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Building Rural Household Resilience Due to Environmental Changes in the Hadejia-Nguru Wetlands, Northeastern Nigeria

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Environmental changes in the Hadejia-Nguru wetlands have grossly affected the functionality of the ecosystem with multiplier effects on livelihoods of more than 1.5 million people. The most critical change occurred through the invasion of the water bodies by Typha grass, which has hampered the predominant activities, fishing and farming, thereby subjecting the people into abject poverty conditions. This has attracted the attention of Nigerian Government, International Development Agencies and Non-Government Organizations in designing and implementing several intervention measures. In many communities, the failure of the interventions in up-lifting the quality of life has been attributed to the wetlands resource utilization strategies prescribed. This study uses the concept of sustainable livelihood framework by focusing on the occurrence of Typha grass (external vulnerability factor), capital assets and policy/institutional structures to construct alternative livelihood strategy model in order to develop household resilience against environmental changes. Data for the study was obtained from household surveys in fifteen communities of the wetlands region and analyzed using descriptive statistics, multiple regression and Foster Greer Thorbeke models. The results indicate that a combination of five capital assets: physical (power, road and markets); human (experience, skills and schooling), social (cooperative, remittance and linkages), natural (land, forest and fisheries); and financial (savings, disposables, credit) resources serve as the optimum factors in yielding higher incomes and thus developing a resilience against environmental vulnerability and poverty.

Keywords: Hadejia-Nguru wetlands, environment, poverty, resilience, rural-areas

Introduction

The Hadejia-Nguru wetlands support the livelihoods of more than 1.5 million primary stakeholders who directly depend on it for agricultural production, artisanal fishing, domestic water and as grazing resource for livestock for more than a century (Kaugama and Ahmed, 2014). The wetland support at least 250 species of flowing plants, over 136 types of aquatic flora and fauna and more than 103 species of fishes and 378 species of birth (Birdlife International, 2013). The International Water Management Institute (2014) reported that small wetlands play a significant role in reducing poverty and supporting both livelihoods and biodiversity. However, in the last few decades the wetland suffered enormous environmental challenges, undermining its contribution and jeopardizing the livelihoods of the resource users (Neiland, 2006), perhaps due to the negative impact of climate change that is now seen as the major threat to the world's ecosystems. Government policies and institutions, and management issues have equally been identified to present additional challenges to the wetlands (Ladu and Ovie, 2001; Neiland, *et al*., 2005). In whichever case, the wetlands communities suffer from the vagaries of nature and humanity. According to Ovie*et al*. (2007) the primary direct drivers of degradation and biodiversity loss in the wetlands include, changes in the environmental factors, infrastructure development, land use, water withdrawal, pollution, over-exploitation of resources, and the introduction of invasive aquatic species -the *Typha* grass. A study by WWF (2011), have predicted that variation in climatic conditions on local and regional levels, soil moisture content and extreme events like floods, droughts and hailstorms, may have negative effect on agricultural productivity, fisheries and food security in the long term.

Over the years, government and several international donor agencies have intervened to resuscitate the wetlands and ameliorate the sufferings of the people, with little or no progress have been achieved. Today, the situation inadvertently remains the same. The realization of the fact that wetlands and natural resources management are crucial for pro-poor growth underscores the need for a more pragmatic and result oriented approach to the problems in the area. This background informed the design of the current study, to develop a framework, which can be used by the wetland's authority, practitioners, and stakeholders for policy design, effective management and building resiliency, for sustainability of the wetland. The concept is a consolidation of sustainable livelihood framework, which aims at resource sustainability through evolving livelihood strategies to serve as building block for resiliency. Its overarching goal is to ensure effective interplay between resiliency, and effective management, policy and institutions for resource sustainability and improved well-being of the people. The study holds that both capacity building and institutional and policy

development are also essential in the process of scaling up successful initiatives in the wetland.

Study area

The Hadejia-Nguru wetland lies between 12° 39′0″N and 10° 35′30″E and stretches across Jigawa and Yobe states of Nigeria, and receives the bulk of its water from rivers Katagum, Jama'are, Kafin Hausa and BurumGana. These rivers, originate mainly from the central Plateau region of Nigeria, and flow in westerly direction eventually unite at Gashua to form the KomaduguYobe River System that empties into the Lake Chad. The total land area of the wetlands is estimated to be about 84,000km^2 and it serves as the major source of employment, income and food security to millions of farmers who integrate farming with fishing and livestock herding (Kaugama and Ahmed, 2014). Because of the annual flooding, the region is known to be very fertile and productive. The area provides grazing to about 506, 000 cattle, 437, 000 sheep, and 529, 000 goats (HNWCP, unpublished, cited by Ovie*et al.* 2006). The Bade people constitute the major ethnic group; although the Hausas, Fulanis, and Kanuris are also important in the area (Neiland, 1997). Figure, 1, shows the Study area depicting the rivers that feed the wetlands and the flow into the Lake Chad.

