Poverty, Vulnerability and Livelihoods in Small Scale Fishing Communities in Nigeria

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To Maggie and Caleb with love

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Zusammenfassug

Armut ein wohlbekanntes und lang bestehendes Phänomen innerhalb der Bevölkerungsgruppen, die von der Inlandsfischerei abhängig sind. Trotzdem wird Fisch oft als hochwertigeres Gut im Vergleich zu landwirtschaftlichen Produkten betrachtet. Kleinfischerei hat den Charakter eines öffentlichen Gutes (freier oder quasi-freier Zugang zu der Ressource), beansprucht relativ viel Arbeitskraft (Beschäftigungseffekte) und ist zeitlich flexibel gestaltbar. Aufgrund dieser besonderen Eigenschaften wird die Kleinfischerei oft auch als Aktivität bezeichnet, die vor allem den Armen zugute kommt. Diese stilisierten Fakten bilden den Ausgangspunkt und die Motivation dieser Studie, die Armut und Vulnerabilität von Haushalten, die in Fischereigebieten leben, zu messen, und die Kausalitätsbeziehung zwischen Armut und den jeweiligen Einkommensaktivitäten zu untersuchen.

Das Ziel dieser Arbeit war es, Armut und Vulnerabilität von Haushalten im Hadejia-Nguru Überschwemmungsgebiet in Nordost-Nigeria zu messen. Die Arbeit basiert auf der Analyse von Primärdaten, die in vier Umfragerunden von April 2007 bis März 2008 erhoben wurden. Zur Ziehung einer repräsentativen Stichprobe von 282 Haushalten wurde ein zweistufiges Zufallsverfahren benutzt. Zum Zeitpunkt der letzten Umfrage reduzierte sich die Stichprobe auf 263 Haushalte. Für die statistische Auswertung der Daten kamen verschieden ökonometrische Techniken zum Einsatz. Die Analyse ergab einige wichtige Ergebnisse im Hinblick auf die Ziele dieser Untersuchung, die im Folgenden kurz zusammen gefasst werden sollen.

In Kapitel drei dieser Arbeit wird ausgeführt, dass die Haushalte im Untersuchungsgebiet oft negativen Schocks ausgesetzt sind. Die am häufigsten genannten sind: Todesfall in der Familie, Trockenheit und Dürre, Schädlingsbefall von Kulturpflanzen, sowie soziale Konflikte. Diese Schocks haben vor allem signifikante Auswirkungen auf die Nahrungsmittelausgaben und damit auf die Ernährungssicherheit der Haushalte. Die Anfälligkeit der Haushalte für bestimmte Schocks wird ebenfalls von der Einkommenshöhe bestimmt. Arme Haushalte sind stärker von Dürren betroffen als reichere Haushalte. Unterschiede gibt es auch im Hinblick auf die Hauptbeschäftigung der Haushalte. Während landwirtschaftlich orientierte Familien verstärkt sozialen Konflikten ausgesetzt sind, leiden Fischer eher durch Trockenheit. Es kann geschlussfolgert werden, dass entwicklungspolitische Eingriffe in dieser Region vor

allem auch darauf abzielen sollten, die Fähigkeit der Haushalte mit Schocks umzugehen zu stärken. Auch sollten Maßnahmen getroffen werden, um die negativen Effekte solcher Ereignisse auf die Ernährungsunsicherheit abzumildern, z.B. durch verbesserten Zugang zu Nahrungsmitteln.

Die Untersuchungsergebnisse in Kapitel vier haben gezeigt, dass die Wahrscheinlichkeit unterhalb der Armutsgrenze zu leben saisonal variiert. So steigt die Wahrscheinlichkeit vor allem in Zeiten der Feldbestellung und während der Trockenperioden im Jahr. In der Zeit während und direkt nach der Ernte sinkt sie jedoch entschieden ab. Die Höhe der saisonalen Variation hängt jedoch signifikant davon ab, welchen Einkommens-generierenden Aktivitäten die Haushalte nachgehen, wie groß die Vermögensausstattung ist, sowie von den sozialen und demographischen Eigenschaften der jeweiligen Haushalte. In Verbindung mit der Tatsache, dass Schocks vor allem die Ernährungsausgaben betreffen, lassen diese Ergebnisse schließen, dass Hunger und Ernährungsunsicherheit eine ernste Bedrohung in bestimmten Zeitperioden im Jahr darstellen. Solche Mangelperioden resultieren vor allem in Unterernährung von Kindern und haben somit langfristige Auswirkungen auf die Armut der gesamten Bevölkerung. Es wird daher empfohlen, saisonalen Mangelerscheinungen durch effektive und gut geplante Politikmaßnahmen entgegenzuwirken. Das setzt ein adäquates Verständnis der Faktoren die die saisonale Variation des Konsums beeinflussen voraus. Wegen der Interrelation von zwischen Einkommen und Konsum wird empfohlen, dass zu verschiedenen Zeiten innerhalb eines Jahres verschiedene Aktivitäten verstärkt unterstützt werden sollten. Allgemein weisen landwirtschaftlich orientierte Familien eine höhere Variation auf, als z.B. Fischer oder Haushalte, die einen großen Teil ihres Einkommens aus außerlandwirtschaftlichen Aktivitäten beziehen. Es wird daher empfohlen, die Einkommensdiversifizierung, vor allem auch in Aktivitäten die weniger von wetterbedingten Änderungen abhängig sind, zu unterstützen und zu fördern.

Es wurde ferner gezeigt, dass die zeitliche Positionierung und die Häufigkeit von Umfragerunden in einem Mehrperioden-Datensatz Auswirkungen auf die Messung von Armut und Vulnerabilität haben können. Die Ergebnisse belegen, dass Vulnerabilitäts-Schätzungen grundlegend überschätzt werden können, wenn bestimmte saisonale Größen nicht erfasst werden. Was zu einer Unterschätzung der durchschnittlichen Jahreswerte für Konsum sowie einer Überschätzung der Varianz des Konsums führen kann. Der

Gebrauch von saisonalen Dummy-Variablen kann zwar die Verzerrung der durchschnittlichen Konsumwerte reduzieren, kann jedoch die Verzerrung der Varianzschätzung nicht korrigieren. Dieses Ergebnis zeigt, dass Umfragen zur Messung von Armut und Vulnerabilität solche Zusammenhänge berücksichtigen und dementsprechend vorsichtig konzipiert und geplant werden sollten. Analysten die bereits erhobene Daten nutzen wird empfohlen, durch den Gebrauch von Dummy-Variablen zumindest die Durchschnittswerte um die saisonalen Effekte zu bereinigen.

Im fünften Kapitel wird ein Messinstrument zur Bestimmung von Armutsvulnerabilität auf Basis der Vermögensausstattung eines Haushalts vorgeschlagen. Das Instrument verbindet die vermögensbasierte Armutsmessung mit dem Konzept der erwarteten Armut. Dieses Messinstrument zerlegt erwartete Armut in verschiedene Komponenten, nämlich strukturell-chronische, strukturell-transitorische und stochastisch-transitorische Armut. Die Ergebnisse zeigen dass vor allem transitorische Armut vorherrschend ist, und nur wenige Haushalte ein kurzfristig erwartetes Einkommen aufweisen, das über der Armutsgrenze liegt. Dabei schneiden Fischer besser ab, als Landwirte sowie außerlandwirtschaftlich orientierte Haushalte. Ein geringerer Prozentsatz der fischenden Haushalte wird als strukturell-chronisch arm eingestuft, und viele Fischer befinden sich sogar in der Kategorie „nicht arm“. Dagegen wird ein großer Anteil der Haushalte, die hauptsächlich von außerlandwirtschaftlichen Aktivitäten leben, erwartungsgemäß arm bleiben, vor allem aufgrund struktureller Ursachen (strukturell-chronische und strukturell-transitorische Armut). Der größte Teil der Haushalte ist anfällig für Armut aufgrund einer geringen Vermögensausstattung, sodass sogar günstige Produktionsbedingungen nicht dazu führen können diese Haushalte dauerhaft über die Armutsgrenze zu heben. Dieses Ergebnis plädiert daher für Politikmaßnahmen, die auf die Stärkung von Vermögensakkumulation (vor allem Wertgegenstände die im Produktionsprozess eingesetzt werden) sowie auf die Steigerung der Produktivität abzielen. Letzteres kann zum Beispiel durch technologischen Fortschritt und Investitionen in Humankapital erzielt werden.

Die Ergebnisse in Kapitel sechs bieten Entscheidungsträgern Informationen bezüglich der erwarteten Reaktion der Haushalte auf Veränderungen in den Randbedingungen ökonomischen Handelns. Zum Beispiel wird gezeigt, dass eine Erhöhung der Arbeitsproduktivität in der Landwirtschaft (durch neue Technologien) nicht

notwendigerweise zu einer Reallokation der Arbeit von Fischerei oder außerlandwirtschaftlicher Beschäftigung zur Landwirtschaft führen würde. Im Gegenteil, Haushalte würden weniger Arbeit in Landwirtschaft investieren, und stattdessen mehr Freizeit beanspruchen. Die Wohlfahrtspolitischen Konsequenzen solcher Eingriffe wären marginal. Im Hinblick auf eine nachhaltige und effektive Nutzung der Fischbestände wären Maßnahmen, die den außerlandwirtschaftlichen Sektor stärken, wirkungsvoller. Die Ergebnisse zeigen, dass weniger Arbeit in Fischerei investiert wird, wenn die Produktivität von außerlandwirtschaftlichen Aktivitäten steigt. Steigende Produktivität im Fischereisektor würde dagegen Arbeit von landwirtschaftlichen und außerlandwirtschaftlichen Aktivitäten abziehen.

Bei der Anwendung dieser Ergebnisse sollten Entscheidungsträger in der Politik beachten, dass verschiedene Produktionssysteme in jeweils unterschiedlicher Weise zur Reduzierung der Armut beitragen. Zum Beispiel sind Fischer die am wenigsten Armen, sind jedoch der höchsten saisonalen Variation unterworfen. Auf der anderen Seite sind Haushalte, die sich vorwiegend im außerlandwirtschaftlichen Sektor betätigen, weniger von saisonalen Schwankungen abhängig, sind jedoch mit die ärmsten Haushalte in der Untersuchungsregion.

Im Allgemeinen hat diese Studie bestätigt, dass innerhalb der ruralen Bevölkerungsgruppen, die von der Inlandsfischerei abhängig sind, Armut immer noch hoch ist. Armut und Vulnerabilität sind vor allem auf eine unzureichende Ausstattung mit produktivem Vermögen zurückzuführen, sowie auf die häufigen negativen stochastischen Ereignisse. Die negativen Auswirkungen von Schocks werden noch durch hohe saisonale Schwankungen im Einkommen und durch die Unfähigkeit der Haushalte, Einkommen über das Jahr gleichmäßig zu verteilen, verstärkt. Rurale Entwicklung im Untersuchungsgebiet sollte daher darauf abzielen, die Vermögensausstattung der Haushalte zu fördern, die Kapazität der Haushalte stärken um besser mit Schocks umzugehen, und die innerjährliche Variation im Konsum zu reduzieren. Diese Ziele könnten durch eine Anzahl effektiver Eingriffe erreicht werden, z.B. technologische Innovationen, Arbeitsbeschaffungsmaßnahmen in trockenen Perioden, Diversifizierung von Einkommen, Einführung von Kreditvergabeprogrammen die auf die Armen zugeschnitten sind, Infrastrukturaufbau, sowie die Verbesserung der Marktfunktionalität auf den Faktor und Outputmärkten. Jedoch sollte ein Mix verschiedener

Interventionsmaßnahmen angestrebt werden, da die einzelnen Eingriffsmöglichkeiten für sich allein nicht unbedingt zu einer Reduzierung der Armut beitragen werden.

Schlagwörter: Vulnerabilität, Lebensunterhalt, Fischerei

Abstract

Poverty in small scale fishing communities is an old phenomenon. However, fish as a commodity is considered a high-value commodity compared to agricultural output. Small scale fishing can also be considered as a pro-poor activity because of its common pool resource characteristic, labour intensity, and flexibility. The study was motivated by these stylised facts to assess poverty and vulnerability of households that are living in small scale fishing communities of the Hadejia-Nguru Wetlands in Nigeria.

The thesis uses primary data that was collected in four waves of household surveys that were conducted between April 2007 and March 2008. A two-stage random sampling procedure was used to identify sample households. A total of 282 households were interviewed during the first survey and this reduced to 263 in the last survey due to sample attrition. Different econometric techniques were used to analyse the data. The analysis yielded some important results in view of the research objectives, which are briefly summarized in the following paragraphs.

From Chapter three, it has been shown that important negative income shocks in the area are death of an adult member, drought, crop pests and social conflict. These income shocks affect food consumption more significantly than they affect non-food consumption implying that negative income shocks mostly threaten household food security. Farming dependent households suffer more from social conflicts; fishing households suffer more from drought. These results show that households with different characteristics are affected by different shocks. It is recommended that rural development policies in fishing communities should include components that can improve the capacity of households to cope with shocks. These policies should also aim at reducing the effects of negative shocks through improving access to food.

In Chapter four, the findings has shown that the probability that a household will have consumption level below the poverty line varies seasonally with high probability levels during the farming and dry seasons and low probability levels during the harvesting period. The extent of seasonal variation in probability of becoming poor depend on household's major income source and asset holdings and also the socio and demographic characteristics of the household. Considering the finding that income shocks mainly affect food consumption, these results reflect serious threats of hunger and food

insecurity during certain times of the year. The effects of hunger and food insecurity during these periods would result to malnutrition mainly in children which may have long term effects on poverty. Seasonal deprivation in consumption should therefore be targeted in rural development policies. Picking of the right policy interventions requires an understanding of the factors that reduce the variation in the expected consumption poverty between seasons. Since there is some relationship between seasonal income variation and seasonal consumption variations, these interventions should aim at promoting different income generating activities at different times of the year. In general, farming households experience the most variations than fishing households and households that obtained more income from off-farm activities. Diversification of income sources to activities that are less dependent on seasonal weather changes such as off-farm activities is therefore recommended.

