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Assessment of diversification strategies on level of living among soybean farmers in Kaduna State, Nigeria

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Abstract

The purpose of the study was to evaluate how on-farm diversification strategies affected the productivity and standard of living of Nigerian farmers who grew based on soybeans in Kaduna State, Nigeria. With the use of a structured questionnaire, 336 farmers provided primary and secondary data. The livelihood diversification index, ANOVA, and the Multinomial Logit model were employed. Results indicate that soybean-based farming systems are predominantly male-dominated, with intercropping of soybean/maize, and soybean/cowpea being more common than sole soybean cultivation. Most rural households diversified their sources of income and generated a substantial amount of money from several sources, though a significant minority relied on a single source of income. The farmers' primary source of income was their farm, accounting for 73.4% of their total mean share. There was a significant difference ($p < 0.01$, $\chi 2 = 31.98$) between their earnings from farming and non-farming sources. According to the principal component analysis (PC1) results, households rely on crop production while minimally engaged in non-agricultural wage work. The multinomial Logit model's results showed the marginal effects of statistically significant variables on income diversification among soybean farmers. Overdependence on farming persists due to structural constraints like limited land access and market integration. To strengthen sustainable livelihoods, policymakers should prioritize expanding extension services, promoting agroecological practices, and incentivizing off-farm enterprise development. This integrated approach could mitigate vulnerabilities and align rural livelihoods with broader sustainable development goals.

***Keywords**:* assessment, income, livelihood diversification, soybean

INTRODUCTION

The global organization such as United Nations (UN) set Sustainable Development Goals (SDGs) and have prioritized sustainable development across all sectors, with a special emphasis on agriculture as the cornerstone of rural livelihoods. Putting an end to a destitution and hunger, attaining food security, and enhancing nutrition through sustainable agricultural production are essential components of achieving the sustainable development goals. Hence, Sustainable development requires progressing in a way that meets current needs while also ensuring future generations' ability to meet their own (World Commission on Environment and Development, WCED, 1987). Nonetheless, the 2022 report by the United Nations (UN) revealed a setback in the long-standing efforts to eradicate poverty and hunger, primarily due to the convergence of the COVID-19 pandemic, climate change, and conflicts. Remarkably, it was estimated that 7.7% of the global population suffered from undernourishment in 2020, and this percentage is projected to remain

the same by 2030 (World Health Organization, WHO, 2021). Additionally, the 2022 global Multidimensional Poverty Index (MPI), created by the Oxford Poverty & Human Development Initiative (OPHI), (2022), identified 1.2 billion individuals (19.1%) experiencing multidimensional poverty.

In the Global South, rural regions bear the brunt of poverty and food insecurity, with smallholder farmers facing systemic vulnerabilities such as resource scarcity, climate risks, and gender inequality (FAO, 2013). Moreover, their livelihoods heavily rely on agriculture, which is susceptible to disruptions caused by weather conditions and natural disasters (Kassa, 2019). Consequently, numerous studies (Pretty *et al.,* 2018; FAO, 2017; Altieri & Nicholls, 2020) have explored sustainable agricultural practices aimed at utilizing land resources to fulfil current demands while safeguarding the interests of future generations.

Agricultural production is a key to achieve some of the SDGs goals, and the fulfilment of this international commitment beyond 2023. Soybean (*Glycine max L. Merr*), recognized as a remarkable legume due to its affordability and high protein content, possesses immense potential for enhancing the well-being and nutritional status of impoverished farming families. In Nigeria, a highly productive crop rotation system involving maize and soybean is practiced. Soybeans effectively minimize *Striga* (family *Orobanchaceae*) infestations by forcing *Striga* seeds to germinate early when sown before maize. Each hectare of soybeans yield approximately 2.5 tons of grain and 2.5 tons of fodder. The leftovers supply of 10 to 22 kg of nitrogen per hectare. When the following crop is maize, it uses the nitrogen, and the yield is usually 2.3 times higher than what could be expected from a monoculture (Sustainable Food and Agriculture, 2019).

In rural areas of Kaduna State, soybean is considered the most valuable protein source for enhancing the nutritional quality of traditional food (Kamara *et al.,* 2018). Soybean is rich in various phytochemicals, including phytic acid (1.0–2.2%), sterols (0.23–0.46%), and saponins (0.17–6.16%), which offer a broad range of potential health advantages (Qin *et al.,* 2022). Moreover, the cultivation of soybean has positively transformed the rural economy, leading to improved living conditions for soybean farmers, particularly for women and children (Paroda, 1999). However, due to the inherent risk and uncertainty associated with production, rural households find themselves compelled to devise a strategy to address the vulnerability of their agricultural production systems by pursuing livelihood diversification (Barrett *et al*., 2001); Babatunde & Qaim, 2010); Abdulrahman *et al.,* 2016).

