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Original Research Article

Market gardeners' perception of the barriers and enablers for agroecological practices adoption in Benin Republic

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There is growing interest in agroecology as a pathway to achieving more sustainable agriculture and food systems. It is increasingly recognized as a viable solution to address the economic, environmental, social, and health challenges associated with food systems. This study aims to explore the factors influencing the adoption of agroecological practices and the challenges faced by market gardeners in Benin. Using qualitative methods, we conducted 120 interviews with market gardeners from the Houéyogbé and Lokossa Communes, guided by a structured interview framework. The findings indicate that the adoption of agroecological practices is primarily driven by traditional knowledge, the perceived benefits of agroecology for human health and environmental protection, and the training and support provided by NGOs and development projects. However, several barriers hinder adoption, including persistent attacks by pests and pathogens, limited market access for agroecological products, and the low availability and high cost of ecological and biological inputs. Additional challenges include climatic and environmental constraints and poor access to agricultural credit.To promote the sustainable adoption of agroecological practices in Benin, it is crucial for policymakers, NGOs, development projects, and researchers to prioritize addressing these limiting factors.

Keywords: Agroecological practices, market gardening, farmers' knowledge, barriers and enablers, Houéyogbé, Lokossa, Benin

INTRODUCTION

Agriculture occupies a central place in the economy and food security of many communities around the world. However, it faces growing challenges, including the need to feed an ever-increasing global population while preserving natural resources and mitigating the effects of climate change (FAO, 2018a, Manono et al., 2019). Sustainable agriculture is becoming a major concern at the heart of development with a view to meeting vital needs without jeopardizing those of future generations (Kindemin et al., 2019). The last decades of domination of conventional agriculture have allowed us to learn that practices such as the abundant use of chemical and synthetic inputs, heavy tillage, the use of a low diversity of cultivars high-efficiency and irrigation techniques unsuitable for local conditions generate significant negative environmental and ecological impacts (Trabelsi, 2017). According to this same author,

growing environmental challenges and the need to preserve natural resources have led to increased interest in sustainable agricultural practices such as agroecology. This approach focuses on promoting biodiversity, soil conservation and reducing the use of harmful chemicals.

Agroecology is emerging in this context as a promising approach, proposing sustainable agricultural methods that harmonize productivity and resource conservation (FAO, 2018b). Agroecology, which combines ecological principles and traditional agricultural knowledge, aims to create resilient and sustainable food systems. It promotes agricultural methods that improve the use of chemical inputs, preserve biodiversity and improve soil health (Atieri, 2018). The promotion of agroecological practices has then become one of the favourable options that can contribute sustainably to soil management and the preservation of ecosystems for food and nutritional security in the current context of changes (Akpatcho et al., 2019). Agroecology is the subject of growing interest as a mean of progressing towards more sustainable agriculture and food systems. It is increasingly presented as a credible solution to face the economic, environmental, social and health challenges raised by the current food system (Abou-Chabi and Tovignan, 2023).

Market gardening presents risks to health and environmental quality since it sometimes uses large quantities of chemical inputs or inappropriate sources of phytosanitary products for their production (Kpadenou et al., 2019). Furthermore, Market gardening is essential to the Beninese economy, to the livelihoods of many farmers and workers, as well as to the nutrition of the Beninese population. In the Strategic Development Plan for the agricultural sector of Benin (2017-2025), market gardening is one of the priority sectors to develop (MAEP, 2020). Furthermore, the government's action programs (PAG 2017-2021 and 2021-2026) place market gardening among the nine priority sectors which should benefit from investments. In addition, since 2017, the country has had a national program for the development of the market gardening sector (PNDF-CM, 2017-2021). In Benin, market gardening is often associated with sometimes the excessive use of chemical inputs to improve yields. However, the use of synthetic chemical fertilizers and pesticides to increase production yield compromises the quality of vegetables due to the presence of toxic residues with adverse consequences on human health and the environment (Yarou et al., 2017; Adjatin et al., 2019; Assogba et al., 2022). Thus, agroecological intensification and the agroecological transition of market gardening systems constitute an undeniable necessity for achieving food and nutritional security objectives while preserving natural, human and nutritional resources and animal health (Assogba et al., 2022).

In view of the issues linked to the promotion of agroecology in Benin, the government of Benin adopted in 2022 a National Strategy for the Development of Ecological and Organic Agriculture (SNDAEB, 2023-2030) which aims to specify the strategic benchmarks for the development of Ecological and Organic Agriculture (AEB). However, it should be noted that well before the development of the SNDAEB to serve as a compass for actions in terms of AEB, several initiatives to promote agroecology saw the light of day in the early 1990s (MAEP, SNDAEB, 2022). These initiatives to promote agroecology have become more and more numerous in recent years. Thus, the market gardeners of the Communes of Houéyogbé and Lokossa have taken advantage of several initiatives in recent years to support the promotion of agroecology by certain NGOs and projects. However, market gardeners in this region continue to face major challenges. The agroecology innovations promoted appear to be poorly adopted by the beneficiaries. To better understand the determining factors of this situation, it is also essential to carry out a compromise study of technical, economic and environmental performance in order to show the dynamics of agroecological transition (Abou Chabi and Tovignan, 2023). To achieve this, it appears appropriate to seek to understand the factors that limit or foster the adoption of these practices in order to design interventions for effective and sustainable adoption of these practices. It is in light of all of the above that this study aims to analyze the different factors linked to the adoption of agroecological practices by market gardeners in the Communes of Houéyogbé and Lokossa.