It has further been illustrated that the timing and frequency of survey rounds that constitutes a panel data set affects the precision of vulnerability estimates. The findings show that if one important season is not included in the panel data set, vulnerability measures that are derived are overestimated due to underestimation of the mean consumption and overestimation of the variance of consumption. The use of seasonal dummy variables assist in reducing the overestimation of the expected mean consumption but the same technique does not correct the bias in the variance of the expected mean consumption. This finding calls for careful consideration in designing surveys that are used to assess poverty and vulnerability. Researchers that use already collected data are advised to correct for the effects of seasonality at least in the expected mean by using dummy variables for the seasons.

In chapter five, an asset based vulnerability to poverty measure is proposed. The proposed measure incorporates the asset based poverty measure into the expected poverty concept. This measure decomposes expected poverty into structural-chronic, structural-transient, and stochastic-transient. The findings show that transient poverty is expected to be most prevalent and very few households are expected to be non-poor in the short term. Fishing households are expected to be better off than farming and off-farming households because fewer percentage of fishing households is expected to be structural-chronic poor and a larger proportion of them are expected to be non-poor. The majority of households are vulnerable to poverty because their asset base is so low that even if favourable

production conditions would occur they are unlikely to be able to move out of poverty permanently. This result advocates for policy interventions that aim at strengthening the accumulation of productive assets and their productivity. Productivity of assets can be attained through technological innovations and improving knowledge.

The findings in Chapter six provides policy makers with the expected household responses to changes in economic opportunities. For example, a policy that aims at increasing returns to labour in farming such as new technologies would not influence labour allocation to fishing and off-farm activities but will reduce time allocation to farming which imply that households will end up increasing leisure time if returns to farming increases. The welfare implications of such a policy may be marginal. Effective fisheries management policies on the other hand can be attained through policies that aim at increasing the returns from off-farm activities. An increase in the returns to off-farm activities would reduce time allocation to fishing. On the other hand, policies that would aim at increasing returns to fishing would increase fishing effort and reduce time allocated to both farming and off-farm activities. In applying these findings, policy makers should realise that different livelihood strategies are performing different poverty reduction roles in the study area. For example, fishing households are found to be the least poor but they experience significant variations in expected poverty between different seasons of the year. Households that obtained most of their incomes from off-farm activities are the most poor but they experience the least variations in expected poverty between seasons.

In general the study has confirmed that poverty incidence in fishing communities is high. Poverty and vulnerability are mainly caused by insufficient productive asset holding by households and incidence negative stochastic events. This is exacerbated by seasonality in the flow of incomes and inability of households to spread the income throughout the year. Rural development goals in the area should therefore aim at building asset base of households, building the capacity of households to cope with the effects of shocks and reduce intra-year variations in consumption. These goals can be attained by implementing a number of interventions such as technological innovations and their diffusion, provision of employment during the dry season, diversification of income sources, introduction of poor friendly credit programs, provision of infrastructure and improvements in the output, input, and labour markets. None of these interventions can

bring sustainable poverty reduction single-handedly and a policy mix is therefore recommended.

Keywords: Vulnerability, Livelihoods, Fisheries

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List of Acronyms

2SLS	Two-Stage Least Squares
3-FGLS	Three-Step Feasible Generalised Least Squares
AIDS	Almost Ideal Demand System
BMZ	Germany Federal Ministry of Economic Cooperation and Development
CPI	Consumer Price Index
CPRC	Chronic Poverty Research Centre
CRRA	Constant Relative Risk Aversion
DFID	UK Department of International Development
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
FGLS	Feasible Generalised Least Squares
FGN	Federal Government of Nigeria
FGT	Foster Greer Thorbecke
Ha	Hectares
HNW	Hadejia Nguru Wetlands
IFGNLS	Iterative Feasible Generalised Non-linear Least Squares
IMF	International Monetary Fund
IQR	Inter Quartiles Range
ITCZ	Inter-Tropical Convergence Zone
IV	Instrumental Variable
JWL	Joint Wetland Livelihoods Project
KYB-WDI	Komadugu Yobe Basin-Wetlands Development Initiative
MDG	Millennium Development Goals
NEAZDP	North East Arid Zone Development Programme
OLS	Ordinary Least Squares
PIH	Permanent Income Hypothesis
PPP	Purchasing Power Parity
UN	United Nations
ICLARM	International Centre for Living Aquatic Resources Management
IUCN	World Conservation Union

Chapter 1

Introduction

1.1 Background

Poverty has dominated development policy agenda for a long time in developing countries. The dominance of poverty in development policy debate has been evidenced by its presence in country specific development strategies and also in international development policy agendas. In the recent past, most developing countries developed country specific poverty reduction strategies where poverty reduction was the main goal. Internationally, the UN system adopted the Millennium Development Goals (MDGs) in the year 2000 whose first goal is to eradicate extreme poverty and hunger. As the result of the poverty reduction emphasis in development policy, poverty studies have dominated development economics literature in the last three decades following the foundation laid by Sen (1976) in his seminal paper. Recently, poverty assessments have started paying more attention to the role of time and risk in poverty. Economists have realised that household's well-being depend not only on its average incomes or expenditures, but on the risk it faces as well (Ligon and Schechter, 2003). Time in poverty assessments considers both poverty duration and movements into and out of poverty. Increasingly, both policy makers and researchers have realised that successful poverty alleviation strategies can be designed if there is a clear understanding of the conditions under which households move in or out of poverty, or remain in poverty or outside poverty. An emerging concept that combines time and risk in poverty assessment is referred to as vulnerability. This thesis assesses household poverty and vulnerability in small scale fishing communities of the Hadejia-Nguru Wetlands in Nigeria. The relationship between vulnerability levels and household livelihood activities are also assessed to understand the roles of the livelihood strategies in reducing vulnerability.

1.2 Concepts of poverty and vulnerability[1]

Poverty is a state in which individuals or populations lack sufficient resources to attain their minimum well-being. Official measurements of poverty as presented in international and national statistics show the *ex post* well-being (usually in terms of consumption or income) of individuals or populations using the Foster-Greer-Thorbecke (FGT) measures (Foster et al., 1984). The most widely used FGT measure of poverty assesses the incidence of poverty by comparing the well-being of individuals, households or populations with an exogenously defined poverty line and individuals are categorised as poor or non-poor if their well-being is below or above the poverty line. Other measures of poverty within the FGT class assess the extent and severity of poverty. The disadvantage of the FGT measures is that they are static. They cannot distinguish between households that continuously stay in poverty, i.e. chronic poverty and households that move into and out of poverty over time, i.e. transient poverty. This distinction is necessary because poverty reduction strategies need to be tailored towards these conditions. As the result, recent empirical studies have concentrated on measuring the extent of chronic versus transient poverty (Gaiha and Deolaiker, 1993; Lipton and Ravallion, 1995; Jalan and Ravallion, 2000; Baulch and Hoddinott, 2000; McKay and Lawson, 2003; Duclos et al., 2006; Dercon and Calvo, 2007).

One shortfall of the studies that distinguish between chronic and transient poverty is that they fail to identify the differences in the nature and causes of poverty. These measures fail to distinguish between different types of poverty transitions namely, structural and stochastic transitions (Carter and Barrett, 2006). Structural transition refers to situations when households move in and out of poverty due to change in asset level while stochastic transition refers to situations when households move in and out of poverty due to positive (for example commodity price increases or abundant rainfall) as well as

[1] This section is based on Section II in Chiwaula, LS, Witt, R. and Waibel H. "An asset-based approach to vulnerability: The case of small scale fishing areas in Cameroon and Nigeria". Accepted paper, *Journal of Development Studies*

negative (such as drought or crop pests) stochastic events. Carter and May (1999, 2001) and Carter and Barrett (2006) thus developed an asset-based poverty approach that helps to identify these forms of poverty transitions. The asset based poverty approach establishes a functional relationship between assets and welfare indicators such as income. Thus, a level of assets exists that predicts a level of income equal to the income poverty line and this is referred to as the asset poverty line. Consequently a household is stochastically poor if it holds assets worth greater than the asset poverty line but its realised income falls below the income poverty line. Conversely, a household is structurally poor if its stock of assets is less than the asset poverty line and its realised income falls below or above the income poverty line as expected.

The asset based poverty measures are related to vulnerability measures as both give likely poverty prospects of households after looking at the characteristics of the household. However, vulnerability measures combines time and risk in poverty assessment which makes them attractive. In general, vulnerability is a concept that is used to describe a state of being susceptible to a negative outcome. As applied to poverty research, vulnerability of a person is conceived as the prospects of a person now of being poor in the future, i.e. the prospects of becoming poor if currently not poor, or the prospects of continuing to be poor if currently poor (Christiaensen and Subbarao, 2005). Vulnerability is therefore a forward looking poverty measure that offers policy makers with a better tool for designing development plans than the static measures. A number of methods are used to assess individual or household vulnerability to poverty and these can be put in the following categories: a) Vulnerability as uninsured exposure to risk and shocks which assesses the ability of households to smooth the effects of negative income shocks (e. g. Jalan and Ravallion, 1999; Dercon and Krishnan, 2000a; Elbers and Gunning, 2003; Morduch, 2005); b) Vulnerability as *expected poverty*, that estimates the probability that a household or individual will be poor in some future period (e.g. Suryahadi and Sumarto, 2003; Christiaensen and Subbarao, 2005; Makoka, 2008; Günther and Harttgen, 2009); and c) Vulnerability as a low level of expected utility that measures the shortfall of a household's expected utility below some threshold level (Ligon and Schechter, 2003; Günther and Maier, 2008).

1.3 Motivation

The persistence of poverty in many developing countries gives researchers enough motivation to continue with poverty research. This thesis has a particular interest on poverty and vulnerability in small scale fisheries in Africa. The question is why is it important to conduct a poverty and vulnerability study in small scale fisheries? This poverty and vulnerability study is motivated by a number of reasons.

Firstly, the multi-objective and multi-task characteristic of small scale fisheries increases its potential in alleviating poverty and vulnerability. The heterogeneity that characterizes small scale fisheries across the world also applies to their levels of contribution (Béné, 2006). For example, NEAZDP (1991) reported that the fisheries are an important component of the regional economy providing food, employment and income for rural people. In the Nguru-Gashua Wetlands, Neiland, et al. (2000) found that about 61% of the households were involved in fishing and fishing accounted for about 37% of total income thereby providing both employment and income to the rural households. In a recent study by Béné et al., (2009) in Congo, it was found that households generate 65% of their total cash-income through fishing and the contribution of fishing to total household cash income was highest for the poorest households showing the potential of fishing in poverty reduction. In terms of employment contribution, FAO (2004) reports that about 90 percent of the 38 million people globally recorded as fishers and fish-farmers are classified as small-scale. Additionally more than 100 million people are estimated to be employed in other fisheries associated livelihood activities, particularly in processing and trading, bringing the total estimated to be directly or indirectly employed in small-scale fisheries and aquaculture to about 135 million in 2002 (FAO, 2005). These statistics are just a portion of the huge benefits of small scale fisheries and this warrants a study on poverty and vulnerability in these areas.

Secondly, poverty and small scale fisheries have been closely related for a long time. Despite the huge contributions small scale fisheries make to the livelihoods of households in these areas, poverty rates have been high for a very long period such that small scale fishers are classified as the poorest of the poor (see Béné, et al., 2003; Smith

et al., 2005). This has led to two famous adages in fisheries literature 'fishermen are the poorest of the poor' and 'fishing is the activity of last resort'. These two statements strongly convey the idea of permanent poverty in fishing communities. Having more and persistent poverty in areas that are associated with high income commodity (fish) creates a puzzle and this calls for a better understanding between poverty and fishing.

Thirdly, there have been very few studies on poverty and vulnerability in small scale fishing areas (Béné, et al., 2003; Béné, 2009). Many authors have stated that there is a dearth in information about the poverty situation in small scale fisheries (see Neiland et al., 2000; Neiland et al., 2005a). As a result, research and development agencies such as the Food and Agriculture Organisation and the World Fish Centre has been calling for more poverty studies in small scale fisheries (Macfadyen and Corcoran, 2002; FAO, 2005, 2006).

Lastly, it is often claimed that small scale fisheries have been ignored, marginalised and overlooked in development policy agendas (Staples et al., 2004; Thorpe, 2005; Béné et al., 2009). One of the reasons why small scale fisheries have been neglected is that these areas are mostly isolated geographically, socio economically and politically (Pauly, 1997). Small scale fisheries may also be neglected because the policy makers consider them less important probably due to lack of information that clearly shows the value of small scale fisheries. When considered less important, other development activities are implemented without considerations of the effects on small scale fisheries. Small scale fisheries often suffer from the negative effects of other development projects that aim at promoting other productive activities such as farming and hydroelectric power generation.

1.4 Research Questions

A number of research questions emerge from the preceding background information. To begin with, literature on risks and shocks and their consequences (see Carter and Maluccio, 2003; Dercon et al., 2005; Dercon 2008) show that households in Africa face a lot of negative shocks that threaten their livelihoods. The important shocks in different

areas may not be the same and their impacts may be different to different households. The first question the thesis aims to answer is therefore on which shocks are important in small scale fisheries and which households in fishing communities are affected by the shocks?

Considering the significance of seasonality in rural agrarian communities (Paxson, 1993; Chaudhuri and Paxson, 2002) in general and in fishing communities in particular (Béné et al., 2003), it becomes necessary to explore the impact of seasonality on household livelihood outcomes. The question is whether households insure are insured from these seasonal fluctuations of opportunities or not. The main focus is on whether poverty expectations (vulnerability) follow seasonal patterns. Additionally, the thesis wishes to find out if there are households that do not experience significant seasonal variations in welfare status.

Research in poverty dynamics places emphasis on identifying chronic and transient poverty (for example, Gaiha and Deolaiker, 1993; Jalan and Ravallion, 2000; Dercon and Calvo, 2006; CPRC, 2008) and also structural and stochastic poverty (Carter and Barrett, 2006). In other words a dynamic poverty assessment should be in a position to state which households are chronically poor and which ones are transiently poor? It should also state which households are poor due to structural reasons and which households are poor due to stochastic negative events? It is of both academic and policy interest to know the form of poverty that prevails more in these areas. This assessment is important for policy design since different forms of poverty require different sets of policy interventions.

The last question the thesis answers is on the livelihood choices of the households in small scale fishing areas. The 'poverty-small scale fisheries' adage stated above implies some questions: Is fishing attractive only to poor households as a safety net because of the open access nature? Is fishing making households to become poor? What motivates households to be involved in fishing?