While rural farmers strive to achieve food security, their ultimate focus revolves around attaining a sustainable livelihood, encompassing crucial aspects such as adequate nutrition and secure housing, thereby leading to an improved quality of life (Aderinoye-Abdulwahab *et al.*, 2015).

In Nigeria, 47% of the population relies on agriculture, but 72% of rural farmers live in poverty due to environmental degradation and socioeconomic exclusion (NBS, 2022). Studies conducted by Aderinoye-Abdulwahab *et al.* (2015), Sheyin (2016), and Omotesho (2019), indicate that rural Nigeria, reliant on agriculture-based livelihoods, experiences higher levels of poverty compared to other occupational groups. Consequently, efforts to sustainably improve the livelihood status of the rural populace, is still yet to be achieved due to sole dependency on agriculture as the primary means of livelihood.

There is an abundance research on soybean production on one hand, and the livelihood diversification on the other conducted by Sanginga *et al.* (2002), Ugwu & Ugwu (2010), Shalma (2014), Biam & Okorie (2012), Ugbabe *et al.* (2017), Sadiq *et al.* (2020), and Kamara *et al.* (2022). However, there is a notable gap in the analysis of

economic diversification strategies specifically related to soybean farmers for sustainable livelihoods in Kaduna state. This research aims to address the following questions: (i) What proportion of livelihood diversification is allocated to on-farm, off-farm, and non-farm income? (ii) What are the strategies employed by farming households to diversify their livelihoods? and (iii) What socioeconomic factors influence the diversification strategies adopted by farming households?

Hypotheses of the Study were as follows: (I) the socio-economic characteristics of soybean farmers do not have a notable impact on their profitability, and (II) the socio-economic characteristics of soybean farmers do not play a significant role in their diversification strategies.

MATERIALS AND METHODS

Study Area

The geographical coordinates of Kaduna State span from 90º N to 12º N latitude and from 6º E to 9º E longitude, encompassing an approximate area of 68 000 square kilometres, which accounts for about 7% of Nigeria land. The region is comprised of 23 Local Government Areas (as depicted in Figure 1) (Kaduna State Government, 2012). The annual precipitation totals 1,272.5 mm, with a humidity level of 56.64%. Temperature range is from 15.1°C to 35.18°C on a daily basis. With an annual population growth rate of 3.2%, the state's predicted population for 2019 is estimated to be around 8,789,003 people (NBS, 2016). Kaduna State is predominantly an agricultural region, with main crops: soybean, rice, maize, cotton, peanuts, tobacco, beans, guinea corn, millet, ginger, cassava, yam, and potatoes. Cattle, sheep, goats, pigs, and poultry husbandry are also important in the state's agricultural activities (Kaduna State Government, 2012). Furthermore, the state hosts numerous entities as businesses, research institutes, higher education institutions, and universities.

