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Article

Securing Agro-Pastoral System and Rural Livelihood Through the Market Gardening in Niger: Unfolding Smallholders' Resilience to Interwoven Challenges

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Abstract: Market Gardening (MG) in Niger is a crucial tool for securing agro-pastoral systems and rural livelihoods amid interwoven challenges such as climate change, conflicts and insecurity, demographic pressure, and poverty, which could not be fully coped with only relying on the very limited availability of capital and modern technology. A study of 60 small garden farmers found that MG significantly enhances farmers' income and household food security. The average annual income from MG accounts for about 70 per cent of the farmers' total income. However, challenges like water scarcity, land insecurity, and limited access to credit and markets hinder their full socio-economic role. The farmers try to overcome those obstacles through cooperation, sending remittance from part-time off-farm activities, and mobilization of resources based on their social capital. Those who could not overcome the challenges left the village for a "safer" location. The study emphasizes the need for community collective action, rural-urban networking, and external support to improve MG for rural poverty reduction and food security improvement.

Keywords: Market Gardening; food security; rural livelihoods; Sub-Saharan Africa; Niger

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1. Introduction

Securing agro-pastoral systems and rural livelihoods in developing countries, particularly Sub-Saharan African (SSA) countries, has long been a critical concern due to the countries' dependence on subsistence agriculture and livestock production for sustenance and income generation (Minot & Sawyer, 2016; Ndimbo et al., 2023). The agro-pastoral system, characterized by the interdependent relationship between crop cultivation and animal husbandry, forms the backbone of Niger's rural economy (Zossou et al., 2020). This system faces numerous challenges stemming from environmental, socio-economic, and climatic factors that threaten the livelihoods of smallholder farmers and pastoralists (Adisa, 2020). Nevertheless, in recent years, market gardening (MG) has emerged as a potential solution to address the vulnerabilities and resilience of smallholders within the agro-pastoral system in some SSA areas, which relies on still very limited availability of capital and modern technology. MG involves intensively cultivating vegetables, fruits, and other high-value crops on a small plot of land, typically close to markets, to meet the growing demand for fresh produce (Orsini et al., 2013). The implementation of MG in Niger holds the potential to strengthen agro-pastoral systems and enhance rural livelihoods by offering alternative income sources, diversifying agricultural practices, and mitigating the impact of climate change.

MG has gained attention as a means to achieve sustainable agricultural practices in resource-constrained environments. Farmers can optimize land use, maximize yields, and reduce environmental degradation by adopting small-scale, intensive cultivation techniques. MG can also enhance soil fertility through organic waste recycling and composting, increasing productivity and resilience against climatic stressors (Razanakoto et al., 2021). Since Niger is highly susceptible to the adverse impacts of climate change, including prolonged droughts, erratic rainfall, and rising temperatures that threaten the agro-pastoral system, decreasing agricultural productivity and livestock losses (Zakari et al., 2022; Zossou et al., 2020). MG appears to be one of the resilient mechanisms

for smallholder farmers in rural and peri-urban areas amid changing climatic condition and insecurities (Ndimbo et al., 2021; Keys et al., 1988). MG allows farmers to diversify income sources since it enables smallholders to capitalize on urban markets' demand for fresh produce, providing them with additional income streams beyond traditional livestock and crop sales (Goldman et al. 2016).

MG enables smallholders to reduce reliance on a single income source and cope better with income fluctuations, ultimately enhancing livelihood security (Dzanku et al., 2021). Women play a significant role in agricultural production and household choirs. However, they often face gender-specific barriers that limit their access to resources and economic opportunities. Market gardening has the potential to empower women by providing them with greater control over their income and resources. MG is transformative in challenging traditional gender roles and empowering women within agro-pastoral communities (Chiba and Thebe, 2023). Market gardening can significantly contribute to food security by increasing the availability of fresh, nutritious produce and reducing the reliance on food imports in areas facing food security like Niger. It also offers a pathway towards achieving food sovereignty and self-sufficiency in local food production (Razanakoto et al., 2021).

This study aims to explore the role of MG in securing agro-pastoral systems and rural livelihoods in Niger by providing a comprehensive understanding of how MG can contribute to smallholders' resilience in the face of interwoven challenges. As Niger grapples with the complexities of agro-pastoral sustainability, the knowledge derived from this research could inform policymakers, development practitioners, and stakeholders in crafting effective strategies to foster sustainable agriculture and livelihoods in the country. The study highlights that smallholders in Niger have a deep-rooted knowledge of their environment, climate conditions, and traditional farming techniques. By valuing and integrating this knowledge into MG practices, smallholders can develop context-specific strategies responsive to their unique challenges. This localized knowledge is a powerful tool for adapting to changing circumstances, enhancing productivity, and reducing vulnerability to external shocks.

2. Literature Review

2.1. The Interwoven Challenges Facing Agro-Pastoral Systems

The agro-pastoral system in Niger has long served as the backbone of rural livelihoods, sustaining communities through the interdependent relationship between crop cultivation and animal husbandry (Zakari et al., 2022). However, the agro-pastoral landscape in Niger is beset by a complex tapestry of challenges that threaten the sustainability and resilience of smallholders' livelihoods (Zossou et al., 2020). This section delves into the intricacies of these interwoven challenges, highlighting the multifaceted nature of the issues faced by agro-pastoral communities. The Niger's agro-pastoral system is intricately linked to the region's climatic conditions. The country's susceptibility to prolonged droughts, erratic rainfall patterns, and desertification significantly threaten crop production and livestock rearing fields (Zakari et al., 2022). Changes in precipitation patterns can reduce soil moisture, affecting crop growth and exacerbating water scarcity, which is crucial for livestock and irrigation.