1.5 Research Objectives

The main objective of this study is to assess poverty and vulnerability levels of households living in rural small scale fishing areas of the Hadejia-Nguru Wetlands in Nigeria. The poverty and vulnerability levels are related to households livelihood strategies thereby showing the potential contribution of these livelihood strategies in poverty reduction. This objective is achieved by addressing the following objectives:

1. To identify important risks and shocks in small scale fishing areas and assess their impact on household food and non-food consumption.

2. To estimate the probabilities that households will have consumption levels below the poverty line in different seasons of the year and to assess the effect of frequency and timing of data collection in panel data sets on the precision of vulnerability estimates.

3. To advance techniques of vulnerability measurement by proposing and applying an asset-based approach to vulnerability that is capable of decomposing household poverty into structural-chronic, structural-transient, and stochastic-transient.

4. To assess how economic opportunities affect household time allocation to fishing and other income generating activities in small scale fishing communities.

1.6 Organisation of the Thesis

The rest of the thesis is organised in six chapters. Except for chapter two and chapter seven, the rest of the chapters are addressing a specific research objective. Chapter two presents survey methodology which includes description of the study area, study design, sampling, data collection tools and techniques and some descriptive statistics that give a general overview of the sample.

In chapter three the first research objective on the impact of risks and shocks is addressed. Most frequently reported shocks and coping mechanisms are first

descriptively assessed. After that the impact of income shocks are assessed by use of estimates of income shocks in consumption expenditure functions. These impacts are assessed also for households with different livelihood strategies.

Seasonal vulnerability to poverty is assessed in chapter four. Household vulnerability levels for three seasons are estimated in this chapter. The chapter uses a buffer stock model to show the presence of seasonal variations in household consumption expenditure which impacts on vulnerability levels. Vulnerability is measured as expected poverty in this chapter.

In chapter five, household vulnerability is assessed using an asset based approach to vulnerability. The approach incorporates the asset based poverty concept (see Carter and Barrett, 2006) into the expected poverty measure of vulnerability to derive a vulnerability measure. The derived measure enables decomposing of expected poverty into structural-chronic, structural-transient, and stochastic-transient. Expected incidence of different forms of poverty is assessed for households with different livelihood strategies.

In chapter six, agricultural household models are used to model household livelihood choices. The model is empirically implemented by estimating a system of earnings share equations from which wage and earnings elasticity estimates are obtained. The information generated in this chapter helps in understanding expected household responses to policy interventions.

Finally, chapter seven provides a synthesis of this research and develops some policy recommendations.

Chapter 2

Survey Methodology

2.1 Introduction

This chapter presents the methods and procedures that were employed to collect the data that is used in this study. A step by step procedure of data generation and utilisation is outlined. Some descriptive statistics are presented at the end of this chapter to describe the sample households. The last section of the chapter presents concluding remarks which includes lessons learnt for data collection for poverty and vulnerability analysis in small scale fishing areas.

2.2 Study area

This study was implemented in the Hadejia-Nguru Wetlands (HNW) which is a flat plain located in semi-arid north eastern Nigeria and forms part of the Komadugu-Yobe basin of the Lake Chad basin as illustrated by Figure 2.1 below.

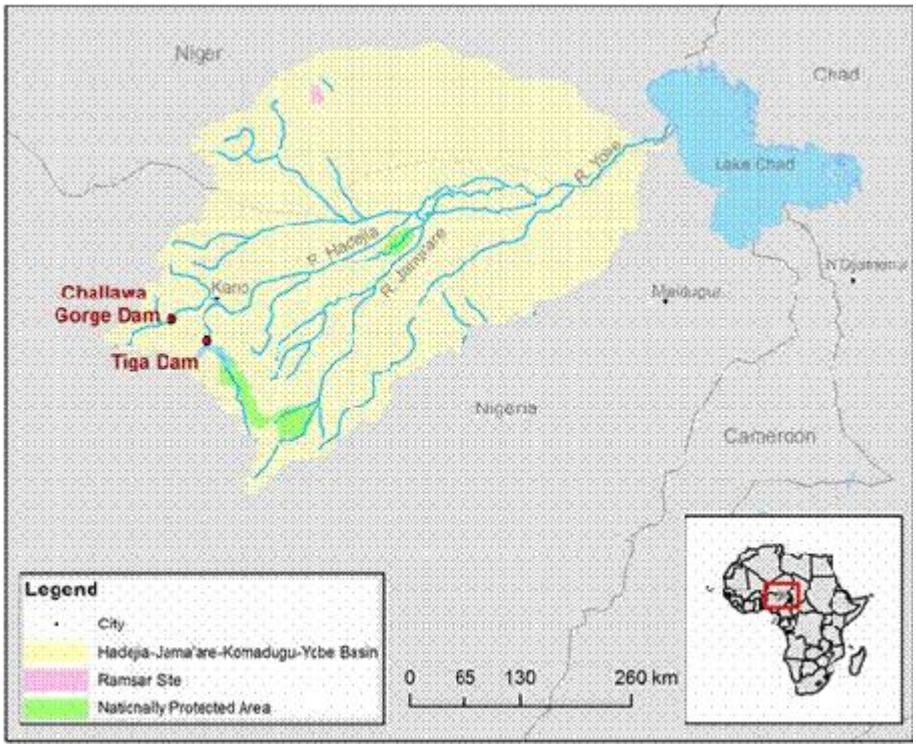


Figure 2.1: Map of the Komadugu-Yobe River Basin showing the location of the Hadejia-Nguru Wetlands, Nigeria
Source: Natural Heritage Institute, http://www.global-dam-re-operation.org

The Hadejia-Nguru Wetlands covers an area of about 3500 square kilometres through which a number of rivers flow. The rivers include the Katagum, the Hadejia, the Jam' are, the Kefin Hausa and the Burum Gana which eventually join to form the river Yobe which converges into the Komadugu-Yobe rivers that drains into the Lake Chad. The climate of the region is dominated by the annual migration of the Inter-Tropical Convergence Zone (ITCZ) which reaches its most northerly position above Nigeria in July or August and whose influence produces the distinct wet and dry seasons (NEAZDP, 1991). Most of the rainfall occurs in three to four months from June to September the wettest month being August. The area receives low annual rainfall (<600mm) and the temperatures are mostly high (30-40°C) (Neiland, 2005). This rainfall pattern results in flooding regimes of the wetland most of which takes place between August and October. In turn, the rainfall pattern and flooding regimes influence the livelihood activities of the area.

Farming is the major livelihood activity of the area (Neiland et al., 2005a). Fishing is also a significant livelihood activity although it is mainly done on part-time. For example, Neiland et al. (2005a) found that 55% of total households were fishing households in the Nguru-Gashua Wetlands. Current statistics on fisheries production in the Hadejia-Nguru Wetlands are scarce but earlier studies in 1990s estimated the annual fisheries production of the Hadejia-Nguru-Gashua Wetlands at 6500 tonnes which represented 6% of inland fisheries production in Nigeria (see Neiland et al., 2005c).

As it is with most of the wetlands in Africa (see Thompson and Hollis, 1995), the wetland is one of the most important wetlands not only to Nigeria but the whole of West Africa and has attracted a lot of attention from different stakeholders. For example, the World Conservation Union (IUCN) has been implementing the Hadejia-Nguru Wetlands Conservation Project which is concerned with conservation and sustainable management of the entire floodplain, since 1987. The UK Department of International Development (DFID) also implemented the Joint Wetlands Livelihoods (JWL) project from 2002 to 2006 with the goal of reducing poverty among poor people dependent on common pool resources in the HNW. The DFID-JWL project was handed over to a local organisation, the Komadugu Yobe Wetlands Development Initiative (KYB-WDI), which is funded by local and state governments that forms the wetland. Additionally, the National Parks Commission of Nigeria designated some areas of the wetland as part of the Lake Chad Basin National Park, while the Nguru Lake which is also part of the wetland has been designated a Ramsar site in 2000 (Schuyt, 2005).

A number of valuation studies have also shown the economic importance of the wetlands. The values of different components of the wetland are summarised in Table 2.1 below:

Table 2.1: Economic values of the Hadejia-Nguru Wetlands, Nigeria

Wetland benefit	Economic value ('000 US$/year, 2002)
Groundwater recharge	17.39
Agricultural activities	11,000.00
Fishing	3,500.00
Fuel wood	1,600.00
Wild resources: doum palm	130.00
Wild resources: potash	0.90

Source: Schuyt (2005)

These values show that the HNW is a very productive ecosystem that can support human population in the entire region. It is even stated that the wetlands have for centuries played a vital role in the regional economy, being one of the most productive areas of north-eastern Nigeria (Adams, 1994). Additionally, an earlier study by Thompson and Hollis (1995) showed that the productivity of the wetland in terms of agriculture, fishing and fuel wood benefits were over five times that of formal irrigation schemes within the same region.

Administratively, the HNW is located in the Northern State of Jigawa of the Federal Republic of Nigeria. This study was conducted in four neighbouring local governments of Hadejia, Malam Madori, Kiri Kasama, and Guri. The estimated population of the wetlands in 2005 was at about 1 million (Schuyt, 2005) and the 2006 Nigerian Population and Housing census estimates the population of Jigawa State at around 4.3 million people and the four local districts account for about 13 percent of the total state population (FGN, 2007).

2.3 Study design

Data was collected in four waves of household surveys and these were supplemented by focus group discussions and village interviews. The four household surveys were comprised of one baseline survey and three follow up surveys. To make sure that seasonality is systematically captured in the monitoring surveys and also that

information for the times of the year when most areas are not accessible is collected, a survey was planned at the beginning of the inaccessible period (August) and at the end of the inaccessible period (November). This resulted in self-defined three-month spacing of surveys. To maintain this spacing of surveys, it became apparent that surveys should be conducted in April 2007, August 2007, November 2007, and March 2008. Figure 2.2 below shows how the four surveys in the study were spaced.

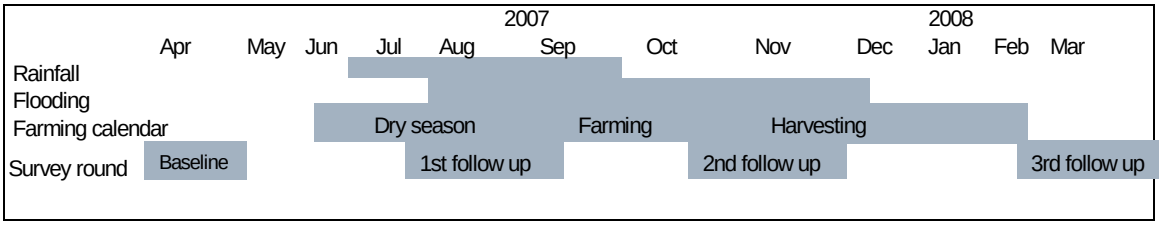


Figure 2.2: Illustration of rainfall and flooding patterns in Hadejia-Nguru Wetlands in Nigeria the frequency of surveys

Source: Own illustration

The baseline survey was conducted in a relatively less active period in terms of livelihood activities. This is about four to six months after most households have harvested their crops and it is three to four months before the next rainy season. On the other hand, the third survey was conducted at a time when most crops were ready for harvesting which imply quality information about crop production levels. Information about household activities during the inaccessible period was captured through recall during this survey. The last survey in March 2008 was conducted to ensure that the households were observed for a full year.

2.4 Sampling

Sampling aimed at obtaining representative fishing and non-fishing households. To better understand the role of fishing, it was necessary to have the non-fishing sub-sample of households from the same ecosystems to hold ecological conditions constant during the analysis. It was important to find the households that could potentially get involved in fishing but they are not because of other reasons.

A multi-stage sampling strategy was adopted. At first a list of villages from the study area was compiled. A total of 121 fishing villages were identified as the sampling frame. The list of villages in the sampling frame was compiled by combining lists of fishing villages from state departments of fisheries and wildlife and conservation. From this list, 11 fishing villages (see Figure 2.3 below) were selected randomly.

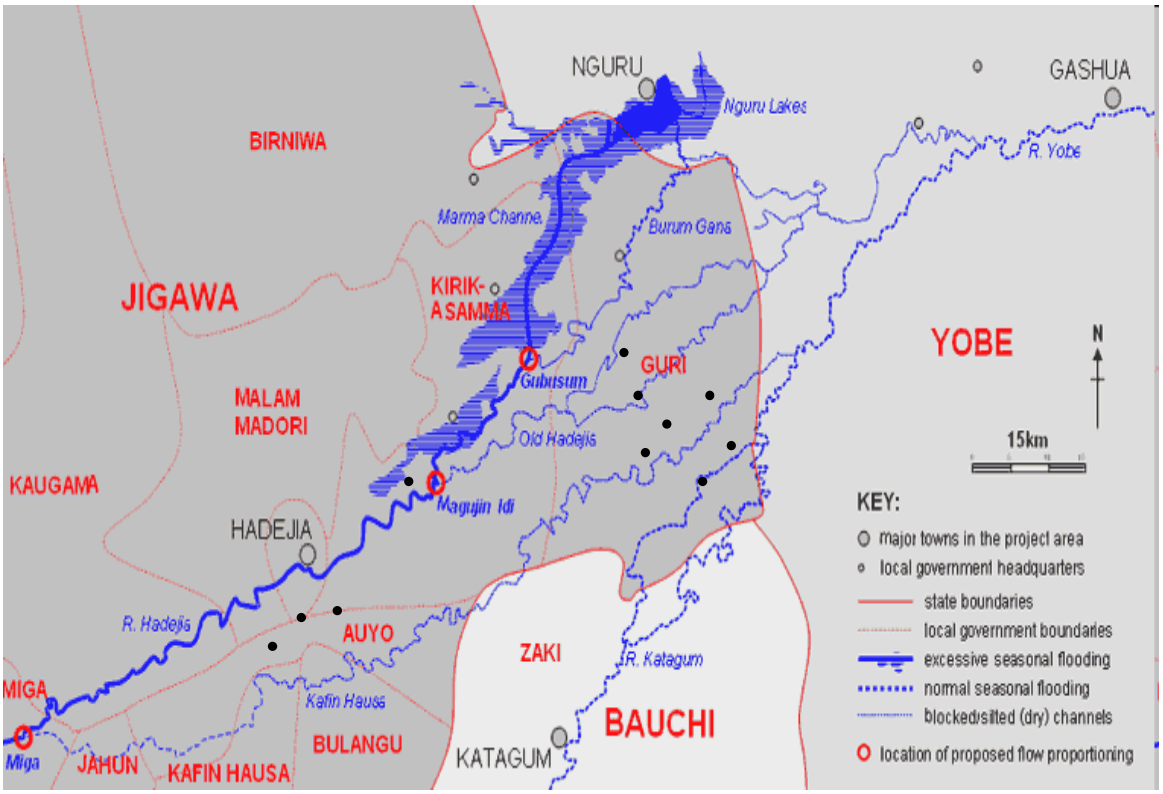


Figure 2.3: Map of the Hadejia-Nguru Wetlands showing the locations of sampled villages

Note: The locations of sampled villages are shown by black dots.