METHODOLOGY

This section addresses the theorical framework, the presentation of the study area, the sampling of the interviewees, then discusses the methods and tools for data collection and analysis.

Theoretical framework

Severals theories have been developed to explain the factors influencing the adoption and diffusion of technological innovations in the agricultural sector (Yo et al., 2020). This study draws on the most relevant of these theories, as outlined below. The first set of theories falls under the "diffusion of innovations" paradigm, with Rogers (1983) being one of its most prominent proponents. Rogers posited that the adoption of an innovation is influenced by certain intrinsic characteristics of the innovation itself. According to him, key factors determining adoption include the perceived advantages of the innovation, its compatibility with existing beliefs and norms, its level of complexity, the possibility of trialability, and the degree to which its benefits are observable.

On the other hand, Davis (1989), through the Technology Acceptance Model, emphasized the individual characteristics of potential adopters in determining whether they choose to adopt an innovation. His model

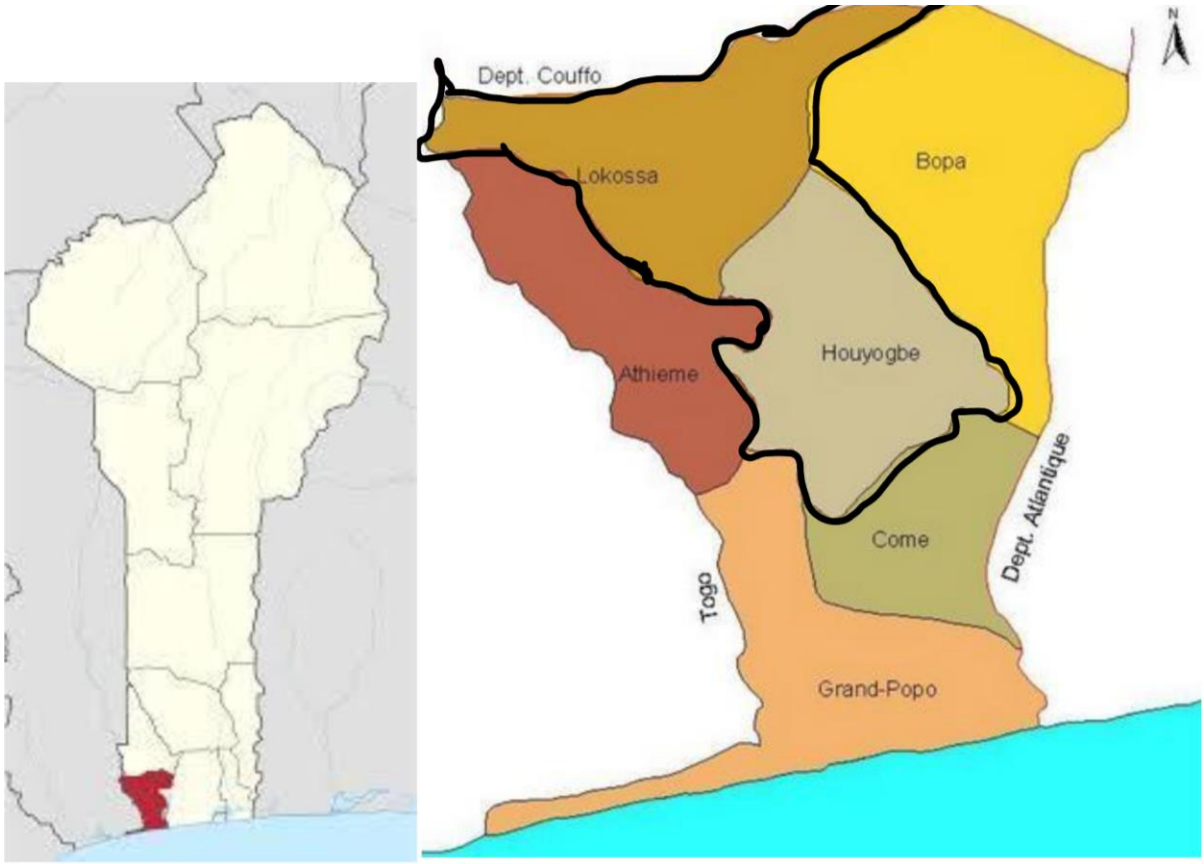

Figure 1: Administrative map of the Mono department showing the Communes of Houyogbé and Lokossa

Source: National Institute of Statistics and Demography (INSTaD, ex-INSAE)

focuses on two main perceptions of potential adopters: the perceived usefulness and the perceived ease of use of the innovation. These perceptions significantly shape users' attitudes and intentions toward adopting new technologies and innovations.

