Livelihood transition and economic well-being in remote areas under the threat of cattle rustling in Nigeria

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Abstract Livelihood diversification has been recognized as an important strategy applied by vulnerable households to cope and adapt with institutional stresses, environmental and economic shocks. However, the complex interaction between cattle rustling, livelihood transition and well-being remains only partially explored. This study investigates the impact of cattle rustling on well-being as well as how cattle raiding is driving the livelihood transition. Using cross-sectional data of 1750 households analysed via multiple indicators and multiple causes (MIMIC), Logit and ordinary least squares regression, the results of this study elicit three key findings. First, cattle rustling has a significant negative effect on well-being. Second, there is a strong tendency for cattle raid affected households to transit out from farm labour, handicrafts and livestock production. However, affected households engaging in high return activities, such as trade and civil service, show a reduced likelihood of livelihood transition. Third, the constructed well-being index is low (0.33), indicating that households are actually transiting to low return sectors. However, participation in high return sectors requires resource investment capacities in terms of human, social and financial capital, which are substantially lacking in remote areas. In this sense, improving the level of literacy through both conventional and vocational education is key to achieving the rural welfare enhancement programmes.

Keywords Agrarian · Income diversification · Livelihoods · Violent conflict · Well-being

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Introduction

Livelihood transition in the context of rural development is commonly considered as a strategy applied by vulnerable households to cope with and adapt to institutional stresses, environmental and economic shocks (Aliero et al., 2010). Livelihood transition, illustrated by job switching or shifting activities away from traditional agriculture to other sectors, can be used as an important instrument for poverty reduction. Livelihood transition is defined as the process by which rural households construct a diverse portfolio of activities essential for smooth job switching in order to survive and enhance their living standards (Ducrotoy et al., 2017).

While livelihood is interpreted as the means of gaining a living or a combination of the resources used and the activities undertaken in order to subsist, the

scarcity of these resources could fuel conflict due to competition and subsequently lead to a drastic reduction in livelihood assets as those affected by scarcity may resort to fighting over the remaining resources (Ibrahim et al., 2019). In this way, the Intergovernmental Panel on Climate Change (IPCC) reported that parts of Africa may experience unpredictable rainfall variability (IPCC, 2014), which is likely to exacerbate the conflicts as a result of the increased competition for already scarce natural resources. It is therefore imperative to understand the various livelihood diversification options and their associated employment, income and welfare effects, particularly now that the income diversification strategy is recognised as the impetus needed for the achievement of the sustainable rural development agenda.

Cattle rustling (or cattle raiding or livelihood raiding—the term was interchangeably used in this study) as a form of violent conflict involves the forceful acquisition of livestock and other livelihood assets. The raiding of livelihood in remote areas has evolved over time, from what was once used as a traditional practice of testing bravery involving small-scale violence, to commercialised cattle raiding facilitated by the proliferation of small arms (Ibrahim et al., 2019). A number of studies have asserted that cattle raiding and other forms of violent conflicts (such as banditry and ethno-tribal crises) are adversely affecting the sustainability drive of Sub-Saharan African countries (see Ducrotoy et al., 2017; Majekodunmi et al., 2017). In Nigeria, particularly in the northern part where 80% of rural dwellers primarily engage in agriculture-based livelihoods (Ibrahim & Ahmad, 2013), the ability of rural individuals and households to enhance their well-being is largely based on the stability of crop and livestock production.

The livelihood strategies in agrarian economies have been discussed in the context of the rural development literature for decades (Aliero et al., 2010; Ellis, 2000). Extant literature has shown that livelihood transition driven by either 'push' (necessity or survival) or 'pull' (choice or accumulation) factors would widen the subsistence options, and can be instrumental in poverty reduction (for instance, see Scoones, 2009; Gautam & Andersen, 2016). However, Walelign and Jiao (2017) argued that the current approach of examining the impact of livelihood transition on level of income is imprecise because of the stochastic nature of income. This approach failed to take into account seasonality and sudden shocks, which may affect the correlation between livelihood transition and well-being. This study departs from and builds upon the extant literature in two ways. First, it utilizes the multidimensional indicators of well-being as opposed to a single metric (income or expenditure). This allow us to establish how income, employment and well-being effects are associated with various livelihood strategies. It also examines the effect of cattle rustling on well-being in Nigeria, which remains only partially explored (Ducrotoy et al., 2017; Ibrahim et al., 2019). Thus, this study aims to investigate the impact of cattle rustling on well-being. The specific objectives are: (i) to investigate how cattle raiding is driving the livelihood transition; and (ii) to explore whether job switching from the traditional mix of crop and livestock production to diversified economic activities can enhance the well-being of households. All these objectives will contribute to the debate on the nexus between violent conflict, livelihood diversification and well-being in remote areas. Understanding this complex interaction is crucial to unravelling how the manifestation of cattle rustling is shaping the role of livelihood transition on well-being enhancement.

The rest of the paper is structured as follows: "Literature review" section reviews relevant literature. "Description of the study area" section describes the study area. "Empirical methodology" section presents the methodology. "Empirical results and discussion" section contains the empirical results and discussion, while the last section concludes the paper.

Literature review

Securing livelihoods and well-being in the remote areas of African continues to be challenging as a result of the rapid changes in an array of socio-ecological conditions, unpredictable climatic conditions, adverse economic indicators, and low adaptive capacities (Ulrich et al., 2012). Several rigorous empirical literature has investigated how livelihood assets and rural well-being have changed as a result of the rapidly changing social context. For instance, Sallu et al. (2009) have examined the dynamic impact of biodiversity on contemporary rural livelihoods in Botswana. They found that complex settlement-specific factors driven by political and socio-economic conditions are critical to livelihood transition. Ulrich et al.

