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Livelihood and Income Diversification Assessment in Northern Nigeria: Evidence from Sudano-Sahelian Region

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Abstract: Agriculture and other income-generating activities in the Sudano-Sahelian region face many natural and human constraints that affect households' economic activities and livelihood development over time. Stratified and simple random sampling considered 1,200 households across four (4) Sudano-Sahelian States with 300 respondents each from Kano, Jigawa, Bauchi and Gombe. Primary data were collected using a structured questionnaire to information on livelihood and income generating activities. The findings regarding household demographics indicated active age, moderate farming experience and average income, respectively. The results further show overall access to credit, market, extension contact and cooperative participation of 14.68%%, 73.21%, 56.90% and 63.28%, respectively. Ownership and the capital problem have been the major constraints to land access for crop production. The majority of the household goes into multiple income-generating activities with a shortage of planning and guidance on the value of income diversification. The COVID-19 pandemic has resulted in high income and livelihood deterioration of households' remittances from internal and external sources. The significant variable that affects income diversification includes education, off-farm income, access to credit, and output volume. The development of households and community requires multiple income alternatives for improved livelihood in saving mobilisation and investment opportunities. Households in the Sudano-Sahelian region engaged in agriculture and additional income sources that must be strengthened to support income generation. The study further concluded the existence of potential income diversification alternatives in rural including multiple cropping, off-farm investment, and non-farm income potentials. COVID-19 period posed a serious constraint to households, particularly deterioration in income sources, making livelihood activities more difficult. Access to credit, educational status, off-farm income generation, and output volume are the strongest determinants of income diversification in the Sudano-Sahelian region. The study recommends the need for government and development agencies to improve the quality and availability of rural infrastructural facilities (road, markets, electricity) in the study area to help rural households sustain their investment and engage in sustainable livelihood activities. The development of essential programs on enterprise support and business development service is essential to strengthen livelihood and income diversification opportunities. Strengthening cooperative participation and awareness creation on savings and investment opportunities is essential for sustainable livelihood, implying the need for collective actions, enhancing risk strategies, and influencing government policies for livelihood development.

Keywords: Livelihood, Diversification, Coping Strategy, Sudano-Sahelian

1. Introduction

Farming families in developing countries both the farm and non-farm sectors derive livelihoods means from agriculture which implies that sustainability of agriculture cannot be discussed or even defined in isolation from the issue of livelihoods. Livelihood is defined as an adequate stock and flow of food and cash with an individual or a family to meet its basic needs. Majority of the small and marginal farmers obtained livelihoods through production on scattered and small pieces of land. For these households, availability or access to inputs and improved production methods are quite critical for their livelihoods. Nigerian economy and particularly livelihood activities throughout the year is made up of a rural the agrarian sector with an increasing level of diversification either within or outside the agricultural sector [1]. In rural Nigeria, where several factors inform marginalised areas that are mainly agrarian, livelihood decisions and strategies. Livelihood diversification is seen as ways or patterns by which households raise income and reduce risks (environmental). It allows for both on and off-farm activities, majorly carried out to obtain extra revenue or benefits to enhance agricultural activities [2].

Livelihood diversifications decisions can be seen as a coping strategy rather than alternative income opportunities. Share of income from non-agricultural sources gives leverage to the dwindling income from agriculture and considerably improves the livelihood of the people of rurality [3]. In addition, a key strategy taking place at various levels of the economy but not necessarily linked is livelihood diversification, as such may be taken as a tool for risk management by farm households. Farm household diversification is viewed as an income strategy of rural households in which there is an expansion of their activities regardless of sector or location [4]. The livelihood constructed by people and households is through three strategies known agricultural intensification, livelihood diversification, and migration.

Diversification comprises the patterns of individuals' voluntary exchange of assets and their allocation across various activities and enterprise which can be on and off-farm to obtain a sufficient balance between expected returns and risk exposure conditional on the challenges or militating factors associated with income alternative [5]. The aspect of diversification is of two faces, which can be a shift away from agricultural activities and an increase in the mix of multiple income generation activities. Furthermore, livelihood diversification is seen as ways or patterns by which households generate income and reduce livelihood risks. It allows for both on farm, off-farm and non farm economic engagement, majorly carried out to obtain dditional revenue or returns to enhance agriculture [6]. Livelihood diversifications is considered as coping strategy rather than alternative income opportunities. The share of income from non-farm sources creates advantagous income opportunity from agriculture and basically improves the livelihood of the people of rurality. In addition, a key strategy taking place at various levels of the economy but not necessarily linked is livelihood diversification [7].

