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Determinants of Farmers' Willingness to Adopt Organic Agriculture: Behavioural Insights and Systemic Challenges

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Abstract: The environmental and health-related challenges associated with intensive and conventional farming practices have underscored the urgency of transitioning towards more sustainable agricultural systems, such as organic farming. Degradation of soil quality, nutrient depletion, biodiversity loss, chemical exposure, and erosion have been widely attributed to prolonged conventional agricultural methods. The adoption of organic farming practices is therefore considered pivotal in addressing these ecological and public health concerns. However, the effectiveness of this transition is largely contingent on farmers' willingness to adopt and sustain organic cultivation methods. In this context, A thorough examination of peer-reviewed literature was conducted to examine the behavioral drivers and systemic barriers influencing decisions by farmers to adopt organic farming. Special attention was given to the level knowledge and perception regarding organic practices, as well as theoretical models of technology adoption in agricultural contexts by the farmers. The findings indicate that perceived health benefits, environmental sustainability, and long-term economic viability are primary motivators of adoption. Conversely, constraints such as reduced yields, labor intensiveness, and certification complexity were identified as significant deterrents. Furthermore, a lack of awareness and limited technical knowledge regarding organic methods were shown to hinder adoption of organic farming practices. These insights highlight the need for coordinated interventions by policymakers, agricultural agencies, and industry stakeholders to facilitate the adoption process. Emphasis is recommended on expanding awareness campaigns concerning the environmental and health benefits of organic farming, enhancing access to training programmes, simplifying certification procedures, and reinforcing institutional support through well-structured extension services. Greater alignment between farmers' perceived risks and the long-term benefits of organic agriculture is essential to achieving widespread and sustainable adoption.

Keywords: Awareness; Environmental concern; Health safety; Farmer willingness and attitudes; Knowledge; Organic farming

1. Introduction

The conventional ideal of production, or mainstream food production, is embedded in the beliefs of humans' guiding nature that stem from explanation (Yazdanpanah et al., 2021). This seeks to briskly make the best use of productivity and profitability by means of agricultural study and extension as well as subsidies and technical know-how transfer that stimulate the use of modern technical know-how, including tertiarily high-quality crop diversities, pesticides, and fertilisers. Harwood (2019) and Llewellyn (2018) highlighted that the production ideal started in emerging nations with the Green Revolution of the 1950s. This exemplar move was remarkable; as production intensified, and, at the same time, both starvation and penury were minimised. However, Norman Borlaug, the front-runner and originator of the Green Revolution, alongside several others, termed it as the halt of human starvation (Borlaug, 1971; Heinrich & Erdkamp, 2018; Lipton & Longhurst, 1989). Due to the recognition and achievement of this modern system of farming in its form, it became known as intensive production (Nemes, 2009) or productivism (Burton & Wilson, 2006).

Irrespective of the universal momentous achievement of conventional farming, this approach of producing food is strongly criticised due to its unfavourable environmental, monetary, social, and health consequences (Abadi, 2018; Bagheri et al., 2019; Eyinade et al., 2021; Mzoughi, 2011). Due to the level of criticism, this has led to a number of authors believing (Cristache et al., 2018; Varanasi, 2019) that conventional farming is not viable. Therefore, a drive for drastic modifications in questing to amend the connection between mankind and the natural environment (Candiotto & Meira, 2014) is a call for more environmentally welcoming farming. Nevertheless, a number of scholars (Bozorgparvar et al., 2018; Candiotto & Meira, 2014) argue that a supplementary welcoming association relating to food production and eco-friendly preservation is required. In reaction to the tension for more viable production of food systems, an array of substitutes has been established, placing emphasis on the minimal usage of low-external material, comprising organic farming. Meanwhile, organic farming, with its restricted usage of synthetic inputs, is supported as an environmentally responsive method that reduces the adverse impacts of conventional farming (Winqvist et al., 2011).

Wójcik-Leń (2019) defines organic farming as a balanced ecological unit of a stable environment that preserves and boosts biodiversity, soil natural activity, and natural rotations, while prohibiting the usage of chemical fertilisers and pesticides. The scholar further adds that this type of farming is all about promoting practices like renewable and local sources that support the system in the form of crop rotation, hand-weeding, mulching, green fertiliser, composting, cover crops and natural pest resistance. In addition, the International Federation of Organic Agriculture Movements (IFOAM, 2017) defined organic farming as a comprehensive method of production that involves a management approach that conserves and supports the healthiness of soils, ecological units, and people. Similarly, the Joint FAO/WHO Codex Alimentarius Commission (2010) defined organic farming as a holistic production management method that supports and improves agri-ecosystem health, including biodiversity, biological cycles, and soil biological activity. The key aim of organic farming is not just concerned with quality produce but also conserving the utmost likely degree of biological diversity in the ecological ecosystem (Maleksaeidi & Keshavarz, 2019).

Literature affirms that organic farming at the farmstead and household level has an extensive advantage that spreads transversely in rural, consumer, conservational, and universal levels. For instance, the extant literature, such as the studies by Meng et al. (2017) and Qiao et al. (2018), argue that organic farming at the farm level can enhance the facet of soil and water, conserve biological diversity, nourish yields, produce excellent foods, and offer natural pest resistance with a lesser amount of chemical contamination whilst decreasing farming input expenses. In the rural context, the study of Lobley et al. (2009) pointed out that organic farming increases the level of job openings and adds to the pastoral economy as well as pastoral growth. Looking at the consumer level, the Soil Association (2025) noted that organic farming offers healthful nourishment, high quality products, and beneficial for gut health. It is vital to state that organic farming does not just enhance the household food basket (Hosseini, 2019; Sitthisuntikul et al., 2018) but also helps the environment by means of improved multiplicity of birds, weeds, wild bees, plants, butterflies, and predacious arthropods on organically farmed farms and grasslands. However, the benefits of organic farming at the universal level cannot be underestimated, as it is a lessening and modification of management (Duquette et al., 2012; Muller et al., 2016). In addition, organic farming promotes ecological and indigenous governance (Yazdanpanah et al., 2021), placing the producer at the centre of the agrarian production approach. This therefore allows for the re-establishing the judgement-building role of indigenous societal groups and their morals to manage their resources and devote their lively involvement within a food cycle of added worth (López, 2007).