Despite the major important role the Hadejia-Nguru wetlands play in the regional economy of northern Nigeria (*Derek Eaton Marie-Thérèse, 1997)*, its total land area have rapidly declined in size, it is now thought that some 50% of the wetlands in existence 10,000 years ago have been eliminated (Mitch and Gosselink, 2000 as cited by Blench, 2013). The wetlands have been threatened by severe droughts and reduced rainfall for decades. More disturbing, is the current environmental degradation and poor viability of the area occasioned by the poor hydrological flow, inefficient water management and massive invasion of the obnoxious weed-*Typha* grass. The water that supplies the wetlands is gradually being shut-off by a series of impoundments, notably the Tiga and Challawa dams. It is estimated that the Tiga dam has reduced flooding in the area by about 350km^2 (FAO, 2009). Low rainfall coupled with the dams has resulted in low flow volumes in downstream rivers and tributaries. The attendant poor hydrological flow enhanced siltation and eventually blocking many channels of the rivers feeding the wetlands. Presently three (Kafin Hausa, BurumGana, and Old Hadejia) out of the four main rivers that feed the wetlands, have completely silted up leaving only the new Hadejia river. This latter river (at flood period), along with the river Katagum are currently the only systems that discharge into the Nguru-Gashua axis of the wetlands, and which ultimately empty into the Lake Chad, through the Yobe River. This largely affects the livelihoods of the wetlands dependent communities, most of whom are

farmers, fishers, herders and wild fruit gatherers. Frenken and Mharapara, (2002) stated that Wetlands agriculture is important for poverty reduction and food security in many developing countries.

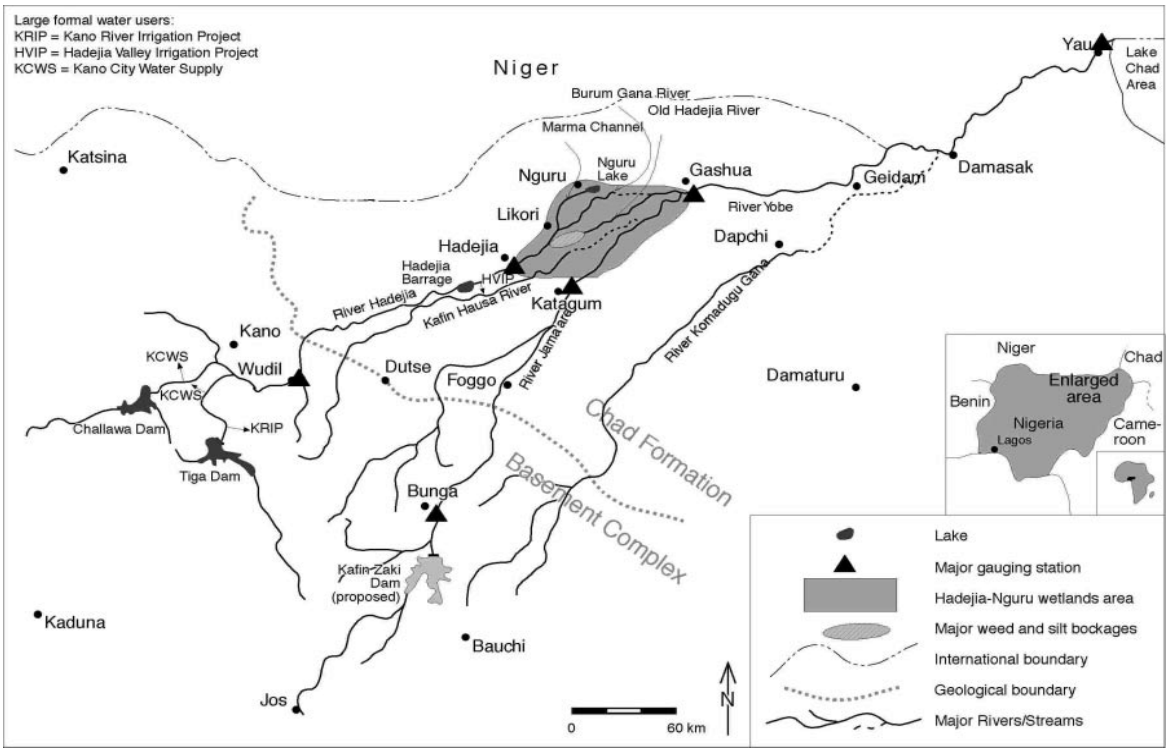

Figure 1: Map of study region

Source: (Goes and Zabudum, 1996)