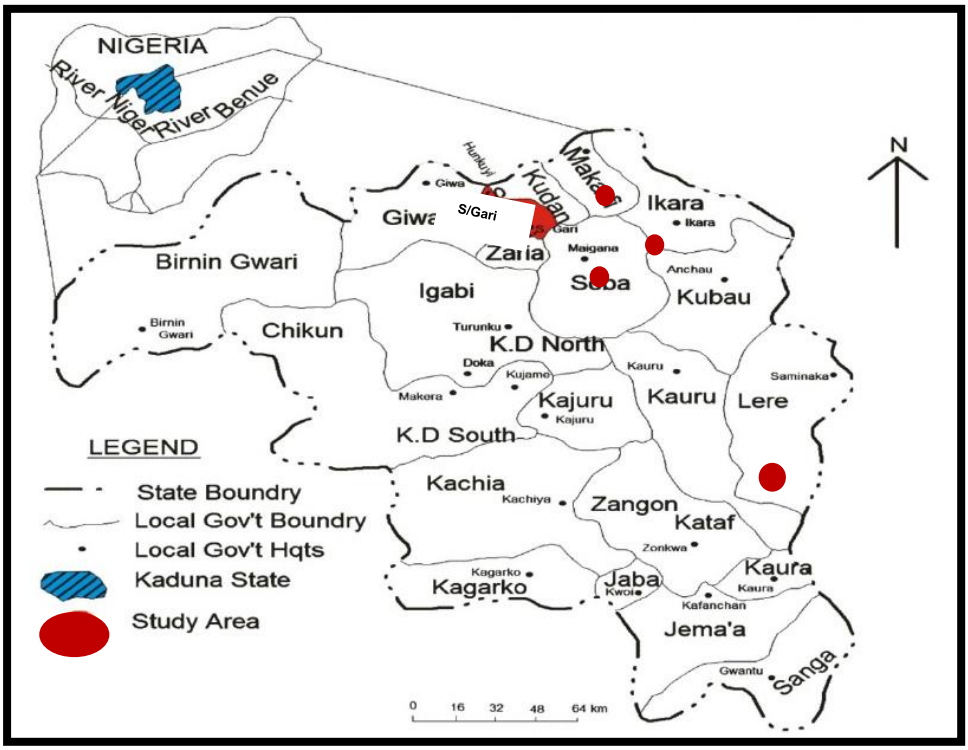

Figure 1. Map of Kaduna state showing the study area

Table 1. Distribution of sampling procedure of soybean farmers in the study area

LGA	Total villages	Selected villages	Sample frame	Sample size (16%)
Makarfi	27	Gubuchi	99	16
		Nassarawa	78	12
		Dorayi	144	23
		Mayere	111	18
Ikara	38	Pampaida	183	29
		Saulawa	117	19
		Kurmin kogi	84	13
		Say-say	75	12
Soba	44	Tamba	126	20
		Maigana	117	19
		Anguwan liman	84	13
		Matari	144	23
Lere	86	Sabon birni	138	22
		Yarkasuwa	117	19
		Dan Alhaji	84	13
		Sigau	54	9
Giwa	49	Kuriga	90	14
		Karau Karau	132	21
		Galadimawa	69	11
		Mujedawa	57	9
Total			**2 103**	**336**

Source: Ministry of LG Affairs Kaduna, KADP desk officer, 2020

Data collection and sampling procedure

The current research utilized a primary data gathered from farmers who were selected as sample and interviewed by enumerators. The interviews were conducted using Computer Assisted Personalized Interview (CAPI) method during the cropping season of 2019/2020. A multi-stage sampling procedure was employed (as shown in Table 1). In the first stage, five Local Government Areas (LGAs), namely Makarfi, Ikara, Soba, Lere, and Giwa, were purposively chosen due to their significant number of soybean farmers. In the second stage, four communities were chosen at random from each of the aforementioned LGAs, for a total of 20 villages. This choice was made based on the comparability of their production systems. Finally, using Taro Yamane's formula at a 95% confidence level, a proportionate random sample technique was used to choose 336 farmers from a registered soybean farmer's cooperative (as shown in Table 1), accounting for 16% of the overall population using the Taro Yamane's formula.

Analytical Techniques

The measurement of farmers' diversification, in terms of their livelihood, was achieved using the Livelihood Diversification Index (SID). The formula to calculate SID (Afodu *et al*., 2019) is as follows:

$$SID = 1 - \sum_{i=1}^{n} P_i^2 \quad (1)$$

Here, SID represents the Simpson's Index of Diversity, 'n' signifies the number of income sources, and Pi denotes the proportion of income derived from the *ith* source. The value

of SID ranges between zero (0) and one (1). In cases where there is only a single source of livelihood ($P_i = 1$), the SID value becomes 0. A higher value of SID, closer to one, indicates a greater level of diversification within the household (refer to Table 2).

This study presents the SID model (Afodu *et al.*, 2019) as:

$$SID = 1 - \sum_{i=1}^{8}\left[\left(\frac{fci}{thi}\right)^2 + \left(\frac{pji}{thi}\right)^2 + \left(\frac{livesi}{thi}\right)^2 + \left(\frac{pfpwi}{thi}\right)^2 + \left(\frac{lwi}{thi}\right)^2 + \left(\frac{sei}{thi}\right)^2 + \left(\frac{remi}{thi}\right)^2 + \left(\frac{csi}{thi}\right)^2 + \left(\frac{fri}{thi}\right)^2 + \left(\frac{othersi}{thi}\right)^2\right] \quad (2)$$

Where: *thi* = *total household* income,
fci = crops farming income,
pji = private job income,
livesi = Livestock income,
pfpi = Processing of farm produce,
lwi = labour wage,
sei = self-employment income,
fri = farm rent income,
remi = remittance income,
csi = civil service income,
and *othersi* = other income sources.