Source: DFID-JWL Project: http://www.jwlnigeria.org/location.htm

After identifying sample villages a list of all households in the sampled fishing villages was generated to create the sampling frame for individual households. A household listing exercise was done with the village head and section (wald) leaders in each of the villages. A sample of 300 households was then drawn randomly from this frame. Number of households selected in each village was based on the size of the village proportion to the total number of households in the sampled villages. Although 300

households were sampled, the final sample size for the baseline survey was 282 due to a number of reasons that are summarised in Table 2.2 below.

Table 2.2: Sample distribution according to villages and attrition reasons

Village	Number of households	Sampled households	Cases lost			Final sample
			Migrated	Died	Under aged	
Azamu	181	21	0	0	0	21
Damege	271	31	0	0	0	31
Dawa	506	59	2	0	9	48
Gamji	119	14	0	0	0	14
Giryo	74	9	0	0	0	9
Kuradige	340	39	1	0	0	38
Masama	92	11	0	0	0	11
Shawara	345	40	1	1	0	38
Una	214	25	0	0	0	25
Wareri	410	47	3	0	1	43
Zagari	38	4	0	0	0	4
Total	2590	300	7	1	10	282

Source: Own illustration

One of the major problems was that many under aged individuals were included in the list of household heads in one of the villages. This was probably done with the anticipation that the project will bring direct assistance to the respondents and this was to increase the level of assistance they may obtain from the project. To maintain the sampling probabilities, it was decided not to replace these households because it was thought this would over represent the village where this problem occurred. It was assumed that the distribution of the under-aged in the sample is the same as the distribution of the under aged in the list of households for that village since simple random sampling technique was used to obtain sample households. Other households were lost due to migration while others were lost due to death of the household head. In case of death of the household head, it was considered as a lost case because most of the times when a man dies, the women remarries within a short time such that there is

discontinuity in the household. Sometimes the widows and children leave the household to stay with relatives when the husband dies.

After the baseline survey, the study still experienced sample attrition in monitoring surveys. At this time, the main causes of attrition were refusal to be re-interviewed and missed identity of the household. Missed identity refers to cases that were interviewed up to the last survey but their identity did not match that of the case that was interviewed in the first survey. These cases could also be the same as the ones that were interviewed during the baseline survey but that the respondents did not provide reliable information during some of the survey rounds. After it was suspected that some cases have been missed in the course of the study, it was decided to collect comprehensive information about household demographic characteristics again in the last survey. These were compared with the information that was collected in the baseline survey and cases whose demographic information did not match the ones from the baseline survey were dropped from the longitudinal sample. The baseline information obtained from these households was maintained and used in types of analyses that only included the baseline survey. A summary of attrition rates is given in Table 2.3 below.

Table 2.3: Summary of sample attrition after baseline survey

Survey round	Sample size	Cases lost	Attrition rate
Baseline	283		
First Monitoring	265	18	6.36
Second Monitoring	264	1	0.38
Third Monitoring	263	1	0.38

Source: Own illustration

The cases that are indicated to have been lost after the baseline survey are mainly due to the cases whose identity was missed. It should therefore be noted that these were almost evenly distributed through out the last three surveys.

2.5 Data collection

Data was collected through focus group discussions (FGDs), village interviews, and household interviews. Focus group discussions were conducted in all the 11 sampled villages. A focus group discussion guide was used to standardize the information that was collected from different villages (see Appendix A). Groups of men in the range of 10 to 18 were involved in these discussions in each of the villages and the discussions were in Hausa language which is the most common language in Northern Nigeria. Attempts to have gender balanced groups for the discussions were not successful because of religious and cultural barriers. The FGDs collected qualitative information on overview of the villages (ethnic groups, religions, and major livelihood activities); access to natural resources; shocks, risks, and risk sharing arrangements; participatory poverty assessment; and fishing and fishing related activities. The information that was collected during the focus group discussions served a number of purposes which include modification of household questionnaire, timing of survey rounds, and providing explanations for the quantitative results from household interviews.

Household interviews used a household questionnaire to collect information on household demographic structure, education and occupation of household members, health information, risks and shocks, farming activities, livestock rearing activities, fishing activities, incomes from other sources, household assets, access to natural resources, access to infrastructure and services, food situation and food purchases and non food purchases. Two types of household questionnaires were used. The first one was used for the baseline survey (see Appendix B) while the second one was for the follow up surveys (Appendix C). Most of the questions during the baseline survey were based on annual recalls while subsequent surveys used previous interview as a reference point. According to Gibson (2005) use of previous interview as a reference point helps to prevent telescoping errors, which are misdating of responses, especially expenditures and incomes. The expectation was that the previous interview would mark the beginning of the recall period and reduce misdating of responses. The household head was considered as the key respondent for household interviews although some household members were allowed and encouraged to assist in answering the questions.

The village interviews were conducted during the time when the last household survey was conducted. The village interviews collected quantitative information about access to basic facilities, economic activities and migration, and changes the village has experienced in the past five years (See Appendix D).

2.6 Logistics and survey implementation

The study recruited 5 enumerators and these were trained for 5 days. During the training, one day was used for pre-testing the questionnaire and focus group discussion guide. The pre-testing aimed at sharpening and testing the skills of the enumerators and also testing the applicability of the survey tools to the study area. One focus group discussion and five household interviews (one for each enumerator) were conducted. Both the focus group discussion guide and household questionnaire were modified after the pre-testing. The household questionnaire was pre-tested for the second time because it was hugely modified after the first pre-testing. During the second pre-testing, enumerators were put in groups of two and were required to interview the respondents in turns. That is, one enumerator interviewed the household while his partner was observing and when they finish with that household, they go to a second household and switch responsibilities. This approach assisted the enumerators to learn from each other and also correct each other.

Considering the value of traditional institutions in the area, all the traditional readers from the village head, district heads and to the Emir (Paramount Chief) were informed before the study started. To reduce the chances of missing the respondents, survey schedules for each of the villages considered market days such that a village was visited on days that did not coincide with market days in that village or nearby villages. Interviews were mainly taking place at the respondent's house. However, in some villages, most of the interviews took place at the village head's house where the respondents gathered. Respondents did not seem to care much about other people who were overhearing their answers to the questions. During the peak farming period (third survey) when most of the respondents were busy with farming activities, some respondents were followed to their farms and interviews were conducted at their farms.

At the end of the last survey, each of the village head was given a gift as a way of appreciating their cooperation throughout the survey period. The village heads were very important in reducing the attrition rates but persuading their subjects to continue with the interviews up to the last survey.

2.7 Sample description

2.7.1 Demographic characteristics

In this sub-section, basic statistics about the sample are presented and these are mainly based on the baseline survey. The study enumerated 2068 individuals from 282 households most (68.9%) of which belong to the Hausa ethnic group. The nomadic cattle herders, the *Fulani* were not included in the survey because of their residence patterns. However, these are very important to the livelihoods of the people in the area as a source of a shock and also suppliers of livestock and livestock products. Household sizes ranged between 2 and 24 with mode sizes of 7 and 8 individuals per household and a median household size was 7 individuals per household. The mean household size was 7.31 individuals per household. In terms of sex structure, the study found that about 50.1% of the population in the study area is male while 49.9% is female. This sex ratio is consistent with national statistics in Nigeria. The 2006 population census figures show that the sex ratio in Jigawa State where the study was conducted is 51% male (FGN, 2007). Detailed age-sex structure is given by the population pyramid in Figure 2.4 below.

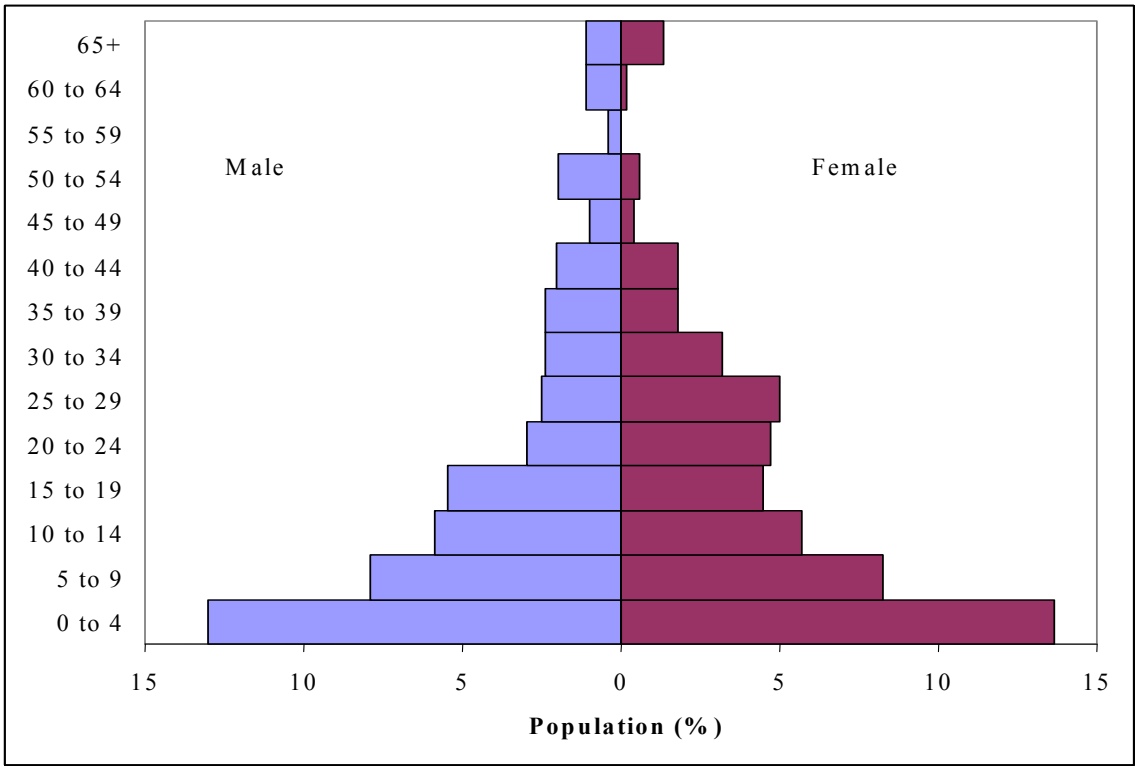


Figure 2.4: Population pyramid showing the age-sex structure of the population in the Hadejia-Nguru Wetlands, Nigeria

Source: Own illustration based on own data

The figure shows that the population is bottom heavy implying that most of the individuals in the area are young. This presents a heavy burden on the active population. Defining active individuals as the persons that are aged above 14 years, the average dependency ratio in the area was found to be 50 per cent which imply that every active individual supports one inactive individual.

2.7.2 Ownership of productive assets

Non-parametric estimations of kernel density functions were used to describe the distribution of productive assets the households own. These are presented in Figure 2.5 below.

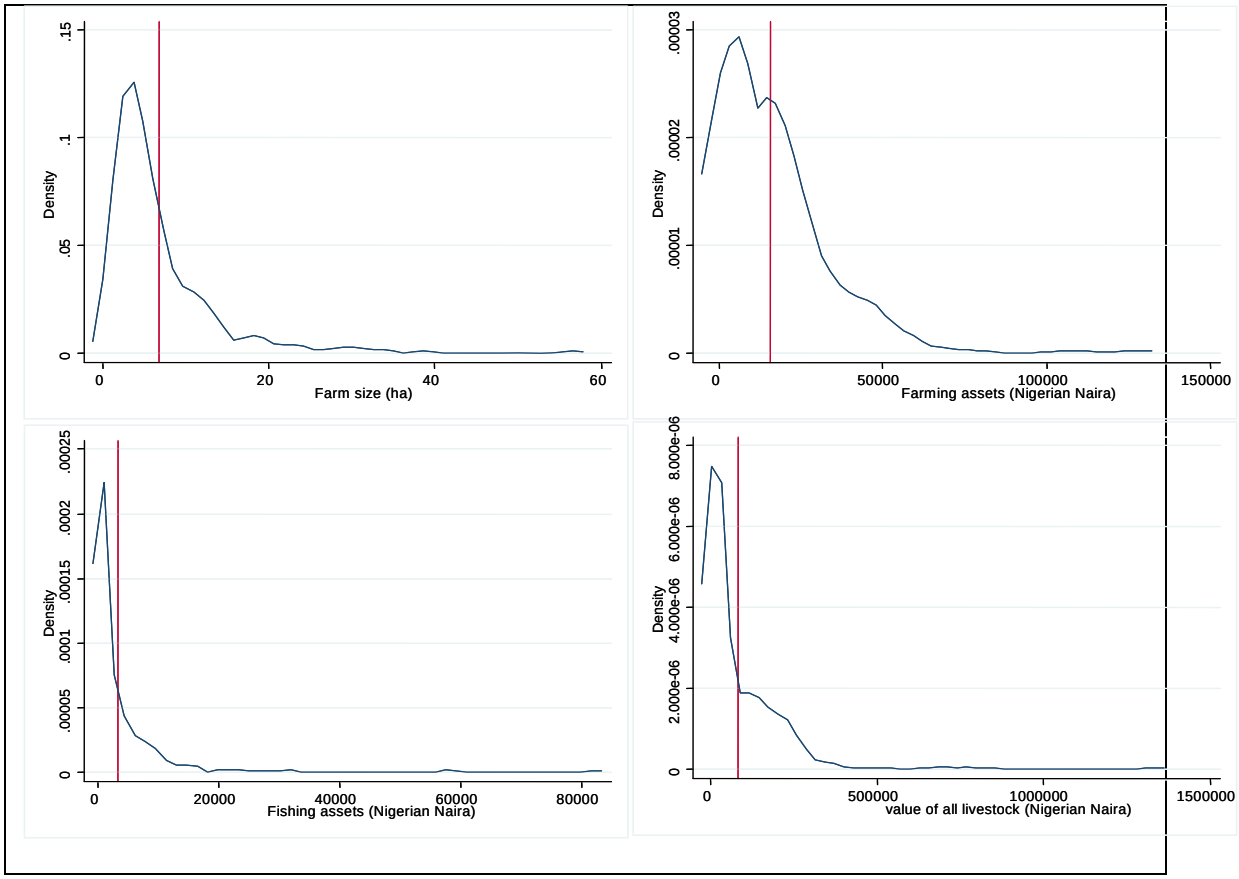


Figure 2.5: Distributions of productive assets owned by households in the Hadejia-Nguru Wetlands, Nigeria

Note: The vertical lines shows the mean values

Source: Own illustration based on own data

Fishing and farming assets can be compared in their absolute values but land holding size and the value of livestock cannot be because land is measured differently to the other assets and livestock is not used exactly the same as the other assets. Livestock can be considered as a productive asset as well as a saving. The figures therefore show that the households in the study area have more farming assets than fishing assets confirming the earlier observation that farming is more important than fishing. The mean land holding size was 6.72 hectares per household. Fishing assets and livestock ownership has the most left skewed distributions while ownership of land and farming assets has

the least left skewed distribution. This shows that almost all households own land and farming assets while few households own livestock and fishing assets.

