by fostering systemic transformations at multiple levels. The concepts of ability, opportunity, and legitimacy can help to structure the array of domains that need to be improved. At plot level, required supporting measures include the continued provision of knowledge support and other training, continued technical assistance from NGOs and extension

services, and facilitation of knowledge co-production and farmer-to-farmer exchanges of practices (Settle and Garba 2011; Méndez, Bacon et al. 2013; McCune 2017). At community or regional levels, strengthening farmer organizations is a crucial step in facilitating small-scale farmers' empowerment and negotiations with other food system actors (Bottazzi and Boillat 2021). More inclusive governance of regional food systems based on agroecological principles in necessary and will depend on farmer organizations' agency and their capacity to negotiate secure access to land and natural resources such as water and biomass. A recent report published by the DyTAES network (for *Dynamique pour une Transition Agroécologique au Sénégal*) – Senegal's largest civil society organization promoting agroecology – proposes 15 measures to support a broad agroecology transition and extend the scope of plot-based interventionism (Dytaes 2020). Six of them are dedicated to securing access to land, water, and other natural resources through cooperative agreements among multiple actors of the land and food systems. Indeed, such agreements are a key instrument to enable a sustainable and fair distribution of resources and avoid their excessive concentration in the hands of the most powerful producers (Juillet and Sarr 2023). Achieving this systemic transformation requires a strong involvement of policy-makers and civil society. The role of the state is key in controlling the prices of imported products, improving the autonomy of national markets, and increasing food sovereignty. International organizations (e.g. GATT) are responsible for allowing member states to take such important measures rather than imposing restrictive free market standards. The same reasoning can also be applied to other measures, such as land reform and subsidies for organic inputs. In Senegal, like in other West African countries (Bendjebbar and Fouilleux 2022), the government is progressively taking measures to institutionalize organic agriculture, as evidenced by its recent decision to subsidize 10% of organic inputs for producers. This announcement is certainly a step forward, although it should be taken with some precautions. In Senegal, as well as in other African countries, input subsidies have been used as an instrument of rural political clientelism and in these cases ended up benefiting wealthy farmers and merchants rather than the poorest producers (Ela 1990; IPAR 2015). Moreover, simple input substitution strategies (Rosset and Altieri 1997) are known to serve foreign input industries and the conventionalization of organic agriculture rather than local operators (De Wit and Verhoog 2007) and should not be adopted at the expense of more comprehensive reforms aimed at a complete transformation of food systems supported by well informed holistic approaches (Holt Giménez and Shattuck 2011).

6. Conclusion

Our framework contributes to a broad and systemic view of the current challenges faced by small-scale organic producers, including social, institutional, economic, and ecological mechanisms limiting or enabling the adoption of organic agriculture. Applying the framework, we were able to characterize the sociological profile of organic producers and highlight incongruities between their generally positive attitude to organic agriculture and the systemic barriers they face at multiple levels. We found it useful to investigate local perceptions of enablers and barriers to change rather than relying exclusively on expert interviews, as it is ultimately the farmers who take the decision adopt organic practices. We shed some light on complex mechanisms and major contradictions between farmers' deep values and attitudes towards organic farming and the structural and systemic deficiencies at the food system level that favour conventional agriculture, export-driven production, and resource grabbing. The transition to more sustainable forms of agriculture will require much more than "sensitization" of farmers and technical transfer. It will take deep institutional transformations supported by strong farmer organizations to improve natural resource security, co-create innovative knowledge, build alternative value chains, and foster national policies that support locally adapted agroecology approaches. Future transdisciplinary research in Senegal and in the rest of sub-Saharan Africa is needed to help assess these wide-ranging transformative processes.

CRediT authorship contribution statement

Patrick Bottazzi: Conceptualization, Methodology, Investigation, Writing – original draft, Supervision, Project administration, Funding acquisition. **Sokhna Mbossé Seck:** Conceptualization, Methodology, Investigation, Data curation. **Madické Niang:** Methodology, Software, Formal analysis, Data curation. **Stephanie Moser:** Conceptualization, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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