Methodology

The data for the study was obtained through a field survey conducted in 15 communities in the Hadejia-Nguru Wetlands using both quantitative (questionnaire) and qualitative (focus group discussion) techniques. A total of 210 questionnaires were administered using stratification and simple random sampling techniques, out of which 172 questionnaires were successfully retrieved and analyzed by descriptive statistics and the application of Foster Greer Thorberke (FGT), 1984 poverty analysis and the multiple regression models. The

conceptual framework for this study takes its lead from a number of livelihood frameworks (DFID, 1999; Carney, 1998; and Scoones, 1998).

Thus, the various measures of poverty (P_α 0, 1&2) were computed using the Foster *et al*. (1984)poverty index given by the following formula:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z - Y_i}{Z}\right)^\alpha, \alpha = 0,1,2$$

Where:

Z = food poverty line

Y_i = per capita food expenditure for ith household (i = 1, 2,..., q) living below the poverty line

q = number of households below the poverty line

n = total number of sampled households

$\alpha = 0,1,2$ Are the special cases for head count poverty index, depth of poverty and severity of poverty (P_0, P_1, P_2) when $\alpha = 0,1,2$ respectively.

Four functional forms (Linear, Semi log, double log, and Exponential) were tried and semi log function gave the best fit, it is explicitly stated as:

$$Y = -\beta_0 + \beta_1 \ln X_1 - \beta_2 \ln X_2 + \beta_3 \ln X_3 - \beta_4 \ln X_4 - \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + Ui$$

Where;

Y= Number of skills

β_0 = Constant

X_1 = Age of the household head (years)

X_2 = Household size (Number).

X_3 = Educational level of the household head (Number of years).

X_4 = Years of experience

X_5 = Worthiness of remittances

X_7 = Worthiness of linkages

X_8 = Worthiness of cooperatives

U= Error term

The concept of livelihood approach

This study domesticates the concept of livelihood approach to comprehensively look at the situation in the Hadejia-Nguru wetlands, particularly in respect to the vulnerability factors such as ecology/environment, economy, as well as the assets accessibility, the institutions and structures. The interplay of these factors permits construction of various livelihood activities that ultimately reflects on the livelihood outcomes. The livelihood approach has been used much frequently in the last two decades for better understanding of natural resource management, sustainability and well-being of people dependent on natural resources (Scoones, 1998; Ellis, 1998; DFID, 1999). The position of Allison and Ellis (2001), succinctly gave some insights to the whole approach "the livelihood approach seeks to improve rural development policy and practice by recognizing the seasonal and cyclical complexity of livelihood strategies, helping to remove access constraints to assets and activities that complement existing pattern, and identifying ways of making livelihoods as a whole, more able to cope with adverse trends or sudden shocks."

The application of the concept's framework (see figure 2) to this study shows that the people who are dependent on the wetland resources are prone to certain risks and uncertainties particularly those related to the environment, ecology, biodiversity degradation and economy. The emergence of the obnoxious *Typha* grass in the early 1990's and its subsequent invasion of the area (Ovie, 2007), which jeopardizes the livelihoods of the people is a clear example. It is still evident that people in the area often construct multiple livelihood activities ranging from farm related to off-farm activities as mitigating strategies (Bene, 2003; Neiland, 2005). These activities are constructed mostly in cognizance of the interplay between assets availability and accessibility such as the land, forest, water, skills, experience, finance, infrastructure etc. and the prevailing policies and structures governing the operations and utilization of the resources. The vulnerability factors, principally the shocks, trends and seasonality affect the assets, livelihood activities and subsequently the outcomes, thereby subjecting the people into poverty conditions. On the other hand, effective and positive use of the assets with support of the institutions and structures to construct diverse livelihood portfolios leads to positive outcomes, particularly reducing vulnerability and poverty, food security, well-being, which would later influence accessibility of more assets and further construction or expansion of livelihoods activities. This as whole is believed to lead to improvement and sustainability of the wetland resources.