Despite their differing focuses, both Rogers (1983) and Davis (1989) agree on the importance of complexity, as it relates to ease of use, and the advantages or utility of the innovation as critical factors influencing adoption decisions.

In this study, these theories provided a framework for data collection and analysis. Specifically, the research examined the intrinsic characteristics of the agroecological practices being promoted, the socio-economic factors (extrinsic factors) tied to the living and working conditions of producers, and the perceptions of producers regarding these practices in terms of norms and beliefs. These factors were analyzed to determine whether they act as enablers or barriers to the adoption of agroecological practices.

Brief presentation and sampling of the study area

The Communes of Houéyogbé and Lokossa are all located in the Mono department (see Figure 1 below), one of the 12 departments of the Republic of Benin. The Commune of Houéyogbé is located at 94 km from Cotonou. It is limited to the North by the Commune of Lokossa, to the East by Bopa, to the South by the commune of Comè, to the South-West by the commune of Grand-Popo, and to the West by the commune of Athiémé. It is subdivided into 6 districts: Dahé, Doutou, Honhoué, Houéyogbé, Sè and Zoungbonou. Located at 107 km from Cotonou, in the North-West of the Mono Department, the Commune of Lokossa is one of the six (06) administrative subdivisions in this Department. Limited to the North by the Commune of Dogbo located in the Department of Couffo, to the South by the Communes of Athiémé and Houéyobgé, to the East by the commune of Bopa and to the West by the Togolese Republic. The Commune of Lokossa is subdivided into five (05) districts which are: Lokossa, Agamé, Koudo, Houin and Ouèdèmè-Adja.

The climate in this area is tropical with 02 raining seasons and 02 dry seasons and this is suitable for market gardening. Agriculture is rainfed and not mechanized. Several types of soil are found in the study area. In the

Table 1. Distribution of the market gardeners interviewed per sex and per cooperative

Cooperative	Number of men	Number of women	Total
Commune of Houéyogbé			
Wallongnon	5	2	7
Sonagnon	3	3	6
Lomnava	3	3	6
Fifonsi	4	4	8
Akofa	3	4	7
Lacim	5	7	12
Sans coopérative	10	4	14
Total			60
Commune of Lokossa			
Saint-Michel Dagbétin	11	7	18
Lanminsin	10	7	17
Nounagnon	7	3	10
Sans coopérative	10	5	15
Total			60

Source : Field data, 2024

Commune of Houéyogbé, there is namely: i) ferralitic soils which occupy approximately 70% of the territory; ii) hydromorphic soils made up of gray colored earth cover a small proportion of the municipality's territory (5.9%). They are found in the areas of Tokpa (Doutou district), Tohonon (Zoungbonou district) and Gbédji, Sohounmè (Sè district); iii) Hydromorphic gley soils (7.9%) are located around certain bodies of water; iv) hydromorphic tropical ferruginous soils are found only in the Sè district; v) Vertisols (16.2%) made up of black earth are mainly observed in the districts of Doutou and Zoungbonou. In the Commune of Lokossa the soils are globally of two types, namely: i) ferralitic soils on the plateau and ii) hydromorphic soils. Ferralitic soils are subdivided into ferralitic soil on loose clay-sandy sediment and ferralitic soil on sandstone and sandy and clayey-sandy colluvial materials. The hydromorphic soils are of the alluvial and colluvial type of the valleys of the rivers and lakes quite rich in organic matter, very fertile but flooded seasonally by the floods of the Mono river. Most of the soils in the studied area are favorable to several crops growing, notably market gardening.

Since the 2020s, the Municipalities of Houyogbé and Lokossa have benefited respectively from the interventions of the NGO Group for the Promotion and Exploitation of Environmental Resources (GROPERE) and the Local Economy Counter of South Benin (GEL -South Benin) through training sessions, support for the supply of agricultural inputs, the marketing of agricultural products, the implementation of sustainable agricultural practices. They benefited from these same NGOs support for sharing of technologies and innovations for production for development actions, capacity building with a view to improving food security and the promotion of sustainable agriculture that respects the environment, especially agroecology for the benefit market gardeners.

The choice of these 02 Communes were done after an exploratory phase carried out with the help of the NGO and The Communal Cell of Agricultural Development agents. During this phase some data were collected on the Communes that have benefited from support for the agroecological practices promotion in which NGOs and projects intervened. Thus, Houyogbé and Lokossa appeared as the most relevant for this study.

Sampling of the respondents

In the case of this study, we used a non-probability sampling method which is the snowball method. The sampling specific criteria were linked to the ease of access to the farms and contact with the farmers, be a farmer benefiting from support in agroecology and having practiced at least two popularized agroecological practices. On this basis we retained 120 market gardeners who were involved in the interviews at a rate of 60 per municipality. The distribution of the respondents is presented in Table 1.