Livelihood diversification is considered as an alternative creation of income strategies for rural households in which there is an expansion of their activities to various sectors or locations [5, 8]. Live livelihood constructed by people is through three strategies known agricultural intensification, livelihood diversification, and migration. The United Nations (UN) mentioned in the report about Food Security and Nutrition in 2017, that the world hunger rate has begun to rise again, threatening 815 million people in 2016, 11% of the world's population, after a remarkable steady decline during the past decade. Meanwhile, the U.N. report revealed in its 2017 edition that multiple forms of malnutrition are threatening the health of millions worldwide. The report indicated, increasing number of people affected by hunger compared to the previous year has increased by 38 million people as a result rampant armed conflicts and climate change in developing countries [9]. When there is an outbreak of infectious disease, there is also an increase in hunger and malnutrition. After initial reassurances that Covid 19 would not threaten global food security, the discourse has changed drastically. The United Nations Economic Commission for Africa (ECA) expects that nearly 29 million Africans will be under the extreme poverty line of US$ 1.9, and 19 million jobs will be lost as a result of Covid-19 [10]. Livelihood diversification constraints are continuous process of life to strengthen the ability of households, especially challenges associated with drought, flood, loss of income sources, and other challenges like COVID-19 pandemic in recent times. This study tends to assess the livelihood and income diversification in the Sudano-Sahelian region with emphasis on the following specific objectives:

i. Describe the profile and income-generating activities of the selected respondents.
ii. Assess the livelihood impact of COVID-19 on household living standard.
iii. Analyse the determinants of income diversification among farming households.

2. Review of Previous Studies and Conceptual Framework

A study on income diversification strategies among farm households in Umuahia North Local Government Area of Abia State was conducted using descriptive statistics and a regression model. It was reported in the study that most of the respondents (63%) were between 41 to 60, 84% were married, and 65% were females. Most farming households were involved in income diversification activities such as cultivating perennial crops, livestock rearing and trading. The reported determinants of income diversification were age and level of education of the household head, number of extension visits, availability of services and returned from production. Most households'

occupations in the study area were agricultural-based.

Additionally, the willingness to diversify was significantly influenced by their socioeconomic characteristics. Findings further indicated that off-farm activities contribute substantially to the increase in household income for improved living standards [2]. Another study aimed to examine the pattern of income diversification and investigate the factors that influence income diversification where income diversification has been identified as a channel for a household to reduce vulnerability to shocks, improve the standard of living, and reduce government expenditures. The study employed descriptive statistics and the Poisson regression model to examine determinants of income diversification. Findnigs revealed that households in the study area are not diversified. It revealed that the majority (51.5 percent) of households in the study area obtain income from only one source apart from transfers. Male headed households tend to have more income sources than female-headed households. Regression result indicates the age of the household head, population group of the head, education attainment of the head, engagement in agriculture, recipient of remittance, and several active economic members of the household were significant in influencing livelihood diversification of rural households [7].

In summary, the main element of the Sustainable Livelihood Framework (SLF) is that it depicts stakeholders as operating in a context of vulnerability, within which they have access to certain assets. Assets gain weight and value through the prevailing social, institutional and organisational environment (policies, institutions and processes). This decisively shapes the livelihood strategies open to people in pursuit of their self-defined beneficial livelihood outcomes [11].

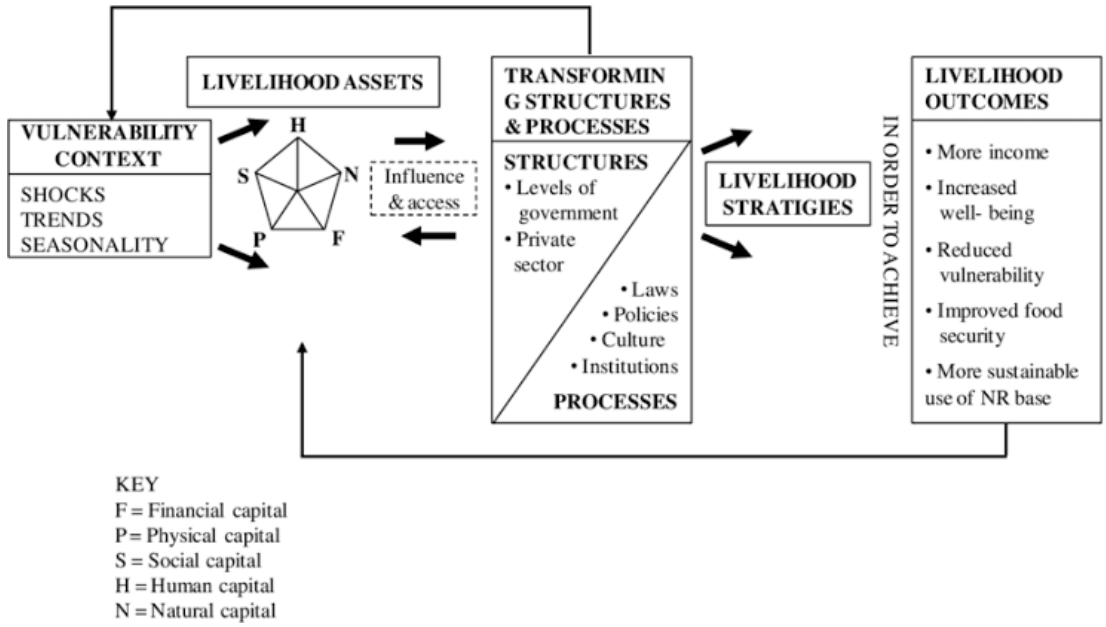

Figure 1. *Livelihood Framework.*

Livelihood diversification was considered as a survival strategy and a means to escape food insecurity among rural farming households in Abia state through descriptive and logistic regression [12]. The study findnigs from logit regression showed that diversification was influenced by household size, amount of credit received, education of the household head, cooperative membership and monthly income. On the other hand, food security status was influenced by years of education of household head, credit access, monthly income, age of household head and household size**.** Rural communities should be encouraged to participate in various income-generating activities in agriculture and non-agricultural ventures to enhance their income and break the vicious cycle of poverty and impoverishment. The provision of soft loans at reduced interest prices will catalyse involvement in non-farm income-generating activities, thereby boosting household income and, consequently, welfare [12].