(2012) employed rich data from 170 Kenyan households and found evidence of livelihood transition driven by low asset endowment. Walelign and Jiao (2017) utilized an integrative method of combining income and assets to investigate livelihood strategies and household movement between strategies over time. While their study revealed that the majority of households changed livelihood strategy at least once over three years, farming, economic migration, and trade were found to be pathways out of poverty. To assess environmental reliance and the dynamism of livelihood transition, Jiao et al. (2017) employed a latent cluster and regression model of rural households from Nepal. The results revealed a weak nexus between livelihood transition and poverty reductions as the majority of households persisted in relatively lower remunerative livelihood strategies. They further identified education, access to basic infrastructural facilities and ownership of physical assets as salient factors that shape access to more remunerative livelihood strategies.

Income inequality and vulnerability are factors that determined the rate of poverty in an agrarian economy. Gautam and Andersen (2016) have identified the low and high pathways through which livelihood diversification can improve the well-being of vulnerable households. Ducrotoy et al. (2017) have examined the structural livelihood changes driven by violent conflict in pastoral communities in Nigeria and found that rapid transhumanism was induced by cattle raiding. Ibrahim et al. (2020a) examines the drivers of pastoral migration in Nigeria and found that pull factors (availability of water and pasture) and push factors (social inequality and violent conflict) were shaping the intensities of transhumanism. Alamgir et al. (2020) have examined income disparity of farm households using rich data of flood-prone communities in Bangladesh. While the study found that per capita income disparity is significant among farm households, low level of income differences is prevalent among more diversified households. Other sets of studies (Aliero et al., 2010; Ibrahim et al., 2020b; Kynoch, & Ulicki, 2012; Majekodunmi et al., 2017) have examined how violent conflict is affecting livelihood diversification, particularly in agro-pastoral communities.

Extant studies have already provided insights into livelihood transition driven by observable idiosyncratic shocks. However, it remains plausible whether job switching from the traditional mix of crop and livestock production to diversified economic activities can actually enhance the well-being of households. An empirical investigation into the complex nexus between cattle rustling, livelihood diversification and well-being is crucial in unravelling how the manifestation of violent conflict is shaping the role of livelihood transition on well-being enhancement. This has policy implications for understanding the contributions of various livelihood strategies on well-being in an increasingly insecurity-prone Sub-Saharan African economy.

Description of the study area

This study covers the remote areas that are prone to cattle rustling in the north-western part of Nigeria (see Fig. 1). The region consists of two distinct agro-ecological zones: the short-grass savannah around Jigawa, Kano, Katsina, Kebbi, Sokoto and Zamfara states on the one hand, and the woodland and tall grass savannah in Kaduna state and the seven Local Government Areas (LGAs) of Katsina South on the other.

With a tropical sub-humid climatic environment and uni-modal rainfall (May–October) as well as an average temperature of 28 °C, the north-western region of Nigeria has an agrarian economy that supports the livelihoods of over 80% of the rural populace (Ibrahim & Ahmad, 2013). The rain-fed agricultural-based livelihood is mainly subsistence in nature as characterised by a mixture of livestock-crop farming via localised technology in small landholdings. Agriculture is the primary source of income for the Hausa and Fulani tribes. The economy also comprises off-farm labour, informal and semi-formal financial sector, construction, craftsmanship, commerce, communication services, transportation, and other sources of income that complement crop and livestock production.

The economy has experienced a rapidly changing social context (economic and environmental changes) over the last two decades, leading to a gradual decrease in farming activities in most of the rural areas in the region. For instance, the Fulani pastoralists who had hitherto almost exclusively engaged in livestock production (mainly cattle and other ruminants) are increasingly embracing crop farming and
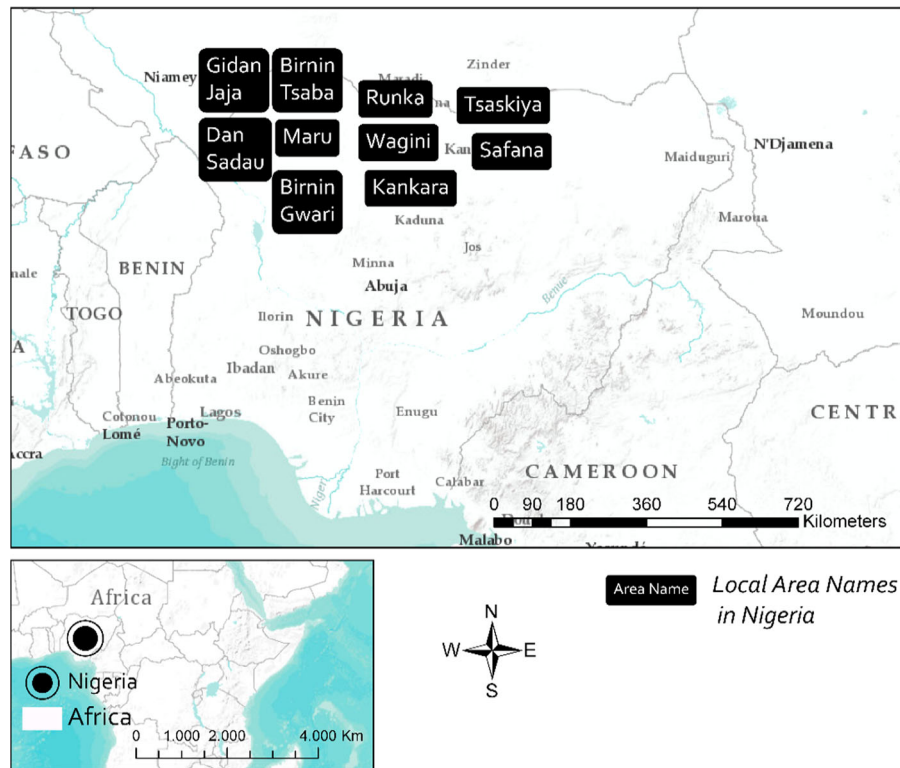
Fig. 1 Enumeration areas

trade (Ibrahim et al., 2019). In this way, the Fulani pastoralists have now settled and practice limited seasonal transhumance. While livelihood transition is more rapid among the pastoralists of the Sudanian Savannah, the Hausa and Fulani who predominantly reside in the northern Guinea Savannah zone are increasingly engaging in off-farm jobs such as government positions. Other minority tribes such as the Ebira, Igbo, Kanuri, Yoruba, among others, are increasingly employed in trade and salaried jobs other than crop and livestock production. In spite of these livelihood structural changes, 87% of the cattle are reared by the Fulani, while other tribes account for only 13% of cattle in Nigeria. Of the 8% Fulani tribe in Nigeria, 4% of them are nomadic whose grazing pattern causes serious problems to food security and forest conservation (Ducrotoy et al., 2017).