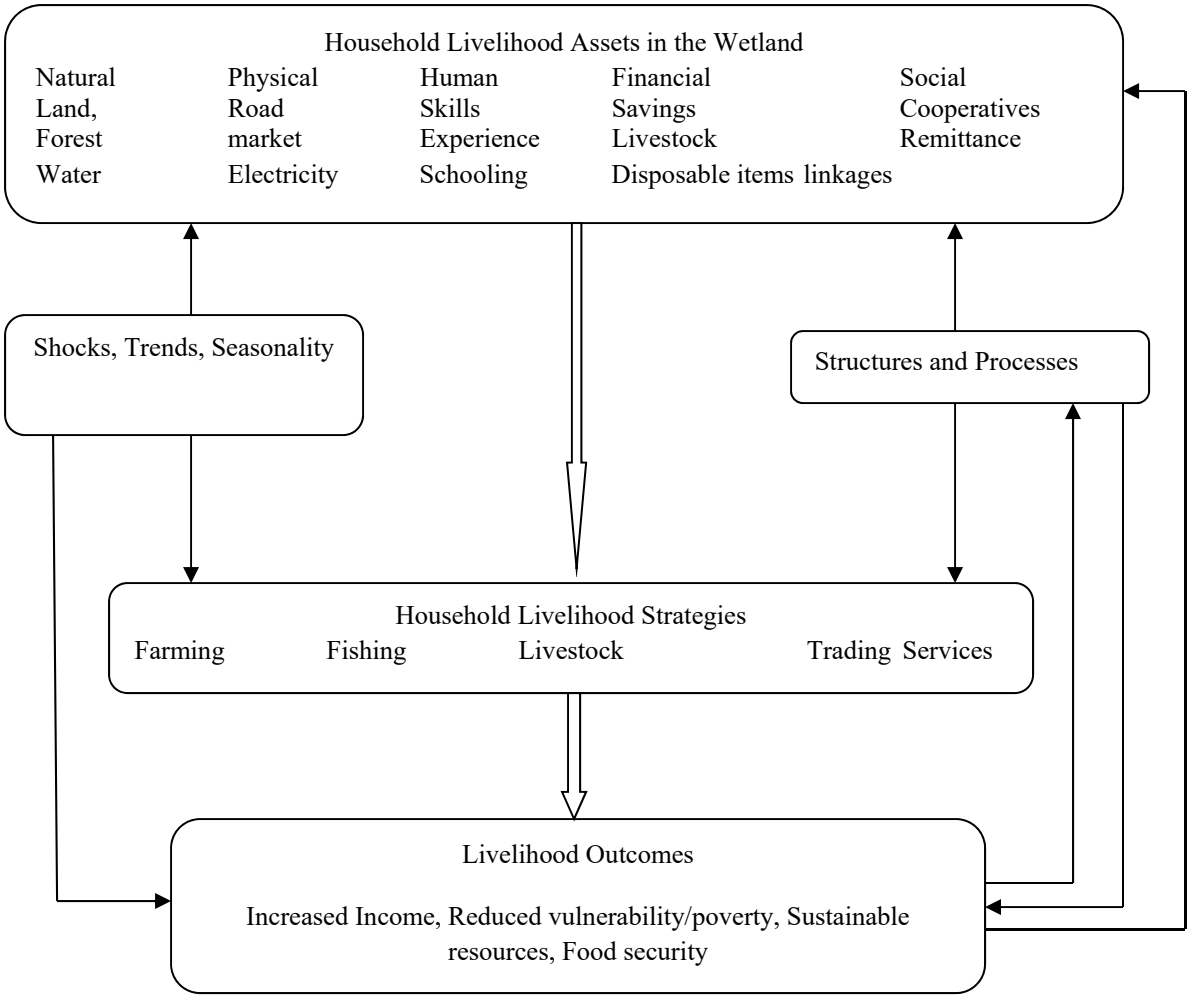

Figure 2: SLA conceptual framework

Poverty levels in the wetlands

In the analysis of the poverty levels of the people, two expenditure baselines of $1.00 USD per capita per day and $2.00 USD per capita per day were considered. This was done to expose the dimension of poverty in the wetlands. The results revealed that more than 54% of the people live below the expenditure baseline of $1.00 USD per day. Similarly, at $2.00

USD per day, more than 90% of the entire population has fallen within this level (Figure 3). Therefore, the wetland communities almost entirely live under absolute poverty conditions, thus threatening the sustainability of the resources in the area. It has been reported that any lack of consideration of the links between poverty and conservation is likely to render any interventionist measures at risk of failure and in the long-term this can exacerbate poverty (IWMI, 2014). This finding supports the UNDP (2013) assertion that the Northeast region of Nigeria, which Hadejia-Nguru wetlands is part of, has over 5 times more multi-dimensional poverty index (MPI) of poor people than the entire country of Liberia, a low-income country still recovering from a prolonged civil war.