Resource scarcity, particularly arable land and water, significantly challenges agro-pastoral communities (Osbahr et al., 2010). Overgrazing and unsustainable land management practices contribute to soil degradation and reduced land fertility, further undermining agricultural productivity. Unsustainable resource use can lead to a vicious cycle of declining yields, ultimately threatening food security and rural livelihoods. Gender inequalities persist within agro-pastoral systems, with women often having limited access to resources, decision-making power, and opportunities (Doss, 2013). The gender gap restricts women's participation in income-generating activities and their ability to adapt to changing circumstances, hampering rural development and diminishing the system's resilience in interwoven challenges. The agro-pastoral communities are highly susceptible to market fluctuations and price volatility, which can significantly impact household income and food security (Stewart, 2008). Reliance on a few agricultural commodities exposes smallholders to the risks associated with changing market dynamics. Price crashes or sudden fluctuations can destabilize livelihoods and limit the capacity to invest in resilience-building measures.

Inadequate access to financial services, including credit and insurance, hampers smallholders' ability to invest in improved agricultural practices and adapt to shocks (Cavatassi et al., 2011). Moreover, the absence of critical infrastructure such as irrigation systems, storage facilities, and transportation networks further constrains the agro-pastoral system's potential to cope with challenges. The impacts of climate change are limited to erratic weather patterns and extend to the shifting of agroecological zones (Sultan et al., 2013). Temperature increases and changing precipitation patterns lead to the northward migration of suitable agricultural areas, affecting traditional cropping calendars and challenging farmers' ability to predict growing seasons (Zakari et al., 2022).

Despite the agro-pastoral system's pivotal role, food insecurity and malnutrition persist in Niger (FAO et al., 2020). A lack of dietary diversity, driven by the limited range of crops cultivated and livestock reared, contributes to persistent malnutrition and limits the system's resilience against shocks. In conclusion, the challenges facing agro-pastoral systems in Niger are intricate and interconnected, requiring holistic approaches to secure rural livelihoods. The multifaceted nature of these challenges underscores the importance of addressing them comprehensively rather than in isolation. By understanding the intricacies of the interwoven challenges, stakeholders can design effective strategies that enhance the resilience of agro-pastoral communities, allowing them to navigate the complex landscape they operate within.

2.2. Role of Market Gardening in Securing Agro-Pastoral Systems and Rural Livelihoods

The agro-pastoral system, characterized by its intricate blend of crop cultivation and animal husbandry, is a means of subsistence and a way of life for millions of rural households. However, the vulnerabilities stemming from environmental uncertainties, climate change, and market fluctuations have prompted the exploration of innovative approaches to enhance the resilience of agro-pastoral systems (Ado et al., 2019). One such approach gaining prominence is the establishment of MG, which holds significant potential in securing rural livelihoods through diversified income streams, increased food production, and enhanced adaptive capacity. MG provides a unique opportunity for diversifying income sources for smallholder farmers and pastoralists. The reliance on a single income stream, often tied to livestock or staple crops, makes households vulnerable to market shocks and climatic uncertainties (Cooper & Wheeler, 2017). Diversification through market gardening allows smallholders to access urban markets and tap into the growing demand for fresh produce (Andres & Lebailly, 2011; Ndimbo et al., 2021). The additional income generated from MG is a buffer against income fluctuations and contributes to overall household resilience.

The nutritional diversity offered by MG has far-reaching implications for rural communities grappling with food security challenges. Traditional agro-pastoral systems may be limited in providing a balanced diet due to reliance on a narrow range of crops and animal products. MG introduces a variety of fruits and vegetables, enriching local diets with essential vitamins and minerals (Abdoulaye & Ramanou, 2015). This diversification contributes to improved nutrition and health outcomes, critical to overall household resilience. MG offers a pathway for smallholders to adapt to changing climatic conditions. The intensive nature of market gardening allows for greater control over production environments, including irrigation and shade netting, to mitigate extreme temperatures (Razanakoto et al., 2021). By integrating climate-smart practices into MG management, smallholders enhance their resilience to climate-induced shocks, safeguarding their agricultural production and livelihoods.

Establishing MG often involves collective community efforts, fostering social capital and knowledge exchange. Cooperatives and producer groups enable smallholders to pool resources, share experiences, and collectively address challenges (Gyau et al., 2014). These networks facilitate the dissemination of innovative techniques, such as improved irrigation methods or pest management strategies, enhancing the overall adaptive capacity of agro-pastoral systems. Besides, MG is crucial in advancing gender equity within agro-pastoral communities. Women often take on active roles in market gardening, gaining greater decision-making power and control over income (Sebastian et al., 2023). This empowerment improves women's socio-economic status and contributes to the resilience of households by diversifying income sources and enhancing resource management.

MG contributes to creating value chains that connect smallholders to larger markets. Its proximity to urban centers allows direct consumer access, reducing intermediaries and increasing profits (Gyau et al., 2014). Establishing strong market linkages bolsters income generation and exposes smallholders to diverse market opportunities, reducing their vulnerability to localized market fluctuations. Therefore, cultivating various crops contributes to preserving and enhancing local agrobiodiversity. Traditional crops that might otherwise be neglected gain prominence in MG, conserving genetic resources and improving the adaptive capacity of agro-pastoral systems (Abdoulaye & Ramanou, 2015). Integrating this agricultural practice into the agro-pastoral system emerges as a transformative strategy to bolster rural livelihoods and enhance resilience. The intricate interplay of challenges, from climate uncertainties to market fluctuations, necessitates holistic solutions. MG offers diversified income sources, improved nutrition, climate adaptation, and empowerment, collectively reinforcing the agro-pastoral system's resilience. Fostering community networks, preserving local agrobiodiversity, and linking smallholders to markets provide a multifaceted approach to addressing interwoven challenges. As many developing countries navigate the complexities of sustaining agro-pastoral systems, MG is a promising avenue to secure livelihoods and preserve ecosystem health while building the foundations of rural well-being (Razanakoto et al., 2021).