Empirical methodology

Data collection

Cattle rustling, like other forms of violent conflict, is a very complex subject to examine (Ibrahim et al., 2019). This calls for the cautious adoption of various techniques of data collection in order to remedy the endogenous problems that are often associated with observational data. Certainly, variables of interest in observational studies are often endogenous (Ibrahim et al., 2019). Thus, estimation of observational data is only robust, efficient and consistent if the endogeneity problem is suitably controlled (Chernozhukov & Hansen, 2013). The endogeneity problem exists because people choose either to raise livestock or not. Furthermore, some dwellers, particularly poor households, may have never had livestock and they could be systematically different from those who do have livestock. Additionally, some may be better equipped to protect themselves. Cattle rustling might occur in poorer areas, and those who rely more on livestock could be more economically challenged. All

this illustrates the potential sources of endogeneity. To eliminate this problem, (endogeneity problem in an observational study), the literature recommends the adoption of the multi-stage sampling procedure as well as the selection of an appropriate variable that controls for the sources for endogeneity associated with observable household characteristics (Aliero et al., 2010). To this end, we applied the empirical sampling guide used in Ibrahim et al. (2019) via which relevant data obtained from various state emergency agencies based on which states, LGAs, districts and villages were selected based on their agro-pastoral potential and the frequency of the cattle raiding. Based on these criteria, three LGAs from the epicentre of the menace and then two districts in the identified LGAs were purposely selected. Villages with severe and moderate cases of cattle theft in the selected districts were further identified and a random sampling process was then applied in selecting the 12 enumeration areas (EA) from each of the selected villages. At the village level, a stratified sampling method was adopted in order to incorporate various clans of Hausa-Fulani and minority tribes, while the altitudinal locations of their settlements were systematically selected proportionate to the total number of inhabitants in each of the selected villages (see Fig. 2).

The study utilised two complementary instruments for data collection: a household questionnaire and an interview guide for Focus Group Discussions (FGDs). The design of the household questionnaire followed extensive preliminary qualitative inquiries (including in-depth interviews and informal discussions), which facilitated the collection of data on various dimension of livelihoods, patterns and processes of livelihood transition. A household questionnaire was designed to solicit detailed salient information on household characteristics, well-being assets, livelihood strategies, consumption expenditures, livestock holding, physical assets, and social amenities, among other factors. The survey questionnaire was administered to 1,750 households, which included a statistically sizable representation of all major ethnic groups dwelling in the enumeration areas. This is roughly proportional to the district population composition of Hausa (48%), Fulani (46%) and other tribes (6%). In addition to the respondents sampled for questionnaire administration, three household heads from each surveyed area were selected for FGDs and a total of 489 discussants participated.
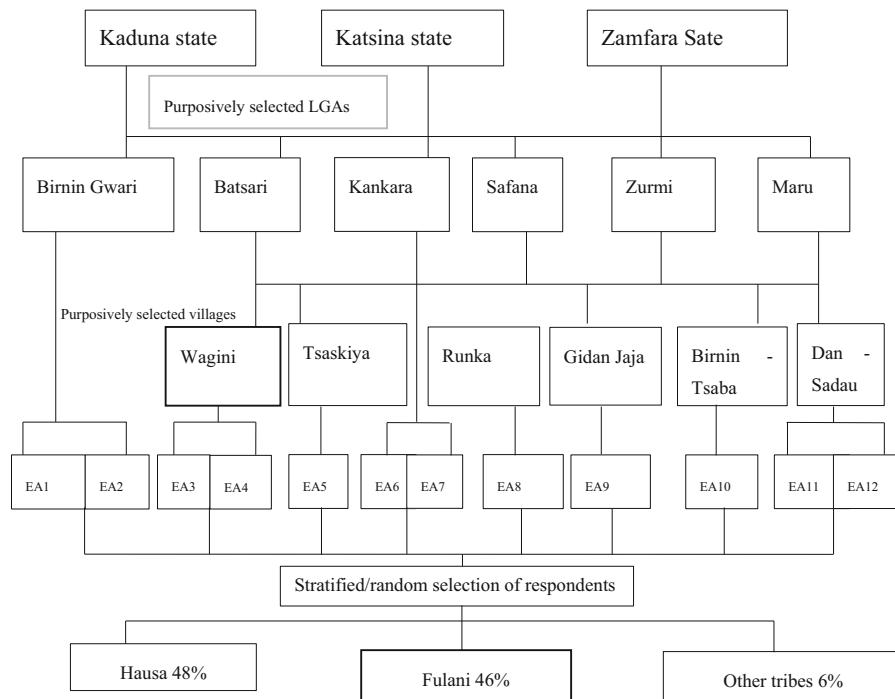

Fig. 2 A schematized multi-staged sampling flow

Estimation procedure

Many economic and social concepts, such as well-being and poverty, are multidimensional in nature and hence conceptually, they require measures or indices that capture and combine their various dimensions in an adequate manner (Ibrahim et al., 2019). Econometricians have shown that, even if an indicator is an unbiased representation of a theoretical construct, measurement error can still lead to biased conclusions (Aaker & Bagozzi, 1979; Ibrahim et al., 2019). For instance, improvement in well-being in the money-metric dimension does not necessarily imply an improvement in the non-monetary dimension of well-being (Ibrahim & Ahmad, 2013). Following previous studies (Gautam & Andersen, 2016; Ibrahim et al., 2019), this study adopted the construction of a self-reported well-being index (SWI) using the multidimensionality of bundle of factors that synthesizes the monetary and non-monetary indicators of well-being.