Another study examines the pattern of income diversification and investigates the factors that influence income diversification among households. Income diversification has been globally identified as a channel for a household to reduce vulnerability to shocks, improve the standard of living, and reduce government fiscal burden. The study employed descriptive statistics and the Poisson regression model to examine determinants of income diversification. The result revealed that households in the Province are not diversified. It revealed that the majority (51.5 percent) of households in the province obtain income from only one source apart from transfers. Male headed households tend to have more income sources than female-headed households. Regression result indicates the age of the household head, population group of the head, education attainment of the head, engagement in agriculture, recipient of remittance, and a number of active economic members of the household were statistically significant in influencing livelihood diversification [7].

Income diversification concerning agrarian livelihood is switching from low-value crops (staple crops) to higher-value

crops livestock and other non-farm activities. It is probably more useful to define them as crops that generate high economic returns per unit of labour and land [7]. Diversification is considered as a source of income growth and thus a potential means of poverty reduction. The rural household's motives for diversification and their opportunities differ significantly across settings and income groups [13]. However, rural households in developing countries have been found to diversify their income sources, which gives them opportunity to spread risk and achieve better consumption and sustainable livelihoods. In line with the above relevance of household income diversification in rural communities, particularly towards poverty reduction, this study employed the poison regression model to estimate factors influencing household income diversification in the Savannah of Northern Nigeria. Poisson regression model is often applied when the dependent variable is a count variable, which is the number of different income sources as a count variable. Poisson regression was used in determining factors that influence income diversification. In addition to the estimated model, the multi-collinearity test was carried out to check the consistency and validity of the estimated model.

3. Methodology

3.1. Sampling and Data Collection Procedure

The study was conducted in four (4) the Sudano-Sahelian States, specifically Kano, Jigawa, Bauchi, and Gombe. The study area is a potential agricultural zone with diverse economic activities across rural communities and within farming households. The four (4) states were purposefully selected for their importance in Agricultural activities and fewer security challenges than other states. Stratified sampling was used to classify each state into three (3) agro-ecological zones. Three (3) LGAs in each Zone were selected in each zone, thus giving 36 LGAs for the study. Simple random sampling techniques were used to select 10 respondents from each LGAs, implying 300 respondents per state and a 1,200 sample size for the study. Primary data were collected using a structured questionnaire to elicit information on respondents' profiles, food security parameters and other household activities. The distribution of sample size is depicted in Table 1 below:

Table 1. *Sampling Techniques.*

State	Zone	No. of LGAs	No. of Respondents
Kano	3	9	300
Jigawa	3	9	300
Bauchi	3	9	300
Gombe	3	9	300
Total	12	36	1,200

3.2. Data Management and Analysis

The Poisson regression model has been popular, most especially for continuous count dependent variables. Some scientists examined the determinants of rural income diversification in Nigeria and Ghana. The studies proxy income diversification by a number of income sources [14-16]. Consequently, the Poisson regression model was applied to achieve their objectives. Vimefall Applied a generalised Poisson regression on the determinants of a number of income sources among female-headed households in Kenya [16]. Applying the Poisson regression model on income diversification and its determinants among households in Eastern Cape Province, South Africa, proved statistical relevance and empirical strength [9]. A Poisson regression model was used to determine the factors influencing rural income diversification. The model was specified in the following relationship:

$$Y_{ij} = X\beta + U \quad (1)$$

The explicit form of the logistic model can be expressed in the following model:

$$Y_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \ldots\ldots + \beta_k X_k + U \quad (2)$$

Where,

Y_{ij}= Number of income generating activities by the household (Count);

X_1 = Age of Respondents (years);

X_2 = Farming experience (years);

X_3 = Access to credit (1= access and 0= No access);

X_4 = Education (years);

X_5 = Farm size (ha);

X_6 = Access to market (Access 1, No access 0);

X_7 = Off-farm income (₦);

X_8 = Cooperative membership (Member 1, Non-member 0);

X_9 = Household size (Number);

X_{10} = Volume output (kg);

X_{11} = Extension contact (Contact 1, No contact 0);

β_0=Slope or intercept;

β_1- β_{10} = Coefficient of regressors;

U = error term.

4. Results and Discussion

4.1. Demographic Profile and Income Generating Activities of Households

Table 2 reveals the average age of respondents within the locations, with an average of 43 years of age across the locations. These findings indicate that the respondents are active and at their productive age for sound decision making in diversifying their income sources through engagement in other income-generating activities for improvement in their livelihood. It will equally assist them in accepting innovations for improvement in their farming activities. Being at an active and productive age will also help the respondents provide solutions to social issues associated with their society and speak with one voice toward policy formulation and implementation. Another study found the

average age of respondents to be 53 years which is a little higher than what is found in this study [17].

The findings in table 2 also revealed that the average years of farming experience was eleven years of farming experience across the locations. The average years were also revealed based on locations specific. This implies that respondents had experience in farming activities that will make them active in diversifying their income sources for improvement in their farming activities as their primary activities and livelihood improvement. And Adelomo (2016) reported that 47.9% of the respondents they studied had above 15 years of farming experience [18].