Notwithstanding, the various advantages of organic farming have, caught the attention of policymakers universally in reaction to the problems of conventional farming and the call of collective necessity for more environmentally friendly methods. A study by Willer & Lernoud (2017) highlighted that the totality of area devoted to organic farming has increased at a fast pace (Figure 1), mostly in the developed nations. These increases are noticed in countries like Oceania, with approximately 35.9 million hectares of organic farming land, which is roughly half of the world's farmed area, followed by Europe (14.6 million hectares), Latin America (about 8 million hectares), Asia (6.1 million hectares), North America (3.2 million hectares), and the least organic farming area is Africa (2.1 million hectares) (Lernoud & Willer, 2019; Willer et al., 2018). In spite of this, areas cultivated under organic farming still constitute one-fourth of the overall agrarian terrain sector, accounting for roughly 57.8 million hectares (Lernoud & Willer, 2019; Lorenz & Lal, 2016). Amongst these nations, organic farming hectares in Africa remain low. It is unclear why the adoption rate remains low in Africa.

However, the report of the United Nations Environment Programme–United Nations Conference on Trade and Development (UNEP-UNCTAD, 2008) on organic agriculture and food security in Africa highlighted that there are a combination of factors namely: financial constraints, perceived difficulties in transition, a lack of local standards, certification, limited awareness and education, a general lack of large domestic organic markets (leading to reliance on foreign markets), limited infrastructure, and external factors. These have been noted to constitute the primary reasons for the low adoption rate of organic farming across the continent.

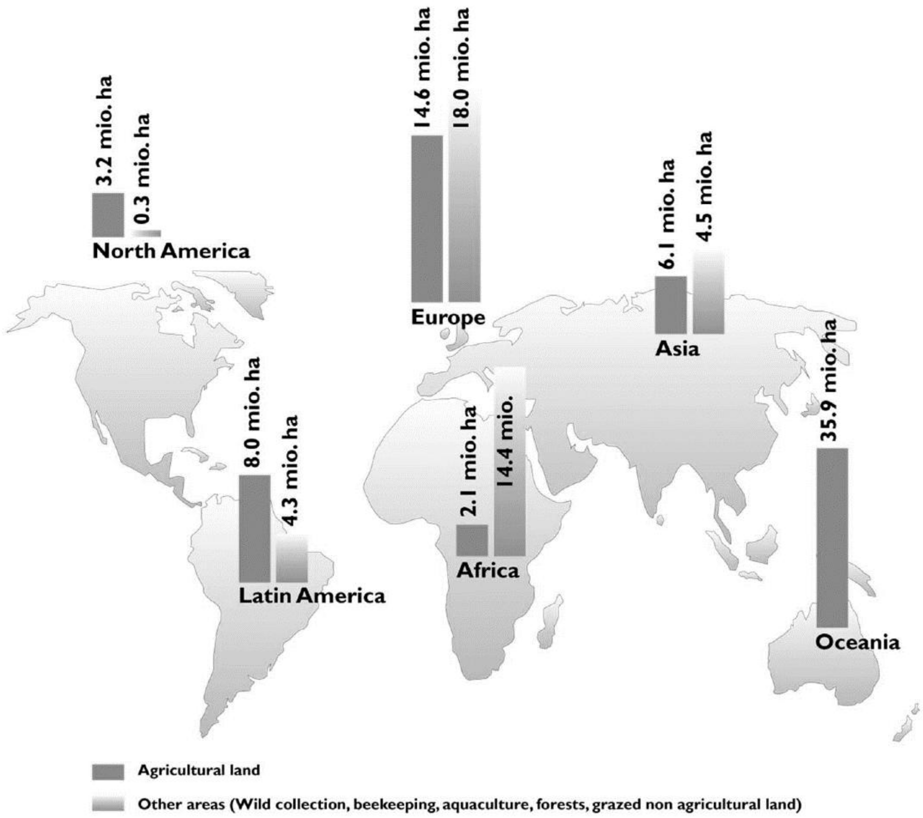

Figure 1. Organic agricultural land and non-agricultural areas in 2017
Source: FiBL survey (Lernoud & Willer, 2019).

2. Methodology

This study aims to provide a literature review, with a focus on why certain farmers are keen to embrace organic farming. Following the collection, evaluation, and integration of data from many sources, relevant research papers were reviewed to actualise this, different peer-reviewed and non-peer-reviewed articles, books, and authorised publications were used to actualise the assessment in a methodical manner. Organic farming and adoption readiness were the two main short phrases utilised to investigate the content. Adoption problems, sustainable farming, and technological adoption were coupled with the lexes. The research utilised the terms to identify relevant studies. Publications from unreliable sources and those not written in English were not included.

3. The Notion of Technology Adoption

Technology is one of the important factors that play a vital role in the development of the agricultural sector, although there are several other factors that influence this development (Ashari et al., 2017). Changes in technology in the agrarian sector are a principal component that shaped the agrarian sector in the past decades (Sunding & Zilberman, 2001). With respect to the significance of technical know-how, the embracing of modern agricultural technologies, particularly in less developed nations, has enticed researchers to uncover this fact. However, they ponder that the agrarian sector, notwithstanding, holds a significant place in those nations. Furthermore, the introduction of better-quality agricultural technology is one of the significant ways to boost agricultural productivity (Doss, 2006).