2.7.3 Major sources of income

To assess the importance of different income sources, the percent contributions of different activities to total household income were computed. This assessment used data from the baseline survey only. Household income was measured as the total inflows (in cash and in kind) to the household. Income from farming was defined as total crop yield valued at market price. Total crop yield included the output that was auto-consumed by the household, the output that was sold, and also the output that was stored for future use. Fishing income included incomes from fishing and other fishing related activities such as fish processing, fish trading, and equipment making and repairing. On the other hand income from livestock rearing included revenue from livestock and livestock products sales plus monetary value of own livestock and livestock products consumed by the household. Finally, off-farm sources of income ranged from wage employment, large businesses, petty trading, and collection of other natural resources such as potash, fuel wood and doum palm[2]. All the incomes are reported as gross, that is, the costs of production are not netted out.

With the way the household income data was generated during the baseline survey (see Appendix B), incomes generated from some sources such as fishing and petty trading/hawking were suspected to be overestimated because households reported very high frequencies of obtaining incomes from those activities and also because households reported very high prices. Some assumptions had to be made to obtain more reasonable estimates of these values. For fishing, it was assumed that the fishing pattern that was reported by the individual/household in the previous year should be similar to the pattern during the follow up surveys). The observed frequencies during the follow up surveys were therefore used to clean the frequencies reported during the baseline survey. It was also arbitrarily assumed that in a week, there could be three days when an individual can

[2] Note that the definitions off-farm income and fishing in this chapter differs with the definitions in Chapter Six for reasons raised in that Chapter.

not go for fishing because of different reasons. Even within the peak fishing period, an individual will be faced with some situations that will not allow him/her to do the activity everyday within a week. This was thought to be a reasonable way of dealing with the overstatement of fishing frequencies in cases where households reported to be involved in fishing every day. Prices were also corrected by replacing prices that were suspected to be too high with observed prices reported by a given household during the follow up surveys. The assumption here was that the fisher is using the same measuring container (basket or basin) for pricing in which case. A similar procedure was followed to correct the incomes from hawking and/or petty trading which also had high frequencies and very high incomes per day at times. Incomes from farming and livestock rearing did not have many cases that were suspected to be overstated.

The percent contribution of each of the income sources to total household income are presented in Figure 2.6 while the percent contribution of different fishing activities to total income are presented in Figure 2.7 below.

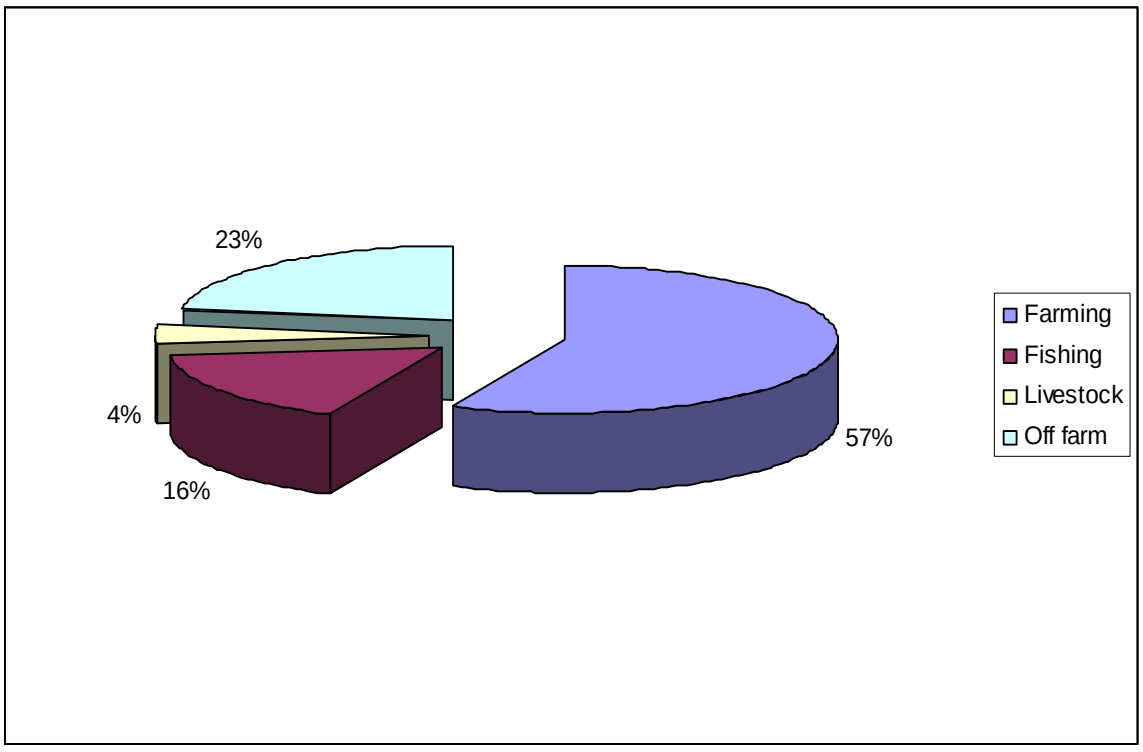


Figure 2.6: Percent contribution of different activities to gross household income in the Hadejia-Nguru Wetlands, Nigeria

Source: Own illustration based on own data

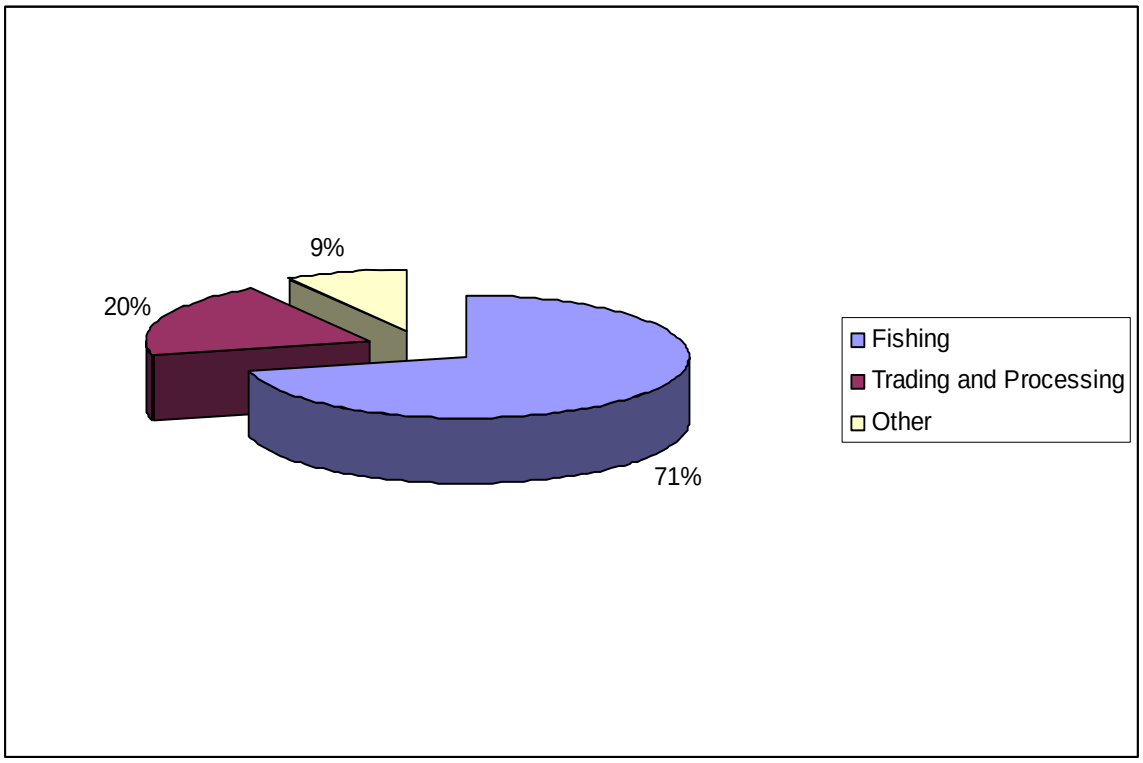


Figure 2.7: Percent contribution of different fishing activities to gross household fishing income in the Hadejia-Nguru Wetlands, Nigeria

Source: Own illustration based on own data

The figures show clearly the high contribution of farming to total household income. Farming is contributing 57 per cent of the total household income while second placed off-farm activities are contributing 23 per cent of the total household income. Fishing is contributing about 16 per cent of total income. Among fishing activities, fishing is contributing the bulk (71 per cent) of the income followed by fish trading and processing.

2.8 Conclusions

A number of lessons and conclusions emerged from the data collection exercise. One of them is on the identification of fishing and fishing households when socio-economic surveys are conducted in fishing areas. This study did not identify fishing households but rather fishing villages from which random samples were obtained. The random samples comprised of both fishing and non-fishing households. This approach seems to

be appropriate because households are not exogenously defined by the researcher as fishers or non-fishers. When defining households are defined exogenously, the researcher will be required to make decisions about the types of indicators (income, assets or time allocation) and some thresholds that define households as fishing households. This is avoided when a random sample is obtained.

The data indicated that the income and consumption values from sources where households obtained their incomes most frequently and foods that were most frequently purchased were overestimated when an attempt was made to compute annual figures from the baseline survey. It is clear here that for such income sources and frequently consumed commodities, more than one survey rounds in a year is necessary to generate reliable estimates. For income sources and expenditures that have high frequencies, shorter recall periods will generate better estimates. However, these estimates can not be easily upgraded to annual figures because the frequencies vary greatly between seasons in rural agrarian societies. It is therefore more appropriate to collect this type of data in many surveys within a year to generate more reliable annual aggregates.

Chapter 3

Impacts of income shocks on household consumption[3]

3.1 Introduction

Rural agrarian households in developing countries that are dependent on natural resources are faced with high levels of uncertainty induced by natural hazards (weather, pests, diseases, natural disasters); market fluctuations; and social uncertainty (insecurity associated with control over resources such as land tenure and state interventions, and war). Risks and shocks affect both productive decisions (Lipton, 1968) and livelihood outcomes such as income, health, education attainment, and food security (see World Bank, 2000; Siegel et al., 2003; Ligon and Schechter, 2003; Dercon, 2008). In Africa, in particular, recurrent droughts, health risks, pests, commodity price shocks, political strife, conflict and many other sources of risk require households and policy makers to make managing and responding to risks and shock of concern (Dercon, 2005).This makes risk management an important aspect of development strategies in rural agrarian societies. The objective of this chapter is to identify important risks and shocks in small scale fishing areas and assess their impact on household livelihood outcomes.

The remainder of the chapter progresses as follows: Section 3.2 presents the conceptual framework and this is followed the econometric estimation in Section 3.3. Section 3.4 describes the data used for this chapter. Empirical results are presented and discussed in section 3.5 and the chapter is concluded in section 3.6.

[3] This chapter is based on a paper titled: "Income shocks and their consequences on food and non-food consumption in fishery-dependent communities in Nigeria" submitted to the *Food Policy*

3.2 Conceptual Framework

Figure 3.1 below presents the conceptual framework that relates the negative shocks households face and household livelihood outcomes.