The average household sizes of the respondents base on locations specific were also showcased in table 2, with an average of nine (9) household members across the locations. Looking at the average age and average households size and considering the culture of the rural areas symbolised a correlation between their age and household size due to early marriage in the traditional northern rural societies. The household members usually served as the labour force in agricultural production. Equally, household members contribute towards the improvement of the livelihood of the household through engagement in other income-generating activities.

The respondents' farm size, which usually serves as the primary factor of their production, was revealed by the findings in table 2. The respondents' average farm size across the locations was 1.54 hectares of land. This indicated that the respondents were small scale farmers cultivating less than five hectares of land classified by food and agriculture organisations. Having small farm holding implies that farmers cannot be able to produce in commercial quantity. This will limit their income for sustaining their lives which warrants the engagement in other income sources to complement the needs of their households.

On average, respondents earned ₦351,016.34 annually across the locations, as shown in table 2. Using an average of three dollars per day per head as recommended by global economy and with the current dollar price per naira, which is equivalent to five hundred naira, it means the respondents are poor and cannot provide good quality food to the household. This shows that the respondents survive below three dollars per day per household, not per head. This is to show the extents to which how people are living in poverty. To reduce the effect, respondents have to engage in other activities for income generation. Paul et al. (2020) reported that the respondents earned ₦210,566.60 per annum [19].

Table 2. *Quantitative Characteristics of Respondents.*

Variables	Kano	Jigawa	Bauchi	Gombe	Pooled
Age (years)	43	46	41	40	43
Farming experience (years)	12	9	10	12	11
Household size (No.)	9	11	8	7	9
Farm size (ha)	1.38	2.05	1.26	1.48	1.54
Average Annual Income	445,655.40	398,965.81	258,982.50	300,461.63	351,016.34

4.2. Distribution of Respondents by Educational Status

It was found from the result in table 3 that the majority of the respondents had one form of formal education or the other. The remaining had no formal but can be able to write and read in another language (Arabic). This implies that they can use their knowledge to make wise editions that will affect their lives appropriately. Similarly, their knowledge will also help them make the right choice in diversifying their income source for the betterment of their life. Another study reported that 73.4% of the respondents had formal education [18].

Table 3. *Distribution of Respondents by Educational Status (%).*

States	No Formal	Primary	Secondary	Tertiary	Total
Kano	12.2	43.2	32.3	12.4	100
Jigawa	15.2	52.2	25.7	6.9	100
Bauchi	13.3	49.4	30.2	7.2	100
Gombe	17.7	50.4	20.0	12.0	100
Pooled	14.6	48.8	27.0	9.6	100

4.3. Household Income Generating Activities

Figure 1 depicts the income-generating activities engaged by the households across the locations**.** It was found from the figure that crop production is one of the major sources of income among the respondents across the entire location, followed by livestock and poultry rearing. Another source of income varies with the location. For instance, after crop production and livestock rearing, it was found that respondents engaged in wholesale and retail trading in Kano and Jigawa states. This has to do with the trading activities in Kano as the centre of commerce, while Jigawa is a neighbouring state created from it. In addition to that, skilled salary employment was also found as an additional income source among Kano respondents. The remaining income-generating activities were petty trading engaged by a small portion of the respondents. This implies that respondents largely depend on agricultural production and livestock rearing as a source of income. Therefore, there is a need to engage in other activities that will help sustain agricultural production. Onyebu reported that 100% of the respondents engaged in crop and livestock farming and engaged in one or two other income-generating activities [20].

	Kano	Jigawa	Bauchi	Gombe	Pooled
Products from crop production	53.56	64.88	58.73	69.65	61.71
Livestrock and poultry raising	39.55	40.48	35.68	49.34	41.26
Fishing	19.23	13.77	8.49	14.37	13.97
Forestry and hunting	2.38	4.54	1.86	4.18	3.24
Wholesale and retail trade	31.54	26.45	10.18	11.32	19.87
Manufacturing/handcraft	2.35	6.87	10.16	8.95	7.08
Skilled salried employment	18.95	11.21	7.38	6.84	11.10
Unskilled salried employment	23.15	18.86	16.48	12.59	17.77
Support from children and relatives	13.28	12.45	16.58	10.56	13.22
Transportation/petty trading/services	3.54	7.45	5.68	8.49	6.29
Daily/Common labourer	8.95	12.58	10.16	9.54	10.31
Mining and quarrrying	0	2.16	1.64	3.36	1.79
Construction/skilled labour	4.35	6.58	3.22	4.48	4.66
Pension, government alowances	1.88	0	2.31	0	1.05

Figure 2. *Household Income Generating Activities.*

4.4. Access to Credit, Market, Extension Contact and Cooperative Participation

The result in table 4 reported the access to credit, market, contact with extension contact and cooperative membership of the respondents. As shown in the table, most respondents across the locations do not have access to credit facilities. This has to do with the procedure to follow before accessing the credit, to be precise. The implication is that production at a large scale will be very difficult among the farming household without enough capital to procure the necessary inputs, which will invariably affect the production and, subsequently, the farmers' income. Therefore, the need to diversify the source of additional income. Adelomo, in their study, reported that 52.1% of the respondents considered having access to credit from informal sources [17]. It was equally found from the result that most of the respondents had access to the marketplace and, at the same time, market information. These will help produce and supply what the market needs to obtain a premium price. The premium price obtained will help ensure more income at the hands of the respondents for diversification into other activities for more income generation.