According to Ahmed *et al.* (2015), as cited by Sherf-Ul-Alam *et al.* (2017), the classification of SID values concerning the level of livelihood diversification can be found in Table 2 below.

Table 2. Extents of livelihood diversification

Level of livelihood diversification	Range of SID
No diversification	≤0.01
Diversification on low level	0.01-0.25
Diversification at medium level	0.26-0.50
Diversification at high level	0.51-0.75
Diversification at a very high degree	≥0.75

Sources: Sherf-Ul-Alam et al. (2017)

Joshi *et al.* (2004), and Ibrahim *et al.* (2009), employed the SID method to assess the variation in crop diversification across multiple South Asian nations. In this investigation, the SID was used to estimate both income and crop diversity. The variable p_i represents the proportion of income or crop derived from source "*i*". When there is only one income source or crop, p_i equals 1, resulting in SID of 0. As the number of income sources or crops increases, the share represented by "p_i" diminishes, as does the sum of squared shares. Consequently, the SID tends to approach 1. If there are K income sources, the SID value falls between zero and 1-1/K. A smaller SID indicates a higher degree of specialization, while a larger value implies greater diversification.

The Multinomial Logit model was used to analyse the socioeconomic factors that influence diversification strategies among agricultural households in the study area. The model's explicit form is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e_i \quad (3)$$

Where Y = income diversification strategy (1= Soybean income only, 2= income from soybeans and other agricultural products 3= Soybean and non- agricultural incomes and 4= Soybean, other agricultural & non-agricultural incomes); X_1 = Gender of the farmer (dummy), X_2 = Age (years), X_3 = Educational level (years of formal education), X_4 = Marital Status (dummy), X_5 = Household size (number), X_6 = Farming experience in years (years), X_7 = Co-operative membership in years (years), X_8 = Access to credit in Naira (naira), X_9 = Farm size (ha), (Table 3), B_0 = Constant, β_1 - β_{11} = regression coefficients and e = error term.

Table 3. Measurement of variables for the multinomial logit model

Variables	Category	Coding system	Exp. sign
Y=diversity index	Continuous	Ratio of diversification (1-0)	
X_1 = Age farmer	Continuous	Number of years	+
X_2 = Sex of the farmer	Dummy	female = 0, male =1	+/-
X_3 = Marital status	Dummy	married =1, otherwise = 0	+/-
X_4 = Household size	Continuous	Numbers of dependents	+
X_5 = Education level	Continuous	Number of years spent in formal education	+
X_6=Farming experience	Continuous	Number of years in soybean farming	-
X_7 = Farm size	Continuous	Number of hectares	-
X_8 = Income in naira	Continuous	Amount of income in naira/year	+
X_9 = Labour usage	Continuous	Amount of labour used in man-days/production cycle	+
X_{10} = Amount of credit Received	Continuous	Amount of credit in naira	+
X_{11} = Number of extension Contact	Continuous	Number per period	-
X_{12} = Membership of farming cooperative	Continuous	Years of membership	-

RESULTS AND DISCUSSION

Soybean-Based Production Systems

The different soybean-based production systems which the respondents identified are shown in Table 4. The majority of farmers (36.7%) were primarily involved in the combination of soybean/maize (SM), soybean/cowpea (SC) – 25.2%, followed by soybean/sorghum (24.6%) production system. Most soybean-based farmers practice crop combination due to the uncertainty of harvest (yield) arising from changing climatic conditions, as well as due to a high input cost (particularly fertilizer). Thus, farmers choose more crop combinations for security. Moreover, selecting two different crop mixtures provides the added benefit of optimizing land resources. Nitrogen being an inert gas cannot be used by plants, animals and micro-organisms. Legumes help to convert the nitrogen gas into its usable form like ammonia which can be used by the plants and other organisms thus reducing expenses on fertilizer.

Table 4. Distribution of respondents based on crop combination

Soybean based cropping systems	F	%
Sole soybean	45	13.4
Soybean / sorghum	83	24.7
Soybean / maize	123	36.6
Soybean / cowpea	85	25.3

Source: Computed from Field Data, (2021)

According to Figure 2, approximately 80.5% of farmers engaged in soybean-based cropping systems are male. This may be explained by the fact that, in the research region, women mostly perform supportive duties, such as planting, harvesting, and handling harvested crops after harvest, whereas males are primarily active in agricultural production.