While measuring well-being via SWI, households were asked to free-list the key components of well-being factors and assign their respective weights during various sessions of the FGDs and household-level interviews (See Table 1 for details of the variables used in computing the components and

sub-components of SWI). A combination of three well-being factors consisting of housing, food and wealth, jointly form the broad components of SWI. To construct a household-specific well-being index, 13 key indicators associated with the broad components of well-being are selected according to their critical importance in the local context. Out of these 13 indicators, eight thematic question were asked to determine a household-specific possession of basic household assets and the status of sanitation. Questions that sought to ascertain the ownership of key household goods that add quality to their life (such as transistor radios, televisions, satellites, beds, dining tables, etc.) were also asked. The second component of SWI measures the aspect of the food consumption of the households via two important questions that capture the food security (inverse of food insecurity score) as well as per capita consumption expenditure.

Lastly, wealth enables households to meet certain social obligation ranging from naming ceremonies, weddings, and mortuary rites, among others. In this way, a high level of well-being is a reflection of adequate wealth, comprising cash, livestock holdings, farm hectares and other landed assets, which can be utilized as a buffer against sudden income fluctuations (Ibrahim & Ahmad, 2013). In standardizing the subcomponents of SWI, this study adopted the

Table 1 Variables used for constructing a well-being index

Component	Sub-component	Indicators	Measurement
Housing	Basic household assets	Owns electronics, such as transistor radio, television, satellite, etc	1 = yes; 0 = otherwise
		Furniture, e.g. bed, dining table, seat, etc	1 = yes; 0 = otherwise
		Has electricity (generator or/and national grid)	1 = yes; 0 = otherwise
		Has separate living room	1 = yes; 0 = otherwise
	Sanitation	Safe drinking water (public water system, borehole)	1 = yes; 0 = otherwise
		Access to indoor kitchen	1 = yes; 0 = otherwise
		Access to latrine	1 = yes; 0 = otherwise
		Has first aid box	1 = yes; 0 = otherwise
Food consumption		Food security	Inverse of food insecurity score
		Average weekly food expenditure	Converted to USD
Wealth	Savings	Cash savings	Converted to USD
		Livestock	Count
	Other assets	Landed assets	1 = yes; 0 = otherwise
		Farm hectares (H)	Valued in USD. $214/H

computational procedure of the United Nations Development Program (UNDP), which is often used in calculating Human Development Indices (HDI):

$$IndexX_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}, \tag{1}$$

where X_i is the observed value of an indicator of sub-component, X_{min} is the minimum value, and X_{max} is the maximum value of an indicator. The calculated index ranges from 0 to 1, while components with more than one indicator were derived simply by averaging the values of the sub-components.

Regression models

The study used Multiple Indicators and Multiple Causes (MIMIC) of a single unobservable latent variable model. This model is beneficial when multiple dependent variables need to be combined into a 'single' variable (Aaker & Bagozzi, 1979). It is normally modelled as a latent variable hypothetical construct which, while not directly observed, has operational implications for relationships among observable variables. The specification of MIMIC depends largely on precise econometric exposition, which suits the assumptions of maximum likelihood regression. The model is expressed as the latent variable z^* which is linearly determined, subject to a shock ϵ, by a set of independent manifest indicators $x_1, \ldots, x_k$:

$$z^* = \alpha'x + \epsilon, \tag{2}$$

$$z^* = \delta y + \mu, \tag{3}$$

where $x = (x_1, \ldots \ldots, x_k)'$ is a set of observable components of well-being, as presented in Table 1; $y = (y_1, \ldots \ldots, y_m)'$ is a set of observable factors that influence well-being; $\alpha = (\alpha_1, \ldots \ldots, \alpha_k)'$ and $\delta = (\delta_1, \ldots \ldots, \delta_m)'$ are the two respective parameters; and ϵ and $\mu = (\mu_1, \ldots \ldots, \mu_m)'$ are disturbances. The latent variable z^* is linearly determined, subject to disturbance ϵ, by the vector of x variables. On the other hand, the latent z^*, which is obtained from Eq. (2), is linearly affected by the components of y, subject to disturbance μ. It is essential to state that the MIMIC model is valid if and only if the estimated disturbances are mutually independent and normally distributed with zero mean and constant variance (Ibrahim et al.,

2019). Unlike the classical causality test, the MIMIC modelling requires that Eq. (2) be used to derive the unobserved variable(s), which would then be used as the endogenous variable to estimate the cause and effect of the other set of exogenous variables in the subsequent equation.

Livelihoods enable people to subsist either on the food they grow themselves, or earnings that are used to provide necessities and hopefully something more (Ibrahim & Ahmad, 2013). Each livelihood activity requires a person to possess or have access to a range of assets (sometimes called 'capitals') such as farm land, a skill, tools, livestock, etc. As such, to determine whether cattle rustling has a significant effect on well-being, the estimated well-being variable derived in Eq. (2) was modelled as:

$$SWI_i^* = \beta_0 + \beta_1 CRI_i + \beta_2 NLL_i + \beta_3 HDS_i + \beta_4 YD_i + \gamma_1 + \varepsilon_i \tag{4}$$

where SWI_i^* is the self-reported well-being of the ith household (a latent variable derived in Eq. 2); CRI is the cattle raid intensity introduced as a dummy variable that controls for the unobserved effect of area of residency (1 = intensive cattle rustling area, = 0 otherwise). Cattle raid intensive areas are villages with a number of reported cases of cattle theft that is greater than the average of the entire enumeration area. YD is income diversity (its detail computational procedure is discussed below) measured as monetary earnings realised from various livelihood activities and converted into US dollars (1 USD = 196.5 Nigeria Naira) to minimize the potential effect of inflation; HDS is herd size measured as total herding stocks owned by households; NLL is the number of livestock lost through cattle rustling; γ_1 measures the period of residency (in year) as a control for endogeneity linked to observable household characteristics (see Table 9 for details on variables measurements). Following previous studies (Ducrotoy et al., 2017; Scoones, 2009), it can be hypothesised that the coefficients of $\beta_1 < 0$ and $\beta_4 > 0$; once this condition holds, then the livelihood transition can be considered as an effective means of enhancing well-being in remote areas. In this sense, some coefficient(s) estimated in Eq. (5) must be statistically different from zero:

$$SWI_i^* = \gamma_0 + \sum_{j=1}^{n} \gamma_{jk} S_{ik} + \varepsilon_i \qquad (5)$$

where S_i denotes the vector of monetary earnings from different livelihood strategies, which consists of the profits from trade, farm wages, government salaries, income generated from handicrafts and earnings from livestock production, while γ and ε are the vector of estimated coefficients and a white noise error term, respectively.