The result in table 4 also reveals that most of the respondents had contact with Contact with extension at different time intervals. This implies that respondents can access vital information concerning the production and marketing of their products. This may be associated with why most respondents had access to market information. Having access to production and market information will assist in obtaining maximum output and better market price, which will help obtain more income for diversification into other activities that will generate more income for improvement of livelihood. A study conducted by Adelomo reveals that 83.3% of the respondents considered having contact with an extension agent at different time intervals [17].

It was also found from the result in table 4 that the majority of the respondents across the locations belong to a cooperative group. This helps in deriving many benefits such as access to information, credit, and social capital for improvement in the member's livelihood. These affect the production and income of the respondents for diversification into other activities. Nlerum and Ogu reported that almost 90% of the respondents belong to cooperative societies [11].

Table 4. *Access to Credit, Market, Extension Contact and Cooperative Participation (%).*

States	Credit Access		Market Access		Extension Contact		Cooperative Membership	
	Access	No Access	Access	No Access	Contact	No Contact	Member	Non Member
Kano	21.55	78.45	78.54	21.46	54.65	45.35	69.33	30.67
Jigawa	14.77	85.23	79.45	20.55	67.67	32.33	66.55	33.45
Bauchi	12.75	87.25	65.78	34.22	53.82	46.18	59.38	40.62
Gombe	9.64	90.36	69.05	30.95	51.45	48.55	57.85	42.15
Pooled	14.68	85.32	73.21	26.80	56.90	43.10	63.28	36.72

4.5. Household Access to Land for Crop Production

Table 5 reveals the accessibility of farmland for arable crop production among the respondents across the locations. It was found that the majority of the respondents in kano (66.7%) and Jigawa (61.6%) had access to arable land for crop production. In comparison, the majority in Bauchi (595%) and Gombe (59.3%) had less access to arable land for crop production. The availability of land within Kano and Jigawa may be associated with the land areas in the locations and the intensity of agricultural production due to the availability of the land. Those with less access to farm land within Kano and Jigawa aligned it with inadequate capital as one obstacle limiting their access to such farmland. While in the other two locations, Bauchi and Jigawa, reported similar issues that hindered their access to farmland. The inaccessibility to farmland negatively affects agricultural production among the respondents and their income, making diversification difficult. This agreed with Onya, Ugochukwu and Ejiba, who found 35% of the respondents had high access to farm land, 42% had moderate access, and 22% had low access to farmland in their study [21].

Table 5. *Household Access to Land for Crop Production.*

Variables	Access to Farm Land for Crop Production		Main Reason for the lack of access to farmland				
	No	Yes	Not into farming	Insecurity/Displacement	Lack of capital	Lack of land	Others, Specify
Zone I							
Kano	29.8%	70.2%	23.5%	0.0%	41.2%	14.7%	20.6%
Jigawa	69.0%	31.0%	4.7%	0.0%	34.9%	34.0%	26.4%
Bauchi	56.1%	43.9%	1.4%	0.0%	38.0%	47.3%	13.3%
Gombe	63.5%	36.5%	0.0%	0.0%	47.3%	35.5%	17.2%
Zone II							
Kano	39.5%	60.5%	32.4%	1.5%	30.9%	32.4%	2.9%
Jigawa	39.0%	61.0%	90.2%	0.0%	4.9%	4.9%	0.0%
Bauchi	57.1%	42.9%	15.8%	0.0%	39.4%	45.0%	12.2%
Gombe	49.2%	50.8%	4.8%	0.0%	56.2%	33.1%	10.7%
Zone III							
Kano	28.7%	71.3%	13.6%	4.5%	43.2%	20.5%	18.2%
Jigawa	4.0%	96.0%	0.0%	14.6%	66.7%	0.0%	18.7%
Bauchi	66.9%	33.1%	0.0%	0.0%	61.7%	28.3%	10.0%
Gombe	57.6%	42.4%	7.9%	0.0%	64.3%	27.8%	0.0%
Pooled							
Kano	33.3%	66.7%	24.7%	2.1%	37.0%	24.7%	11.6%
Jigawa	38.4%	61.6%	21.5%	3.6%	36.4%	19.5%	19.0%
Bauchi	59.5%	40.5%	9.2%	0.0%	40.7%	38.9%	11.2%
Gombe	59.3%	40.7%	5.2%	0.0%	54.3%	32.2%	13.5%

4.6. Engagement in Multiple Income Generating Activities

As depicted in table 6, though the result is locations base and across, the pooled result shows that most of the respondents engaged in one form of income generation activity besides crop production and livestock rearing in the previous results. The ability to generate revenue from the activities is a subject of discussion at the time of this study. The respondents base this on series of issues ranging from falling sick in Kano (27.3%), temporary dismissal from a place of work due to Covid-19 in Jigawa (54.0%) to closer of working place in Bauchi (20.1%) and Gombe (11.1%) states. These negatively influence the income of the respondents and subsequently affect their livelihood. Odoh, Nwibo, Eze, and Igberi reported that 82.5% of rural households diversified their income sources into non-farm activities against 17.5% that depended solely on-farm activities [22].