Studies in support with the adoption of modernisation have been carried out for more than four decades. The most well-known adoption model was proposed by Rogers (2003), which was described as “diffusion of innovation”. The proposed model has been extensively used as an elementary notion to organise a background in different fields. This model has also been used by a number of scholars in agricultural technology adoption. Rogers (2003) explicated the definite meaning of the technology and innovation phrase and then defined a technology as a plan for a causative deed that decreases the ambiguity in the root cause correlation entailed in attaining an aspired result. However, the innovation was described as a viewpoint, exercise, or programme that is observed as modern by a unique or other entity of adoption. Thus, it is crucial to note that an idea that the public considers modern is an innovation. Given this explanation, innovation encompasses more than just technology. While technology is mainly identified with a function, innovation highlights the formation process that is both a modern advancement and a refinement.

Meanwhile, another school of thought described innovation as a new approach, ways, or plans to apply to carry out the new task (Sunding & Zilberman, 2001). Innovation is a crucial element since it includes the essential elements of institutional and technical change (Sunding & Zilberman, 2001). Chemical, agronomic, mechanical, biological, bio-technological, and informational categories can all be applied to the innovation. Innovation can also be distinguished between process and product innovations (Sunding & Zilberman, 2001). It was concluded that innovations can also be identified by how they affect markets and economic agents. Regarding this type of invention, its functions include increasing yield, reducing costs, improving quality, lowering risks, enhancing environmentally friendly safety, and enhancing storage durability. Accordingly, a farmer's readiness to embrace organic farming is determined by the assumptions they make about the anticipated advantages of organic farming production, such as environmental concern and health safety.

In the aspect of technology, this comprises two facets (hardware and software). According to Rogers (2003), the former is a device that physically embodies technology, whereas the latter is related to the gadget's knowledge base. After the technology is produced, it must be made available to the user. Thus, this process might be referred to as the adoption or spread of technology. According to Rogers (2003), the adoption process is a psychological process that a person goes through from learning about an innovation to ultimately adopting it. This suggests that the process of adopting and implementing a new technology takes time, and that a farmer's choice to accept or reject it will involve a number of considerations and judgements. However, Feder et al. (1985) proposed that a proper quantitative demarcation is necessary to provide an accurate exploration of adoption. As a result, it is important to distinguish between adoption at the business or farm scale and full adoption.

4. The Grasp of Sustainable Farming and Organic Agriculture

The continual provision of food and other resources by the agrarian sector to cater to the world's ever-growing populace is vital for human survival and development. Meanwhile, there are teething problems (e.g., the issue of land dilapidation, pollution, and soil erosion) that have jeopardised the power of agriculture to satisfy human wants at present and in the upcoming years (Kapiel, 2021; Pimentel & Burgess, 2013; Velten et al., 2015). Therefore, to lessen these problems, suggestions have been made to develop other strategies (e.g., sustainable agriculture) that are appropriate and viable for the agrarian sector.

The sustainable agricultural method covers a wide facet, which encompasses the environmental issues and social and economic viability in its technique (Bello, 2008; Siebrecht, 2020; Zahm et al., 2008). Prior to this, Ikerd (1993) provided a more thorough description of sustainable agriculture as being able to sustain its output and efficacy for a long time. This suggests that it needs to be advantageous, resource-efficient, economical, socially beneficial, and competitive in the marketplace.

The practice of organic farming is crucial to the growth of viable farming as its primary objective of organic farming is to build a viable farming production technique. Padel (2001) contends that organic farming and sustainable farming are comparable. On the other hand, Rigby & Cáceres (2001) believe it to be a distinct concept that is not interchangeable. However, viability lies at the core of organic farming and is one of the most crucial factors that determines whether a particular production strategy is appropriate or not (Lampkin & Padel, 1994). Henning et al. (1991) further contended that organic farming might be considered a definition of sustainable agriculture.

Narayanan & Narayanan (2005) and the Food and Agriculture Organisation of the United Nations (FAO, 2018) noted that organic farming is amongst the various methods to meet the goals of sustainable agriculture. It is imperative to note that there are other facets of alternative methods that are allied with the method of sustainability. The alternative methods include low-input agriculture, integrated pest management, agroecology, low-input sustainable agriculture, permaculture, low external input, integrated pest management, biodynamic farming, and organic farming (Rigby & Cáceres, 2001).

Nevertheless, the literature provides a number of definitions of organic farming. For instance, Bello (2008) explained the basic idea of organic farming from a comprehensive perspective. Mannion (1995) defined organic farming as a comprehensive approach to agriculture that aims to consider the close connections between farm biota, agricultural output, and the environment as a whole. By maximising the use of farm-derived renewable resources and managing environmentally friendly and biotic practices and associations. Organic farming is a method of agriculture that seeks to establish unified, humane, ecologically and efficiently viable agricultural production methods (Lampkin & Padel, 1994). Additionally, organic agriculture is a production strategy that promotes the health of soils, ecological units, and the individuals engaged (IFOAM, 2017). Rather than relying on external inputs that have a negative impact, the method relies on ecologically friendly practices, biological diversity, and progressions that are adapted to local surroundings. As a result, organic farming combines tradition, creativity, and science to benefit the environment, promote inclusive relationships, and improve the quality of life. However, Wallace (2001) argued that organic farming as a cohesive farming strategy needs to be based on eco-friendly principles. According to Rigby & Cáceres (2001), organic farming methods are expected to avoid the use of chemical pesticides and fertilisers. Instead, they should emphasise the cropping method strategy and biological procedures for pest handling as well as rely on organic inputs and reprocessing for nutrient supply. It is therefore important to note that the willingness of a farmer to adopt organic farming relies on several components, as indicated in Section 5 and Figure 2.