Data Collection

As mentioned above, the present study was conducted following a purely qualitative approach. It is analytical and comprehensive in nature. Data collection began with the documentary review. Subsequently, interviews were carried out using an interview guide with 120 market gardeners for individual interviews, 29 of whom were mobilized to carry out 04 focus group discussions at a rate of 02 per Commune. The individual interviews allowed us to collect data on the detailed perceptions and motivations of market gardeners for the adoption of agroecological practices. These latter were related to the agricultural practices (the techniques used for cultivation, types of inputs used, water management, biodiversity management methods, etc.),

Table 2. Enablers for the adoption of agroecological practices

Factor	Number of respondents (%)	Description of the respondents' perception of the effects of the factor	Justifications given by the respondents
Traditional local knowledge	56%	Market gardeners have traditional knowledge of techniques such as composting, manual weeding, the fallow system and the use of natural biopesticides. This knowledge also allows them to understand the importance of agroecological practices in preserving the environment and human health Their traditional knowledge enables their easier transition to agroecological practices, as they are often in line with the principles of agroecology	Market gardeners are more inclined to adopt sustainable practices that draw on their traditional agricultural knowledge Continuing training and the promotion of this traditional knowledge can strengthen this trend and facilitate the widespread adoption of agroecological practices
Availability of cultivable land	42%	The availability of cultivable land is essential for the adoption of agroecological practices. Market gardeners with access to suitable land can diversify their crops and implement techniques such as crop association and rotation	In the study area, market gardeners with sufficient land show a greater capacity to adopt and maintain agroecological practices Land security and land distribution policies can play a crucial role in the expansion of these practices
NGO and projects support	86%	Support from NGOs and projects is a determining factor in the adoption of agroecological practices NGOs provide training and technical resources to market gardeners	The interventions of NGOs and projects in the study area have allowed many market gardeners to become familiar with agroecological practices and to adopt them successfully Continuing to strengthen partnerships with NGOs and increasing their presence on the ground could accelerate the adoption of these practices
Access to information and continuing education	40%	Market gardeners who have regular access to training on agricultural innovations and best practices are better equipped to adopt and maintain these practices The dissemination of information through workshops and practical demonstrations allows market gardeners to stay informed of the latest advances and to overcome the challenges encountered in the implementation of agroecological practices	In the study area, market gardeners who regularly participate in training and workshops organized by NGOs show faster and more effective adoption of agroecological practices Information networks and knowledge exchange platforms between market gardeners also facilitate the sharing of experiences and practical solutions, thus strengthening the agricultural community and supporting the dissemination of agroecological practices
Favorable (national and local) agricultural policies	68%	Policies can facilitate market access for ecological products, thereby increasing the economic viability of these practices for market gardeners	Favorable agricultural policies, implemented by the government and local authorities in the study area, were instrumental in creating an environment conducive to the adoption of agroecological practices. Strengthening existing policies and adapting them to the needs of market gardeners could further improve the adoption and sustainability of these practices

Source: Field data, 2024

their advantages and disadvantages, vectors and specific barriers to their adoption. Furthermore, the focus group discussions made it possible to prioritize the factors influencing the adoption of agroecological practices

through the method of estimating percentages using stones. This method consisted in assigning a set of stones representing the importance of a factor among several others. The higher the number of stones attributed to a factor is, the more important this factor is in the perception of the market gardeners involved in the group interview. This is a traditional qualitative method of ranking. The final step is the consensus of the participants around the final result of ranking. In addition to these, we tried to understand, through the focus group discussions, the social and economic dynamics related to the adoption of agroecological practices as perceived by the market gardeners. These data were supplemented by those from participant observation.

Data analysis

For the analysis of the collected data, we used the content-based analysis method. It made it possible to group into categories or themes all the statements which come together in meaning, given that our intentions are oriented much more towards understanding the phenomenon rather than its theoretical explanation or even on ways of doing things. We therefore, after processing and manual transcription of the data, carried out a thematic sorting and analysis of the content. In addition, we used descriptive statistics to calculate averages and percentages for tables and graphs realization as to display barriers and enablers summary as well as barriers hierarchization as per their harmfulness degree as perceived by the market gardeners.

RESULTS

Agroecological practices of market gardeners listed in the study area

Through the various surveys that we carried carry out during data collection, we identified several agroecological practices adopted by the market gardeners of Houéyogbé and Lokossa. These practices were disseminated by the NGOs cited above which intervene in the sector to promote agroecology in market gardening. Among the numbers of these practices, we have: crop rotation (80%); the association of cultures (60%); the use of urea coated with neem oil (30%); techniques for good water management (55%); the use of aqueous extracts as pesticides (50%); the use of organic materials as fertilizers (60%) and the appropriate soil preparation, sowing and transplanting techniques (70%).

Enablers of the adoption of agroecological practices

The results of the study made it possible to identify some factors which, according to the respondents, favor the adoption of agroecological practices promoted by market gardeners in the study area. These factors are summarized in Table 2 above.