Table 6. *Practice of Multiple Income Generating Activities.*

Variables	Ability to practice one or more of these income activities that generate revenue?		Reasons why were you unable to PARTIALLY or FULLY generate revenue from these activities						
	No	Yes	Temporary dismissal due to COVID-19	Closed workplace and cannot work from home	Sick of not feeling well	Need to care for a sick household member	Reduction of working time	Curfew and lockdown measures	Other reasons (specify)
Zone I									
Kano	28.7%	71.3%	7.7%	0.0%	34.6%	7.7%	7.7%	3.8%	38.5%
Jigawa	38.8%	61.2%	8.1%	0.0%	10.8%	2.7%	0.0%	0.0%	78.4%
Bauchi	34.6%	65.4%	3.5%	0.0%	27.0%	1.4%	11.0%	0.0%	38.5%
Gombe	31.8%	68.2%	2.4%	18.9%	1.7%	2.5%	13.6%	0.0%	60.9%

Variables	Ability to practice one or more of these income activities that generate revenue?		Reasons why were you unable to PARTIALLY or FULLY generate revenue from these activities						
	No	Yes	Temporary dismissal due to COVID-19	Closed workplace and cannot work from home	Sick of not feeling well	Need to care for a sick household member	Reduction of working time	Curfew and lockdown measures	Other reasons (specify)
Zone II									
Kano	17.6%	82.4%	10.5%	5.3%	21.1%	10.5%	5.3%	15.8%	31.6%
Jigawa	10.9%	89.1%	98.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%
Bauchi	25.4%	74.6%	2.5%	22.2%	2.4%	3.6%	1.4%	0.0%	67.9%
Gombe	26.8%	73.2%	3.6%	7.8%	0.4%	0.0%	9.2%	0.0%	79.0%
Zone III									
Kano	33.3%	66.7%	25.0%	0.0%	25.0%	9.4%	3.1%	6.3%	31.3%
Jigawa	42.6%	57.4%	47.5%	6.8%	6.8%	3.4%	3.4%	3.4%	25.4%
Bauchi	16.8%	83.2%	1.8%	17.8%	13.6%	1.4%	0.6%	0.0%	65.0%
Gombe	29.2%	70.8%	6.8%	5.6%	3.6%	3.0%	12.7%	0.0%	68.3%
Pooled									
Kano	25.7%	74.3%	15.6%	1.3%	27.3%	9.1%	5.2%	7.8%	33.8%
Jigawa	30.8%	69.2%	54.0%	2.8%	5.5%	2.1%	2.8%	2.1%	30.3%
Bauchi	31.0%	69.0%	2.8%	20.1%	8.4%	3.3%	4.6%	0.0%	60.8%
Gombe	30.2%	69.8%	4.1%	11.1%	2.0%	2.7%	12.1%	0.0%	68.0%

4.7. Livelihood Impact of COVID-19 on Household Living Standard

4.7.1. Effect of COVID-19 on Household Income Source

The result in table 7 reveals the effect of Covid-19 on household income sources. Despite the effort made by the respondents to engage in one or two income-generating activities, the global pandemic (Covid-19) brought many issues that affected the life of the respondents. As shown in the result, the pandemic resulted in a disproportionate increase in the cost of living, as reported by most of the respondents from Kano (43.5%) and Bauchi (48.7%). In comparison, Jigawa (52.6%) and Gombe (40.1%) reported a deterioration in income, which increased the cost of living. This implies that the pandemic (Covid-19) surely influences the respondents' income, which also necessitates the need to diversify ways of earning means of living.

Table 7. *Effect of COVID-19 on Household Income Generation Source.*

	Complete loss of income source	Deterioration in income	No difference	Improved income	Change in income source	The disproportionate increase in the cost of living
Zone I						
Kano	0.0%	34.5%	0.0%	0.7%	16.2%	48.6%
Jigawa	8.6%	12.9%	1.7%	0.0%	49.1%	27.6%
Bauchi	2.3%	42.4%	0.0%	1.0%	7.3%	47.0%
Gombe	6.1%	37.3%	1.2%	2.0%	4.6%	48.8%
Zone II						
Kano	7.2%	37.8%	1.6%	0.4%	16.5%	36.5%
Jigawa	0.0%	91.2%	6.9%	0.0%	0.0%	1.9%
Bauchi	1.3%	36.2%	0.0%	0.7%	14.9%	46.9%
Gombe	3.4%	47.5%	0.0%	0.5%	17.7%	30.9%
Zone III						
Kano	1.3%	34.0%	0.0%	0.6%	14.0%	50.0%
Jigawa	27.8%	43.0%	0.0%	0.0%	23.8%	5.3%
Bauchi	5.1%	27.5%	3.1%	1.6%	12.3%	50.4%
Gombe	6.1%	40.1%	0.3%	3.0%	17.2%	33.3%
Pooled						
Kano	3.7%	35.8%	0.7%	0.5%	15.7%	43.5%
Jigawa	15.9%	52.6%	2.7%	0.0%	28.4%	0.2%
Bauchi	3.0%	33.3%	3.1%	1.2%	10.7%	48.7%
Gombe	5,5%	40.1%	0.5%	1.8%	12.3%	38.2%

