Innovations

Livelihood Security Status of Uncertified Organic Vegetable Farmers in Delta State: A Comparative Control Analysis

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Abstract : *Uncertified organic farming has become rampart among farmers in an attempt to practice sustainable farming as a means of livelihood in Delta State. This study examined the livelihood security status of uncertified organic vegetable farmers as a possible conversion to certified organic farmers in the study area. Purposive and cluster sampling techniques were adopted to select 163 uncertified organic farmers, UOF (treatment units) and 275 conventional farmers, CF (control unit). Data obtained from questionnaire was summarized with descriptive statistic such as frequency count, percentage and mean; while Composite Index Model (CIM) was used for analysis. The results show that the natural capital index which stood for biodiversity, deforestation, soil pollution and vegetation cover for UOF (NSI = 0.5501, SD = 1.1299) was higher than that of CF (NSI = 0.4631, SD = 0.9953). The Social Capital index which monitors farm labour, social network resources, empowerment and trust stood above 0.5 for UOF (SCI = 0.5507, SD = 1.0900) and CF (SCI = 0.5282, SD = 1.0813). The Human Capital index which qualify the contributions of skill, soil management, land management, water management, education and health was higher for UOF (HCI = 1.15) than for CF (HCI = 0.4565, SD = 1.0769). The sustainable livelihood index which cater for NSI, SCI, HCI, FCI and PSI of UOF (SLI= 0.5351, SD =1.1096) was more sustainable than that of CF (SLI= 0.5032, SD=1.0858). Hence, Potential interventions include government and private-public partnership on conversion and infrastructural development targeted at UOF.*

Keywords*: Uncertified, Organic farmers, Livelihood, Security status, Index, Conventional*

Introduction

As we learn more about the long-term impacts of convention farming practices, the appeal of organic farming, whether certified or not, continues to grow. With a focus on ecological sustainability and reliance on natural systems, non-certified organic farming is becoming the preferred choice for those who want to promote healthy agriculture and protect the environment without having official certification for future generations (Hamilton, 2019; Clark, 2019). In developing countries where smallholder farmers make up the majority of the agricultural population, convention farming systems cannot meet the real needs of resource-poor farmers due to the need for expensive synthetic inputs, but organic farming can provide them with low-cost solutions (Akinwumi and Adepoju, 2019).

Non-certified organic farming refers to the practice of growing crops and livestock using organic methods without official organic certification. This involves adopting organic practices but not complying with specific organic standards established by certification organizations (Nieto-Romero et al., 2018; M'bayo et al., 2020). Non-certified organic farming represents a commitment to organic principles and practices without the formal recognition of certification. While this may pose some challenges, it can still appeal to consumers looking for locally produced, organic food that supports small-scale, sustainable farming operations. (Meryem et al., 2021; Barber et al., 2019; Cedar et al., 2018).

In (Meena and Meena, 2021; Bunchy-Murphy, 2020), it is clear that organic farming is not limited to certified organic farms and products but also includes non-certified organic farming. These are all efficient agricultural systems that use sustainable, natural processes instead of external inputs to improve agricultural productivity. For organic farming to be accepted and popular among farmers in Nigeria, it must be feasible, efficient (Muller et al., 2017), and profitable (Senfert and Ramankuffy, 2017; Meemken and Qaim, 2018).

In Nigeria, various approaches have been adopted by farmers to achieve sustainable livelihood security. Non-certified organic farming as a livelihood option assesses the economic and agronomic impact on a large number of smallholder farmers. For example, in sub-Saharan Africa (SSA), non-certified organic farming livelihood projects are often established to produce safe and healthy food for local markets, while third-party certified organic livelihoods are primarily aimed at local markets exporting to North America or Europe (Reganold and Wacher, 2016; Thanes and Blackman, 2016).

The World Bank (2018) defines livelihood security as the ability of individuals or households to have reliable and sustainable access to basic needs and services such as food, drinking water, shelter, health care, and education and income opportunities. This includes all economic, social, environmental and institutional factors that contribute to a person's life and general well-being. Securing the livelihood of an individual or group depends on a variety of factors such as education level, skills, access to resources, social networks, and above all economic and social environment. Individuals who benefit from livelihoods have a better quality of life, have access to diverse economic opportunities, and are better able to cope with economic shocks and stresses such as unemployment and natural disasters (UNDP, 2020 ; Rajan et al., 2019; Islam et al., 2021).

Measuring livelihood security involves assessing the extent to which an individual or household's basic needs, such as food, shelter, health, water, and sanitation, are met. This includes measuring access to economic opportunities, financial resources and social networks that support resilience and adaptation during stress and crisis. By monitoring and understanding the livelihoods situation, policymakers, governments and international organizations can improve people's lives and help the most vulnerable build a more secure and sustainable future. In this regard, interventions and investments can be prioritized.