The analysis of Table 2 reveals that there are several positive factors which contribute to enhance the adoption of agroecological practices. Among other, it emerged: the role of local and traditional knowledge of market gardeners on techniques and some practices such as composting, manual weeding, the fallow system and the use of natural biopesticides. According to the respondents, this local and traditional knowledge allows them to combine or use elements available in their environment to produce fertilization products based on low-cost plant debris or animal waste in the farms. In addition, they believe that this knowledge has a positive effect on the motivation to adopt agroecological practices. They also mentioned the importance of land availability in the adoption of certain natural soil regeneration practices such as cultural rotation and association. This observation was reinforced by the following testimony:

"*We have been using traditional techniques such as manual weeding and the use of animal manure for a long time. These practices have been passed down to us from generation to generation and help us maintain soil fertility without the need for expensive chemicals. In addition, the availability of land allows us to diversify our crops and try different agroecological techniques*" said Honoré, market gardener in Lokossa

Furthermore, the importance of support from local NGOs and projects was also highlighted as crucial in the transitional phases of adoption. According to the respondents, these NGOs and projects play a role in training and capacity building and facilitating access to agroecological technologies and innovations adapted to local contexts as evidenced by one of the respondents below:

"*NGOs provide us with training, and through their programs we have learned to make our own compost and use natural biopesticides. Their help gave us the confidence to adopt more sustainable practices*." Words from Norbert, market gardener in Lokossa.

The results also revealed that access to information and continuing training improves the ability of market gardeners to adopt and adapt these practices, as evidenced by the comments collected from one of the respondents below:

"*The continuing education sessions helped us a lot. We have access to information on agroecological practices and we can exchange our experiences with other market gardeners*" Words from Fabrice, market gardener in Houéyogbé.

Finally, respondents believe that favorable institutional and political support is essential to encourage and facilitate the adoption of these practices.

Barriers to the adoption of the agroecological practices

The results of the study made it possible to identify some

Table 3. Barriers to the adoption of agroecological practices

Factor	Number of respondents (%)	Description of the respondents' perception of the effects of the factor	Proposal for mitigation actions by respondents
Climate change effects	42%	Extreme climate variations, such as prolonged droughts or rains, can damage crops and reduce yields Market gardeners may hesitate to adopt agroecological practices that require a certain climatic stability to be effective Market gardeners in the study area believe that the unpredictability of climatic conditions limits their ability to plan and invest in agroecological practices	Suitable irrigation and water management systems could alleviate these constraints, but they require financial and technical resources. They such to take into account in the coming policies of agroecological practices promotion
Lack of support and incentives	37%	There is a little government or local subsidy support to encourage the adoption of agroecological practices	Develop or strengthen the impact of national and/or local policies to support market gardeners in adopting agroecological practices
The unavailability and the high cost of biological and ecological inputs	78%	Stores selling ecological fertilizers are almost non-existent in the study area and the market gardeners concerned sometimes say they travel long distances to obtain their supplies. The high cost of organic inputs such as composts, biopesticides and organic fertilizers seems prohibitive for low-income market gardeners. As a result, some market gardeners prefer less costly solutions in the short term, even if they are less sustainable	Market gardeners express a preference for inputs available locally and at lower cost. Developing local solutions and building capacity for composting by market gardeners themselves could help reduce costs Subsidies or financial aid from the State or TFPs for the purchase of organic inputs could encourage their adoption
Limited access to the remunerative sales market	58%	Limited access to markets where ecological products can be sold at a premium price discourages market gardeners from adopting these practices. Without adequate commercial outlets, market gardeners see no economic incentive to produce in an agroecological manner	Raising awareness among local consumers about the importance of ecological products for consumer health could increase local demand
Limited access to productive resources	44%	Limited access to essential resources, such as water, agricultural tools, hinders the adoption of agroecological practices and market gardeners may be forced to continue using resource-intensive practices to maximize immediate yields	The establishment of support programs to provide the necessary resources to market gardeners could promote the adoption of agroecological practices Training on the efficient use of available resources can help market gardeners overcome these limitations
The high attack of pests and pathogen agents	46%	Market gardeners fear that agroecological practices are less effective in controlling pests and pathogens agents' attacks compared to chemical pesticides and herbicides. Post-harvest losses due to pests and pathogens agents' attacks are often devastating, dissuading market gardeners from changing practices	The integration of biological control and integrated pest management methods can offer an effective alternative. Demonstrations of local success in managing pests and pathogen agents with agroecological practices can encourage their adoption
Perceived risks of adopting new practices (risk aversion)	40%	Market gardeners believe they are often reluctant to adopt new practices due to the perceived risk of reduced yield or economic loss. The lack of guarantee of immediate success with agroecological practices increases their hesitation	Continuing training and sharing of experience between market gardeners can reduce the perception of risk and increase confidence in the adoption of new practices. Support programs that offer technical and financial assistance during the transition period can help mitigate perceived risks
Unavailability and the need to renew quality seeds	16%	The availability and renewal of seeds for market gardening poses a problem for market gardeners. They are concerned about the poor quality of seeds purchased or harvested	The establishment of local mechanisms for the production and promotion of quality seeds for market gardening would facilitate their adoption and improve yields