The wetlands provide diverse benefits that can be utilized for agriculture in a sustainable manner. However, the major constraint is lack of knowledge for government planners, managers of natural resources and local communities (McCartney *et al.*, 2010). Although wetlands have traditionally been protected for their value to wildlife and the environment, policy-makers and conservation groups are increasingly recognizing the role that these areas play in supporting rural livelihoods and reducing poverty. Millions of people worldwide directly depend on wetlands for their livelihood, and these are often the poorest groups in society. This includes; more than 1 million in the Sudd wetland in South Sudan; 1 million people near Lake Chilwa in Malawi; and 300,000 in the Inner Niger Delta in Mali. Nonetheless, it is now widely recognized that wetlands must be protected and the relevant international agreement is the RAMSAR convention, first established in Iran in 1971 and currently ratified by some 120 countries worldwide, including Nigeria (Blench, 2003).

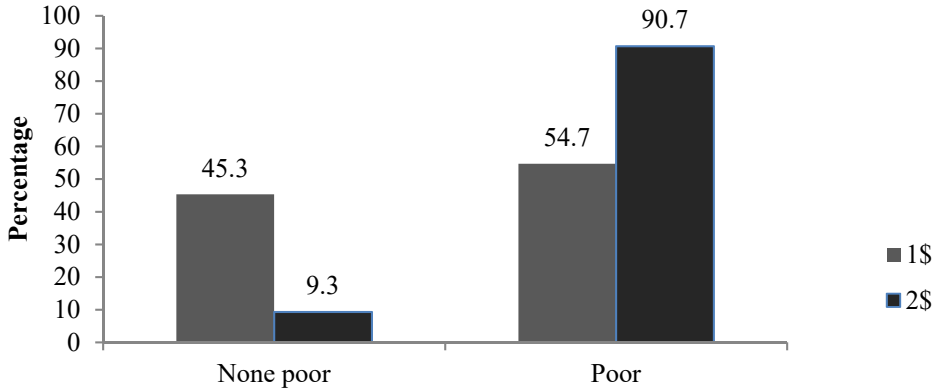

Figure 3: Poverty situation in the wetland at 1$ and 2$, 2015

Livelihood assets accessibility and productivity

Table 1 presents the status of assets as accessed by households in the wetlands. Three important assets each of natural, physical, human, social and financial were identified and assessed accordingly. The productivity for land, forestry and fisheries (natural) with mean of 2.8, 2.5 and 1.8 respectively, on a 5-point scale, were found as low for optimum production particularly of fisheries. The standard deviation for the three components was determined as 1.1, 0.8 and 0.9 respectively, showing a true reflection of the respondents' opinion about the resources. This presents tendencies for poor economic situation particularly with the people's dominant activities being based on natural resources. Similarly, the results further showed that physical assets are generally poor, particularly with the mean of values of 0.6 and 2.5 for power and road efficiencies respectively. According to FAO (2005) rural infrastructure plays a crucial role in poverty reduction, economic growth and empowerment for the African rural poor. The human capital in the wetlands in terms of experience has a mean of 22 years with standard deviation of 9.5 and number of skills (mean of 3.0) was remarkable, with standard deviation of 0.6. However, education among the respondents was low with 4.1 mean school years, with standard deviation of 5.6. Education plays a great role in permitting people to construct multiple activities thereby improving their livelihood and sustaining the environment. A study conducted in Uganda showed that individuals who pursued primary and higher education have higher likelihood of participation in non-farm activities than those without education (Newman & Canagarajah, 1999).

In terms of social capital, 55 percent and 54 percent of the community members got remittances and benefits from their linkages respectively. However, only 33 percent of them are members of cooperative society and associations. It is imperative to note that social capital has direct impact on other types of capital; they can help increase people's income and savings (financial capital). Social networks also facilitate innovations, the development and sharing of knowledge, thereby creating a close relationship with human capital (Kudigi *et al*., 2007). Generally, collective arrangements and social networks, for example, can have a positive impact on development outcomes such as growth, equity and poverty alleviation (Uphoff & Wijayaratna, 2000). However, the financial assets, savings and credit facilities are generally poor: only 22 percent and 20 percent of the people have savings and accessed credit facilities. Access to finance permits diversification into multiple livelihood portfolios either by addition or by expansion. Lack of access to financial services is a constraint to potential diversification into non-farm economic activities (Reardon, 1997; Ellis, 1998). In Nigeria, financial services are hampered by poor management, cultural affiliation and stringent conditions accompanying the procedure.