Income diversity is driven by the desire of vulnerable households to build buffers against recurrent shocks, which are often induced by either the need to survive or take advantage of market opportunities. While vulnerability seems to be a driver for survival-led income diversity, opportunity-led diversification is pursued by households that want to engage in multiple income earning activities so as to accumulate wealth for future investment opportunities (Ellis, 2000). In most developing countries, the opportunities for off-farm jobs are limited due to low entry qualifications leaving many with no option than to engage in jobs that require fewer academic requirements (such as petty trade, crude manufacturing, among others). Income diversity can simply be measured as the multiplication of number of sources and income earned (income x number of sources). Alternatively, an index can be used to construct a value that ranges between 1 (denotes diversification) and 0 (specialisation). This study adopts Simpson's index of diversity (SID), which calculates income diversity on the basis of the distribution of total income in the diverse sources (Ibrahim et al., 2019) using as the following formula:

$$SID_i = 1 - \sum_{i=1}^{n} P_i^2 \qquad (6)$$

where P_i is the share of income from the sources i, and n is the number of income sources. Given that SID ranges between 1 and 0, higher value of the index means a higher level of income diversification.

Empirical results and discussion

Household characteristics

The survey respondents typically live in an extended family system with one household head who is usually the oldest person in the family. The descriptive results in Table 2 show that 74% of household heads are male and are saddled with the responsibility of coordinating economic, security, social and political matters. Households with female heads are disadvantaged due to social practices, beliefs and discriminatory policies that in most cases reduce their access to key livelihood resources and widen the level of inequality. This structural inequality is partly the product of skewed inheritance distribution in a 2:1 ratio between males and females. Although women are responsible for the sale of milk, cheese and other livestock products, they are (women) largely disempowered and denied Western education, which restricts their ability to participate in modern businesses and be employed in government jobs. As such, Hausa-Fulani women are ill-equipped to compete favourably with women from other tribes who have unhindered access to Western schools (e.g. Atyap, Ebira and Nupe). The ages of the household heads range from 23 to 78 with a mean age of 43 years.

Furthermore, the households are increasingly engaging in livelihood transition as a response to changing social contexts. The results in Table 2 show that 62% of the households surveyed derived income from a combination of agriculture and off-farm jobs such as trade, salaried jobs, crude manufacturing, among others. The overall level of human capital is significantly low as the study found 3 years' per capita literary rate. With respect to livelihood transition, 45%, 28% and 15% of the households had been in the process of job-switching for more than 10 years, 1 to 10, and 3 to 5 years, respectively.

Income diversity and well-being

The enhancement of well-being in the context of rural development discourse, particularly in resources-scarce communities, can best be achieved through income diversification strategies. However, it remains plausible whether a significant difference in well-being exists between a single livelihood with many income streams (for instance, livestock income and

Table 2 Household characteristics

Variables	Min	Max	Mean	SD
Gender of the household head	0	1	0.74	
Age of the household (years)	23	78	42.51	15.11
Household size	2	35	12.1	7.4
Literacy of household (years)	0	15	2.77	1.62
Herd size	0	43	11	17.69
Number of cattle lost	0	63	14.7	16.69
Income diversity (off-farm and non-livestock income)	0	635[a]	318.96[a]	272.73[a]
Years engaged in livelihood transition	12% (1–2)[b]	15% (3–5)[b]	28% (6–10)[b]	45% (> 10)[b]
Number of activities		2.31		
Diversified households		62%		

[a]USD

[b]Years in parenthesis

income from sales of milk, as associated with pastoralism) and multiple income earning activities. In this sense, the well-being indices of various households that engage in either single or multiple income earning activities are compared. The results as highlighted in Table 3 show that households with multiple income earning activities, specifically crop-livestock and livestock-trade, have higher well-being indexes than those engaged in livestock-off-farm or those solely dependent on livestock production. This coincides with the findings of Majekodunmi et al. (2017), which revealed positive relation between livelihood diversity and level of income.

Well-being increases with income diversity as households pursue a variety of economic activities, including trading cattle, selling of grains, provision storage, driving of commercial vehicles, and engaging in handicrafts and crude manufacturing, among others. Among the economic activities presented in Table 3, livestock sales account for more than half of the income sources of the households. Households that pursue all livelihood activities have less livestock income (54%) than those in livestock-trade (68%), livestock-crop (70%) and livestock-off-farm (73%). Other important components of income diversity (beside livestock income) that contribute to well-being are crop production, milk sales, off-farm income and trade profit. Households with multiple income streams are more disposed to take advantage of any opportunities than could enhance their resilience and reduce their vulnerability to recurrent shocks (Ibrahim et al., 2019).