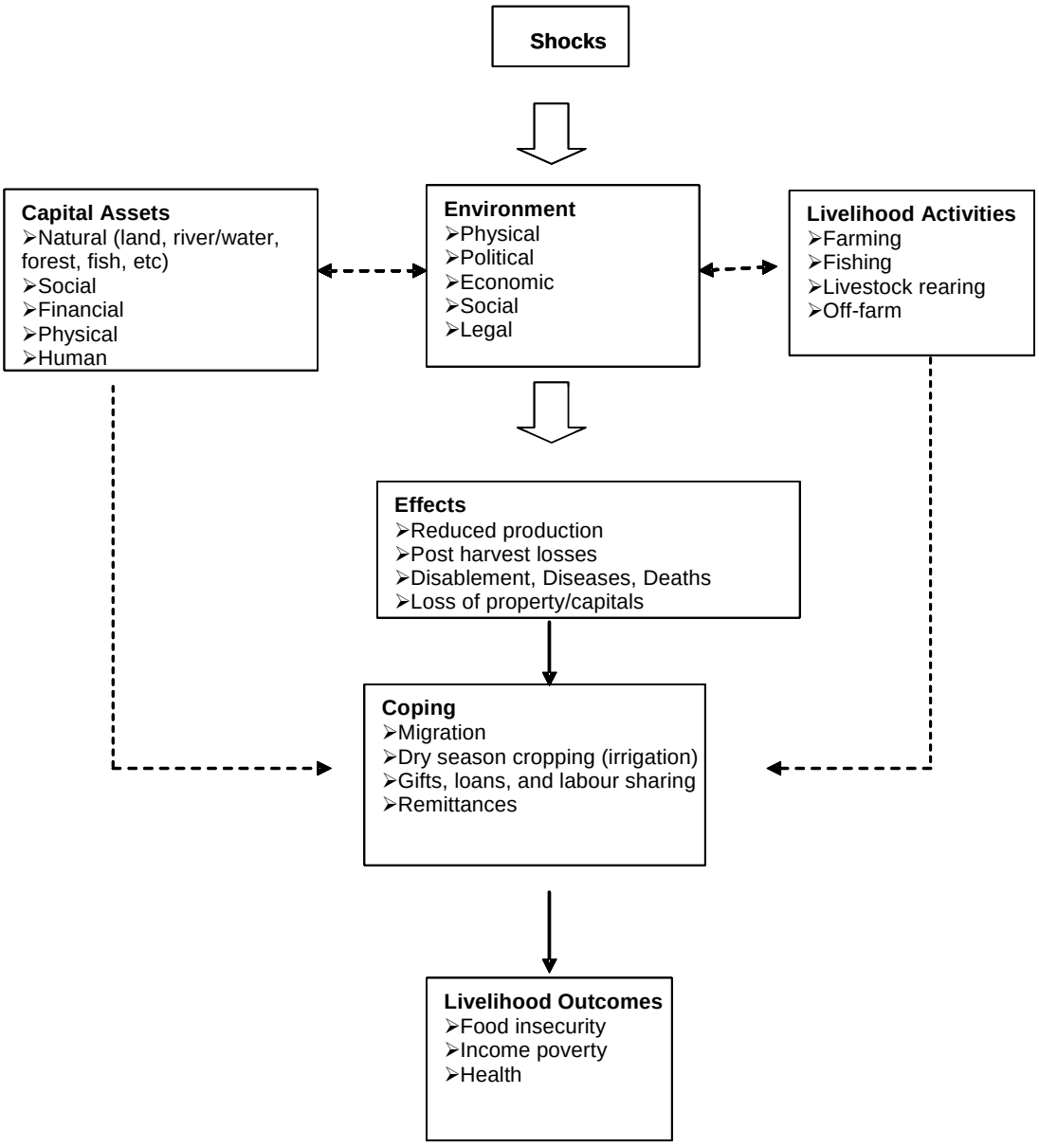


Figure 3.1: A conceptual framework for analysing risk, vulnerability and poverty

Source: Own illustration

The framework presented here borrows from similar concepts that have been previously used in analysing risks and shocks, vulnerability and poverty (see Smith et al., 2005; Hoddinott and Quisumbing, 2003; and Bebbington, 1999). A livelihood approach to poverty is taken to escape the temptation of narrowing household well-being to income and/or consumption while ignoring other equally important aspects of livelihood such as food security, health, nutrition and others. Following Bebbington (1999), the framework has been designed to address the diverse assets that rural people draw on in building livelihoods; the way in which people are able to access, defend and sustain these assets; and the abilities of people to transform those assets into consumption levels that improve their well being. Capital assets include physical (agricultural tools, livestock), natural (land, water, forest, fish), human (knowledge, skills and health), financial (cash-in-hand, bank accounts, net loans outstanding), and social (networks, norms and social trust that facilitates the ability to borrow from or get help from family and friends). These assets are not simply resources that people use in building livelihoods but they are also assets that give them capabilities (Bebbington, 1999). For example, possession of human capital not only means people produce more and more efficiently, it also gives them the capability to engage more fruitfully and meaningfully with the world (Sen, 1997). The environment defines the opportunities and threats people face within the community when making livelihood decisions. These are mostly external to people's decision realms. These may include amount of rainfall received, quality of land, access rights to resources, physical infrastructure, existence of social norms and behaviours, existence of social cohesion and strife, processes for setting general rules of the game and policies that affect level, returns, and variability of returns to assets (Hoddinott and Quisumbing, 2003). The environment in which the household is operating defines how exposed a household is to risks and negative shocks. Any change in the environment that will negatively affect the household can be considered as a shock. A simultaneous consideration of the assets possessed and the environment assists households to decide on livelihood strategies to engage in. Smith et al. (2005) supports this notion by saying that in the rural communities, the capacity to resist poverty and improve livelihoods often depends on the opportunities offered by natural resource based production systems as conditioned by wider economic, institutional and political environment. Shocks are

exogenous and they pass their effects to the households through the environment and these are then transmitted to asset stocks and livelihood strategies. As noted by Hoddinott and Quisumbing, (2003) shocks affect the stock of the asset endowment and/or the returns to these endowments. A set of negative effects will thus be felt such as reduced production, poor health (such as injury), insecurity, loss of capitals, and post harvest losses. Depending on the assets the people have access to which defines livelihood activity opportunities, a household will then choose a set of coping strategies. Variations in household access to assets determine different capabilities to cope with crises (Smith et al., 2005). The net of the gain from coping strategies and the loss due to the negative shock then determines the final impact of the shock on household livelihood outcomes.

3.3 Empirical estimation

The dependent variables are logarithms of total per capita consumption expenditure, per capita non-food consumption expenditure and per capita food consumption expenditure and measures of shocks are used in consumption functions as regressors to assess their impacts. The consumption expenditures are specified as follows;

$$\ln c_h = \alpha + \beta X_h + \gamma S_{hj} + \varepsilon_h \qquad 3.1$$

where $\ln c_h$ denotes the natural logarithm of per capita consumption expenditure for household h, X_h denotes the demographic and socioeconomic characteristics of household h, and S_{hj} is an income shock measure. α, β, γ are vectors of parameters that were estimated while ε_h is the error term.

One of the important aspects of studies that assess the impact of shocks is the measurement of the income shocks. Different methods have been used in risks and shocks literature. One strand of studies uses indicators of shocks as reported by the households (Dercon, et al., 2005; Makoka, 2008) while another strand uses estimates of income shocks. The studies that use measures of income shocks include Rosenzweig (1988) who uses the difference between a household's income and its mean over a 9-

year panel; Kochar (1995) who measured crop income shocks as the residual in a regression of crop profits on household fixed effect, lagged income, and amount of land under crops; while other studies use the deviation of the log full income from the change in income(see Ravallion and Chaudhuri, 1997; Jacoby and Skoufias, 1998; Dercon and Krishnan, 2000a). In this study estimates of income shocks are measured as the decrease in the logarithm of total per capita household income that is caused by a given shock. Using the estimate of the income shock helped to capture the magnitude of the shocks and also identify the important shocks. The approach is also appropriate when one single study together with recalls of shocks that occurred previous years are used because with such type of data set the methods that require panel data can not be used. Additionally, this approach helped to reduce the problem of endogeneity that is expected when growth rate in income is used because the estimated income shock can be considered as more exogenous than the total income. The income shock caused by shock *j* to a household *h*, S_{hj} is formally defined as:

$$\hat{S}_{hj} = \ln \hat{Y}_h - \ln \hat{Y}_{hj} \qquad 3.2$$

where $\ln \hat{Y}_h$ is the natural logarithm of the expected total household income in the absence of the negative shock while $\ln \hat{Y}_{hj}$ is the natural logarithm of the expected total household income when the household is negatively affected by shock *j*. Following Barrett (2005) and also following the conceptual framework in Section 3.2 above, it is assumed that the observed household income, Y_h, is the sum of earned returns from productive assets (structural income), temporary income shocks, and measurement error. This is a reasonable assumption since most households are self-employed and they use their assets to generate their income. The household income is presented as a function of productive assets as follows:

$$\ln Y_h = \alpha + \beta X_h + u_h \qquad 3.3$$

$$\ln Y_{hj} = \alpha + \beta X_h + \delta D_{hj} + v_h \qquad 3.4$$

where X_h is a vector of productive assets such as land holding size, farming assets, fishing assets, and value of livestock; D_{hj} is a binary variable taking the value one for households that reported to have been affected by shock j and zero otherwise; β and δ are the parameters that were estimated in which β reflects returns to productive assets; and u_h and v_h are residual terms that are comprised of the effect of temporary shocks and measurement error. When the dummy variable for a shock is included, the predicted structural income includes the effect of the shock such that when equation 3.4 is subtracted from equation 3.3 as shown in equation 3.2 an estimate of the loss in income due to the shock that was used in the regression is obtained. Equation 3.4 was run separately for each of the identified shocks. The estimated losses were then used in the consumption equation (equation 3.1) as explanatory variables to estimate the impact of the shocks on household consumption.

Using predicted income shocks in the consumption equations raises a number of econometric problems. Firstly, there was need to properly identify the estimated income shocks in these regressions. To make sure that the consumption functions are properly identified, dependency ratio was not included in the income equations and fishing assets and livestock value were not included in the consumption equation. Another issue was that any errors and bias generated in the first stage regression will be transmitted to the second regression. Additionally, asymptotic theory is likely to yield poor approximation of the distribution of test statistics derived from such this procedure. Bootstrapping technique was used to solve the problems accrued errors and bias, and to obtain correct standard errors. A total of 1000 replications were done with random seed of 20 to obtain the corrected standard errors. Bootstrapping is a re-sampling and estimation technique that is used to derive properties (standard errors, confidence intervals and critical values) of the sampling distribution of estimators. Bootstrapping resolves problems of accumulation of errors in sequential estimators (Horowitz, 2001).

Empirical application of this chapter used data from the baseline survey (refer section 2.5 and Appendix B). In assessing the exposure to negative shocks by the households in the area, respondents were asked if they were negatively affected by any negative shock

from 1997 to present (i.e. past ten years). A list of shocks was presented to the respondents to help them remember the shocks. Respondents were then asked to identify the worst three severe shocks among the reported shocks that have affected them. Further questions were asked about these three worst shocks. Health shock was captured by death of an adult member and also by the incidence of an illness to the household head that led to loss of working days in the previous 3 months. This was measured by number of days the household head did not work due to an illness. The analyses in this paper only considered these three worst shocks. Leaving out the other shocks does not mean that the other shocks do not impact on household livelihoods but this is to make the analysis focussed and meaningful since many shocks were reported by the households.

3.4 Results and discussion

3.4.1 Descriptive statistics

Description of variables used

The descriptive statistics of the variables that were used are presented in Table 3.1 below.

Table 3.1: Descriptive statistics for variables used in assessing impact of shocks in the Hadejia-Nguru Wetlands, Nigeria

Variable	Mean	Std. Dev.
Household size	7.31	3.49
Dependency ratio	0.50	0.20
Age HH head (years)	42.26	14.67
HH head education (1= formal education)	0.27	0.44
Associations	0.67	0.78
Ethnicity (1=Hausa; 0= otherwise)	0.67	0.47
Farm assets (naira)	15818.73	17428.97
Fish assets (Naira)	3246.22	7377.99
Farm size (Ha)	6.72	6.69
Livestock value (Naira)	80526.16	135695.00
Farm income share (%)	0.68	0.24
Gross per capita annual income (Naira)	72400.48	73853.69
Per capita consumption expenditure (Naira)	43072.77	29174.37
Per capita food expenditure (Naira)	25700.15	15946.60
Per capita non-food consumption expenditure (Naira)	17498.46	20981.01
N	282	

Official exchange rate at time of survey: US$1=126.1 Naira
Source: Own computations based on own data

The descriptive statistics show very low levels of education attainment for the household heads. Only 27% percent of the household heads had some formal education and many of them were just educated up to junior primary school. It should also be noted that most individuals in the area know how to read or write Arabic but few can read or write in other languages such as Hausa and English.

The average land holding size is 6.72 hectares per household. This is relatively an abundant resource considering the land holding sizes in other African countries. However, the benefits of large land holding sizes are reduced by the large household sizes which mean show that the per capita land holding size is less than a hectare. The descriptive statistics also show that households own different productive assets which lead to diverse household income portfolios but most of the income (68%) is coming from farming. Non-farm activities in the area include fishing and fishing related

activities, livestock rearing, and petty trading. This shows the dominance of farming in the household income portfolio.

The mean gross annual per capita income is 72,400.48 Nigerian. The gross income is used here because the income equations that are estimated are representing household production functions in which net income would not make sense. The statistics also show that the mean annual per capita consumption expenditure is 43,072.77 Nigerian Naira which translates to US$0.92 per person per day in PPP (see Chapter 5 for PPP exchange rate). Using the US$1.25 poverty line, poverty incidence in the area is found to be 79% which is lower than the 95% that was reported by the National Bureau of Statistics for Jigawa State where the study area is located (see NBS, 2005). This shows that the study was conducted in a poor community but poverty levels in the wetlands may be lower than that of surrounding arid regions because of the high productivity of the wetlands.

Common shocks and coping strategies

To assess the prevalence of shocks, an analysis of shocks that are frequently reported by the households in the previous one year and ten years was conducted. The results of the shocks that are frequently reported by the households are presented in Table 3.2 below.

Table 3.2: Percentages of households that reported different shocks in the Hadejia-Nguru Wetlands, Nigeria

Shock type	Households that reported this shock last year (%)	Households that reported this shock last ten years (%)
Crop pests	28.27	48.41
Social conflict	23.67	30.04
Drought	7.42	42.76
Floods	6.01	40.99
Housing destruction	6.01	15.90
Typha	3.53	8.83
Death	2.47	9.54
Theft	1.77	7.07

Source: Own computations based on own data

The results also show that households are affected by a wide array of negative shocks that include household specific (idiosyncratic) shocks and community wide (covariate) shocks. Crop pests are the most frequently reported shock. Households reported to have been affected by more than one shocks even in a single year. For example, an analysis of the number of shocks that were reported by households in the previous year whose results are not reported here show that about 17% of the households reported to have suffered from two shocks while 41% reported to have suffered from one shock only. This means that the percentages that are reported in the table above are not mutually exclusive. However, the prevalence in column 3 includes the prevalence in column 2.

The most common crop pest in the area is water fowl which attacks small grain crops such as rice, wheat, sorghum and millet which are the major crops grown in the wetlands. Results from focus group discussions revealed that the increase in the problem of waterfowl is associated with the *Typha* grass shock. It is believed that *Typha* grass provides both a good habitat and breeding environment for water fowl. This implies that the impact of *Typha* grass on household livelihoods in the area may be underestimated if the impact is only asses through the reduction in farm land or fishing ground encroached by the grass. It is also find that social conflict between the settled farmers and the nomadic Fulani was the second most frequently reported shock. These conflicts

normally emerge from competitions over the use of natural resources such as land and water.

Comparing the short-term (column 2) and the long-term (column 3) picture of the prevalence of shocks, the results show a different distribution although crop pests are the most frequently reported shocks for both time horizons. The order of the top five frequently reported shocks in the previous one year and the order of the top five in the previous ten years are different. In that case, findings about shocks from a single survey that does not ask about incidence of shocks for a longer period in the past do not always give an appropriate picture of prevailing shocks an area. The short term picture is still important in assessing the proportion of the population that is affected by a given shock at a time. Households employed different strategies to cope with the shocks that affected them in the previous one year and these are summarised in Table 3.3 below.