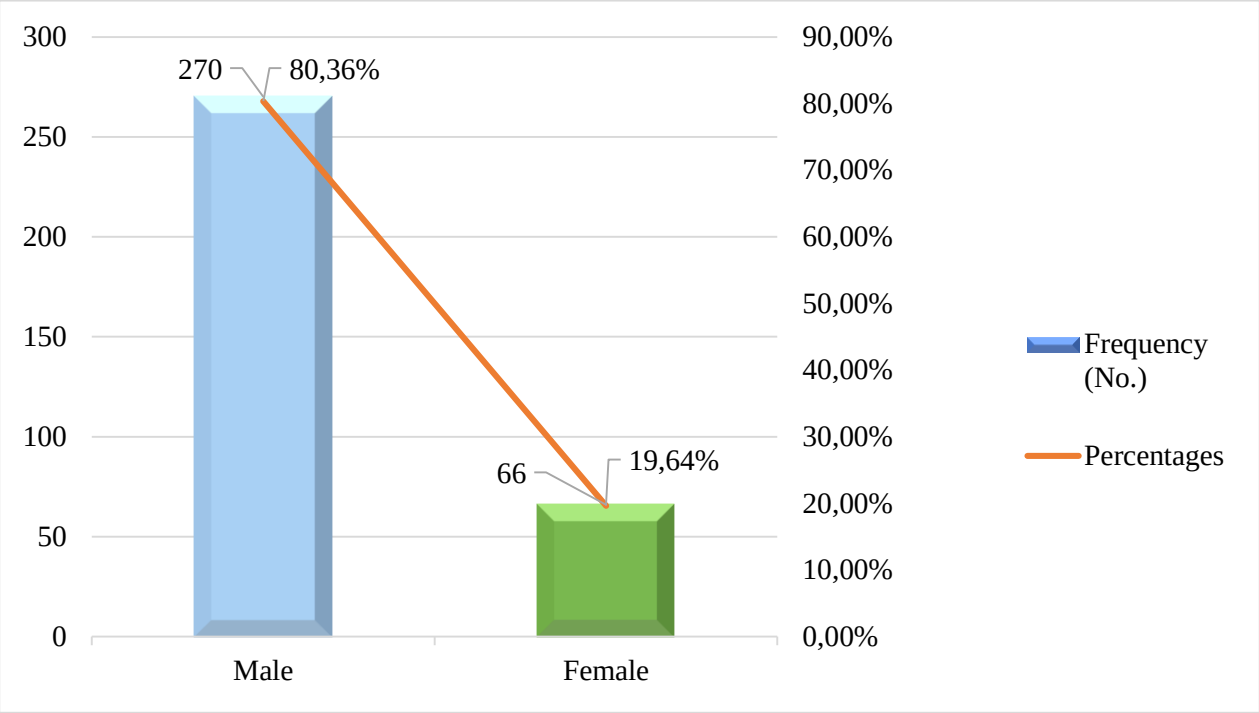

Figure 2. Gender distribution of farmers

Income share of livelihood diversified activities by the farmers

The outcomes regarding the distribution of income derived from various livelihood pursuits undertaken by the farmers are shown in Table 5. The primary source of income, which stems from farming activities, represents the largest portion, accounting for approximately 73.4% of the average total farmers' income in the study area. On the opposite, the off-farm income contributes a mere 4% to the overall income share of the farmers, while non-farm revenue constitutes approximately 23% of their total income. Similarly, Arifa *et al.* (2019) assess the impact of agricultural modernization on the sustainable livelihood of tribal and non-tribal farmers in Bangladesh, with respective proportions of 25.08% and 23.69%.

Livelihood diversification strategies of the soybean based crop farmers

Most rural households have increased their earning potential by engaging in a variety of activities and producing significant income from several sources. As depicted in Figure 3, approximately 70 percent of farming households are engaged in the diversified livelihoods. Merely 30.5 percent of these households possess a Simpson index below 0.01, indicating their reliance on a solitary source of livelihood activity. Around 30.5 percent of households lack any form of diversification, while 1 percent display a moderate level of diversification. Additionally, 2.9 percent exhibit a high level of diversification, and the remaining 65.7 percent demonstrate a very high level. These findings suggest that a majority of households are engaged in a medium to high levels of diversification by means of making a living. This evidence contrasts the result of Sherf-Ul-Alam *et al.* (2017), who used the SID approach to investigate an income diversification among farmers in selected areas of Bangladesh's Sunamganj District. The study revealed that the highest level of diversification among farmers in the region was medium, accounting for a total of 42.50 percent, while only 22 percent had no diversity at all.