Table 3. Continue

Low access to agricultural subsidies and credits	8%	The difficulties of financing production were also mentioned by the producers. Financing poses a problem especially at the start of the season for seeds purchasing Sometimes, they request loans from certain financial institutions, but these latter impose a guarantee that exceeds the capacity of the farmers. This makes difficult to obtain loans by the farmers. Sometimes, the time required for the reimbursement is before the time to start their sales. Furthermore, interest rates are not adapted to agricultural activities	They suggest setting up subsidy projects adapted to the promotion of agroecological practices by market gardeners.

Source: Field data, 2024

factors which, according to the respondents, hinder the adoption of agroecological practices promoted for the benefit of market gardeners in the study area. These factors are summarized in Table 3 above.

The analysis of Table 3 shows the existence of several unfavorable factors which negatively influence the adoption of agroecological practices. Indeed, it appears that limited access to sales markets for products from agroecological crops, the effects of climatic hazards as well as the high cost of organic and ecological inputs compared to chemical inputs are among other factors which limit the adoption agroecological practices.

Indeed, market gardeners say they often encounter difficulties in finding commercial outlets for their ecological products after the harvest and perceive a high risk of not recovering their investments. This fact is supported by the following comments from certain respondents:

"*Even if we produce organic vegetables, it is difficult to find buyers*," says Marcellin, market gardener in Houéyogbé;

"*The prices we obtain on the market do not always cover our production costs. Without a stable and profitable market for our ecological products, it is difficult to recover investments in agroecological practices*", words from Ayihouede, market gardener in Lokossa

Regarding the cost of organic inputs, such as composts, biopesticides and other organic fertilizers such as urea coated with neem oil (adopted by some market gardeners in Lokossa), it is seen as an important factor unfavorable, often prohibitive for most market gardeners (74%), especially small producers with low incomes. In this situation the fall back in some non-recommended practices is usual. This situation is supported by the following testimony:

"*I would like to use compost and biopesticides, but their cost is too high for me. On a limited budget, I cannot afford these inputs. I often have to turn to cheaper chemical products, even though I know they are not ecological*," said Sossa, market gardener in Lokossa.

In addition, according to the respondents, while chemical fertilizers abound on the market, they rarely find natural or organic fertilizers in stores or shops selling agroecological inputs. This situation leads market gardeners to simply manufacture their fertilizers in an artisanal manner, with the constraint of unstable quality and imprecise instructions for use. Furthermore, they estimated that manure or animal droppings, are still not available in large quantities and are difficult to obtain for producers who operate large areas. Some of them, said that they are sometimes forced to travel long distances to acquire them with all the difficulties linked to transport and the increase in related costs. To compensate for this, some producers combine small livestock farming with agriculture while others negotiate the parking of cattle with the herdsmen.

Analysis of the table shows that 42% of market gardeners surveyed mentioned climatic constraints such as flooding and temperature variations as directly affecting agricultural production. These extreme conditions, according to them, lead to crop losses, a reduction in product quality and an increase in management costs if irrigation is required. This is evidenced by the following testimony from one of the respondents.

"*During floods, our crops suffer and yields drop considerably. We have tried agroecological methods, but the results are often disappointing in periods of extreme climate, which pushes us to return to traditional methods less sensitive to climatic conditions*", said Sanou, market gardener in Lokossa

Likewise, access to resources necessary for production such as water, due to logistics or its seasonal availability and the attack of pests and diseases, are perceived as very important problems facing market gardeners and which according to them dissuade them from adopting recommended agroecological practices. The comments of one of the respondents below support this situation.

"Limited access to water and fertile land prevents us from fully adopting agroecological practices. Additionally, pests destroy our crops, especially during wet seasons. We have tried natural methods, but they are not enough. We are afraid