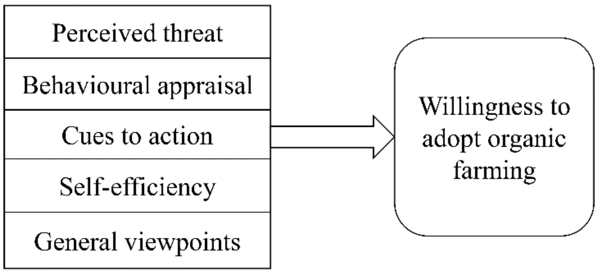

Figure 2. Factors influencing farmers' willingness to adopt organic farming

5. Theoretical Consideration on Willingness to Adopt Organic Farming

5.1 Perceived Threat

Perceived threats have two facets: perceived susceptibility and severity. Montanaro (2011) described perceived susceptibility as the way an individual perceives the risk of performing a certain behaviour or how susceptible individuals perceive health troubles. This relates to the subjective comprehension of a farmer on the danger associated with the usage of extensive man-made pesticides and fertilisers. On the other hand, perceived severity refers to the belief concerning the severity allied with performing a certain behaviour. It is a person's subjective certainty about the magnitude they may be exposed to if carrying out a certain behaviour (Orji et al., 2012). This is related to the certainty in the gravity of the effects and detriments allied to the vast usage of chemical pesticides and fertilisers by a farmer, leading to water and soil contamination, ecological biodiversity dilapidation, and disease. Meanwhile, Yazdanpanah et al. (2021) noted that some studies affirmed that both perceived susceptibility and severity are the main reasons for foreseeing the willingness to adopt organic farming, and thus, it is hypothesised as follows:

H1: Perceived susceptibility relating to conventional farming certainly affects farmers' willingness regarding organic farming.

H2: Perceived severity relating to conventional farming certainly affects farmers' willingness regarding organic farming.

5.2 Behavioural Appraisal

The element of behavioural appraisal consists of two parts: perceived benefits and barriers (Cao et al., 2014). A person's understanding of whether a certain activity will minimise their threat and menaces is termed perceived benefits. For example, a farmer may believe in the effectiveness of farming organic produce, that is, safeguarding ecological resources, lessening disease, and producing food with improved taste and quality. On the other hand, perceived barriers are said to be viewpoints about hindrances and limitations that may hinder them from taking on a new behaviour, such as financial limitations, cognitive limitations, physical constraints, and an inability to gain access to the resources required to perform certain deeds (Coreil, 2010). Therefore, it is assumed that the detrimental facets and hindrances of growing organic crops (e.g., time-consuming and decreased yield) exist. Thus, it is hypothesised as follows:

H1: Perceived benefits of organic farming certainly affect farmers' willingness regarding organic farming.

H2: Perceived hindrances of organic farming negatively affect farmers' willingness regarding organic farming.

5.3 Cues to Action

This refers to indications from friends/acquaintances or the media that aid in moving a person from being eager to accept a new behaviour to truly accomplishing such behaviour (Coreil, 2010; Orji et al., 2012). Nevertheless, the indications to action are assumed to be factors like family, friends, and mentors who inspire farmers to grow organic produce, and this is hypothesised as:

H1: Cues to action relating to organic farming certainly affect farmers' willingness regarding organic farming.

With respect to this concept, to accomplish preventative behaviours, it is important to note that firstly, an individual must feel endangered by the hitch of farmers' intensive usage of synthetic pesticides and fertilisers (i.e., perceived susceptibility). Further, they must then comprehend the gravity of the menace and the damage of its several impacts in relation to psychological, physical, economic, and social threats (perceived severity). External or internal environmental cues (cues to action), belief in the effectiveness and relevance of organic farming (perceived benefits), and the evaluation that the obstacles to taking action are less significant than the potential benefits (perceived barriers) all contribute to the decision to ultimately adopt organic farming practices.

5.4 Self-efficiency

Self-efficiency refers to a person's understanding of their capability to participate in preventative behaviour (Coreil, 2010). With regard to this scenario, it relates to the farmers' simplicity of minimising the usage of synthesised plant nutrients in the production of agricultural produce. Thus, it is hypothesised as:

H1: Self-efficiency about organic farming positively impacts farmers' willingness regarding organic farming.

5.5 General Viewpoints

Coreil (2010) described general viewpoints as one's precise viewpoints and eagerness to be concerned regarding health matters in general. In this case, it refers to farmers' viewpoints regarding the use of synthetic pesticides and fertilisers in the growing of agricultural produce. In other words, the general viewpoints of a farmer are said to be an important predictor of their willingness regarding organic farming adoption. It is therefore hypothesised as:

H1: General viewpoints relating to organic farming positively impact farmers' willingness regarding organic farming.

According to Möhring et al. (2024), the adoption of organic farming from a farmer's viewpoint entails four key elements: (a) choosing the farming system, (b) the production process, (c) the transportation and processing, and (d) the sale of organic goods. The adoption procedure is illustrated in a flowchart in Figure 3.

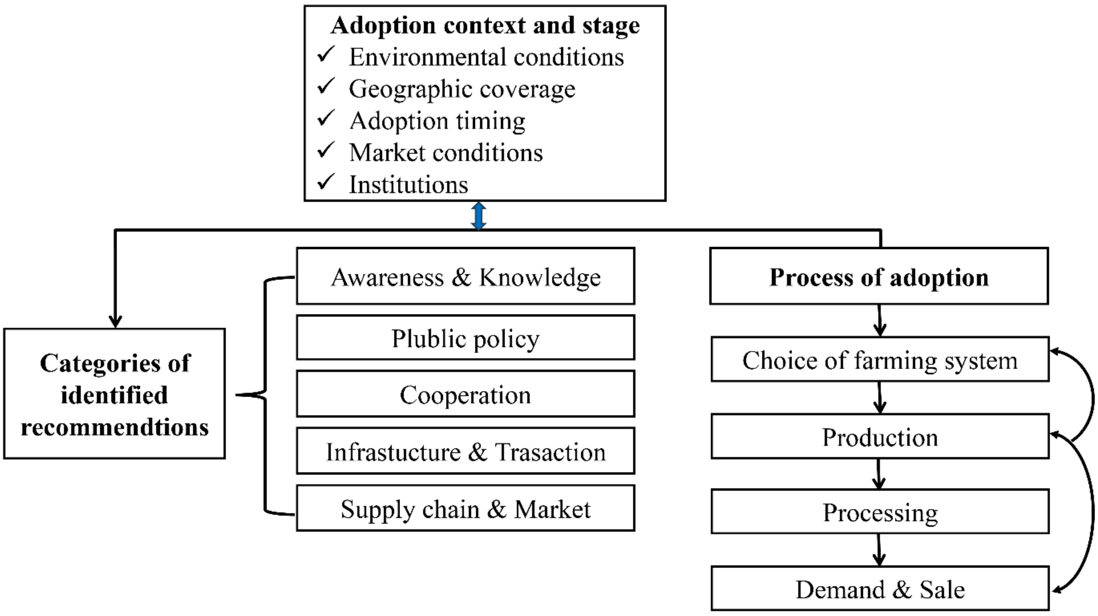

Figure 3. Process of organic adoption and global recommendations
Source: Adapted from the study by Möhring et al. (2024).