4.7.2. Remittances and Its Frequency During COVID-19 Pandemic

The results from table 8 depict the situation of the households' alternative source of income during the covid -19 pandemic for livelihood improvement. The result shows that almost all the households received remittances before the start of the Covid 19 pandemic across the entire locations of Kano (90.0%), Jigawa (99.7%), and Bauchi (84.4%) and Gombe (84.6%) as reported by the respondents. But during the pandemic, changes occurred in terms of frequency and the amount received by the households from their members for the sustenance of the household day to day activities, as reported by the respondents. Though the results vary with the

zones within a location and also between locations, across the locations, it was found that in kano (56.3%), Jigawa (63.0%), and Gombe (48.4%) reported increase in the remittances from the members of the household for the running of the affairs of the households despite the Covid -19 pandemic while in Bauchi 40.2% of the respondents reported decrease in the remittances received by the households from their members working somewhere else. This influences the livelihood of the members and their ability to diversify their activities for income generation.

Table 8. *Remittances and Its Frequency during COVID-19 Pandemic.*

Variables	Did the household receive remittance before the start of the COVID-19?		SINCE THE START OF THE COVID-19 PANDEMIC, has there been any change in frequency and/or the amount of money sent by household member (s) working outside the community or the country?			
	No	Yes	No change	Increased	Reduced	Resorted to alternative income sources
Kano	81.9%	18.1%	10.5%	60.5%	21.1%	7.9%
Jigawa	100.0%	0.0%	3.9%	58.3%	29.1%	8.7%
Bauchi	78.6%	21.4%	10.5%	28.5%	56.0%	5.0%
Gombe	84.2%	15.8%	5.8%	45.0%	57.0%	6.2%
Zone II						
Kano	93.3%	6.7%	3.4%	52.5%	32.2%	11.9%
Jigawa	100.0%	0.0%	2.0%	98.0%	0.0%	0.0%
Bauchi	82.8%	17.2%	4.4%	19.5%	37.4%	13.5%
Gombe	81.0%	19.0%	3.5%	52.0%	38.3%	6.2%
Zone III						
Kano	94.3%	5.7%	0.0%	58.6%	41.4%	0.0%
Jigawa	99.0%	1.0%	34.0%	50.0%	15.0%	1.0%
Bauchi	91.1%	8.9%	29.9%	47.1%	19.9%	3.1%
Gombe	87.6%	12.4%	3.5%	49.2%	45.3%	2.0%
Pooled						
Kano	90.0%	10.0%	4.8%	56.3%	30.9%	7.9%
Jigawa	99.7%	0.3%	15.4%	63.0%	17.7%	3.9%
Bauchi	84.4%	16.6%	14.3%	38.1%	40.2%	7.4%
Gombe	84.6%	15.3%	4.3%	48.4%	43.0%	4.3%

4.8. Determinants of Households Income Diversification

The result in table 9 reveals the mean variance inflation factor (VIF) multi-co linearity test to be 1.19 and none of the individual variables have a VIF value above 6.00, and the tolerance level of 79.8 percent indicates the absence of any serious multi-co linearity. Findings indicated that coefficient of access to credit was 0.059 implying that a unit increase access to credit ends to correspondent increase in the number of income diversification sources. This result is in conflict with findings of Ahmed who reported access to credit as variable that doesn't significantly influence household income diversification [23]. This disagreement can be argued that since most of the alternative investment requires finance for diversification, agricultural credit/loan has a greater role to play for the improvement of rural income diversification to venture into off-farm and non-farm income generating activities.

Educational status indicates a significant positive relationship with number of income sources or diversification alternatives at 10% probability level. This shows that the higher the level of farmers' education, the higher will be the probability of creative thinking to venture into alternative income source. Similar findings were reported by Adepoju and Obayelu on relevance of educational attainment to income diversification [24]. Bishop also reported similar findings concerning educational attainment in respect of income diversification determinants in rural communities [25]. The influence of off-farm investment in increasing income sources of the household is shown in table, 30 with statistics of positive and significant coefficient of the variable at 1% level of probability (table 10). This implies that a unit increase in off farm income might result to corresponding increase of household income diversification. This is in conformity with findings of Amanze, Ezeh and Okoronkwo who reported off-farm income as an important parameter that contribute substantially to rural livelihood [26].

The study further revealed household size as a significant important variable that positively influence household income diversification at 10% level of probability. The estimated coefficient (0.065) implies that income diversification of household will increase by 7.9% for a unit increase in household size. This result conforms to the findings of Bishop (2014) who reported significant positive influence of household size on income diversification in rural areas. The nature of household composition with more adult and energetic members can be used to support farming and other alternative investment in rural communities. Volume of output produced were significant variable that positively influence household income diversification at 1% level of probability. The estimated coefficient of 0.215 for maise output implies that a unit increase in maise output will increase the number of income diversification sources by 53.9%. Production surplus of maise in this context can be used to initiate alternative income source among smallholder farmers in the study area. Megabowon and Mushenge reported positive probability of agricultural activities in increasing the number of income diversification sources in rural areas [9].