Table 3.3: Frequently reported coping strategies by households in the previous year in the Hadejia-Nguru Wetlands, Nigeria

Coping strategy	Percentage of households
Work harder	31.15
Additional occupation	16.39
Sold assets	11.48
Borrow from friends	8.61
Sold livestock	7.38
Sold crops	5.74
Help from family and friends	4.51
Use savings	3.28
Migration	2.87
Fishing	2.46
Nothing	3.69
Reduced consumption	1.23
Borrow from money lenders	0.82
Help from government	0.41

Source: Own computations based on own data

The results show that about 31% percent of the respondents indicated that their households had to work harder to cope with the effects of negative shocks that affected them. By saying that they worked harder, households implied that they spend more time on their existing sources of income. This response is therefore indicative of the limited coping strategies that are available to the households in the Hadejia-Nguru Wetlands. Related to this response is the second most frequent response where households took up additional occupations. Households were also found to sell assets, livestock, and crops to cope with the effects of negative shocks. Additionally borrowing from non bank institutions which include friends and family is another important coping strategy. In general, households are using their labour, savings (financial and non-financial), assets, and social networks to cope with the effects of shocks. This implies that the capacity of households to cope with the effects of negative shocks depend on the household's productive capacity (which include assets and labour) and the social networks. Unfortunately, poor households have less of these resources making the negative shocks to trap them in poverty. Clearly absent among the coping strategies is the external assistance from both governmental and non-governmental agencies.

3.4.2 Econometric results

Measuring income shocks

Following the empirical procedure presented in Section 3.3, measurement of income shocks involved two stages. In the first stage, household income was estimated in the absence of shocks. This stage involved estimation of the income equation by ordinary least squares (OLS) method without including dummy variables of the shocks. To control for village level unobserved factors that would affect the productivity of assets, village fixed effects variables were included in the models. The fitted values of this regression (Table 3.4 below) give the expected household incomes in the absence of the shocks.

Table 3.4: Estimated regression results for household income in Hadejia-Nguru Wetlands, Nigeria (Dependent variable: log(Household per capita income)

Variable	Coefficient	Absolute t-values
Age head	0.0003	0.10
Education head	0.1365	1.33
Household size	-0.1485	3.62***
Household size sqd	0.0065	3.07***
Log (land size)	0.3937	6.63***
Log (livestock value)	-0.0194	1.67
Log (farm assets)	0.0350	3.92***
Log (fishing assets)	0.0371	3.00***
Percent non-farm income	0.2466	1.24
Constant	11.3030	53.88***
Village fixed effects		2.23**
Adjusted R		0.35
F statistics		16.12***
N		278

Note: *** denotes parameter statistically significant at 1%; **denotes parameter statistically significant at 5%; and * denotes parameter statistically significant at 10%.
t-values are presented in absolute values
Source: Own estimations based on own data

The results show that village fixed effects are statistically significant from zero which imply that there exists unobserved village heterogeneity in household income level. Other model statistics suggest that the regression results have a good fit and all the explanatory variables have expected signs. The fitted values of the logarithm of the per capita income from this regression define the expected per capita income in the absence of shocks. In the second stage, the same equation was estimated but each of the dummy variables for the reported shocks was introduced one after another into the equation to estimate the expected per capita income with the given shock (equation 4). Estimated income loss due to a given shock was then computed by subtracting the fitted per capita income when the household experienced the shock from the fitted per capita income in the absence of a shock (i.e. when the shock dummy was not included). To describe the distribution of different income shocks, non-parametric method of box plots was used.

Box plots use a median as a measure of central tendency and inter quartiles range (IQR) to show variability of data points. Figure 3.2 below is the presentation of the plots.

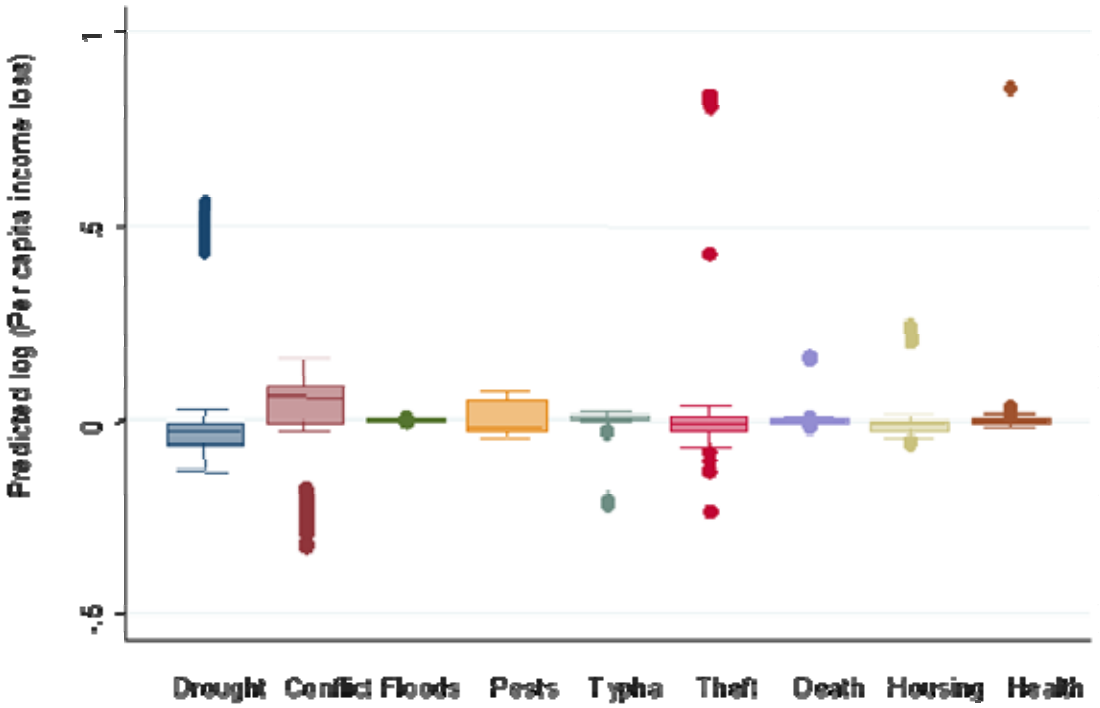


Figure 3.2: Estimated income losses due to negative shocks in 2007 in the Hadejia-Nguru Wetlands, Nigeria

Source: Own illustration based on own data

The box in the plot contains the middle 50% of the data while the horizontal line in the box is the median value of the data. The upper end of the box is the 75th percentile of the while the lower end of the box represents the 25th percentile of the data. On the other hand, the horizontal lines at the end of the vertical lines represent the maximum (for the upper line) and minimum (for the lower line) values. All the points outside the maximum and minimum data points are outliers.

The plots therefore show that income losses that are caused by social conflicts are high in most households and this is followed by income losses caused by crop pests. This is shown by both the position of the 50% of the data and also the median values. The income losses caused by drought are low in most households. Drought is considered as a

serious shock because it affect many productive activities such as farming, fishing and livestock rearing but the estimated losses due to this shock are negligible in this case because the study area generally received good rains for the year that was covered by the survey (i.e. 2006/2007 growing season). The spread of the income losses caused by the rest of the shocks were spread around zero in most households although outliers were also observed in some shocks.

Assessing impact of shocks on consumption

To assess the impact of the shocks on household welfare, the estimated losses were included in for total consumption, food and non food consumption expenditure equations as explanatory variables and the results are presented in Table 3.5 below.

Table 3.5: Estimated consumption regressions for assessing impact of income shocks in Hadejia-Nguru Wetlands

	Log Total consumption		Food consumption		Non-food consumption	
Variable	Coeff.	t-stat[a]	Coeff.	t-stat[a]	Coeff.	t-stat[a]
HH size	-0.092	2.18**	-0.100	2.39**	-0.086	1.17
HH size sqd	0.003	1.63	0.003	1.71*	0.004	1.00
Dependency	-0.502	2.80***	-0.551	2.76**	-0.445	1.84*
Education head	0.214	1.73*	0.192	1.47	0.232	0.94
Age head	-0.004	1.36	-0.002	0.61	-0.009	1.63
Associations	0.024	0.60	0.039	0.93	-0.003	0.06
Ethnicity	0.049	0.71	0.082	1.01	0.001	0.01
Ln (land)	0.169	4.44***	0.205	4.52***	0.103	1.71*
Ln (AGRassets)	0.021	2.58**	0.019	2.22**	0.031	2.24**
Drought	-0.170	0.77	-0.318	1.39	0.023	0.08
Social conflict	-0.061	0.23	-0.350	1.23	0.197	0.54
Flooding	2.399	0.13	-0.591	0.03	12.949	0.45
Pests	0.074	0.10	-1.020	1.20	1.496	1.34
Typha	0.527	0.77	0.296	0.42	0.355	0.42
Death	-1.598	1.17	-2.644	1.77*	0.365	0.19
Theft	0.168	0.61	0.130	0.43	0.190	0.29
Housing	0.087	0.15	-0.225	0.39	0.650	0.88
Illness	0.250	0.03	0.224	0.03	0.359	0.02
Constant	11.227	75.29	10.660	62.99***	10.274	47.98***
R-squared		0.41		0.45		0.24
Wald $\chi 2$		140.7***		150.4***		80.6***
N		275		275		275

Note: *** denotes parameter statistically significant at 1%; **denotes parameter statistically significant at 5%; and * denotes parameter statistically significant at 10%.
t-values are presented in absolute values

Source: Own estimations based on own data

The R-squared and Wald χ^2 suggest that the all the models have a fit that can be trusted. The estimated results show that all the control variables have expected signs. In general the

results show that there is a weak relationship between income shocks and household consumption. The weakest relationship is found in the non-food consumption regression. It is surprising to find that household food consumption is more sensitive to income shocks than non food consumption. It was expected that households would protect food consumption more than non-food consumption. The reduction in food consumption here may be both a coping strategy and a direct effect. As a coping strategy, households may have reduced food consumption to maintain food stocks for a long time while a direct effect may imply that households do not have food for now and some foreseeable future. Income shock due to death of an adult in the household is the only significant shock. While there may be different channels through which death of an adult would reduce food consumption, the main channel may be through reduction in family labour supply which is the main source of labour in the area. This would reduce household production and then food consumption.

The results above may give a broad view of the effects of the shocks but the shocks may affect different sub-populations differently. Further explorations therefore assessed the impact of the income shocks on food consumption[4] of households with high and low proportion of income from farming, households with high and low proportions of income from fishing, and households with high and low consumption levels. These variables were used on the expectations that households with different major income sources will have different abilities to cope with shocks, and empirical findings in other studies that rejected perfect insurance against income shocks among the poor (see Jalan and Ravallion, 1999). High and low in these variables was simply defined by looking at the position of the household with respect to the median. This definition of high and low was adopted to have sub-populations that could be enough to run independent regressions. The parameters of the shocks that were significant only were extracted and these are presented in Table 3.6 below.

[4] Since non-food consumption seemed to insensitive to income shocks, the effects of household heterogeneity was explored on food consumption only.

Table 3.6: Estimated food consumption regressions for assessing impact of income shocks by household types in the Hadejia-Nguru Wetlands, Nigeria

Type of households	Shock type	Coefficient	R-squared
More farming income	Conflict	-0.731	0.58
More off-farming income	None	N/A	0.48
More fishing income	Drought	-0.738	0.47
Less fishing income	Conflict	-0.764	0.54
Low consumption	Drought	-0.561	0.43
High consumption	Crop pests	-2.943	0.37

Note: All models were significant at 1% level of significance and coefficients are significant at 10%

Source: Own computations based on own data

The results suggest that households with different major income sources and consumption expenditure (poverty) levels are affected by different shocks. To begin with, the results show that income shock caused by drought is the only one that significantly reduces food consumption for households that obtained most of their income from farming. This may be the case because one of the ways in which this type of shock affects households is for the nomadic cattle herders to graze their animals on crop fields of farmers. This means that households who depend more on farming are likely to experience great effects if they experience this shock. On the other hand, households that obtained most of their incomes from off-farm activities were not significantly affected by any income shock. The off-farm incomes in this case were all non-farm incomes which include fishing, petty trading, livestock sales, temporary jobs, and extraction of other types of natural resources. This shows the significance of non-farm income sources in increasing household resilience to the impact of the income shock cause by social conflict. When households are compared according to their incomes from fishing, the results show that drought is an important income shock for households with high dependency on fishing while conflict is an important shock for households with low dependency on fishing. Drought restricts fishing activities and this makes its effect severe on fishing dependent households. These results present a rural development policy paradox. To protect fishing households from income shocks caused

by drought, construction water reservoirs in the form of dams may be an alternative. However, a lot of studies on impact of dam construction on fisheries show that there are major losses in downstream fisheries when dams are constructed (Goes, 2002; Turpie et al., 1999; Smith, et al., 2005). While accepting the findings of these studies, it is still necessary to note that dam construction would ease the levels of poverty in small scale fishing communities since the water from the dam will support other livelihood activities such as farming. Promotion of other income sources that have weak link with natural resources and weather in such cases will also ease the effects of shocks.

Food consumption for households with low levels of consumption (poor households) is found to significantly decrease when households are faced with drought income shocks while income shocks by crop pests are significant in reducing food consumption of non-poor households. Additionally, social conflicts seem also to be significant shock among the non-poor. Although Jalan and Ravallion (1999) found that the poor are least insured against income shocks in China, the results of this study show that the type of shock matters. Income shocks that affect livelihoods of the poor will affect the welfare of the poor and the same if the none-poor. In this study, rice is a major cash crop and it is a crop that is frequently affected by waterfowl. That is why income shocks caused by crop pests are only affecting the non-poor. This is similar to the findings of Dercon et al. (2005) in Ethiopia who found that land poor households were significantly affected by drought shocks while land non-poor households were significantly affected by lack of demand for non-agricultural products. result also suggest that the poor are affected by just a slight dry spell because the year was almost a normal year but the long dry spells that occurred managed to reduce food consumption of the poor significantly.