Möhring et al. (2024) further linked the adoption process to five distinct groups: awareness and knowledge, public policies, cooperation, infrastructure and transactions, and supply chains and markets. Each category is connected to the global scientific evidence base and corresponding recommendations for expanding organic farming. The flowchart identifies recommendations in the awareness and knowledge category, which includes initiatives to increase public understanding of the existence of organic farming and enhance understanding of practices, anticipated expenses, and advantages. Additionally, the cooperation category identifies recommendations mostly focused on farmer-to-farmer collaborations in production. The infrastructure and transaction category recognizes the proffered recommendations to lower transaction costs as well as suggestions to enhance agricultural or overall infrastructure for transport, processing, or production.

The supply chain and market group identify suggestions that include measures at the market and supply chain levels that are crucial for farmers' adoption decisions, and the public policy group identifies suggestions that cover every aspect of public policies (such as market-and information-based instruments, cross compliance, and command and control) to scale up organic farming. However, it is crucial to remember that recommendations vary depending on the production environment (e.g., institutions and market conditions, growing and environmental conditions) and the degree of adoption (e.g., geographical coverage and timing). With respect to this process, Table 1 shows a meta-analysis of several authors, various adoption stages and recommendations in scaling up organic farming.

Table 1. Comprehensive summary of global and evidence-based recommendations for scaling up organic adoption

High-Level Class Recommendations	Sub-Level Class Recommendations	Specific Recommendations	References
(A) Awareness and knowledge	A1. Provide knowledge through agricultural extension service (general).	A.1.1 Establish an agricultural extension service, providing local knowledge and training on agricultural production.	(Bui & Nguyen, 2021; Deka & Goswami, 2021; Jiumpanyarach, 2021; Lampach et al., 2020; Sharma & Pudasaini, 2021)
	A2. Improve knowledge by specialising, targeting, differentiating or extending extension service for organic farming.	A2.1 Establish or improve extension service for sector-and crop-specific organic production (e.g., fattening pigs and high-value crops).	(Adhikari et al., 2016; Bravo-Monroy et al., 2016; Heinze & Vogel, 2017; Läpple & Kelley, 2013; Ma et al., 2017)
		A2.2 Differentiate extension service across farm and farmer characteristics (e.g., farm size, time of organic farming, interest, specific programmes for women, young farmers).	(Fattahi Ardakani & Hashemi Shiri, 2019; Karaturhan et al., 2018; Mattila et al., 2018; Opoku et al., 2020; Yazdanpanah et al., 2021)
		A2.3 Improve methods and information channels for organic extension services (e.g., participatory methods, mobile phones, and networks).	(Läpple & Kelley, 2015; Rezvanfar et al., 2011; Sodjinou et al., 2015; Wollni & Andersson, 2014)
	A3. Improve the capacity of (targeted) farmers to find (agronomic and management) solutions.	A3.1 Develop cognitive skills and general education (e.g., general education, general agricultural education, specific training for women with no access to education, management training).	(Badu-Gyan et al., 2019; Bravo-Monroy et al., 2016; Pornpratansombat et al., 2011; Thapa & Rattanasuteerakul, 2011; Väre et al., 2021)
	A4. Provide knowledge through (targeted) information about organic farming.	A4.1 Provide targeted and in-depth information about organic farming (e.g., prices and markets, organic exports, organic certification, availability of organic inputs, targeting farms likely to exit).	(Badu-Gyan et al., 2019; Bravo-Monroy et al., 2016; Cakirli Akyüz & Theuvsen, 2020; Torres & Marshall, 2018; Yazdanpanah et al., 2021)
	A5. Improve awareness of and attitude towards organic farming.	A5.1 Raise the general awareness that organic agriculture exists and improve farmers' attitude towards it.	(Forouzani et al., 2018; Läpple & Kelley, 2013; Nokandeh & Karamjavan, 2018; Yazdanpanah et al., 2021)
		A5.2 Improve awareness of benefits and costs (incl. environmental and human health effects) of conventional and organic agriculture (media, show other farmers environmental footprints, use moral/religious norms).	(Badu-Gyan et al., 2019; Imani et al., 2021; Yanakittkul & Aungvaravong, 2020; Yazdanpanah et al., 2021)
(B) Infrastructure and transactions	B1. Improve the general (agricultural) infrastructure and reduce transaction costs.	B1.1 Improve access to the internet and mobile phones, labour markets, access to marketing and processing and the general agricultural infrastructure.	(Badu-Gyan et al., 2019; Deka & Goswami, 2021; Kaufmann et al., 2011; Khaledi et al., 2010; Pornpratansombat et al., 2011)
	B2. Improve the infrastructure for organic production and reduce transaction costs.	B2.1 Improve access to inputs, contract farming, processing and marketing for organic production.	(Bravo-Monroy et al., 2016; Khaledi et al., 2010; Métouolé Méda et al., 2018; Thapa & Rattanasuteerakul, 2011; To-The & & Nguyen-Tuan, 2019)