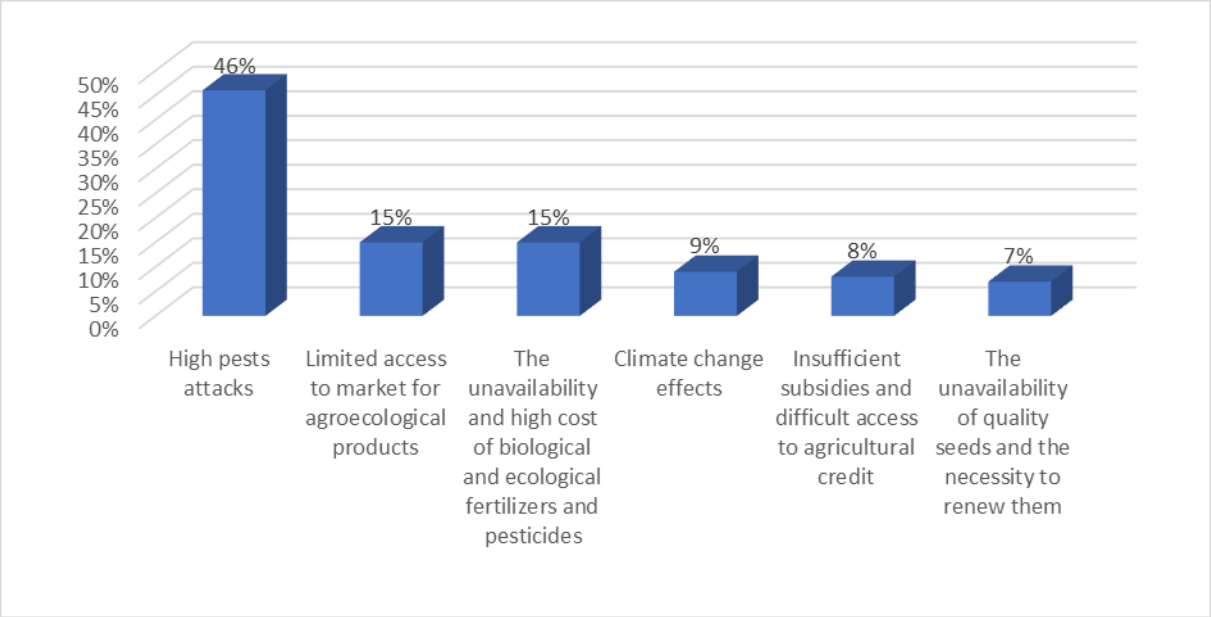

Figure 2: Prioritization of the barriers to agroecological practices adoption in the study area

Source **:** Field data, 2024

of losing our entire harvest if we do not use chemical pesticides," said Emmanuel in Houyogbé.

In addition, during the growth and development of plants, (56%) of market gardeners surveyed said they notice that harmful insects attack the leaves of their plants, even when they use ecological pesticides. These insects cause significant damage, reduce photosynthesis and weaken plants. According to the respondents, insect infestations lead to a reduction in yields and lower quality of crops even with the use of agroecological products. This state of affairs coupled with the late decomposition of organic materials used by market gardeners discourages them from adopting agroecological practices. Indeed, (18%) of the market gardeners surveyed noted that organic matter buried in the soil, such as animal excrement and cow dung, takes much time to decompose. This late decomposition is believed to be due to the failure to compost organic matter before use, which delays the release of nutrients necessary for plant growth, thus affecting the initial development of crops.

Prioritization of the barriers to agroecological practices adoption in the study area

Figure 2 above presents the ranking in order of priority, the factors raised by market gardeners and which hinder the adoption of agroecological practices in our study area. The analysis of this table shows that among the many factors unfavorable to the adoption of agroecological practices, the most important and urgent to which policies and interventions must focus as a priority is the high attack of pests and other pathogens agent on the market gardeners' farms. Subsequently, the respondents considered that another priority is to work to find profitable outlets for the sale of the agroecological products harvested and to promote the manufacturing and marketing of agroecological inputs at an affordable cost to market gardeners. According to the respondents, national and local policies as well as the interventions of NGOs, development projects and research should focus on resolving these problems urgently in order to boost the adoption of agroecological practices in our study area. in particular and in Benin in general. Then, they consider it important to carry out actions to mitigate the effects of climate change and to promote local production of quality seeds and make them accessible at a lower cost to market gardeners without forgetting the establishment of mechanisms to facilitate their access to suitable credits.

DISCUSSION

The results showed that there are both many barriers and many enablers for the adoption of agroecological practices. These results are somewhat similar to those of Kadenou et al. (2019), according to whom, the adoption of these practices by market gardeners varies considerably depending on several socio-economic, environmental and institutional factors. Among the barriers to the adoption of agroecological practices, the most priority ones to which appropriate solutions must be found as revealed by the

results are among others: the high pests and pathogen agents' attacks, the limited access to remunerative sales market, the unavailability and the high prices of fertilizers and pesticides as well as the climate change effects, difficulties in accessing quality seeds as well as the limited access to agricultural credits. These results are corroborated by those of Trabelsi (2017) and Shrestha et al. (2021), who noted that agroecology presents undeniable advantages compared to conventional agriculture, but that its adoption faces obstacles which can be technical, socio-economic and/or institutional. Furthermore, these results are similar with those of Assogba et al. (2022) which revealed that land insecurity, difficulties in accessing loans adapted to market gardening, organic inputs and the marketing of vegetables at remunerative prices as well as the low technical capacity to manage soil fertility, pests and post-harvest losses; low level of equipment, lack of water mastering; the poor quality of seeds are the main constraints limiting the agroecological transition. Furthermore, the harmful effects of climate change as revealed in our results are in the same line with those of Biaou et al. (2016) and Kindemin and al., (2019) who noted that upstream constraints linked to production or the profitability of agricultural production in Benin, soil degradation and decline in fertility, as well as climate variability, constitute a major limit to sustainable production. However, all these factors lead to low yields in agroecological market gardening farms in our study area. Furthermore, this fact is often not widely revealed in most studies on the adoption of agroecological practices. These results corroborate those of Viaux (2016), who estimate that for agroecology theorists, the question of yields (generally lower than in conventional agriculture) often remains taboo and little addressed.