3. Materials and Methods

3.1. Description of the Study Area

The study was carried out in the eastern part of the Tillabérie region located between 14°23'08" and 15°41'49" north latitude and 3°35'40" and 4°15'38" east longitude. Created by law No. 2002-014 of 11/06/2002, it comprises the northeastern portion of the Abala department and has an area of 5,500 km2. It is bounded on the south by the communes of Kourfeye Centre, Soucoucoutane, and Dogon Kiriya, on the southeast by the commune of Bagaroua, on the east by the communes of Tébaram and Tillia, on the north by the Republic of Mali, and the west by the commune of Abala. The total population was about 111,358 inhabitants, of which 54,349 are men (48.80%) and 57,009 are women (51.20%). The active labor force aged 15 to 49 is 41,590 (39.14%), which means that the area has a very active human potential for agriculture practiced in all villages of the commune. The ethnic groups "Touaregs, Peulhs, and Djermas follow the Haoussas regarding population size".

This region's year is divided into dry and rainy seasons. The dry season begins from October to June. It includes a cold period (October to February) with temperatures dropping to 15°C and a warm period (March to June) with temperatures of up to 45°C. As for the rainy season (July to September), the average temperature is around 27°C. The average annual rainfall in the area is 471.4 mm (Andres and Lebailly, 2011). The predominant economic activity among the population in the study area depends on agricultural practices, with small-scale MG also playing a critical role in facilitating food security. The cultivation of small plots of land to grow various types of crops, including cereals like millet and sorghum, legumes such as cowpeas and groundnuts, as well as cash crops like sesame, sorrel, voandzou, cassava, cucurbits, and okra is dominant. Millet and cowpeas are the predominant agricultural commodities under cultivation.

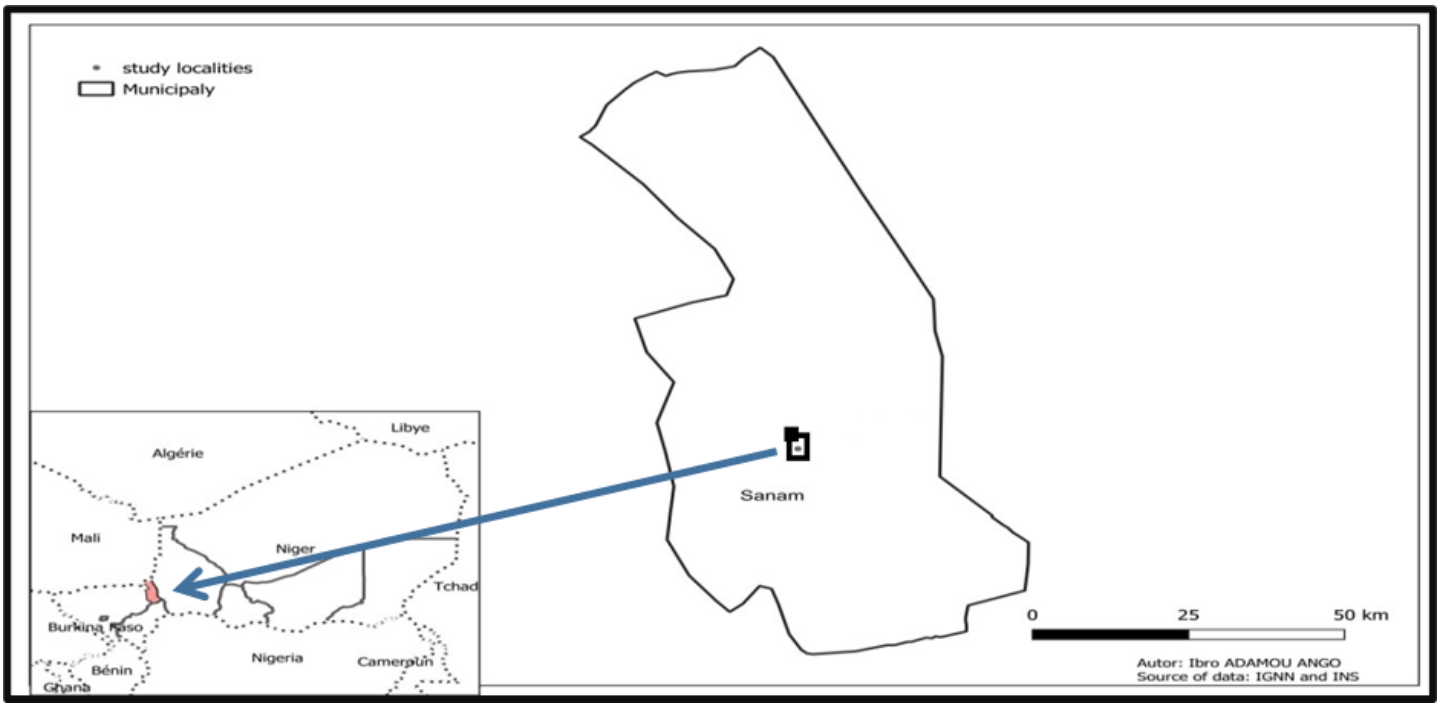

Figure 1. Map of the study areas.
Source: Created by authors.