The growth of organic agriculture in developing countries is mainly due to the transformation of existing convention agriculture, and the Nigerian concept is no exception in this application. Therefore, further insight into uncertified organic farming practices is needed to fully understand the potential of switching to organic farming as a livelihood option for smallholder farmers. Based on the information collected about organic farming, research recommendations from the Agricultural Knowledge Information System (AKIS) were generated. Several discoveries made have created a need for vegetable growers to bridge the gap between pre-organic and organic production in the production process. The presence of vegetable gardens, plantations, and orchards indicates that the country has a sufficient supply of annual and perennial crops that can withstand the transition to organic agriculture (Onwulezi and Obi, 2020; Tyagi and Tiwari, 2020; Sa and Roumagnac, 2019).

Organic agriculture in Nigeria, unlike other countries in Africa, has not yet been able to develop its hidden qualities, although the country once had its status as an agricultural nation and has proven that the country is a leading global manufacturer in the production of several crops (Aborisade and Awoyemi, 2020). The Nigerian government in its effort to promote sustainable agriculture has not introduced any policies to protect organic farming. They may have some plans, but these plans have not been translated into working documents to develop policies that organic farmers can follow to make safe and sustainable investments in the agricultural sector's organic matter. This delay is attributed to the lack of convincing evidence or data that could motivate the government to develop the necessary policy to make organic farming practices a success in Nigeria.

Therefore, the strength of this study is to provide supporting evidence by comparing the livelihood security status of non-certified organic farming with conventional farming. This research helps investigate factors affecting livelihood security and explore potential interventions or support systems for the target group. To this end, this study sought to analyze the possibility of converting to organic farms using non-certified organic gardeners in Delta State. In the authors' view, no work has been done to analyze the livelihood security situation of uncertified organic vegetable farmers in Delta State using comparative control analysis.

3.0 Methodology

3.1 Research area

The study was conducted in Delta State. The state is one of the 36 states that make up Nigeria. It is geographically located at Latitude 5.8775° North and 5.5344° East. The territory is one of the most populous in Nigeria, with about 198 people per square kilometer, compared to average of 130 for Nigeria (NPC, 2006). The consequence of this population density is a shortage of agricultural land. The people are mainly farmers who grow food crops such as yams, cassava, and vegetables.

3.2 Sampling Techniques

A multi-stage sampling technique was used to select farmers to participate in the study. The first phase involved the purposive selection of towns such as Asaba, Ughelli, Agbor, Sapele, Ozoro, and Abraka. They were selected based on towns that mainly grow vegetables such as pumpkin leaves, water leaves, pepper, okra, etc. Urban market-oriented vegetable production is mainly carried out along perennial water sources and deltas. The second stage involved the use of cluster sampling techniques to select vegetable growers in the selected towns in Delta State. Uncertified organic farmers (UOF) were 204 farmers, while conventional farmers (CF) had a sample frame of 350 farmers. The choice of un-certified organic vegetable producers for the study corroborates Fuentes et al. (2018) that it is the path to converting to organic farming due to their knowledge, experience, reduction risk mitigation, financial flexibility and commitment to chemical-free agriculture. These farmers provide a solid foundation for a smoother and more successful transition to organic practices. Additionally, this choice was based on fact that the procedures for both types of farm practices are the same. The third stage, which includes sample size selection applied Cochron (1977) to estimate the sample size of uncertified organic farmers and convention farmers for the study. Several authors (Chow et al., 2017; Maltrude et al., 2016) have confirmed its popularity and general acceptance in determining sample size.

$$n = \frac{n_o}{1+\frac{(n_o-1)}{N}}. \text{ ....Eqn1}$$

$$n_o = \frac{Z^2pq}{e^2} \text{.................... Equation 2}$$

Where

N represents the sampling frame (including 350 UOF and 204 CF),

n represents the sampling size with a finite population.

n_0 is the sample size for an infinite population.

Z is the critical value (1.96) of the required 95% confidence level.

P is the specified proportion in the population (0.50), assuming maximum variability.

q = 1 - p, and

e is the desired level of accuracy (5%).

The formula was applied to estimate the sample size of farmers, for UOF (treatment sample) and conventional farmers (control unit). To ensure equal opportunity for each farmer to be included in the sample size selection, the proportional sampling (PPS) technique was used (Stellmacter et al, 2018). A total of 163 uncertified organic farmers (treatment units) representing 37% were selected, while 275 conventional farmers (control units) representing 63% were selected. Taking into account the larger size of the control sample, sufficient pre-displacement characteristics were intended to allow comparison of the two groups.