Table 9. *Determinants of Households Income Diversification.*

Variables	β	S.E	t-value	Sign.	Tolerance	V.I.F
Constant	10.559	0.061	51.412	0.023***	----	----
Age of the farmer	-0.051	0.004	-0.352	0.651	0.512	2.431
Farming experience	0.092	0.008	3.617	0.571	0.564	2.621
Access to credit	0.059	0.021	4.651	0.032**	0.653	1.813
Educational status	0.036	0.011	2.652	0.082*	0.884	1.321
Household farm size	-0.071	0.065	-0.653	0.351	0.563	1.321
Access to market	0.028	0.023	0.452	0.562	0.193	1.421
Off-farm income	0.546	0.008	10.452	0.001***	0.677	1.317
Cooperative membership	-0.008	0.061	-0.098	0.041	0.654	1.651
Household size	0.065	0.512	2.653	0.061*	0.786	1.564
Volume of output	0.251	0.549	4.651	0.004***	0.892	1.217
Extension contact	0.079	0.321	7.631	0.301	0.906	1.185
Model Statistics						
R	0.695					
R-square	56.711					
R-square adjusted	55.86					
F-value	51.321***					
DW-statistics	2.077					

4.9. Major Agricultural Constraints in Sudano-Sahelian Region

Result in table 10 above shows the constraints that militate against agricultural production among the farming households which necessitate the need for diversification of activities to be able to meet the expected output from agricultural production more especially crop production. Some of these problems as reported by the respondents were high cost of agricultural input reported by 14.8% of the respondents from Kano, 19.9% from Jigawa, 19.3% from Bauchi and 22.95 from Gombe. Other problems were as reported as shown in the table above. This problem may hinder the production of agricultural produce in the locations as their primary occupation and invariably affect the income of the respondents and ability to diversify their activities for better improvement in their livelihood**.**

Table 10. *Major Agricultural Constraints in Sudano-Sahelian Region.*

Variables	Increasing Insecurity	Lack of improved seeds	Low soil fertility	Pests and diseases	Lack of cash/money	Lack of land	Lack of rain/delayed rainfall/Lack of water	High costs for agricultural inputs	High costs for labour
States	**Agricultural Constraints I**								
Kano	1.9%	11.7%	9.4%	9.2%	13.0%	6.9%	4.3%	14.8%	7.0%
Jigawa	3.3%	6.8%	9.3%	5.9%	14.2%	3.8%	1.9%	19.9%	14.1%
Bauchi	1.8%	5.9%	7.3%	8.0%	17.4%	5.0%	2.4%	19.3%	13.2%
Gombe	2.6%	6.6%	8.5%	7.2%	21.4%	3.6%	4.2%	22.9%	11.5%

Table 11 reveals other constraints that are livestock production base which also affect their production across the locations. It was found from the result that inadequate access to credit facilities largely affect the production of livestock across the locations except for Gombe where largely the constraint there was insufficient feed/fodder to feed the animals. These also affect the income source of the respondents and their livelihood. Ojeka, Effiong and Eko reported that, food imports, diversion of funds meant for agricultural purposes and low technology diffusion in agriculture are among the factors identified as constraints to agricultural development in Nigeria [27].

Table 11. *Major Agricultural Constraints in Sudano-Sahelian Region.*

variables	Lack of access to credit, collateral	Lack of storage facilities	Lack of animal health staff	Lack of animal Feed//Fodder	Lack of access to market	Lack of fishing inputs	Fish diseases	No other constraint	Others Specify
States	**Agricultural constraints II**								
Kano	7.3%	4.1%	2.7%	3.2%	0.5%	0.0%	0.1%	1.2%	2.7%
Jigawa	7.7%	1.5%	3.5%	4.5%	1.4%	0.1%	0.0%	0.0%	2.1%
sBauchi	6.3%	3.1%	1.8%	5.5%	0.9%	1.1%	1.0%	0.0%	0.0%
Gombe	5.5%	2.5%	1.6%	6.6%	1.0%	0.8%	0.6%	0.0%	0.0%

5. Conclusion and Recommendations

The development of household and community requires multiple income alternatives for improved livelihood in the area of saving mobilisation and diversification through reliable investment opportunities. Households in Sudano-Sahelian region engaged in agriculture and various additional

income sources which must be strengthened to effectively support income generation at all times. The study further concluded existence of potential income diversification alternatives or enterprises in rural areas including multiple cropping, off-farm investment and non-farm income potentials. COVID-19 period posed a serious constraint to household particularly deterioration in income sources which make livelihood activities more difficult during the period. Access to credit, educational status, off-farm income generation and volume of output are the strongest determinants of income diversification in Sudano-Sahelian region. In line with aforementioned findings, the study therefore recommends the following:

1) There is need for government and development agencies to improve the quality and availability of rural infrastructural facilities (road, markets, electricity) in the study area so as to help the rural household sustain their investment and engage in addition sustainable livelihood activities.
2) The development of essential programs on enterprise support and business development service is very essential to strengthen livelihood and income diversification opportunities. This will provide conducive rural environment in terms of providing adequate employment and income generation for sustainable livelihood development.
3) There is need for government to provide more support to the formal and informal capacity building at the local level to enhance human, social and financial assets of rural households and make them adopt more non-farm livelihoods for sustainable living.
4) Strengthening cooperatives participation and awareness creation on savings, investment opportunities is very essential for the sustainable livelihood. This implies the need for rural households in Sudano-Sahelian region to strengthen collective actions, enhance risk strategies and influence government policies for livelihood development.

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