3.2. Data Collection and Analysis

This article follows a qualitative research approach to explore the role of MG in securing agro-pastoral systems and rural livelihoods in Niger. The study unravels smallholders' interwoven challenges to understand farmers' resilience strategies to sustain their agro-pastoral activities and navigate market dynamics. Qualitative research approaches are highly used when there is little understanding, significantly if the current knowledge is fragmented (Kyngäs, 2020). It is uniquely positioned "to provide researchers with process-based, narrated, storied data that is more closely related to the human experience" (Stahl & King, 2020). The qualitative research approach enabled the researcher to learn about farmers' experience in MG, particularly regarding challenges and adaptive strategies amid the interwoven challenges. Through a qualitative research approach, researchers were able to gain a deep understanding of some specific questions, such as: *What are the key challenges faced by small-scale MG farmers in Niger's agro-pastoral societies? How do smallholders*

adapt and respond to the interwoven challenges? What role does MG play in securing the agro-pastoral system and rural livelihoods in Niger? How do smallholders engage with market forces and market opportunities in the context of agro-pastoral activities?

Purposive sampling was employed to select the information-rich respondents who effectively responded to the research question. Participant observation, semi-structured interviews, and key informant interviews were used to collect primary data from 60 small-scale farmers actively involved in MG activities, four development officers, and two local leaders from the study sites. Field trips and extended stays in the study sites facilitated the establishment of interpersonal connections with the respondents, hence facilitating the acquisition of detailed information to address the research question. A thematic analysis was undertaken to discover emerging patterns and themes (Byrne, 2022) on the problems faced, resilience mechanisms employed, and the significance of MG in ensuring the sustainability of livelihood strategies and household socio-economic characteristics.

3.3. Analytical Framework

The study's findings are analyzed using a sustainable livelihoods approach (SLA)—a framework that seeks to investigate how to improve the livelihood capabilities of individuals and communities. It acknowledges the significance of various capital assets, including natural, human, financial, physical, and social capital, as the basis for rural poverty reduction and sustainable development (Scoones, 2015; Serrat, 2017). The SLA is a comprehensive framework that aims to understand and enhance the lives and livelihoods of individuals and communities, which is the case in our study area. It emphasizes the importance of considering the interplay between various factors that shape people's livelihoods, such as different resources, social institutions, and economic opportunity. This approach recognizes that livelihoods are dynamic and influenced by multiple dimensions, and therefore, interventions need to address these complexities. By employing this methodology, policymakers and practitioners can better comprehend and promote strategies that strengthen livelihoods and support communities in overcoming challenges. As endorsed by Corsi et al. (2018), MG plays a significant role in ensuring the resilience of agro-pastoral systems. MG provides smallholders with diversified income sources, food security, and a potential pathway out of poverty. Smallholders can capitalize on market demand, generate additional income, and improve their living standards by cultivating high-value horticultural crops.

However, this study emphasizes the importance of smallholders' resilience to interwoven challenges such as climate change, market volatility, and limited access to resources. Scholars like Scoones (2015) argued that smallholders' resilience can be enhanced by adopting sustainable agricultural practices, building social networks, and accessing financial and technical support. MG contributes to income diversification and fosters knowledge exchange and community cooperation, enabling smallholders to cope with and adapt to these challenges effectively. Consequently, policy interventions are essential to promote the widespread adoption of MG to secure agro-pastoral systems. Borras et al. (2011) highlight the significance of empowering smallholders through land tenure security, access to credit, and participation in decision-making processes. Governments and development organizations must provide smallholders with essential support systems and a conducive environment for agricultural success.

Since smallholder farmers face numerous challenges ranging from climate change, market fluctuation, and limited access to agricultural information (Ndimbo et al., 2023), adopting different livelihood strategies such as MG is crucial to creating resilient and sustainable livelihoods. These external shocks can significantly impair agricultural productivity and livelihoods. In this case, we bring forth the neo-endogenous development approach that brings together local and external knowledge to facilitate development. Indigenous agricultural knowledge, passed down through generations within local communities, can offer valuable insights and practices for building resilience in the face of such challenges. Nevertheless, indigenous knowledge alone cannot bring changes and promote sustainable rural livelihoods. The framework below shows how neo-endogenous knowledge could help promote sustainable livelihoods and ensure security in agro-pastoral rural communities.