For this study, questionnaire was the main source of information. The questionnaire was divided into two parts: socio-economic characteristics of the respondents and livelihood security status.

Livelihood security status was determined using four Likert options (strongly agree, agree, disagree, and strongly disagree). The test's reliability has a criterion value or Cronbach alpha of 0.89. Five sources of livelihood capital (natural, social, human, financial, and physical) and 27 sub-indicators were taken into account.

Sustainable livelihood index(SLI) is a calculating mechanism which allows people to evaluate and measure the differing level of livelihood security (Hickey and Mohan 2019).Through measuring and examining these indicators, SLI gives an all-encompassing insight into the livelihood conditions and security status of a specific demographic group or region. Moreover, SLI allows comparing various groups or regions and monitoring changes in livelihood security within time

Once each index representing a specific livelihood security sector is standardized, a household livelihood security index related to that specific sector will be constructed by averaging the standard index according to the formulas below:

SLSIijk = $\frac{X_{IJK} - Min\ X_{IJK}}{Max\ X_{IJK} - Min\ X_{IJK}}$…(2.0) -- for indicators with a positive implication on SLS

SLSIijk= $\frac{Max\ X_{IJK} - X_{IJK}}{Max\ X_{IJK} - Min\ X_{IJK}}$…(3.0)- for indicators with a negative implication on SLS

Due attention was directed to earned income for the year 2022 from farm activities of both farm practices. For summary of results, descriptive statistics such as mean, percentage and frequency count were used. Inferential statistics such as the composite index model (CIM) was used to analyze the data. A statistical package such as Microsoft Excel spreadsheets and IBM SPSS version 21 was employed.

4 Result and Discussion

4.1 Socio-economic Characteristics of Farmers

The results in Table 1.0 show that most vegetable growers in the study area are involved in the production of pumpkins and green water leafy vegetables, represented by 53.4% of the farmers grouped together. This ratio largely explains the large domestic production of pumpkins and water leaves, in contrast to imported tomatoes and chili peppers from the northern regions of Nigeria. Still, according to Table 1.0, the majority (63.9%) of respondents were women, while 36.1% were men. This shows that women are more involved in vegetable growing in the agro-ecological zones. This result contradicts the assertion of Atoma et al., (2023) that men are more involved in farming in the region because socio-cultural benefits such as land rights and institutional support services such as agricultural extension, credit, etc. are skewed towards men. Thus encourage more men to work in agriculture than women.

According to the analysis on respondents' ages in the results, more than 75% of farmers are older than the youth age group (18–35 years old). The average age of farmers was 46 years, which is larger than the age gap among young people. This age dichotomy clearly explains why in the study area, fewer young people are involved in agriculture than older people; which are indicative to low agricultural output. These results which support Adaigho et al. (2023), suggests the movement of young workers from rural to urban areas thereby contributing to increased age gap involvement in agriculture. Young people seemed dissatisfied with farming and prefer to pursue white-collar jobs in cities where social amenities are easily accessible. Employing youths at competitive farms established by the government in rural areas, where they are paid well compared to what urban occupations or other government organizations can offer, can limit the migration of rural residents to seek white-collar jobs in urban areas.

The results of the table further suggest that farm size can be an important factor in agricultural decision-making. The average farm size in the area is less than 1 hectare (0.099 ha). On the contrary, large scale of farms may lead to increased adoption of innovations or improved practices. This can also determine the level of commitment to the farm business, investments, and operational status. The farm size is indicative of the type of farm enterprise that is practiced, whether cash crop or food crop production. The results also showed that CF farmers had higher annual income from farm on average of ₦642, 780 compared to UOF (₦576, 012). This amounts to N1, 785 per day for CF and N1, 600 per day for UOF. With the stable market rate of the dollar, UOF cannot meet the international poverty line of $2.15 per day (about N1,654 per day), unlike what the World Bank-approved. This means that people living below this income level are considered to be living in extreme poverty. But ACS et al. (2007 argue that with UOF's optimal use of resources, their income can be higher than that of CF. Therefore, farmers should learn best practices that encourage low input costs to optimize resources for organic farming.