Table 3 Income diversity and well-being

Sources of income	Livestock only	Crop-livestock	Livestock-off-farm	Livestock- trade	All*
Households (%)	35	38	12	9	6
Average per capita cash income ($)	291	420	356	491	339
Livestock income (%)	88	70	73	68	54
Income from crop production (%)	–	21	–	–	12
Off-farm income	–	–	20	–	18
Income from milk sold (%)	12	9	7	10	6
Trade profit (%)	–	–	–	22	10
Well-being index	0.12	0.26	0.16	0.28	0.18

*All is defined as household that combines crop, livestock, off-farm and trade as sources of income

Given the existence of significant variations in the well-being index for households that engage in different combinations of economic activities, it is important that various well-being index groups be compared with households; income and other forms of assets relevant to pastoralists. While cash income includes livestock income, crop income and income from sales of milk, the Tropical Livestock Unit (TLU) was used at 0.7 and 0.1 in the conversion of cattle and small ruminants, respectively, into single unit. This is consistent with the conversion rate adopted in numerous past empirical studies (see Majekodunmi et al., 2017).

Table 4 presents the 1st, 2nd, 3rd and 4th quartiles of the well-being index of various groups of households based on two key determinants of pastoral wealth—cash and livestock income. The results show that well-being decreases from 0.63 in the 1st quartile to 0.54 in the 2nd and then falls to 0.51 in the 4th quartile, indicating that smaller sized households are better off in terms of well-being than larger ones. Conversely, a positive relationship exists between per well-being and capita income, as well-being index increases rapidly from the 1st to 4th quartiles. The comparative analysis between the contribution of cash and livestock income to the well-being index based on the results in Table 4 reveals a rising effect of cash income across the four quartiles in comparison to marginal contribution of livestock income. Low well-being index groups are characterised by large household size, livestock dependence and reduced income from milk sales. Members of larger-sized households

Table 4 Well-being index groups, income and assets of various household groups

| | Well-being index quartiles | | | |
	1st	2nd	3rd	4th
Household size	0.63	0.54	0.52	0.51
Tropical Livestock Unit (TLU)	0.41	0.62	0.68	0.77
TLU per capita	0.39	0.58	0.72	0.81
Cash income per capita	0.44	0.68	0.73	0.85
Total income per capita	0.53	0.62	0.71	0.87
Livestock income	0.37	0.44	0.48	0.53
Income from crop production	0.31	0.42	0.50	0.62
Income from milk sold	0.22	0.36	0.41	0.45
Other income	0.18	0.25	0.32	0.36

have less incentive to work hard and accumulate wealth since important economic decisions (income, expenditure, and livestock sale) are taken by the head of household.

Crop production remains a primary complementary source of income for pastoralists, which significantly contributes to their well-being. Income from crop sales increases the well-being index from 0.31 in 1st quartile to 0.42 and 0.62 in the 2nd and 4th quartiles, respectively. However, both milk cash and other income show marginal contributions to well-being across each of the quartiles. This is line with previous findings that well-being increases with income diversity as households pursue variety of income earning activities (Ducrotoy et al., 2017; Gautam & Andersen, 2016).

To test the conjecture that seeks to determine whether cattle rustling has any well-being retardation effect, certain socio-economic factors including income, employment, assets, access to market, among others, which have a direct bearing on the well-being of the rural populace, were examined. The results of two mean comparison test (Table 5) reveals significant differences in households who perceived that raiding has a significant negative effect on rural well-being. The households affected by cattle raiding indicated that their income had decreased by 88% ($p < 0.01$), as 90% of their assets had been raided, leading to a massive reduction in growth (92%) employment (88%), access to health (82%) and access to market (85%) in the affected areas. However, households are increasingly diversifying their livelihood as a response to changing social contexts. This is consistent with the results, as highlighted in Table 2, which revealed that 62% of the households surveyed engage in activities outside traditional agro-pastoralism, participating in an average of two livelihood strategies to counteract the effects of cattle raid-induced income reduction.

Cattle rustling, livelihood transition and well-being

In the preceding section, the results (Table 5) indicated that cattle raiding has a negative effect on some factors critical to the well-being of households. This effect could perhaps shape the livelihood transition of households differently, depending on how they have been affected by previous cattle raiding. To investigate the likelihood that affected ho-useholds will

Table 5 Perceptions of the households on the well-being of the surveyed communities

Factors	Affected	Not affected	Diff.	P
Growth	0.92	0.08	0.84**	0.001
Income	0.88	0.12	0.76**	0.003
Employment	0.88	0.12	0.76**	0.003
Assets	0.90	0.10	0.80**	0.002
Population	0.92	0.08	0.84**	0.001
Child education	0.83	0.17	0.66*	0.011
Access to health facilities	0.82	0.18	0.64*	0.013
Market day	0.85	0.15	0.70*	0.011

The results show the perception of households on how cattle rustling affect (or not affect) certain macroeconomic indicators of well-being. *&** denotes significant at the 0.05 and 0.01 levels

engage in livelihood transition, a logit regression was run with a dummy dependent variable (1 = affected, 0 = otherwise) indicating whether or not a household will transition to a particular livelihood strategy (S).

Columns 1 to 6 (S_1 to S_6) in Table 6 represent livelihood strategies in the form of trade, farm labour, off-farm labour (non-government), civil service, handicrafts, and livestock production, respectively. The results show the likelihood that cattle raid affected households will transit out from farm labour, off-farm labour, handicrafts and livestock production. However, affected household engaging in trade and civil service show a reduced likelihood of livelihood transition, partly because these activities are not directly linked to the agro-pastoralism value chain.