Table 5. Diversification strategies and mean shares of income (level of living)

Income Sources	Variables	Mean Income Share		%MIS
Farm income		**(₦)**	**($)**	
	Crop farming	451,548.00	1,268.39	72.64
	Livestock	5,205.00	14.62	0.84
	Farm income	**456,753.00**	**1,283.01**	**73.48**
Off-farm income				
	Farm labour	10,360.00	29.10	1.67
	Processing of farm produce	3,409.00	9.58	0.55
	Farm rent/resources	10,620.00	29.83	1.71
	Off-farm income	**29,594.00**	**83.13**	**3.92**
Non-farm income				
	Self-employed business	42,427.27	119.18	6.83
	Private Organization Job	28,842.55	81.02	4.64
	Government job income	31,950.00	89.75	5.14
	Remittance	16,437.50	46.17	2.64
	Others	20,833.33	58.52	3.35
	Non-farm income	**140,490.65**	**394.64**	**22.60**
Household income		621,632.65	1,746.16	100.00

Source: Researchers' computation, (2021); Note $1USD = ₦356.00 at the time of the survey

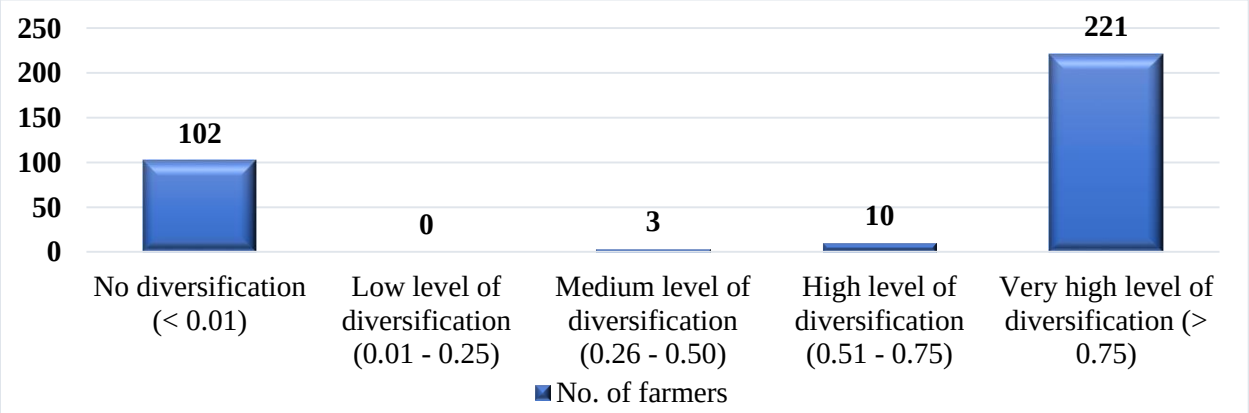

Figure 3. Farmers' livelihood diversification levels

Principal component (PC) loadings estimated scores for diversification in livelihood activities

The approach to diversify livelihoods was captured by obtaining a binary response (either 'yes' or 'no') regarding the involvement of any household members in alternative endeavours. Principal Component Analysis (PCA) reduced the nine livelihood strategies into four principal components (PCs), collectively explaining 81.83% of the variance (Table 6). The Kaiser-Meyer-Olkin (KMO) measure (0.691) and Bartlett's sphericity test (χ^2=311.852, p<0.001) confirmed the suitability of the dataset for factorial analysis. A Varimax rotation and Kaiser normalization were applied to enhance interpretability. The primary component (PC1) (On-Farm Activities) accounted for 31.58% of the variance. This component was dominated by crop farming (loading = 0.951), reflecting households' reliance on crop production, while minimally engaged in non-agricultural wage work. According to Giller *et al.* (2021), self-employed farming is still very important for

household food security and income. Furthermore, farming production contributes to 53% of farmers' income, cattle activities account for 13%, and farm wages make up 4% of the overall earnings. In a separate study, Abdulrahman *et al.* (2016), reported that 60.6% of the average household income originated from on-farm livelihood activities conducted by the farmers. The second primary component (PC2) (Livestock Activities) explained 24.93% of the variance. This component highlighted diversification into livestock (loading = 0.909), with reduced dependence on non-agricultural wages. In their investigations, Covarrubias *et al.* (2012), discovered that rural households obtain 70% of their total income from agricultural pursuits such as cultivating crops, raising livestock, and engaging in farm work.