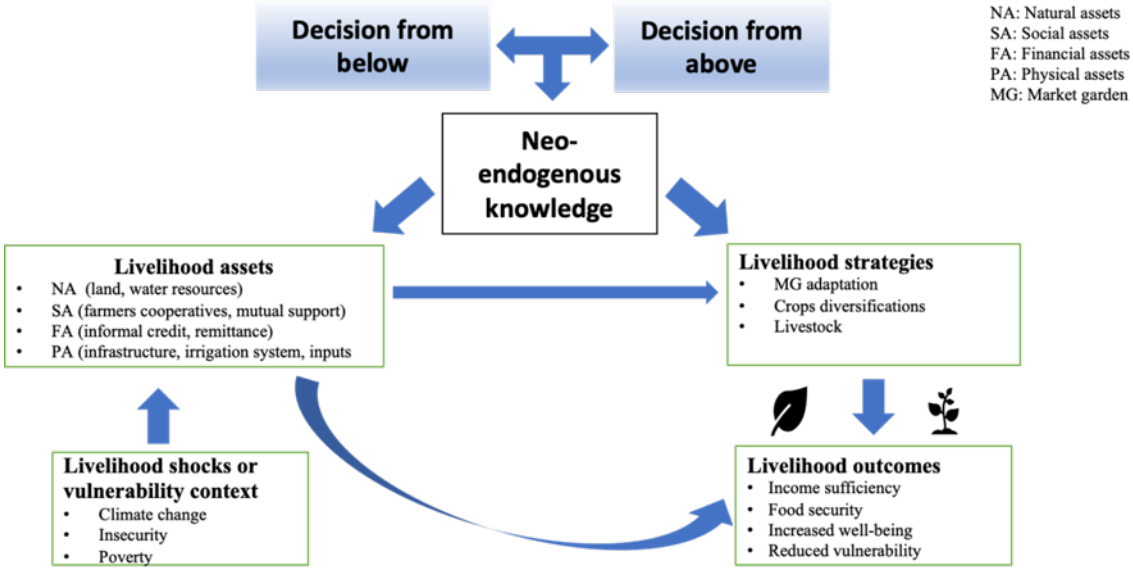

Figure 2. Sustainable livelihoods framework.
Source: Modified from Scoones (2015); Serrat (2017)

4. Results and Discussion

4.1. Demographic and Socio-Economic Characteristics of the Respondents

It was essential to describe the demographic and socio-economic characteristics of the respondents, such as gender, education, age, marital status, and land ownership, since these variables determine farmers' participation in MG. This diversity in demographic characteristics can influence the methods employed in farming operations and farms' overall sustainability and profitability. As stated earlier, data for this study were collected from sixty MG producers (N = 60) from the eastern portion of the Tillabérie region. According to the data shown in Table 1, it can be observed that a higher proportion of women (76.7%) are engaged in MG production compared to males (23.3%) within our sample, implying that there is higher women's representation in the MG than that of their men counterparts which is very minimal. Women's struggle for economic freedom and improving household food security drives them to engage in MG. On average, the mean age of the respondents is 49.00, where the maximum and minimum age of the respondents is 75 and 22, respectively. This observation suggests that adult individuals, mainly women, exhibit higher levels of involvement in MG than their younger counterparts.

Table 1. Demographic characteristics of the respondents.

Demographic Characteristics	No. of Respondents (N = 60)	Percentage (%)
Gender		
Male	14	23.3
Female	46	76.7
Marital status		
Single	0	0.00
Married	33	55.00
Divorced	13	21.67
Widow	14	23.33
Age		
Below 22	13	21.66
23–35	7	11.66
36–55	25	41.66
56–75	15	25.00
Education		
No formal education	17	28.33
Primary	25	41.66
Secondary	16	26.66
Certificate/ Diploma	2	3.33
Bachelor's degree	0	0.00

The current study shows that vegetables are cultivated on minimal land within the production basins. In the Sanam region, most market gardeners (89%) possessed land ranging from 0.25 to 1 hectare. Conversely, a smaller proportion of those examined (11%, N = 5) owned plots above one hectare. Most market gardeners operating on the Soubéra producing site possess relatively tiny land parcels, typically ranging from 0.15 to less than one hectare. The compact dimensions of plots in specific producing basins can be attributed, firstly, to the significant presence of market gardeners and, secondly (in the instance of Bassin de Soubéra), to the exclusive reliance on a solitary irrigation well and the acquisition of land through loans or donations. Market gardeners typically cultivate small plots to guarantee adequate upkeep and achieve desirable crop yields. However, in both locations, the land is owned by a limited number of people who inherited it from their parents. At the Sanam site, it can be observed that approximately two-thirds of the basin surrounding the pond was under the ownership of the royal family, which allocated land temporarily to individuals interested in participating in MG activities.

Table 2. Respondents' land size (ha).

Land size (ha)	Frequency (N = 60)	Percentage (%)
0–0.25	39	65.00
0.26–0.5	13	21.66
Above 0.51	8	13.33

4.2. Resilience Building and Adaptive Strategies of Smallholders

Strengthening smallholders' adaptation and resilience strategies in the face of interwoven challenges is critical for their survival and long-term development. MG ensures food availability and access for smallholders and their communities, particularly during conflict-induced food shortages and climate-related risks. The diversification of crops and shorter cultivation cycles in MG enables farmers to harvest multiple times within a year, increasing their resilience to climate shocks and minimizing food insecurity (Gwan & Kimengsi, 2020). Market gardeners grow diverse products in the study sites rather than relying on a particular crop. Crop diversification enables farmers to mitigate potential risks associated with climate change, agricultural diseases, and market trends. Both research sites have a wide range of crops grown, with significant yields. Market gardeners in these communities specialize in producing a variety of mixed fruits and vegetables, including leafy greens and fruits. Based on the growers' responses and field observation, the market gardeners grow different horticultural crops, such as lettuce, carrot, cabbage, potato, and eggplant. Besides, vegetables such as zucchini, tomato, okra and moringa are produced by market gardeners, and the production of these crops varies to different degrees depending on farming practices.

Nevertheless, lettuce and cabbage are the most extensively grown commodities, contributing 17% and 16% of total crop production. These two crops are grown by nearly 90% of the surveyed growers at the designated locations. 14% comprises potatoes, making them the second-most prevalent crop. Tomatoes and moringa follow at 13% and 12%, respectively. Carrots and okra have the lowest representation, with 10% of the sample for each. Zucchinis comprise 5% of the sample, whereas eggplants account for 3%. Given the limited area of the facilities, agricultural producers choose to cultivate crops with a short life cycle. Multiple production cycles can be attained through the cultivation of short-cycle crops. Adopting sustainable farming practices, such as crop rotation, water management, and agroforestry, helps to improve soil fertility and withstand extreme climatic conditions. In the study areas, farmers utilized inputs consisting of seeds, fertilizers, and plant protection products. Market gardeners understand the dynamic nature of soil fertility, recognizing the necessity of cultivating multiple crops that sustain and enhance their productive capacity (Ruch et al., 2023).