Table 1: Assets accessibility and their productivity in the wetlands

Natural	Land	Forest	Fisheries
Mean production	2.8	2.5	1.8
SD	1.1	0.8	0.9
Physical	Power	Road	Market
Mean production	0.6	2.5	3.2
SD	0.7	1.3	0.8
Human	Years of experience in main occupation	No of skills	Years of schooling
Number	22.2	3	4.1
SD	9.5	0.6	5.6
Social	Cooperative members	Remittance	Linkages
Members(%)	32.6	54.3	53.5
Non-members(%)	67.5	45.3	46.5
Financial	Savings	Disposables	Credit
Worth (mean)	5296.5	114366.3	105872.1
SD	0.8	1.5	1

Note: Means for natural assets productivity, and physical assets efficiency were obtained from a range of 1-5 points. In scoring for human assets, years and number were used, the social assets were scored on the basis of membership, either a member or non-member, and finally for the financial assets, access to credit, saving, and disposables were scored.

Users' compliance with government policies and institutional structures

The results in figure 4 depict that there are policies and institutional structures, and community resource management strategies put in place for managing the wetlands resources effectively for general economic benefits to the dependent population. The results showed that there is low/poor compliance with the government based policies, due largely to poor implementation mechanisms, enforcement and monitoring by the established institutional structures to oversee the effective utilization of the resources in the area. On the contrast, there is good compliance with the community based (traditionally) resources management practices. This might be as a result of the peoples' involvement and the respect they accord to the traditional institutions and leaders. Neiland, (1997), in his studies on inland fisheries management explained that management is statutorily a responsibility of the

authorities (*De Jure*), but in practice the traditional system manages and control the resources more (*De facto*).

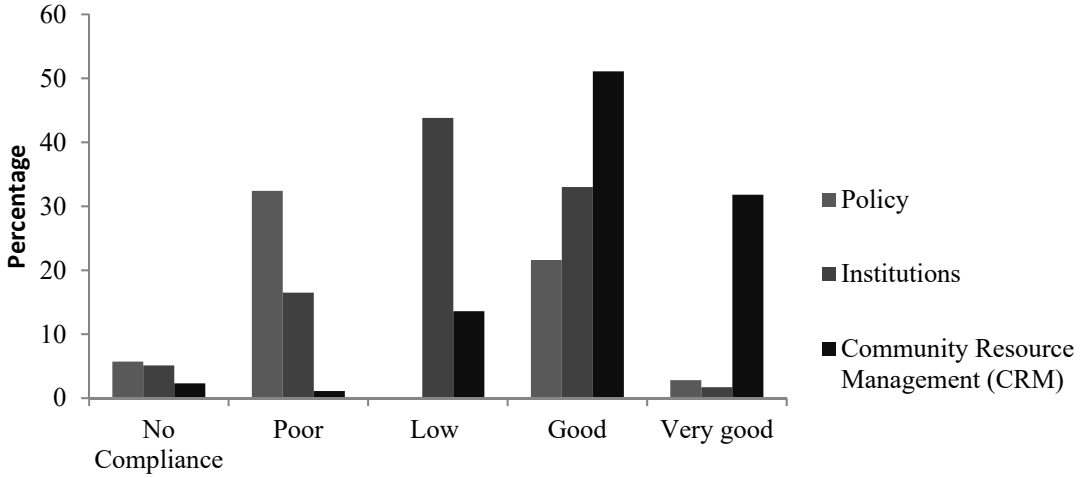

Figure 4: Existence and compliance with policy, institutions and CRM

Determinants of acquiring and use of multiple skills as a resilience strategy

The relationship between number of skills acquired and used by the people as a resilience strategy to mitigate the effect of environmental changes in the wetlands and selected variables was evaluated using multiple regression model, where four functional forms were tried and semi log was selected as the lead equation. The number of skill acquired and use was the dependent variable (Y), while the various socio-economic variables were the independent variables. The results, in Table, 2, show that the coefficient of multiple determinations (R^2) was 0.635, which means that about 64 percent of the variations in the number of skills adopted by the people were explained by the variables under consideration. The F value of 3.727 and statistical significance at 1 percent level shows that the model is fit. All the coefficients except household size, years of experience and worthiness of remittances, carried the expected positive signs. The coefficient of age (1.602) is statistically significant at 10 percent level. This implies that an increase in the age of the respondents will result to increase in the number of activities adopted. Years of experience is statistically significant but has an inverse relationship with number of skills adopted by the respondents. Impliedly, years of individual experience lead to perfection, while concentration on a particular activity is seen to lessen the number of skills. The coefficients of worthiness of

linkages and cooperative (2.655 and 0.506) are statistically significant at 5 percent and 1 percent levels respectively. This shows that the more they access money from either their linkages or cooperative the more they acquire and use multiple skills to mitigate the negative effects of the environmental changes.