(C) Supply chain and markets	C1. Market access	C1.1 Establish (specific) organic markets and improve farmers' access.	(Azam & Shaheen, 2019; Fattahi Ardakani & Hashemi Shiri, 2019; Torres & Marshall, 2018)
	C2. Organic price premia	C2.1 Improve consumer awareness and willingness to pay for organic products.	(Digal & Placencia, 2019; Thapa & Rattanasuteerakul, 2011; Veldstra et al., 2014)
	C3. Certification	C3.1 Improve organic certification (reduce transaction costs, adapt locally) and access to it (availability, financial support, education).	(Badu-Gyan et al., 2019; Cakirli Akyüz & Theuvsen, 2020; Opoku et al., 2020; Skolrud, 2019; Veldstra et al., 2014)
	C4. Supply chains	C4.1 Develop (integrated) organic supply chains and marketing channels.	(Allaire et al., 2015; Heinze & Vogel, 2017; Khaledi et al., 2010)
		C4.2 Create risk management (tools) for organic production both on and off the farm (e.g., insurance or diversification).	(Chmielinski et al., 2019; Lu & Cheng, 2019; Sauer & Park, 2009; Serra et al., 2008)
(D) Policies	D1. Differentiate existing policies spatially.	D1.1 Differentiate existing policies supporting organic adoption (e.g., subsidies) spatially by clusters of adoption rates, production prospective, or eco-friendly conditions.	(Boncinelli et al., 2016; Boncinelli et al., 2017; Bonfiglio & Arzeni, 2020; Taus et al., 2013)
	D2. Differentiate existing policies accounting for farm and farmer characteristics.	D2.1 Differentiate existing policies supporting organic adoption (e.g., subsidies) by farm size, education, gender, opportunity costs, input intensity, socio-economic traits, or openness to innovation.	(Bui & Nguyen, 2021; Digal & Placencia., 2019; Hoang, 2021; Imani et al., 2021; Suwanmaneepong et al., 2020)
	D3. Farm-level economic incentives	D3.1 Provide economic or tax subsidies for conversion periods, the extent of organic production areas (per ha), organic inputs, credit and investment access, or agri-environmental benefits (schemes).	(Bui & Nguyen, 2021; Digal & Placencia, 2019; Hoang, 2021; Kirchweger & Kantelhardt, 2015; Lampach et al., 2020; Sharma & Pudasaini, 2021)
	D4. Abolish disincentives.	D4.1 Abolish disincentives (e.g., tax advantages and production subsidies), and realign and reduce trade-offs of policies (e.g., between organic and direct marketing policies).	(Chen et al., 2020; Jaime et al., 2016; Veldstra et al., 2014)
	D5. Continuation (long-term perspective)	D5.2 Continue and keep policies long-term, stable and reliable to avoid exits (e.g., subsidies), pooled with continuous support of education and knowledge sharing (e.g., targeting and scholarships).	(Cakirli Akyüz & Theuvsen, 2020; Chatzimichael et al., 2014; Digal & Placencia, 2019; Heinze & Vogel, 2017; Kuminoff & Wossink, 2010)
	D6. Demand side	D6.1 Public procurement policies stimulating demand and organic adoption.	(Lindström et al., 2022)
	D7. Structural change and R&D	D7.1 Support farm succession, farmland consolidation and organic productivity (through R&D policies).	(Mayen et al., 2010; Parker & Munroe, 2007)
(E) Cooperation	E1. Co-operatives, producer groups, and networks.	E1.1 Promote or establish membership in farmer-to-farmer networks, producer groups, and cooperatives.	(Haldar & Damodaran, 2022; Hoang, 2021; Lampach et al., 2020; Mrinila et al., 2015; Wollni & Andersson, 2014)

Source: Adapted from the study by Möhring et al. (2024).

The meta-analysis research of the data mentioned above offers a number of evidence-based suggestions for expanding organic farming. According to Möhring et al. (2024), the recommendations identified primarily target the first two phases of the adoption process: the selection of the farming technique and the reorganisation of farm management and production. However, the identified research shows that awareness and capacity-building methods, such as providing information relating to the prospective costs and advantages of organic vs.

conventional farming, can increase the eagerness to embrace the production of organic food (Hattam et al., 2012; Torres & Marshall, 2018; Yazdanpanah et al., 2021), particularly in areas with low rates of adoption. Additionally, a number of studies (Kleemann et al., 2014; Lampach et al., 2020; Sharma & Pudasaini, 2021) have demonstrated that expanding extension services and providing more information about organic production can lessen obstacles to adoption. This is due to the increased difficulty of organic management procedures and the requirement to adjust to the local environment and production technique, which in turn calls for new extension services.

Additionally, the meta-analysis highlighted ideas that prioritised improving farmer-to-farmer collaboration through cooperatives, membership in networks, or producer organisations. For example, research by Lampach et al. (2020) and Wollni & Andersson (2014) reveal that farmer-to-farmer collaboration can raise the awareness of organic farming and the availability of organic inputs, and help farmers learn and improve organic practices in certain locations. The basic prerequisites for the development of an organic sector, according to the results of the studies by Badu-Gyan et al. (2019) and Bravo-Monroy et al. (2016), are the availability of organic inputs, access to the labour market, a fundamental agricultural infrastructure, and access to mobile phones and the internet, intending to improve infrastructure and transaction costs. Furthermore, To-The & Nguyen-Tuan (2019) found that the adoption of organic farming may also be increased by access to contract farming as well as marketing infrastructure and processing.

The creation of new organic markets and the advancement of existing ones, along with the creation of organic price premiums, are necessary steps in enhancing the adoption of organic farming at the supply chain and market levels. Digal & Placencia (2019) state that this can be achieved by enhancing consumer awareness and export markets. The upscaling of organic farming adoption at this level also requires farmer access to organic certification as well as reduced transaction costs of organic certification by enhancing the accessibility of certification bodies, education, and farmer support (Badu-Gyan et al., 2019). The various recommendations of public policies that may enhance the uptake of organic farming were identified through a meta-analysis, which included the establishment and enhancement of financial incentives at the farm level, such as area-based subventions for organic farming conversion and maintenance, tax subventions for conversion periods, subventions for organic inputs, and agri-ecofriendly systems.