The third primary component (PC3) (Non-Farm Wage Labor) contributed to 13.23% to the variance. This component linked to government job income (loading = 0.787) and moderate farm labor involvement, termed non-farm wage labor. The fourth primary component (PC4) (Off-Farm Labor) explained 12.09% of the variance. This component captured off-farm labor (loading = 0.764), often low-paid and seasonal, alongside reduced reliance on government jobs (loading = – 0.469).

Socio-economic factors influencing diversification strategies of the rural farming household heads

Table 7 displays the findings of the Multinomial Logit analysis concerning the elements influencing the diversification of income among soybean farmers in the designated region. The model demonstrated statistical significance, as indicated by the Wald chi-squared estimate probability, which was significant at the 1% threshold. Instead of focusing on the coefficients the current study presents the marginal effects since they not only point in the direction of change in income diversification but also precisely predict the probability and magnitude of such shift in response to changes in socioeconomic and institutional factors.

Table 6. Principal component loadings estimated scores for diversification in livelihood activities

Component	Factors				
	1st (on-farm)	**2nd (off-farm)**	**3rd (non-farm)**	**4th (off-farm)**	**Extraction**
Eigen-values	0.269	0.212	0.112	0.103	-
% of Variance	31.58	24.93	13.23	12.09	-
Cumulative %	31.58	56.52	69.74	81.83	-
livelihood diversification strategy					
Crop farming	**0.951**	-0.255	-0.153	-0.053	0.997
Farm rent/resources	0.35	0.345	0.023	-0.006	0.242
Private Organization Job	0.342	0.305	0.314	-0.182	0.341
Livestock	0.112	**0.909**	-0.331	-0.19	0.984
Remittance	0.213	0.385	0.238	0.146	0.271
Processing of farm produce	0.254	0.35	0.237	0.182	0.276
Self-employed business	0.293	0.334	-0.034	0.15	0.221
Farm labour	0.327	0.41	0.313	**0.764**	0.958
Government job income	0.276	0.239	**0.787**	-0.469	0.973
Extraction Method: Principal Component Analysis.					
Rotation Method: Varimax with Kaiser Normalization					
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.691					
Bartlett's Test of Sphericity: df = 36; Approx. Chi-Square = 311.852; Sig. = 0.000					

Gender as a socio-economic factor

The result shows that males are 97.8% less likely than females to choose the soybean plus non-agricultural income sources (SN) diversification approach when the model's other predictor variables are all kept constant. This suggests the likelihood of female soybean growers is higher to diversify by incorporating non-agricultural sources of income, particularly through self-employment activities like petty trading, which play a significant role in remote settings. As opposed to that, the men farmers are more likely to consider diversification of their businesses through agriculture. It is interesting to note that males are statistically significantly more likely to engage in other agricultural activities in addition to soybean farming and to employ a strategy that depends on both agricultural and non-agricultural incomes. (SA and SAN) compared to females. Males are statistically significant at a 5% level by 112.6% and at a 10% level by 145.5%, which is a substantial difference. This preference for income diversification can be linked to the fact that men farmers in the study area typically have better access to productive resources as land, inputs, and loans than their female counterparts. Men are therefore more likely to engage in cultivating different crops on separate plots of land. These findings align with previous studies by Hjelm and Dasori (2012), and Fontana *et al.* (2006), which indicate that females are more inclined towards non-farm activities than males.

Level of education as a socio-economic factor

The findings indicated that that the households comprised of individuals with higher levels of education exhibited a greater inclination to both non-agricultural and agricultural activities in pursuits in comparison to self-sufficient households. At 5%, 5%, and 10% levels of significance, respectively, the educational background of the household head had a positive and notable impact on SA (0.433), SN (0.406), and SAN (0.634). This implies that households with more educated family members may choose to engage in activities other than farming, maybe incorporating both external labor and on-farm labor at the same time. The United Nations defines literacy as the ability to read and write. Existing literature asserts that educational achievement, knowledge, and skills are the most influential factors affecting farm productivity, income, and labor mobility (Farooq *et al.*, 2021). As a result, the education encourages a clearer distinction between on-farm and off-farm labor, leading farmers to replace family labor with hired labor in the agricultural sector and family labor with hired labor in off-farm employment, provided the additional cost of hired labor is kept below the additional off-farm income.