	Pooled Frequency	**Pooled Percentage (%)**	**Uncertified Organic Farmers (UOF) Mean/ Mode/ (percentage%)**	**Convectional Farmers (CF) Mean/Mode/percentage%)**	**Pooled Mean/*Mode***
Crop Enterprise					*Pumpkin/water leaf*
Okro	142	32.4	46(28.2)	96(21.9)	
Tomato/pepper	62	14.2	25(15.3)	37(0.08)	
Pumpkin/ Water leaf	234	53.4	92(56.4)	142(32.4)	
Gender					Female
Male	158	36.1	53(32.5)	105(38.2)	
Female	280	63.9	110(67.5)	170(61.8)	
Age (years)					45.70
≤30	04	0.92	8(4.9)	34(12.4)	
31–40	95	21.79	39(23.9)	65(23.64)	
41-50	212	48.62	68(41.7)	88(32.0)	
>50	125	28.67	49(30.1)	78(2)	
Marital Status					*Married*
Married	327	72.8	111(68.1)	185(67.3)	
Others	121	27.2	52(31.9)	90(33.5)	
Years in School (Years)					Primary
0	03	0.7	-	03(1.1)	
1–6	149	34.0	97(22.2)	50(18.2)	
7–12	231	52.7	58(13.2)	175(63.6)	
>12	55	12.6	8(13.2)	47(17.1)	
Farm size (Hectares)					0.99
0.5-1.0	281	64.2	135(82.8)	146(53.1)	
1.01-1.5	113	25.8	27(16.6)	83(30.2)	
1.51-2.0	36	8.2	1(0.6)	35(12.7)	
>2.0	8	1.8		8(2.9)	
Annual Farm income					
0-200,000	4	0.91	₦576,012	₦642,780	₦609,396

201,000–400,000	23	5.25			
401,000–600,000	197	44.98			
601,000-800,000	181	41.32			
801,000-1,000,000	38	8.68			

Table 1.0: Socioeconomic Characteristics of Respondents
Source: Survey Data, 2022

4.2 Livelihood Capital of Displaced Farmers

4.2.1Natural Capital

The results in Table 2.0 show the security indexes (SI) of the two types of agricultural practices with respect to biodiversity, deforestation, soil pollution, and vegetation cover. Regarding biodiversity, the security index of uncertified organic farmers, UOF (SI=0.5603, SD=1.1039), is higher than the security index of CF (SI=0.4274, SD=1.1028). This implies that there are more weeds around organic farms compared to convection farms, which support many wild plant species that benefit wildlife, such as bees and birds. In fact, several studies (Holt et al., 2019; Chen et al., 2019; Bommarco et al., 2020; Thomsen et al., 2021) have shown that organic farms Soil biodiversity in plants and animals is greater than in conventional farms. Many crops depend on pollinators such as bees, birds, and butterflies to reproduce successfully. A diverse range of crops can provide greater stability and adaptability to changing conditions, improving the ability of farms to withstand climate-related challenges. High biodiversity creates a more sustainable, resilient, and balanced ecosystem around the farm. This report also supports (Zhang et al. 2018; Montero et al. 2019) meta-analysis results, showing that organic farms have higher spatial richness and organic matter content than conventional farms..Contrary to views, Kotspoulos and Kotsampasi (2019) found that convention vegetable growing also implements sustainable practices, minimizing negative environmental impacts while meeting demand. But Maltina and Franc's (2015) meta-analysis found that in 56 studies (14%), there were no verified differences between the two forms of agriculture, and organic farming in another 13 contributions (3%) produces less biodiversity than convection farming. In improving biodiversity around farms with low biodiversity; it is advised to regularly monitor and evaluate the effectiveness of measures to improve biodiversity. This will determine what works best for a particular farm, make adjustments where necessary, and share lessons learned with others to improve biodiversity conservation efforts.

Results on soil pollution of natural capital shows that the security index of UOF (SI = 0.5583, SD = I.II05) is higher than that of CF (SI = 0.4969, SD = 1.0266). The results imply that the risk of soil contamination is reduced, chemical contamination is minimal, or soil degradation is avoided in UOF compared to CF. Therefore, UOF is a more sustainable option for food production. Not using pesticides, fertilizers, or wider crop varieties improves biodiversity, leading to richer soil quality. As argued by (Li et al., 2018; Wale and Kpangban , 2019), farms with a higher soil pollution security index will prioritize sustainable and environmentally friendly activities, create healthier soil, reduce the risk of pollution, and improve overall environmental sustainability.