6. Challenges Faced in Adoption

Despite the various benefits of organic farming, farmers still face numerous challenges that affect the entire farming procedure, while others are unique to specific phases (Njeru, 2015). Some of these challenges include the following:

6.1 Low Yield

Universally, farmers prioritise crop yield as the most crucial outcome of agricultural production (Fess & Benedito, 2018). The variation in crop output relating to organic and non-organic approaches, is considered a significant disadvantage that prevents small and large farmers from implementing organic production methods (Fess & Benedito, 2018). Seufert (2012) noted that yields in most organic farms are about “25%” lower than those of traditional farms. Observations reveal that yield disparities are observed to differ across countries and are influenced by local characteristics. Several studies (Badgley et al., 2007; De Ponti et al., 2012; Kniss et al., 2016; Lee et al., 2015; Pimentel et al., 2005; Seufert et al., 2012; Suja et al., 2017) have reported yield differences between conventional and organic agriculture. These studies contend that many investigations into yield gaps may incorporate factors that introduce bias, thereby complicating the interpretation of their findings.

The use of crop types intended for traditional high-input methods, which are unlikely to demonstrate equal “superior performance in resource-limited environments”, as well as uneven fertiliser applications across systems, were major flaws in early experiments that undermined the validity of studies comparing system yields. Findings from several studies (Kniss et al., 2016; Lee et al., 2015; Suja et al., 2017) indicate that crop yields are generally higher in conventional management relative to organic systems, especially for grains and horticultural crops, despite the existence of numerous experimental biases. However, when equated to traditional systems, some studies have found that organic systems produce higher yields, particularly for hay (containing perennial and legume crops) and forage (such as alfalfa, rye, and buckwheat) crops (Fess & Benedito, 2018). It is crucial to note that the beneficial environmental conditions and agronomic techniques used in those areas may have contributed to the increased yields in these reported studies.

The yields from organic farms are typically lower than those from conventional farms in numerous countries that have high levels of poverty. This could pose a problem for farmers operating in this production system. Small-scale farmers may earn more money and improve food security through organic farming. However, the potential advantages of organic farming rely on a number of context-specific elements (nutritional and health benefits of organic products as well as environmental, economic, and social benefits) (Jouzi et al., 2017). In a study of small-scale organic farms in Latin America, the International Fund for Agricultural Development (IFAD, 2002) noted that controlling these factors effectively requires a thorough grasp of several components. The report underlined that in order to help small-scale farmers grow and secure food availability, increase income, and improve livelihoods, knowledge must concentrate on farmer organisation, technical assistance, and quality assurance in food production.

A relative assessment of the differences between organic and conventional approaches is shown in Table 2. Different authors' meta-analyses of yield differences have produced varying conclusions about how well organic farming performs in terms of yield compared to conventional farming. Agro-ecological zones, regions, and management approaches may all be attributed to variations in average yield performance. As noted by some authors, organic farming typically produces higher yields than conventional farming in some regions, while others have observed lower yields. However, some studies noted that organic yields were comparable to conventional systems. Several authors have generally demonstrated that organic yields are lower than those produced by conventional systems.

Table 2. A yield differential analysis comparing organic and conventional techniques

References	Authors' Deduction
De Ponti et al. (2012)	On average, organic practices resulted in "80%" more yield than traditional methods. Statistical analysis of pre-2004 data with 2004–2010 data revealed that the relative yield performance of organic systems had not changed.
Forster et al. (2013)	In the first rotational cycle, organic cotton systems yielded 42% less than traditional ones, but in the second cycle, they produced the same amounts. Soybean production under organic systems was "7% less" than under conventional systems. The wheat output in organic fields was "37% less" than that in conventional fields in the initial rotational system, but the same afterwards.
Kniss et al. (2016)	The output of organic hay systems was either comparable to or higher than that of conventional hay crops. The yields of organic peaches, sweet corn, squash, and snap beans were similar to those of their conventional counterparts.
Lee et al. (2015)	The market output in "conventional" onion fields was 71.5 t/ha, whereas it was only 55.8 t/ha in organic onion fields. Freshly harvested conventional onions had a weight of "220.2 g/plant", which was greater than the weight of organic onions at "175.6 g/plant".
Ponisio et al. (2015)	Scientific research has repeatedly shown that organic yields are "19.2%" lower than conventional yields, indicating a lesser disparity in yield than previously found. The yield gap is reduced in organic methods that employ crop rotation and multiple cropping.
Seufert (2012)	On average, organic practices resulted in "25%" lower yields than those from traditional methods for all types of produce. According to reports, the yield of organic vegetables and grains is "26% and 33%" lower than that of conventional crops. The yields of organic fruits and oilseed crops are "3% and 11%" lower, respectively, than those of conventional crops. An enhanced organic realisation of "legumes over non-legumes and perennial over annual crops" was exhibited. In underdeveloped countries, the yield gap between conventional and organic produce is higher than in wealthy countries, ranging from 43% to 25%, respectively.
Suja et al. (2017)	"10.61 and 11.12 t/ha" are the respective yields of taro in organic and conventional management methods. Equal yield features between organic and conventional methods are based on "cormel number, yield per plant, and weight and number of mother corms".

Source: Adapted from the study by Fess & Benedito (2018).