Age as a socio-economic factor

With a confidence level of 5%, it was determined that the age coefficient (0.065) had a favorable and substantial influence on soybean farmers' choice for SAN. There is a projected 6% increase in the likelihood of farming for every year that the household head's age rises opting for SAN activities, as opposed to relying solely on soybean as source of livelihood. Therefore, with all other factors being equal, younger farmers have a larger propensity to engage in non-farm and off-farm activities as opposed to only cultivating crops or depending on the soybean for their living. These findings are in line with studies by Edlam (2003), and Dinku (2018).

Size of the household as a socio-economic factor

The fact that soybean farmers have adopted an income diversification strategy is consistent with the study hypothesis that as household sizes rise, so does the possibility of income diversification. The results show that the chance of the soybean farmer adopting SN diversification increases by 0.220 units (equal to 22%) with the addition of each new household member, which is statistically significant at a

1% confidence level. Due to increased responsibility, it makes sense for the soybean farmer to increase their income-generating activities with increase of the household. This finding align with the study of rural Malawi done by Asfaw *et al.* (2015) who associates larger households with income diversification.

Farming expertise as a socio-economic factor

The ability of the household head to farm has a significant and positive influence on the household's decision to diversify its sources of income apart from soybean production and towards on-farm and non-agricultural sources. This suggests that compared to individuals who exclusively depend on soybean as their primary means of subsistence (baseline scenario), a one-year increment in the farming expertise of household leaders is likely to shift farmers' choices of livelihood options towards SA and SN by 0.044 units (4.4%) and 0.040 units (4.0%) respectively, both at a 5 percent probability level. Hence, it is plausible that households with extensive years of agricultural experience will potentially facilitate the cultivation of additional crops. This aligns with earlier empirical research conducted by Zhang *et al.* (2008), and Lancaster & Torres (2019).

Table 7. Multinomial Logit Results for Factors Influencing Income Diversification

Variable	**Soybean income only (S)** Marginal effect	**Soybean and other agricultural incomes (SA)** Marginal effect	**Soybean and non-agricultural incomes (SN)** Marginal effect	**Soybean, other agricultural & non- agricultural incomes (SAN)** Marginal effect
Sex	-0.883**	-1.126**	0.978*	-1.454*
Marital Status	0.631**	0.522	0.678	-0.389
Education	-0.205	0.433**	0.406**	0.634*
Age	0.009	-0.014	0.008	0.065**
Household size	-0.006	-0.028	0.220***	-0.005
Farming experience	-0.000	0.044**	0.040**	-0.017
Cooperative	-0.023	-0.047*	-0.111***	-0.070
Credit	-7.11e-07	3.24e-06	-8.96e-06*	-3.25e-07
Constant	0.599	1.892	-1.412	-0.546
No. of observations	377			
Pseudo likelihood	-181.241			
Wald chi2(348)	156.912			
Log Prob > chi^2	0.0000			
Pseudo R^2	0.48			

Legend: *** Significant at 1%; ** significant at 5%; * significant at 10% level

Source: Computed from Field Data (2021)

Credit as a socio-economic factor

At a 10% probability level, the credit accessibility coefficient (-8.96e-06) had a negative and statistically significant ($p < 0.010$) effect on the choice of soybean and non-agricultural revenue source. This suggests that if farmers have greater access to subsidies, there is a -8.96e-06 unit reduction in the likelihood that they will choose SN income diversification techniques. These results are consistent with those of Asfaw *et al.* (2015), and Ahmed (2012), both of whom found that credit accessibility had a negative impact on people's decisions to diversify their sources of income. The loan that farmers were able to acquire was meant exclusively for their soybean cultivation, which caused a greater emphasis on soybean farming than on diversification.

CONCLUSIONS

The majority of the interviewed in the current study families produce crops and/or livestock as essential components of their livelihood strategies. The results show that males dominate soybean farming systems, with predominant cropping systems of soybean/maize, soybean/cowpea, and soybean/sorghum. Most of the households diversified income sources, though the farming remained the primary contributor of total income. Some variables influencing diversification choices, such as access to land and extension services show significance of livelihood diversification variance and was linked to factors such as income source variety and asset ownership. To enhance resilience and productivity, the policies must prioritize on expanding the access to arable land and strengthening the extension services towards on-farm diversification. Addressing gender disparities in soybean production is critical; interventions should promote gender-sensitive opportunities to reduce biases and enable equitable income expansion. Fostering savings mechanisms and tailored training for rural households could further incentivize diversified strategies. These measures will empower farmers to balance farm and non-farm activities, improving livelihoods and reducing vulnerability to economic or climatic shocks.

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