The farmers utilize both organic and conventional fertilizers. All market gardeners exclusively employ organic manure derived from animal dung and domestic waste in the designated study areas. Inorganic fertilizers are commonly utilized, with the nitrogen phosphorus (NPK) components being sourced through contributions from development partners and local merchants. The neo-endogenous approach to MG is centered around the objective of optimizing agricultural productivity through the implementation of ecologically sustainable agriculture and the promotion of local resource use. Farmers also emphasize the significance of water management strategies in this arid region (Baker et al., 2012). Sonam's and Soubéra's smallholders have developed innovative water-saving techniques in MG, such as rainwater harvesting, small-scale irrigation systems, and efficient water use. These practices help farmers use limited water resources effectively, ensuring crop growth even during water scarcity.

The MG practice relies on the small-scale irrigation system. 95% (N = 57) of the market gardeners use running water, defined as water originating from the waterhole and flowing through the minor bed of the waterhole. In comparison, only 5% (N = 3) of the market gardeners use water from wells and boreholes. On the other hand, it makes it abundantly evident that all of the market gardeners located in the vicinity of the waterhole drew their water supply from the exact location. Nevertheless, the Soubéra market gardeners have had advantageous outcomes due to implementing a borehole, a vital resource for conducting their market garden-producing operations. Implementing this borehole has facilitated various local activities, including providing water for livestock and domestic use.

In the rural regions of Niger, the capacity to adapt and assume control of their destinies is reflected in the adoption of new farming strategies and agricultural varieties. Farmers are experimenting with and employing new crops, production techniques, and methods of organizing and marketing production to take advantage of their favorable environment. They demonstrate the capacity of African rural communities to establish innovative value-added strategies (Pritchard et al., 2019). In addition to MG, farmers generate income through other sources, such as rain-fed agriculture, livestock breeding, agri-food processing, or handicrafts, to reduce dependence on a single source of income. The rural community of Sanam is an agro-pastoral community par excellence, where agriculture and livestock breeding are the dominant activities. However, other activities of no less importance exist and contribute to increasing household incomes: trade, handicrafts and women's economic activities. These activities occur in a context marked by an upsurge in extreme phenomena known in the community as recurrent droughts, insecurity, and floods.

Generally, the MG plays a significant role in promoting food security, economic resilience, and social stability in conflict-affected Niger, particularly study area. In the study areas, MG contributes to the local production of fresh vegetables, agricultural job creation, community food security, and local economic stimulation. It also promotes sustainable farming practices and helps reduce dependence on imported vegetables. However, climatic factors, water management and other local considerations must be considered to ensure the success of MG in this region. The development of cash and food crops (CCS) was, therefore, a new necessity to avoid accelerated impoverishment of the area and simultaneously satisfy the increasing needs linked to demographic growth. MG significantly enhances food security in the study area regarding quantity and quality.

From an economic perspective, MG offers smallholders an opportunity to generate income and stabilize their livelihoods amidst conflict and climate-related insecurity. It provides a sustainable source of income and employment for smallholders, reducing their vulnerability to economic shocks. The sale of surplus produce supports farmers' families and contributes to local economic development. The examination of the study data reveals that the lowest amount received by farmers at the two sites under investigation was 35,000 XOF CFA (equivalent to 55.82 USD). In contrast, the highest amount per farmer reached 4,500,000 XOF CFA (756.29 USD). Each farmer received an average of 75,275 XOF CFA (or 126.51 USD).

4.3. Farmers' Access to Markets and Value Chains

Market access and value chain management are essential for market gardeners in Sanam, as in many agricultural regions. Proper access to MG and developing efficient value chains are vital for promoting agricultural output, improving local incomes, and ensuring food security. The local distribution network, training and empowerment, technology and digitization, and access to credit and marketing awareness are critical challenges to improving the study area's value chain and market access. However, local authorities, farmers' organizations, and development actors work together to implement measures and support mechanisms for market gardeners in Sanam and Soubéra to improve market access and value chains. Farmers also collaborate with other value chain actors to access broader markets, enhance the marketing of their produce and obtain fair prices. This enables market gardeners to grow and trade MG crops of diverse varieties and generate income.

Market access for MG is essential for farmers to utilize their resources effectively and contribute to the local economy. Both rural and peri-urban market gardeners rely on local and growing urban markets. This indicates the significance of MG access for small-scale farmers in meeting the growing demand for fresh produce in urban centers. Establishing efficient value chains further enhances the impact of MG access. Value chains encompass various stages, including production, processing, distribution, and marketing, that add value to agricultural products before they reach the end consumers. Enhancing these chains leads to increased farmer income, reduced post-harvest losses, and improved market access. A report by the International Institute of Tropical Agriculture IITA (2018) emphasizes the importance of strengthening value chains to ensure food security and alleviate poverty in Niger. This highlights the potential of value chains in enhancing the overall socio-economic development of the research areas and its surrounding regions.

Access to markets and well-functioning value chains also reduce hunger and malnutrition. The availability of fresh and nutritious produce through MG offers affordable and healthy food options for the local population. MG positively affects value chain improvements, dietary diversity and nutritional outcomes of both growers and consumers (Hantchi et al., 2022). This underlines the crucial role of these factors in tackling food insecurity and promoting a healthy diet among the population in Sanam. Nevertheless, stakeholders must work together to address existing challenges to ensure sustainable MG access and value chains in Sanam and Soubéra. These challenges include limited infrastructure, lack of proper storage facilities, and inadequate access to credit. Strategies such as supporting farmers' cooperatives, investing in infrastructure development, and promoting market information systems are essential for overcoming these obstacles (FAO, 2021). This is due to the paramount importance of MG in boosting agricultural productivity, improving livelihoods, and promoting food security. Through effective implementation of strategies, stakeholders can contribute to the sustainable development of the agricultural sector and improve the overall well-being of the local population.