Table 2: Determinants of number of skill acquired and used by the respondents

Variable (Model)	Coefficient	Std. error	t statistics	Sig
(Constant)	-5.273	3.144	-1.677	.114
Log age	1.602	.897	1.785	.094*
Log household size	-.048	.240	-.200	.844
Log educational level	.134	.212	.630	.538
Log years of experience	-.666	.281	-2.365	.032**
Log worthiness of remittances	-.005	.111	-.047	.963
Log worthiness of linkages	.257	.097	2.655	.018**
Log worthiness of cooperative	.165	.055	.506	.009***

*, ** and *** denote significance level at 10%, 5% and 1% respectively

Livelihood diversification in the wetlands

The result in figure, 5 shows the engagement and contribution of the various livelihood activities to economy of the wetlands. For simplicity, several related activities were grouped into five components of farming, fishing, livestock, trading and services. Figure 5, depicts that agriculture remains the most important economic activity, with crop production contributing the highest with mean income of ₦296,674.40 per annum. Fishing is ranked as the second most important economic activity in the area with mean of over ₦100,000 and closely followed by livestock, which has more number of households into its' practice than the households that are into fishing. The difference in income is informed by the fact that the daily monetary turn-over from fishing is more than that of the livestock. Trading and services ranked equal. Trading includes selling of grains, fish products, groceries, while services include, barbing, transportation (vehicles and motor bike) carpentry etc. These two are weak due to poor financial and physical assets holdings as earlier seen in figure, 3. According to Allison and Ellis, (2001), diversification reduces the risks of livelihood failure by spreading it across more than one income source. It is believed that it helps to overcome the uneven use of assets (labour) caused by seasonality and also confers a host of other advantages in the presence of widespread market failures and uncertainties.

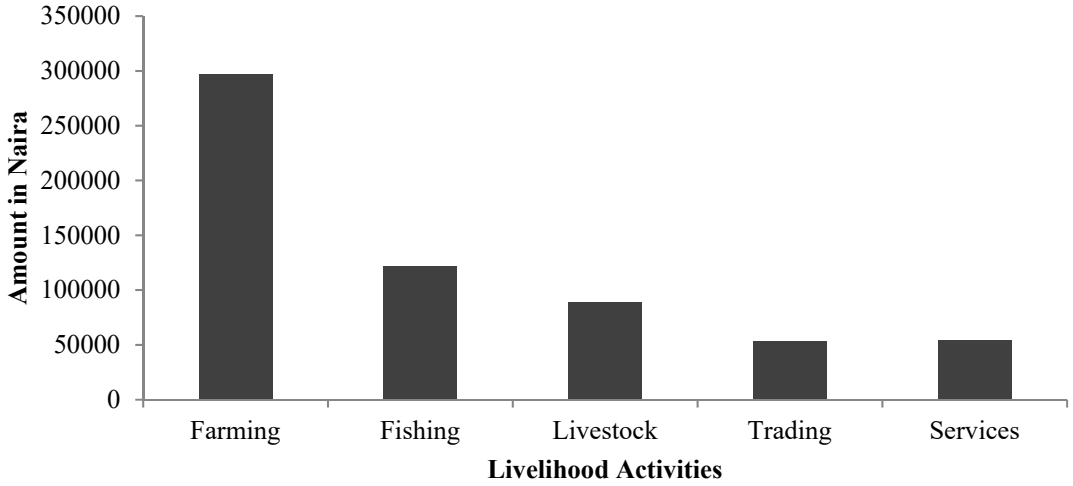

Figure 5: Contribution of livelihood activities to the overall income

Towards a livelihood strategy model

Ellis (1998), distinguished coping strategies from risk strategies in terms of their occurrences (after or before shock). The two are operational in the wetlands in the sense that the people diversify their livelihood activities to mitigate the existing ecological and biodiversity degradation (reactive measures) at the same time they diversify to address the future occurrence of risk. Based on the framework of livelihood approach this study has identified some weaknesses and make suggestions for possible adoption by both the people and policy makers towards the sustainability of the wetlands resources in enhancing the welfare of the people. The adaptation strategy is defined as a "continuous process of change to livelihoods, which either enhance the existing security and wealth or try to reduce vulnerability and poverty" (Davies and Hossain, 1997). Figure 6 indicates that the wetland communities are vulnerable, the institutions and structures are weak, and the people have poor access to assets particularly the physical (infrastructure), financial (credit facilities) and social (lack of functional associations). To address these problems and to attain certain level of sustainability, the current study introduced the idea to enhance the institutional structures and individual capacities, sensitization on values of resources and general capacity building to make positive use on the one hand. On the other hand, provision of assets such as electricity, roads, inputs, schools, health facilities etc., and injecting them into the system

will directly change the status of vulnerability content, policies and structure, and access to assets, thereby permitting effective construction of livelihood activities and improving the outcomes (Figure 6). The absence of the interjection would further affect access to the assets, leading to poor construction of livelihood strategies, which translate to poor outcomes. Hence, the communities would remain in abject poverty, and will continue to face the vagaries of nature, environment, poor management etc.