Furthermore, this same author believes that in agroecological farms, organic fertilization is often too low compared to what would be desirable to have good yield levels. Speaking about the availability of organic matter (animal droppings for example), this same author revealed that those who do not have livestock often do not have enough organic fertilizer on the farm and even when they buy it outside, quantities remain limited due to the very high purchase price, not to mention spreading costs. Sometimes, and as some respondents in our study area mentioned, certain market gardeners say they negotiate animal grazing with certain breeders in order to have sufficient animal waste for manuring.

The results revealed also, the existence of several enablers which can serve as a lever for the adoption of agroecological practices such as local knowledge and traditional practices of market gardeners. This result is similar to that of Forsans (2022), according to whom endogenous culture must be able to find its place alongside agronomic knowledge and allow the spread of agroecological practices. In the same vein, Pretty et al. (2018) believe that the individual characteristics of farmers, such as their knowledge of agroecology, and their perception of the risks and benefits associated with these practices play a crucial role in the adoption of agroecological practices. In addition, the availability and access to land resources, the support of NGOs and projects and by extension the development of policies favorable to the promotion of agroecology were highlighted as enablers. These results are corroborated by those of Kremen and Miles (2012), who estimate that factors such as access to resources, support networks, and public policies also influence the adoption of agroecological practices. In the same vein, farmers highlighted as a solution to the lack of support that hinders their efforts in the adoption of agroecological practices, the development or strengthening of local and/or national policies to support promoting agroecology.

However, it is really important that the actions of these policies and projects are defined in such a way as to have a positive impact on the activities and well-being of market gardeners. This state of affairs is very evocative, especially since the adoption of agroecological practices in the study area remains mixed despite the support of certain NGOs and projects through agricultural advice for the benefit of market gardeners and adoption by the State of a policy to promote agroecology at the national level. Indeed, as pointed out by Kpadenou et al. (2019), contact with an extension agent or an NGO or a project does not have a significant effect on the adoption of different agroecological practices apart from biological, mechanical and use of other alternatives to pesticides. Thus, although necessary as highlighted by Abou-Chabi and Tovignan (2023), who believe that in order to allow farmers to produce healthier and more sustainable products, popularization policies and promotion of agroecological practices must be implemented. But this should not just be a question of putting in place policies to support market gardeners, it is also necessary that these policies are adapted and truly and positively impactful. In view of all of the above, the observation emerges that the transition to agroecological systems is far from easy (Boilat et al., 2022). Indeed, its adoption and application by farmers comes up against difficulties of different kinds, in terms of temporality, investment, land security, apprehension of risks, characteristics and policies of movements which carry them (Abou-Chabi and Tovignan, 2023). Thus, to better achieve the related objectives, it is appropriate to facilitate farmers' access to secure land and suitable natural inputs at lower cost; by developing agroecological value chains and markets. In addition to this, promoting public and private investments to make technologies accessible and affordable for producers; facilitating knowledge management and learning processes for producers; promoting the development of organic input production units to facilitate farmers' access to these latest products (Assogba et al., 2022) and working to ensure that these actions can have real impacts on the beneficiaries are also required. Indeed,

according to DeLonge et al. (2016), studies show that economic incentives, adequate technical support and favorable policies can significantly increase the adoption of agroecological practices.

CONCLUSION

Through the results of this study, we understand that the adoption of agroecological practices by market gardeners in our study area depends mainly on several factors including their traditional knowledge of agroecological techniques, training and partnerships to which they have access, as well as support from, projects and NGOs. These practices are also influenced by the high and persistent attack of pests and pathogen agents on the market gardens crops, limited access to sales market, low availability and high costs of inputs, climatic and environmental constraints as well as the negative effects of market gardeners' poor access to credit. These factors are seen as priority ones that actions to develop and promote agroecological practices should seek to address. Thus, to successfully resolve the barriers to the adoption of agroecological practices, it is appropriate to facilitate farmers' access to suitable natural inputs at lower cost; by developing agroecological value chains and markets. In addition, policies must promote public and private investments to make technologies accessible and affordable for market gardeners; by facilitating knowledge management and learning processes for them. Also, setting up a policy for the development of production units for organic inputs at reduced costs to facilitate farmers' access to these latest products could enhance greatly enhance the agroecological practices adoption. Furthermore, popularization and promotion policies for agroecological practices must be reviewed and strengthened so that they are better adapted to truly and positively impact beneficiaries. In this frame, research must be strengthened to help to develop suitable innovations to overcome the high pests and pathogen agents 'attacks on the agroecological market garden crops.

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