4.4. The Contribution of Development Actors to Smallholders in Market Gardening

Development actors have played a crucial role in improving smallholders' agricultural practices, enhancing productivity, and facilitating market access. In the context of the MG, development actors play different roles. Firstly, development actors have provided technical assistance and training to smallholders in sustainable farming techniques, crop diversification, and water management. These interventions have helped smallholders in Niger to increase their agricultural productivity and improve their resilience to climate change. Secondly, development actors have facilitated the formation of farmer organizations and cooperatives, promoting collective action and market linkages. These organizations have assisted smallholders in gaining better access to inputs, credit facilities, and information on market opportunities. By providing smallholders with access to improved technologies, market information, and financial services, development actors have contributed to a shift from subsistence farming to market-oriented production.

The International Fund for Agricultural Development (IFAD) is a key actor in the study area. IFAD's projects in Niger, such as the Market Gardening and Small-Scale Irrigation Program (PMPADAI), implemented in collaboration with the Nigerien government, aim to improve the productivity and market access of smallholder farmers. These efforts involve training, technical support, and infrastructure development, enabling smallholders to adopt sustainable farming practices and increase their income. Besides, NGOs like Oxfam have also contributed significantly to developing smallholders in MG. Through their projects, such as the Sustainable Agriculture and Resilience Program, Oxfam has focused on building the resilience of small-scale farmers to climate change and market volatility. Their interventions include training on climate-smart agriculture, promoting sustainable farming techniques, and supporting the formation of farmers' cooperatives to enhance market access and bargaining power.

Moreover, development actors have facilitated the establishment of market infrastructures such as rural marketplaces, collection centers, and storage facilities. These interventions have helped smallholders in Niger to reduce post-harvest losses, enhance product quality, and negotiate

better prices. Development actors have also played a significant role in policy advocacy and creating an enabling environment for smallholders. They have influenced government policies and programs, encouraging greater investment in agricultural research, rural infrastructure, and market development. This has led to improved market access, reduced trade barriers, and the formulation of supportive policies for smallholders. The contribution of development actors to smallholders in MG in Niger has been substantial. These actors have enhanced smallholders' productivity, income, and market participation through technical assistance, farmer organization formation, market facilitation, and policy advocacy. However, continuous efforts are required to ensure sustainable and equitable growth for smallholders in the MG sector in Niger.

4.5. Social Empowerment and Community Development Through Market Gardening Initiatives

MG initiatives in rural areas significantly influence social empowerment and community development. Market gardens provide local communities with direct access to fresh, nutritious produce. They reduce their dependence on external supplies and improve nutrition and food security. In Sanam and Soubéra, local people have preferences and often attach specific symbolic values to the essential foods they consume. The analysis of our interviews with farmers shows that the population appreciates fruit and vegetables because of the consideration they are given (sweets). Regarding job creation and income generation, MG initiatives offer employment and income opportunities to members of the local community, particularly women and young people. They improved their economic situation and strengthened their role in society. Income from MG has become a guarantor of food security when cultivated correctly. It can give growers more than enough income to outperform traditional crops (cereals, cowpeas). The MG is almost exclusively for market-oriented crops.

MG in Sanam and Soubéra (two neighboring villages) enables women to produce actively and market produce. It can significantly impact their economic autonomy, self-esteem and participation in decision-making within the family and community. An illustration in this regard is that young people and women play a significant role in the mutations that are taking place to reduce environmental constraints and food insecurity (Burney et al., 2010). Nevertheless, the recognition they receive needs to be more balanced. Women are heavily involved in soil restoration and MG. Certain crops, such as sesame, perceived as minor and reserved for women, are experiencing substantial expansion thanks to the efforts of female producers to organize. Women's positions have improved in the family, on the farm and in rural areas (Hassane, 2015). Nevertheless, despite the persistence of certain representations and constraints, they continue to suffer discrimination in several areas. Frequently, women are not considered as producers in their own right. The critical tasks they perform in food production are still often perceived as an extension of the domestic activities linked to their status in this locality.

This activity (MG) strengthens the social fabric by promoting cooperation and collaboration within the community. In both villages (Sanam and Soubéra), members work together to plant, cultivate and market produce, thus strengthening social ties and solidarity. Neo-endogenous theory encourages collaboration and cooperation between local players, producers, governments, research institutions and businesses. This collaboration can foster the sharing of knowledge and resources for the sustainable development of MG. The survey results showed the importance of producer collaboration at the sites studied. According to the head of the Sanam women's cooperative, "Producers have learned about production thanks to the support of the various partners and through their willingness to work as a team, sharing knowledge and using similar production techniques."

Furthermore, MG promotes environmental awareness by encouraging sustainable agricultural practices, which can raise environmental awareness within the community and contribute to preserving natural resources. Indeed, it should be remembered that neo-endogenous theory encourages this development approach, which valorizes local skills and resources to stimulate economic growth. In the context of market gardeners, this would mean supporting their training, collaboration, and access to innovation to improve their competitiveness and contribute to the development of their local communities. In short, MG initiatives in rural areas have the potential to positively transform the lives of communities by strengthening their social and economic empowerment and promoting sustainable development on a local scale.