Table 2.0: Results of security index (SI) of variables influencing natural capital

Natural Capital	Abbreviation	Uncertified Organic Farmers (UOF)		Convectional Farmers (CF)	
		SI	SD	SI	SD
Biodiversity	BD	0.5603	1.1397	0.4274	0.8598
Deforestation	DF	0.5593	1.1276	0.4663	1.0195
Soil Pollution	SP	0.5583	1.1266	0.4965	1.1105
Vegetation cover	VC	0.5226	1.1097	0.4622	1.0132
Nat. capital index	**NCI**	**0.5501**	**1.1259**	**0.4631**	**1.0008**

Computed from data survey, 2022

4.2 Social Capital

The results of social capital research in Table 3.0 shows that farm labour with security indexes of UOF (SI=0.4849, SD= 1.0617) and CF (0.4826, SI=1.0612) are relatively close to each other. This implies that for market gardening, both types of agricultural practices are labor-intensive, as indicated by a security index above 0.5. Krause and Machek (2018) argued that both forms of agriculture rely on the mechanical growing of vegetables, as opposed to the conventional chemical protection applied to convection farming. Benita and Barbier's (2018) study of market gardening found no significant differences in labor. This is due to the intensive and inherent nature of labor in vegetable production, which both forms of agricultural practices have in common. Naglova and Nasicova (2016) found that high labor costs in organic farming are due to the high proportion of unpaid family labor. Agricultural cooperative models such as cooperative societies or collective farming can help exploit resources and labor, facilitate cost sharing, and promote economies of scale. This approach can help reduce individual labor costs and improve overall profits.

High labor costs have also encouraged women to network, as shown in Table 3.0, with security indices higher in UOF (SI = 0.6626, SD = 1.0122) than in CF (SI = 0.4928, SD = 1.0324), as they took turns responding to labor demands on each other's farms. Strategies that can help ameliorate high labor demands include efficient labor use (crop rotation and cover crops), farm management practices (crop diversification, crop thinning, and natural pest control methods), cooperative agriculture, training, and education. This requires a comprehensive approach that includes adopting new practices (being open to technological advances) and improving continuous learning. World Bank (2019) has advocated that African leaders should empower women farmers by improving their access to hired labour.

The Social Capital Index (SCI), which tracks agricultural labor, social network resources, empowerment, and trust, is above 0.5 for UOF (SCI = 0.5507; SD = 1.0900) and for CF (SI = 0.5282; SD = 1.0813). Since SCI is greater than 0.5, this implies that there is a relatively high level of social capital in the study area for vegetable crops farmers(UOF and CF). Social capital refers to the connections, trust, and shared values that exist within social networks and communities. A high social capital index indicates that they have a high sense of social cohesion and trust, which can lead to increased opportunities for cooperation, collaboration, and collective action to improve the sustainability of agricultural productivity. Similarly, Poudel et al. (2021) conducted a case study and found that social capital measured by social interaction and trust among community members has a positive impact on collaborative efforts to achieve sustainable agricultural productivity. The study also revealed cooperative efforts such as joint farming and collective marketing, better access to resources, and reduced production costs.

Table 3.0: Results of security index (SI) of variables influencing Social capital

Social Capital	Abbreviation	Uncertified Organic Farmers (UOF)		Convectional Farmers(CF)	
		SI	SD	SI	SD
Farm labour	FL	0.4849	1.0617	0.4826	1.0612
Network with marketer	NWM	0.4622	1.0503	0.6585	1.1276
Network with transporter	NWT	0.5930	1.1178	0.4786	1.0632
Network with women association	NWA	0.6626	1.1324	0.4928	1.0733
Social Capital Index	**SCI**	**0.5507**	**1.0900**	**0.5282**	**1.0813**

Computed from data survey 2022

4.3Human Capital

Results in Table 4.0 show that UOF (SI = 0.5335, SD =1.1007) requires more comprehensive skills than CF (SI =0.4274, SI =1.1187) in management, analytical and critical thinking to access and monitor the quality of their crops or land, and problem solving. Uncertified organic farmers (UOF) may have to spend more time and effort on various cultivation practices, such as manual weed control, intercropping, and crop diversification. This requires expertise and skill to manage these practices effectively. But Fraley (2019) is of the opinion that conventional farming requires more skill as it also involves complex scientific principle understanding and biotechnology use.

It is important to note that skill levels in both organic and conventional farming can vary greatly based on individual farmers experience, agricultural education, and access to resources.In Ray et al. (2019), suggest that the impact of climate change on agriculture is a natural occurrence that can undermine individual skills. Likewise, according to Hoffman et al. (2019), precision agriculture technologies such as drones, remote sensing and GPS-based systems have the potential to improve crop yields and reduce the need for manual intervention in land and soil management. These different perspectives do not negate the importance of skills, just as the opinions of most researchers and experts support the idea that land, soil, and water resource management skills remain very important for sustainable and effective agriculture.