The data reported above was subjected to a meta-analysis study that revealed differences between systems over time. However, according to the statistics, organic methods are prone to lower yields during the first three to four years of organic production, which is roughly the same time needed to complete one full crop cycle (Fess & Benedito, 2018). The yield variance then becomes noticeably less or no longer predominant, due to sporadic rises as soil characteristics and microbial populations are restored (Table 2). In a comparative meta-analysis, Ponisio et al. (2015) found that extended rotation cycles and multiple cropping can further reduce the yield variance between conventional and organic techniques by 4% to 9%. In addition, the concentration of "nitrogen minerals", which is mostly influenced by "soil temperature", affects the amount of nitrogen that is accessible in organic systems. It is crucial to mention that the quantity of nitrogen accessible in organic practices is mostly influenced by soil temperature, which in turn determines the concentration of nitrogen minerals. Therefore, it is noteworthy that organic crops produced an average yield that was 80% higher (De Ponti et al., 2012), suggesting the possibility for farmers who practice on a small scale when they transition to organic farming practices. Additionally, organic crops often exhibit greater yield differences, especially in poor nations (Seufert et al., 2012). This implies that agricultural producers have the potential to produce more than they need, which they can then export to wealthier countries, thereby resulting in monetary benefits through the export of their produce.

6.2 Problems Associated with Production

Njeru (2015) noted a number of challenges associated with the production of organic farming. Double digging, a shortage of raw materials for composting, and pest management concerns are obstacles identified during the analysis of the challenges and benefits of organic farming amongst growers in the Nembure Division of Embu County, Kenya. Njeru (2015) asserted that double digging is a labour-intensive technique that is necessary for creating 5/9 seed holes, sunken beds, and raised beds, which are all crucial elements of organic farming. However, it was mentioned that composting presents a significant challenge, particularly due to the labour-intensive nature of turning the compost. Small-scale farmers face the combined issues of labour shortages and insufficient raw materials as challenges related to composting.

Existing studies (Akharume, 2017, Cisilino & Madau, 2007; Nieberg & Offermann, 2000) have demonstrated that the labour costs in organic farming are between 7% and 13% higher than in conventional farming due to the increased labour requirements. According to the report of the Department of Agriculture, Forestry and Fisheries, South of Africa (DAFF, 2011), when implemented correctly, organic farming can address most issues related to soil health, natural pest control, and weed management, as well as mitigate irrigation challenges. Furthermore, the report noted that soils enriched with organic compost foster healthier pastures and crops, thereby enhancing livestock production.

6.3 Certification Challenges

Two different organic farming methods were distinguished by Jouzi et al. (2017). The certified organic agriculture is offered at premium prices, majorly for organic markets in wealthy nations. While the non-certified organic production is primarily used for local markets in poor countries. According to Rundgren & Parrott (2006), most certified organic products produced in these developing nations are intended for export. Nevertheless, many small-scale organic farmers fail because of the exorbitant and high fee of certification, which is unaffordable for most farmers who are resource-poor or operating on a small scale (Gómez et al., 2011). Furthermore, Rundgren & Parrott (2006) pointed out that farmers who grow for their own consumption or who reside in regions without dependable organic markets do not benefit from certification. According to Jouzi et al. (2017), certified products can occasionally be less profitable than non-certified ones.

Beuchelt & Zeller (2011), for instance, studied 327 Nicaraguan coffee growers over a ten-year period who produced conventional, fair-trade, and organic coffee. According to the study, organic producers lost ground to conventional producers because of their lower output, even though “certified coffee prices” were higher at the farm gate. Furthermore, Beuchelt & Zeller (2011) observed that the premium prices paid for coffee that was certified organic and organic-fair trade were 11% and 8% higher than those of conventional coffee, respectively. To address the challenges posed by the high costs of certification for small-scale farmers, it is suggested that if farmers could consider forming a group certification, this could help lower individual certification expenses. Kumar (2023) explained that group certification is a novel approach that enables small farmers with small plots of land to jointly gain organic certification. This process allows farmers to come together as a group and distribute the responsibilities and costs, rather than each farmer shouldering the significant expenses and management issues on their own. This method is beneficial for “small-scale farmers” who may struggle with the high costs of the certification process. Group certification requires the establishment of an internal control mechanism to guarantee that all participants comply with the requirements of organic standards. However, the certification body also performs random inspections according to the group’s size, with further evaluations carried out if risk assessments suggest a need.

7. Conclusion

Loss of biodiversity, environmental dilapidation, exposure to hazardous chemicals, and food safety are a call to a unified system of farming. The extent to which organic farming can feed the ever-increasing population is not clear. This study reviewed several studies involving organic farming, the grasp of organic farming, the notion of adoption, and the willingness to adopt organic farming. A farmer-based approach to understanding organic farming, involving such a comprehensive evaluation, is useful in helping to comprehend the motives of farmers toward organic farming adoption. In general, farmers’ decision-making and willingness to adopt organic farming are consistent with the concern for health. Meanwhile, the health behaviour model has significant power for predicting an individual’s decision-making in relation to risks.

Notwithstanding, the literature shows that adopting organic farming is normally carried out as a result of the risks and menaces caused by conventional farming and thus suggests that organic farming could be used as a preventative strategy to minimise the effects of toxic pollution. It is imperative to understand why a farmer chooses to farm organically either for one reason or the other. In conclusion, as pointed out in the literature, perceived threat, behavioural appraisal, cues to action, self-efficacy, and general viewpoints are all components that relate to farmers’ willingness to adopt organic farming. As noted in the literature, choosing a farming system, the production process, transportation and processing, and the sale of organic goods are some of the processes of adoption. It is essential to also note that a number of challenges in adoption exist among these farmers. The issue of low yield, shortage of labour during production, and certification are some of the challenges that could serve as a drawback for farmers, as indicated in the literature. However, the study identified suggestions such as awareness and knowledge, public policies, cooperation, infrastructure and transactions, and supply chains and markets for scaling up the adoption of organic farming. Since organic farming can be utilised to address some of the issues associated with conventional farming, it is necessary for a number of stakeholders in the organic food industry to increase their investment in organic farming production if farmers are to continue to prosper in this sector.

Author contributions

G.A.E. conceived the original idea and wrote the original draft manuscript. A.M. participated in designing and helped to draft the manuscript. S.F.G.Y. re-evaluated the design, drafted and revised the manuscript. All authors have read and agreed to the published version of the manuscript.

Data availability

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

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