4.6. Smallholders Market Gardening Cooperatives and Mutual Support

MG cooperatives play a crucial role in improving smallholders' economic and social conditions. Cooperative structures enable smallholders to collectively access resources, such as land, water, and seeds, which would be difficult to attain individually (Burney et al., 2010). These cooperatives also facilitate collaborative decision-making, skill-sharing, and knowledge exchange (Abraham et al., 2022). Furthermore, cooperatives can strengthen the bargaining power of smallholders in the market, enabling them to negotiate better prices for their produce.

Mutual support is a key component of MG cooperatives in the study areas. This entails collaborative efforts among community members to enhance agricultural productivity and overcome common challenges (Jelsma et al., 2017). For instance, farmers within a cooperative can pool their resources to purchase irrigation equipment or secure credit collectively. This mutual support fosters resilience among smallholders, as they are better equipped to cope with the uncertainties of climate change and market fluctuations. Additionally, establishing cooperative savings and credit schemes helps members allocate resources effectively and invest in sustainable farming practices. MG cooperatives serve as platforms for community-led learning and knowledge exchange. Members benefit from shared learning experiences, such as training on sustainable farming techniques or marketing strategies (Marchesi & Tweed, 2021). This knowledge exchange empowers smallholders to adopt innovative practices, which can improve agricultural productivity and diversify income sources. Moreover, cooperative platforms provide opportunities for farmers to participate in decision-making processes and shape the development of their communities.

One remarkable example of a successful MG cooperative in the Sanam study area is the Sanam Cooperative of Women Farmers (SCWF). The SCWF has significantly improved the livelihoods of its members through collective marketing, skill development workshops, and microlending initiatives (Abraham et al., 2022). This cooperative allows female smallholders to overcome gender-based constraints and gain economic independence. The SCWF has been able to tap into local and regional markets, increasing its members' income and market share. The success of SCWF demonstrates the transformative potential of MG cooperatives and mutual support. MG cooperatives and mutual support are vital for smallholders in our case areas to enhance their resilience and livelihoods. Farmers can access resources, exchange knowledge, and increase their bargaining power by working collectively. The success of the SCWF exemplifies the positive impacts that can be achieved through cooperative initiatives. Therefore, it is crucial to foster an enabling environment that supports the establishment and growth of MG cooperatives, with a focus on mutual support and community-led learning.

5. Conclusions and Policy Implications

5.1. Conclusions

This paper has explored the role of MG as one of the viable approaches to securing agro-pastoral systems and rural livelihoods in Niger. Empowering smallholders and building on inherent resilience enables communities to address interwoven challenges and achieve sustainable development. The neo-endogenous approach recognizes the inherent knowledge, resources, and capabilities of smallholders in Niger. Instead of relying solely on external interventions and solutions, it leverages local assets and expertise to drive change. Through MG, smallholders can tap into their traditional agricultural practices, adapt them to modern challenges, and create innovative solutions that strengthen agricultural productivity and rural livelihoods.

The study findings revealed that MG has played a vital role in securing agro-pastoral systems and rural livelihoods in Niger. Through cultivating horticultural crops, smallholders have demonstrated their resilience in the face of interwoven challenges, such as climate change, political unrest, limited access to resources such as inputs and technologies, and market limitations. For instance, the study shows that MG is an adaptive response to climate change. Niger, a region highly vulnerable to the impacts of climate change, has witnessed erratic rainfall patterns, prolonged droughts, and increased temperature variability. In such a context, market gardening has emerged as a viable option for smallholders to mitigate climate-related risks. Innovative agricultural techniques, such as rainwater harvesting and efficient irrigation methods, have enabled smallholders to sustain agricultural production despite water scarcity. By diversifying crops through MG, smallholders have also reduced dependency on rainfall and improved resilience to climate uncertainties.

Furthermore, the research has underscored the significance of market gardening in addressing the limited access to resources smallholders face in rural Niger. Access to land, finance, and inputs, such as quality seeds and fertilizers, has historically challenged smallholders. However, MG has allowed smallholders to utilize micro plots of land effectively, making it possible to intensify their agricultural production, complementing the lack of large-scale production bases such as capital and modern technologies. Smallholders have overcome financial constraints through collective action and cooperation by pooling resources and accessing credit facilities. Collective actions and cooperation have improved agricultural productivity and empowered farmers to negotiate better prices and market produce effectively. The research sheds light on the role of MG in alleviating market limitations smallholders face. In rural Niger, smallholders often struggle with inadequate market infrastructure, limited market access, and price volatility. However, MG has enabled smallholders to establish direct linkages with wholesalers, retailers, and direct consumers, bypassing intermediaries and gaining better control over market transactions. Smallholders have developed collective marketing strategies by organizing themselves into producer groups and cooperatives, allowing

them to negotiate fair prices and access higher-value markets. This has not only improved their income generation but has also enhanced their market power and reduced their vulnerability to price fluctuations.

5.2. Policy Implications

While MG has demonstrated its potential to enhance the resilience of smallholders, there are still areas for improvement and intervention. Firstly, access to resources remains a critical issue. Smallholders require improved access to land, water, finance, and inputs to optimize agricultural production further. This necessitates targeted government interventions, such as land reform policies, investment in irrigation infrastructure, and credit facilities tailored to the needs of smallholders. Additionally, smallholders would benefit from training and capacity-building programs that focus on sustainable agricultural practices, resource management, and entrepreneurship. Secondly, market integration and value addition need to be strengthened. Smallholders would benefit from increased market linkages with processors, exporters, and agribusinesses, providing them with opportunities for value addition and access to higher-value markets. This requires investment in market infrastructure and establishing value chain alliances that promote fair trade practices and support smallholder inclusion. Furthermore, research and development efforts should focus on developing appropriate technologies and techniques that improve MG produce's post-harvest handling, storage, and processing.

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