Land, water, and soil management security indices for UOF (SI = 0.5315, SD = 1.0996; SI = 0.5663, SD = 1.02760; SI = 0.5653, SD = 1.0276) were higher than the security indices for CF (SI =0.4274, SD = 1.1870; SI = 0.4294, SD = 1.0984; SI = 0.4622, SD = 1.0203), respectively. This implies that uncertified organic farmers are more equipped with relevant knowledge and skills in these areas as to maintaining healthy land and water resources than conventional farmers. This information is essential for the sustainable and effective management of precious resources and their preservation for future generations. These resources can be can be improved by providing education, research and innovation, policy support, and market incentives to the farmers.

The research results further show that UOFs have a lower educational level (SI = 0.4990, SD = 1.1187) than CFs (SI = 0.5200, SD = 1.0326). This result supports Kucinska, Golba, and Pelc's (2009) claim that CF has a higher level of education than UOF. But (Jensen 2019; Hanisch, 2020) are of the opinion that organic farmers requires more education than conventional farmers as it involves sustainable practices. A number of steps can be taken to improve education, including accessing information about government guidelines, research finding, best practices, providing technical assistance, networking, and providing support.

The results in Table 4.0 also show that health prevention measures are better implemented by UOF (0.5873) than CF (0.4734) practices. In Benbrook (2018) evaluation, the sustainability of conventional and organic farming methods based on 35 years of testing, found that organic farming systems can be more sustainable in terms of soil health, pesticide use, and energy efficiency. Tran et al. (2018) conducted a systematic review and meta-analysis and found that organic farming practices may have a positive impact on diet-related health outcomes, such as increased consumption, absorbent of antioxidants and reduced risk of obesity and allergic diseases. Also, Curl et al. (2019) found that choosing organic foods may reduce pesticide exposure because pesticide residues were detected less frequently in the urine of people who ate more organic foods. In contrast to all these views, Smith-Spangler et al. (2012) systematic review, examined studies comparing the safety and health impacts of organic and conventional foods. The analysis found no consistent evidence that organic foods are safer or more nutritious than conventionally produced foods. These results raise questions about the justification for high prices for organic products based on their health benefits.

The Human Capital Index (HCI) in Table 4.0 for UOF (HCI = 0.5471; SD = 1.1520) was higher than for CF (SI = 0.4566; SD = 1.0769), and greater than 0.5. This implies that market gardeners in the study area for UOF have relatively high levels of human capital compared to CF.HCI for UOF can quantify the contribution of skills, land management, soil management, education, and water management to agricultural productivity and socio-economic development. Uncertified organic farmers HCI points out that market gardeners in the study area have unlimited access to education. Through government intervention in providing education and training programs to farmers and extension agencies, this can help improve their technical know-how (management practices and increased efficiency) in organic farming.

Table 4.0: Results of Security index (SI) of variables contributing to human capital

Human capital	Abbreviation	Uncertified Organic Farmers (UOF)		Convectional Farmers(CF)	
		SI	SD	SI	SD
Skill		0.5335	1.1007	0.4274	1.1028
Land management		0.5663	1.0276	0.4294	1.0484
Water management		0.5315	1.1870	0.4272	1.0496
Soil management		0.5653	1.2376	0.4622	1.0903
Education		0.4990	1.1187	0.5200	1.1026
Health		0.5873	1.2403	0.4734	1.0678
Human Capital Index		**0.5471**	**1.1520**	**0.4566**	**1.0769**

Computed from data survey 2022

4.4Financial Capital

The Table 4.0 shows that the security index of income for UOFs (SI = 0.4315, SD = 1.0439) is lower and less sustainable than that of CFs (SI = 0.6033, SD = 1.1683). In ACS et al. (2007), based on the calculated optimal resource use, variables such as organic farm labor and organic matter consumption were higher, while fertilizer purchases were lower compared to a regular farm. Fixed and variable costs of organic production are slightly higher than in convection agriculture. On the other hand, Binta and Barbier (2015) found that organic production costs were lower, even though there was no bonus for them. Since biological productivity is lower than convective productivity, it is likely that lower UOF income will be higher than CF income even in the absence of higher prices for its products, due to optimal resource use. The higher net profits observed in organic businesses are mainly due to lower production costs, which is not supported by the results of this study. They can achieve higher yields with better seeds, organic fertilizers, and technical support. As an improvement, it is recommended to completely switch from non-certified organic farming to certified organic farming to take advantage of higher prices. This opinion supports Banerjee et al.'s (2017) emphasis that switching to organic production may be more beneficial for small-scale farmers in developing countries.