Since the argument of livelihood transition holds for certain economic activities, examining the impacts of cattle theft on well-being by adding income derived from pluriactivity would permit testing the transition-resilience hypothesis. This is crucial, because it provides the information necessary for the understanding that the income derived by transitioning from the customary agro-pastoralism to other forms of employment can augment the well-being of households dwelling in conflict prone communities. The results would also provide more grounds to support or

Table 6 Effect of cattle rustling on livelihood transition

	Livelihood transition					
	(1) S_1	(2) S_2	(3) S_3	(4) S_4	(5) S_5	(6) S_6
Cattle rustling (1 = affected, 0 = otherwise)	0.043	0.403**	0.130*	0.037	0.418*	0.614**
	(1.14)	(5.31)	(1.98)	(1.36)	(2.04)	(5.59)
Literacy	0.006	0.071**	0.032	0.012	0.022**	0.125**
	(0.81)	(2.09)	(1.16)	(1.42)	(2.35)	(3.21)
Age	0.172**	0.021**	0.015*	0.045*	0.025	0.011
	(4.13)	(3.42)	(1.94)	(2.03)	(1.04)	(1.39)
Household size	0.023**	− 0.015	0.082*	− 0.035**	0.019	0.025**
	(5.23)	(− 1.09)	(2.13)	(− 5.15)	(1.34)	(4.92)
Years of residency	0.012**	0.062**	0.132**	0.025**	0.032*	0.132**
	(5.13)	(6.32)	(5.42)	(3.02)	(2.42)	(4.33)
Pseudo R^2	0.326	0.273	0.321	0.281	0.318	0.258
N	1640					

S_1 to S_6 represent livelihood strategies in the form of trade, farm labour, off-farm labour (non-government), civil service, handicrafts and livestock production. Robust t-values are reported in parenthesis. *&** denotes significance at the 0.05 and 0.01 levels, respectively

refute the empirical studies, which favour diversification (Ducrotoy et al., 2017; Gautam & Andersen, 2016) instead of specialisation.

The three main hypotheses of interest are on the coefficients of β_1, β_2 and β_4, associated with cattle rustling intensity (measured as a dummy controlling for the time invariant effect for villages with the number of reported cases of cattle raiding that are greater than the average of the entire enumeration area), number of livestock lost and income diversity, respectively. Table 7 shows significant negative coefficients for cattle rustling intensity as well as the number of livestock lost. Controlling for cattle rustling intensity, well-being diminishes by approximately 0.10 units ($p < 0.01$). This finding is consistent with the theoretical assumptions documented in the literature (Ibrahim et al., 2019; Kynoch & Ulicki, 2012). Furthermore, holding other factors constant, every one unit of livestock lost affects well-being by 0.78 units ($p < 0.01$).

While testing the diversification-resilience hypothesis, the results in Table 7 show that the coefficient of income diversity is positive and insignificant ($p > 0.10$). Considering the fact that the overwhelming majority of the rural populace is substantially engaged in agricultural-based income diversification and given its seasonality, one would expect an insignificant impact of income diversity on well-being.

Table 7 Coefficients of variables included in the well-being model

Variables	Coefficients	t-value	P > t
Cattle rustling intensity	− 0.980**	− 3.17	0.002
Number of livestock loss	− 0.770*	− 2.48	0.013
Herd size	− 0.066*	− 2.11	0.035
Income diversity	0.020	0.66	0.510
Years of residency	0.320	3.28	0.020
R^2	0.51		
F	8.40** (0.000)		
X^{2}Breusch-Pagan	2.43(0.2768)		
X^{2}normal	0.2281		
N	1640		

Years of residency was used as an instrumental variable controlling for endogeneity. *&** denotes significance at the 0.05 and 0.01 levels, respectively

Lastly, the important parameter controlling for endogeneity in household characteristics, as highlighted in Table 7, shows that the estimated coefficient of years of residency is positive and significant at 1% level of significance. The sources of differences in observationally equivalent households are driven by the number of years of residency. This shows that the inherent endogeneity has been remedied by the instrument.

Livelihood transition as a source of well-being enhancements strategy

The surveyed households substantially engage in off-farm activities (such as trade, salaried jobs, crude manufacturing, among others) with the aim of enhancing their well-being. It however remains plausible if income generated from diversified economic activities could sufficiently compensate for the cattle raiding induced well-being loss. The researchers learnt from the FGD sessions that, although the households have developed varied livelihood portfolios, they are yet to translate this into higher welfare gain. The overall well-being index reported in Table 8 is significantly low (0.33), and is also lower than the 0.76 reported in (Ibrahim et al., 2019) for the whole of Nigeria. This suggests that households residing in communities under the threat of cattle raiding exhibit well-being lower than the entire country's threshold.

To test the conjecture that the well-being gains associated with the various livelihood strategies are heterogeneous, the preselected economic activities and their associated well-being, income and employment effects are presented in Table 8. The results show that profit generated from trade is the most important stimulant of well-being. Holding other factors constant, well-being is predicted to increase by 0.53 when profit increases by one unit ($p < 0.01$). Furthermore, of all the livelihood options, trade profit has the highest well-being index and income effect values of 0.41 and 0.30, respectively. Similarly, a unit variation in each of government salary and off-farm wages affects well-being by 0.43 ($p < 0.01$) and 0.21 ($p < 0.01$), respectively. While government jobs have relatively higher well-being index and income effects, the employment effect of off-farm jobs outpaced that of government jobs.

Handicrafts and crude manufacturing jobs are estimated (positive and significant at 1% probability

Table 8 Sources of well-being enhancement

Variables	Coefficients	P-value	Well-being index	Income effect	Employment effect
Trade profit (wholesale and retail)	0.528**	0.000	0.41	0.30	0.22
Farm wage	− 0.126	0.250	0.04	0.10	0.46
Off-farm wage (non-government)	0.212*	0.016	0.11	0.16	0.11
Government salary	0.433**	0.001	0.35	0.23	0.07
Income from handicrafts and crude manufacturing	0.179**	0.000	0.09	0.21	0.14
Income from livestock production	− 0.351	0.000	–	–	–
Year of residency	0.431	0.000	–	–	–
Overall well-being index	0.33				
R^2	0.64				
F	6.32** (0.000)				
X^2 Breusch-Pagan	0.88 (0.8210)				
X^2 normal	0.2556				
N	1640				

The results show the impact of various economic activities on well-being, as well as, their associated income and employment effects. *&** denotes significance at the 0.05 and 0.01 levels, respectively

level) to strongly enhance household well-being. This is partly explained by the recent improvements in rural road networks, which have extended the market coverage of some manufactured tools and products (for instance, local kitchen utensils, pots, beaded jewellery, etc.) to some West African countries. In contrast, households that engage in low return sectors (farm wages and income from livestock production) have the lowest well-being effect. Despite the high employment effect (46%) resulting from farm labour, the wages earned from this activity are unsurprisingly low.