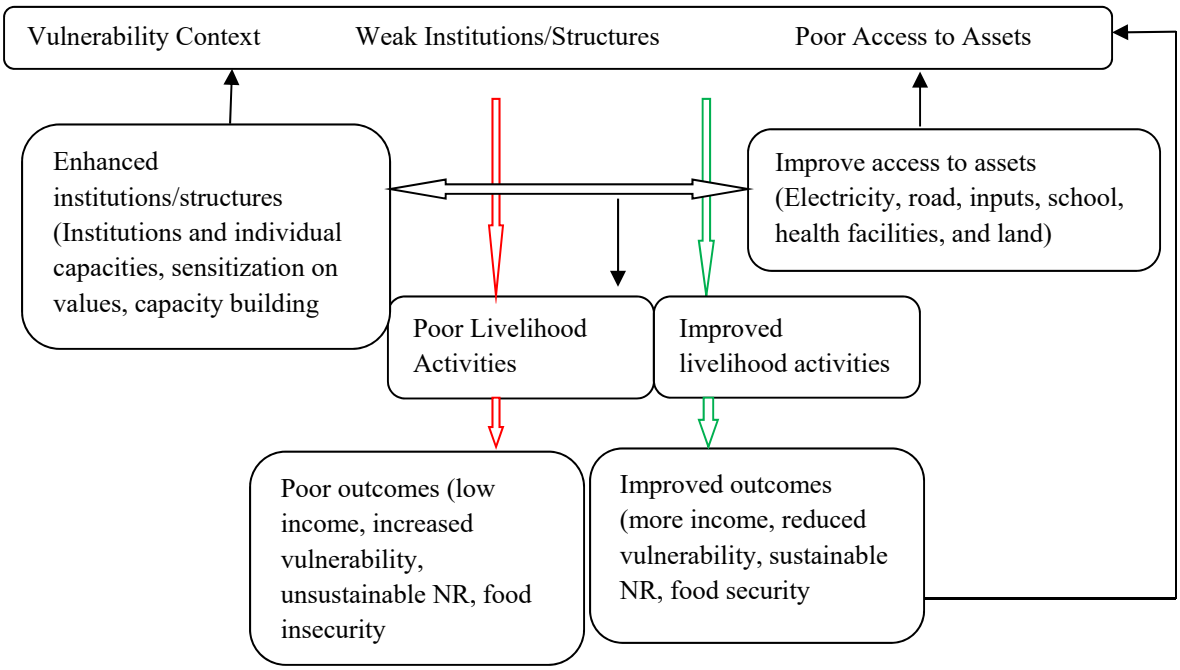

Figure 6: Livelihood strategies model for sustainable resource management

Conclusion and recommendations

The wetlands serve as the basis for food security and nutrition, domestic water and source of livelihoods. Best management practices of the wetland resources could provide opportunities for improving economic activity and human health, thereby making a lasting contribution to poverty reduction. As a coping strategy for food production and income generation, wetlands and uplands are used in an integrated manner by the rural people to achieve sustained livelihoods. The significance of diversity of activity in wetland livelihoods, and the cultural importance that this represents has largely been overlooked in

national development strategies. Diversity allows people to minimize risks to their livelihoods and maximize the benefits the environment offers. Communities in these areas are often repositories of natural resource knowledge that will be lost if their ways of life are irreversibly damaged. Despite their importance, the world's wetlands are frequently mismanaged, and many are now so degraded that the people who rely directly on them for their livelihoods have become more vulnerable to or have fallen deeper into poverty. Socio-economic and biodiversity data are often not available to support decision making. Some of the most significant threats to these livelihoods come from environmental degradation and habitat loss. The potential for preserving and promoting these sustainable livelihoods, and so alleviating poverty and contributing to national development through wise management of wetland ecosystems, has not yet been realized.

Wetland management has to integrate environmental perspectives with livelihood benefits, especially the sustainable production of food. These approaches are seldom integrated in decision-making processes that establish management procedures. There is, therefore, an immediate need for decision makers to be aware of and understand the links between poverty and environmental issues in relation to wetlands. This includes keeping abreast of the current research and wetland policy development, especially in relation to international laws, conventions and other relevant mechanisms. Consideration of how to improve the complementarities of strategies for food security, income generation and environmental sustainability in wetlands is particularly pertinent in this case. We need to identify key information needs, which will enable us to identify the requirements for sustainable wetlands management.

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