The financial capital index (FCI) was above 0.5 for CF (FCI=0.5645; SD= (1.1191) and less for UOF (0.4845, SI= 1.0697); implying a relatively sustainable level of agricultural income, savings, access to credit, and non-farm income for convention farmers in the study area.
A financial security index below 0.5, as in the case of UOF, indicates that farmers in the study area have limited access to financial resources, which can cause a series of negative effects. These negative impacts can include lack of investment, low levels of financial inclusion and exclusion, high levels of poverty and inequality, and more. According to Kumar and Singh (2019), many small farmers have difficulty marketing their products effectively and may not be able to reach buyers willing to pay a fair price. Providing marketing training and connecting farmers with buyers interested in purchasing organic products can help increase their income and improve their financial stability. More also, becoming certified organic can be a lengthy and expensive process. Providing support to farmers interested in organic certification can help them access higher value-added markets and increase their income.

Table 5.0: Security index (SI) of variables influencing financial capital

Financial capital	Abbreviation	Uncertified Organic Farmers (UOF)		Convectional Farmers(CF)	
		SI	SD	SI	SD
Farm income	FI	0.4315	1.0939	0.6033	1.1683
Savings	SAV	0.4622	1.0203	0.5663	1.1118

Thrift	THR	0.4616	1.0201	0.5673	1.1075
Non-farm income	NFI	0.5673	1.1103	0.5261	1.1026
Credit	CR	0.4997	1.1040	0.5597	1.1052
Financial Capital Index	**FCI**	**0.4845**	**1.0697**	**0.5645**	**1.1191**

Computed from data survey 2022

4.5Physical Capital

The results in Table 5.0 reveal that the security index for use of agricultural machinery by UOF (SI = 0.4325, SD = 1.1063) was less than that of CF (SI = 0.6264, SD = 0.0538). This implies that agricultural machinery is less employed in organic farming than in conventional farming for fear of damage to plants and soil. Numerous authors (Fagerstrom et al. 2018; Lai, 2018; Berti et al., 2020, Zikeli, 2021 etc) are of the view that agricultural machinery can be used in organic farming, but it needs to be carefully selected and operated in a way that minimizes its negative impact on the environment and soil. Natasha (2020) opined that organic farms that provide large-scale crop production will still need equipment to realistically profit from the large average.

Other variables, like market access to produce for UOF (SI = 0.4669, SD = 1.1063), were less than those of CF (SI = 0.5685, SD = 1.1107). This implies that UOF products are subject to market access restrictions compared to CF products. But the view of authors like Raynolds and Tomaselli, (2019)Willer and Lemoud (2020); and Diemer et al., (2019) supports organic farming as having a better market access. In Mainardi (2020), the author found that market access constraints faced by non-certified organic products include limited financing opportunities, high transaction costs, and a lack of institutional support. These barriers can prevent the expansion of organic agriculture and hinder the development of a viable organic supply chain. Potential interventions include targeted government policies, improved infrastructure and certification systems, and increased consumer awareness, which could help overcome barriers. There is also a need to strengthen collaboration between small farmers and other stakeholders to overcome market barriers and build more sustainable food systems.

The Physical capital index (PCI) was above 0.5 for UOF (0.5245) and CF (0.5054). This implies that both UOFs and CFs have good access to physical assets such as land, equipment, infrastructure, and other resources needed for agricultural production. As a result, they may face fewer difficulties in improving crop yields, increasing production capacity, and generating income that has a positive impact on the sustainability of their livelihoods and overall well-being. This may also indicate that investment opportunities in agricultural infrastructure and services could promote the development of the agricultural sector in the region.

Table 6.0: Security index (SI) of variables influencing Physical capital

Variable	Abbrev.	Non-certified Organic Farm UOF		Convectional Farmers CF	
		SI	SD	SI	SD
Agricultural machinery	AG-M	0.4335	1.1033	0.6264	1.2535
Market access	MA	0.4669	1.1066	0.5685	1.1107
Dietary diversity	DD	0.5817	1.1207	0.4629	1.1061
Physical Capital Index	**PCI**	**0.4940**	**1.1102**	**0.5526**	**1.1568**

Computed from data survey, 2022

4.6Sustainable livelihood Security Index

The results on Tables 2.00 --5.00 show the livelihood capital index for the natural, social, human, physical, and financial sectors for UOF and CF. For UOF, Natural capital (NCI =0.5021, SD =1.1259); Social capital (0.5998, SD= 1.0900); Human capital (HCI=0.5471, SD =1.1520); Financial capital (FCI= 0.4845, SD =1.0697), and Physical capital (PCI = 0.4940, SD =1.1102). For CF, NCI (0.4631, SD=0.9953), SCI (0.4791, SD=1.0813), HCI (0.4566, SD=1.0769), FCI (0.5645, SD=1.1191), and PCI (0.5526, SD=1.1568). (See Fig 1.0 showing the representation of the various livelihood capitals of UOF and CF).