The income effect of farm labour is only 10% and this was found to be the lowest of all livelihood strategies. The estimated coefficient of earning from livestock production is negative and significant ($p < 0.01$). Controlling for this variable, well-being is predicted to decrease by 0.35 when livestock earning decreases by one unit. The authors have not reported the income and employment effects, as well as the well-being index of this activity due to inherent simultaneity in response to the thematic question on livestock earnings (e.g., income from milk sales, cow dung, etc.).

Discussion

Cattle rustling is one of the institutional stresses that frequently deepens the vulnerability of poor households below the subsistence thresholds, leading to a massive livelihood transition from the customary mixed crop-livestock production to more diversified economic activities. This livelihood diversification is expected to offer flexibility, widen the subsistence options and thus enhance the household well-being. The finding of this study indicates that violent conflicts, illustrated by cattle raiding, have been retarding some factors critical to the well-being of the rural populace, thereby causing a significant income reduction, reduced on- and off-farm wages, and has made rural markets inaccessible, among other factors.

Indeed, different economic activities demand different levels of investment and offer different returns. The study further found a low well-being index of 0.33 (Table 8), indicating that households are actually transiting to low return sectors. This qualifies the general understanding in the rural development literature that the well-being enhancement effect of livelihood diversification is tenable if and only if households opt for livelihood transition into trade, salaried jobs, handicrafts, among other off-farm

opportunities. These livelihood activities offer asymmetric contributions on employment, income and well-being. For instance, the results in Table 8 indicate that trade as an economic activity contributes 41% of well-being index, as well as, 30% and 22% of income and employment effect, respectively. However, although government jobs offer greater income (23%) and well-being (35%) with little employment effect (7%) participation in these high return sectors is not a matter of free choice. It requires resource investment capacities in terms of human, social and financial capital, which households residing in remote areas are substantially lacking; thus, they are less likely to become involved in high return sectors (Ibrahim & Ahmad, 2013). This study further found a 3-year per capita literary rate for the entire sample, which is less than the a 9-year basic educational requirement of Nigeria's educational system and reflects low human capital. At the household level, only 11% contained any member that had completed basic education. This low literacy rate inhibits the households' employability in jobs that require certain skills. In this sense, improving the level of literacy through both conventional and vocational education is the key to achieving sustainable rural development.

Another interesting issue critical to rural development is the debate about whether livelihood diversification is transient or not, particularly if some recurrent shocks exist that could shape and intensify the transitioning process. The pattern exhibited in the results of Table 2 show some elements of consistency and stability in the longevity of livelihood diversification, as 73% of the households had diversified their livelihoods over the past 6 years. Such consistency is mainly demonstrated by households that have been victims of cattle raid that currently engage in trade and civil service, partly because these activities are not directly linked to the agro-pastoralism value chain. However, there is strong likelihood of livelihood transition for the affected households involves in farm labour, off-farm labour, handicrafts and livestock production.

Conclusion

This study contributes to the literature on rural development by testing the complex interaction between cattle rustling, livelihood transition and well-being. The results of this study elicit three key findings. First, cattle rustling has a significant negative effect on household well-being. Second, there is a strong tendency for cattle raid affected households to transit out from farm labour, handicrafts and livestock production. Third, the constructed well-being index is low, indicating that households are actually transiting to low return sectors. However, participation in high return sectors is not a matter of free choice as it requires a substantial amount of investment. In this sense, improving the level of literacy through both conventional and vocational education is critical to sustainable rural development. A key implication of the findings of this study points to the fact that even though significant efforts have been made by the government and international donor agencies (for instance, millennium development goals, sustainable development goals, better life for rural women, anchor borrowers' etc.) to improve household well-being, it is suggested that these efforts are largely misguided; they are not geared towards expanding market access and improving human capital, capacity building and human empowerment. The extant efforts are predominantly politically motivated and focus entirely on the money metric indicators of well-being. Furthermore, the arrival of such policy intervention is alien to the methodology of participatory rural appraisal, which advocates that people should express and analyse their conditions as well as plan and act on issues impacting their standard of living. The study suggests that achieving substantial communal well-being is the impetus for the attainment of sustainable rural development goals.

Data availability Data, codes and DO-files used in this article are available from the author upon request.

Declarations

Conflict of interest The author declares no conflicts of interest.

Ethical approval Author confirmed no ethical issues associated with the manuscript. The Ethical committee of Federal University Dutsin-Ma has approved the manuscript.

Appendix

See Table 9.

Table 9 Variables definition and measurements

Variable	Description	Measurement
Gender	Measures gender of household	1 = male; 0 = Female
Age	A continues variable that measures the household	Respondent provide information about their age in years
Household size	A number of individual under the control of head of household	Count
Literacy	Indicator of human capital of household by measuring the number years in formal schools	Count
Herd size	Indicator of herding stock possessed by household	Count
Years of residency	Measures the period of residency in a given area	Years
Livestock lost	Measures the number of small ruminants and cattle rustled	Count
Cattle rustling intensity	Measures the severity of cattle raiding	Nominal measure with 1 = severe; 2 = moderate; 3 = low
Income diversity	Indicator of livelihood diversification which measures the income earned from combination different economic activities	Simpson diversification index
Trade profit	Profit earned from wholesale, retail and petty trading	Converted in USD
Farm wage	Income earned from hours of labour sold in farm	Converted in USD
Off-farm wage	Irregular income earned from non-government salary including driving taxi, commercial motor cycle, tricycle, factory work, etc	Converted in USD
Government salary	Income earned from government jobs	Converted in USD
Manufacturing income	Income earned from handicrafts and crude manufacturing (e.g. local kitchen utensils, pots, beaded jewellery, etc.)	Converted in USD
Livestock income	Monetary earnings from livestock production	Converted in USD
Wealth	Total monetary of wealth possessed by household (cash and non-cash)	Converted in USD (landed assets were valued at $214/h

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