The average livelihood capital share of all the indexes represents the farmers' Sustainable Livelihood Security Index (SLSI). Since the SLSI of UOF (0.5351, SD=1.1096) and CF (0.5032, SD=1.0858) are greater than 0.5, it indicates a high level of livelihood security and that vegetable farmers are not vulnerable to economic, social, and environmental shocks. The sustainable livelihood index in both cases implies that the vegetable farmers have considerable access and control over the several forms of capital. A value greater than 0.5, indicates a relatively favorable and heterogeneous resource base that can positively affect the sustainability of livelihoods and resilience. This means farmers can access basic needs such as food, clean water, housing, education, and healthcare, which can lead to better health outcomes and increased productivity. This can translate into high labor capacity and have a positive impact on the country's economic growth prospects. It also suggests that the farmers have the opportunity to generate secure and sustainable income, which can lead to long-term wealth and better living conditions.

Table 6.0: Results of livelihood capitals that constitute SLSI

Livelihood capital	Abbrev.	Non-certified Organic Farm UOF		Convectional Farmers CF	
		SI	SD	SI	SD
Natural capital index	NCI	0.5501	1.1259	0.4631	0.9953
Social capital index	SCI	0.5998	1.0900	0.4791	1.0813
Human capital index	HCI	0.5471	1.1520	0.4566	1.0769
Financial capital index	FCI	0.4845	1.0697	0.5645	1.1191
Physical capital index	PCI	0.4940	1.1102	0.5526	1.1568
Sust. Live. Sec. Index	**SLSI**	**0.5351**	**1.1096**	**0.5032**	**1.0858**

Computed from data survey 2022

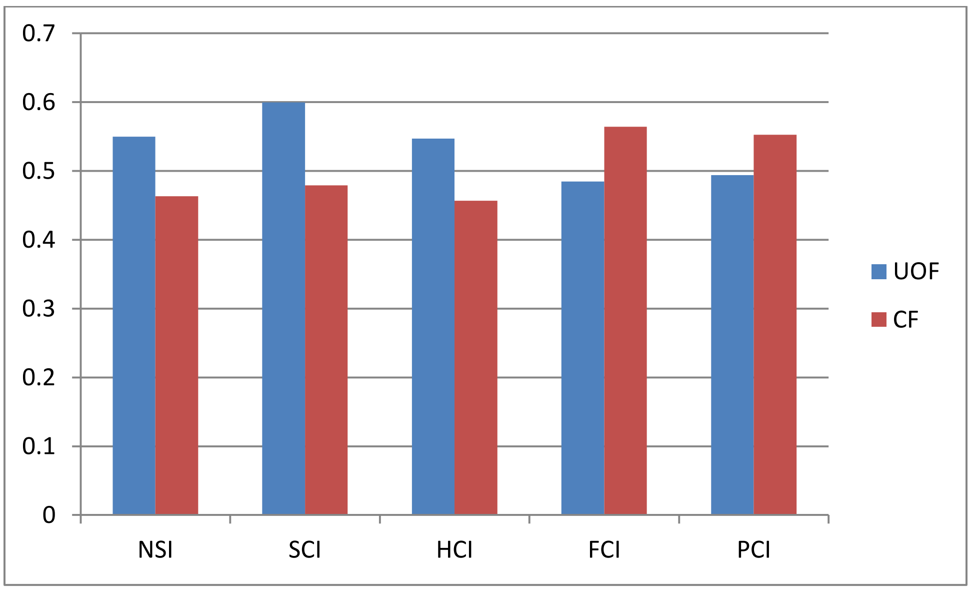

Fig:1.0 showing natural, social, human, financial and physical capital representations of UOF and CF.

5 Conclusions

In all, the security indexes of UOF were higher than of CF for NSI, SCI and HCI while reverse was the case for FCI and PCI. Therefore, the lower financial and physical capital indexes of UOF compared to CF imply that non-certified organic farmers may face financial constraints in their careers. They may also have limited access to physical infrastructure and advanced machinery due to their orientation towards sustainable and less resource-intensive activities. The SLSI for UOF was above 0.5, and therefore sustainable. This farm practices therefore is a good source of conversion to certified organic farming. Potential intervention includes launching infrastructure development programs by government, and specifically targeting non-certified organic farmers. This may include investments in physical infrastructure such as organic processing and storage facilities, which are necessary to maintain the quality and supply chain of organic products. Public-private partnerships can be exploited to mobilize resources and expertise for infrastructure development projects.

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