3.5 Conclusions

The main aim of this chapter was to identify important risks and shocks in small scale fishing areas of the Hadejia-Nguru Wetlands in Nigeria and assess their impact on household livelihood outcomes. The study identifies illness of household head, drought, pests, floods, social conflict, destruction of housing, death of adult member of the household and theft of production assets, livestock and cash as frequently reported

shocks. However, important negative shocks only include death of an adult member, drought, crop pests and social conflict. The findings suggest that income shocks affect food consumption more significantly than they affect non-food consumption implying that shocks threaten household food security. Additionally poor and non-poor households and households with different livelihood strategies are found to be affected by different income shocks. Since households that obtain most of their incomes from non-farming sources were not significantly affected by any of the shocks, it is recommended that non-farm income generating activities should be promoted as a way of building the capacity of households to deal with the effects of negative shocks. The non-farm income sources in this analysis included every source outside farming, and it is difficult to point to a specific activity. However, it can be said that the income sources that should be promoted to increase the coping capacities of the households should be those that are not dependent on weather and natural resources.

Despite the result that household food consumption is negatively affected by different shocks in fishing communities, these communities have often been overlooked and marginalised in rural development policies (Staples, 2004; Thorpe, 2005; Béné, 2009; Béné et al., 2009) in general and have not been targeted with social protection programs in particular. It is therefore recommended that the design of rural development programs in small scale fisheries should have social protection components as an integral part. Policies that aim at reducing the effects of shocks should also prioritise improving access to food by households.

Chapter 4

Seasonality and household vulnerability to consumption poverty

4.1 Introduction

Household income and consumption in rural agrarian communities of developing countries that depend on seasonal cropping patterns vary significantly within a year. Seasonality in household income and consumption has been an issue of concern for those interested in the living standards, nutrition, and health of individuals in developing countries for a long time (Paxson, 1993). The levels of consumption for households in such communities are normally high during harvest season and very low during lean season, mostly the period just before the main harvest. The presumption in policy circles has been that the observed consumption seasonality is largely driven by seasonal variation in income and that the link between the two can be attributed to poorly functioning credit markets (Chaudhuri and Paxson, 2002). Due to its importance to the living standards of the people living in such areas, there have been a number of studies that aimed at understanding the impact of seasonality on household livelihoods. Studies on seasonal variation in household or individual welfare have looked at short-run variations in poverty (Dercon and Krishnan, 2000b), sources and extent of consumption variations (Paxson, 1993), the extent to which households smooth consumption in the presence of seasonal variations in income (Chaudhuri and Paxson, 2002) and how agrarian households respond to transitory seasonal fluctuations (Jacoby and Skoufias, 1998), among others.

Considering the recent recognition of the importance of forward looking rural development policies, it is inevitable to consider seasonal variations in household vulnerability estimations. While there is some literature on seasonality and household income and consumption, there is very little on seasonality and household vulnerability to poverty. For marginalised rural communities, seasonal variation in vulnerability is also closely related to food security which adds an additional means to vulnerability

assessment. However, this aspect of seasonal consumption variation has not been adequately studied.

In one of the first papers on vulnerability to poverty estimations, Pritchett et al. (2000) noted the potential impact of seasonality on vulnerability estimates. Using two panel data sets that were collected in different seasons in Indonesia, the authors found that vulnerability levels were differed by 17 percent points. In a study in Ethiopia, Dercon and Krishnan, (2000b) showed the relationship between vulnerability and seasonality, however they did compute vulnerability as probabilities. Hence, this chapter aims at filling two important information gaps in the vulnerability literature. The first one is to extend the seasonal vulnerability assessment by Dercon and Krishnan (2000b) by estimating probabilities that households will fall below critical levels of consumption in different seasons of the year. Secondly, the study explores the observation that was made by Pritchett et al. (2000) by showing how the frequency and timing of data collection in panel data sets affect the precision of vulnerability estimates. This test is inevitable since most consumption data sets from which vulnerability to poverty estimates are derived such as the Living Standards Surveys are seasonal and it is necessary to know how much do this cause a bias in vulnerability estimates.

4.2 Theoretical model

In this section a model that describes seasonal consumption patterns is presented. The model facilitates the assessment of seasonality in household consumption that is expected to impact on vulnerability estimates. The buffer-stock model of household consumption (Deaton, 1991; Deaton and Paxson, 1994; Chaudhuri and Paxson, 2002) is used to derive the seasonal consumption expenditure functions. Unlike the permanent income hypothesis (PIH) model (see Hall and Mishkin, 1982) that assumes the existence of complete credit markets where households borrow freely to smooth consumption in the presence of income variations, this model assumes that households are not permitted to borrow, an assumption that is plausible for the conditions in the study area. Consumers in this model are also assumed to be impatient such that they prefer consumption now to consumption later, and they are not persuaded by the rewards of

waiting. This means that the rate of time preference for the consumers (δ) exceeds the rate of return, r. Impatience prevents long-term asset accumulation, but caution coupled with borrowing constraints provides incentives to hold a buffer of assets in most periods. In this case, consumers save only to buffer their consumption from short term income fluctuations. Chaudhuri and Paxson (2002) made a further assumption that income is seasonal and this is adopted in this study because most of the income sources in the study area are also seasonal.

Assuming that there are two seasons 1 and 2 in a given year t, and that infinitely living consumers choose seasonal consumption levels to maximise a discounted additively separable utility function:

$$u_{1t} = \sum_{j=0}^{\infty} E_{jt}\left[u(c_{1,t+j})\beta^{2j} + u(c_{2,t+j})\beta^{2j+1}\right] \qquad 4.1$$

where $\beta = 1+\delta$ and δ is the time preference for the consumers, c_{mt} is the consumption in season m of year t, and $u(c_{mt})$ is the instantaneous (sub)utility function, assumed to be increasing, strictly concave, and differentiable.

The cash-on-hand for an individual in a given season m of year t, a_{mt} is equal to the sum of assets held over from the previous season (including any interest they have earned), plus income earned in the present season:

$$a_{mt} = R(a_{m-1,t} - p_{m-1}c_{m-1,t}) + y_{mt} \qquad 4.2$$

Where $R = 1+r$ and r is the interest rate, p_m is the price of consumption in season m, and y_{mt} is the income earned in season m of year t. Specifically for seasons 1 and 2 of year t, the asset evolution constraint is given by:

$$a_{2t} = R(a_{1t} - p_1 c_{1t}) + y_{2t}$$

$$a_{1t} = R(a_{2,t-1} - p_2 c_{2,t-1}) + y_{1t} \qquad 4.3$$

In normal years (i.e. in the absence of major negative and positive shocks), consumption and production in corresponding seasons of different years are assumed to be equal. If this assumption holds, then $a_{2,t-1} = a_{2t}$ and $c_{2,t-1} = c_{2t}$. Utility maximisation of the intertemporal utility function 4.1 leads to the following Euler equation:

$$u'(c_{1t}) = \beta R u'(c_{2t}) \qquad 4.4$$

This is a common result in inter-temporal consumption optimisation (for example see Deaton, 1991; Chaudhuri and Paxson, 2002). Assuming that the utility function takes the constant relative risk aversion (CRRA) form, such that $u(c_{1t}) = \frac{c_{1t}^{1-\theta}}{1-\theta}$, where θ is the risk aversion parameter then $u'(c_{1t}) = c^{-\theta}$. Substituting this marginal utility into equation 2.4, an equation that relates consumption in the two seasons is obtained:

$$c_{1t} = (\beta R)^{-\frac{1}{\theta}} c_{2t} \qquad 4.5$$

Substituting equation 4.5 into the budget constraint (equation 4.3) and rearranging the equations results in seasonal specific consumption equations c_{1t}^* and c_{2t}^* which when multiplied with the prices of consumption results in season specific consumption expenditures presented below:

$$E_{2t}^* = p_2 c_{2t}^* = \frac{\lambda p_{2t}}{R p_{1t}} \left[R a_{1t} - a_{2t} + y_{2t} \right]$$

$$E_{1t}^* = p_1 c_{1t}^* = \frac{\lambda p_{1t}}{R p_{2t}} \left[R a_{2t} - a_{1t} + y_{1t} \right] \qquad 4.6$$

Where $\lambda = (\beta R)^{-\frac{1}{\theta}}$. The results in equation 4.6 above contain important information about seasonal consumption patterns. The result shows that seasonal consumption expenditure is positively related to seasonal flow in income and the net of the assets held

between the two seasons. This implies higher consumption during the harvesting period and lower consumption during the lean period. Inferring from the asset evolution process (equation 4.3), the term in the bracket can also be looked at as consumption in the previous season which implies that households adjust previous season consumption using prices and preferences to attain current season consumption. The net of assets show the use of savings to smooth consumption. Consumers are saving to maintain a certain desired consumption level which is consistent with the consumer's permanent income.

The effect of price of consumption in a given season on consumption in that season is the direct effect where an increase in price increases expenditures. On the other hand, price of consumption in one season has effects on consumption smoothing strategies. Increase in price of the consumption in one season reduces consumption in the following season. In principle households will not consume everything if they expect the price of consumption to be high in the coming season and they may consume everything if the price of consumption is expected to be low in the coming season.

4.3 Analytical framework and propositions

This chapter defines vulnerability as expected poverty (Chaudhuri et al., 2002; Suryahadi and Surmarto, 2003; Christiaensen and Subbarao, 2005), the approach that has probably become most prominent (Günther and Maier, 2008) due to its direct link to the traditional FGT static poverty measures (Foster et al., 1984). Denoting vulnerability level of household, h in season m of year t, as v_{hmt}, household vulnerability is formally defined as:

$$v_{hmt} = \Pr(c_{hmt} \leq z) = \int_{-\infty}^{z} f(c_{hmt}) d(c_{hmt}) \qquad 4.7$$

where c_{hmt} is the per capita consumption expenditure for household h in season m of year t; z is the poverty line; and $f(.)$ is the probability distribution function of

consumption in season *m* of year *t*. One of the major challenges in estimating vulnerability using this definition is to use past realisations of consumption expenditures to estimate the probability of possible future consumption outcomes (Ligon and Schechter, 2004). This involves estimating the *ex ante* probability distribution *(f(.))* of *ex post* consumption (Christiaensen and Subbarao, 2005). Observing actual expenditure cannot by itself provide enough information to compute vulnerability. There is a need of an estimate of the probability distribution of what consumption expenditures might have been. To compute this there is need to make some identifying assumptions to allow map past outcomes into predictions about the future (Ligon and Schechter, 2004). Different estimation strategies are found in the literature. One of them is to assume that for any particular household, the probability distribution of consumption in one period is identical to the probability distribution in any other period. In this case, if one observes consumption expenditures for each household for two or more periods, one assumes that each of these observations was just as likely to have happened to the same household in any other period. Another strategy is the one that was employed by Pritchett et al. (2000) who required that changes in consumption expenditures be fixed across periods. Due to data limitations Chaudhuri et al. (2002) and Chaudhuri (2003) directly assumed that household consumption is log-normally distributed, and they used household characteristics as determinants to predict the mean and variance of future consumption. When log-normality is assumed, equation 4.7 is empirically estimated as:

$$v_{hmt} = \Pr(\ln c_{hmt} < \ln z | X_{hmt}) = \Phi\left(\frac{\ln z - \ln c_{hmt}}{\sqrt{\text{var}(\ln c_{hmt})}}\right) \qquad 4.8$$

Where X_{hmt} is the vector of household characteristics; $\Phi(.)$ denotes the cumulative density of the standard normal; and $\text{var}(\ln c_{hmt})$ is the household specific variance of consumption expenditure in season *m* of year *t*.

Equation 4.8 above suggests that the first and second moments (mean and variance) of consumption are important in vulnerability estimation. Since these depend on observed values and that these values follow seasonality in rural agrarian societies, the resulting

vulnerability estimates will be sensitive to the season in which the observations are made. The study makes the following propositions about seasonality and vulnerability estimation:

Proposition 1: In rural agrarian societies where household incomes and consumption expenditures follow seasonal patterns, vulnerability will vary between seasons as well. Since household income is more volatile than household expenditure, more seasonal variations in vulnerability levels are to be observed when income data is used than when consumption data is used. High levels of consumption expenditure have been observed during harvest period while low consumption levels have been observed during lean season. High levels of consumption during the harvesting period would lead to low vulnerability to consumption poverty and high levels of vulnerability are expected during the lean seasons. Therefore vulnerability to poverty on annual basis may be misleading

Proposition 2: The timing of data collection in panel data sets biases vulnerability estimates. The seasonality bias of vulnerability estimates will result from the effects of seasonality on expected mean consumption and their variances. If the panel consists of data from high consumption seasons only, the predicted mean consumption and its variance for a given point in the future will be high and this would bias vulnerability to poverty estimates. Whether the bias will be upwards or downwards will depend on the relative levels of bias in the predicted mean and variance. The opposite will occur if the panel consists of data from lean seasons.

From the theoretical model above and from earlier related work (Hall and Mishkin, 1982; Moffitt and Gottschalk, 2002; Abe, 2008) it can be said that observed seasonal consumption expenditure for a given household, h in season m of year t, E_{hmt} is composed of three components:

$$E_{hmt} = E^{*}_{hmt} + \upsilon_{hmt} \qquad 4.9$$

$$E^{*}_{hmt} = E^{*}_{hm-1,t} + \varepsilon_{hmt} \qquad 4.10$$

where E^{*}_{hmt} is the desired expenditure in season *m* of year *t*, υ_{hmt} is an independently and identically distributed temporary (seasonal) shock in expenditure, and ε_{hmt} is an independently and identically distributed permanent (long term) shock in expenditure. This formulation assumes that consumption expenditure is measured with minimum or no error which is a strong assumption but can not be relaxed because of data limitations. The desired consumption is the same as the deterministic component of consumption expenditure and this depends on the household endowments and preferences. The desired expenditure can therefore be thought of as the permanent component of consumption which is time varying but is expected to persist.

If it is assumed that the desired consumption expenditure in the previous season, the permanent shock on consumption expenditure, and the temporary (seasonal) shock on consumption expenditure are not correlated, such that $\text{cov}(E^{*}_{hm-1,t}, \varepsilon_{hmt}) = 0$, $\text{cov}(E^{*}_{hm-1,t}, \upsilon_{hmt}) = 0$, and $\text{cov}(\upsilon_{hmt}, \varepsilon_{hmt}) = 0$, the variance of observed seasonal consumption expenditure in season *m* of year *t* can be given as:

$$\text{var}(E_{hmt}) = \text{var}(E^{*}_{hm-1,t}) + \text{var}(\upsilon_{hmt}) + \text{var}(\varepsilon_{hmt}) \qquad 4.11$$

Equation 4.11 shows that the variance of consumption expenditure for a given household at a given time will be composed of the variance of the permanent consumption, the variance of the long term shock, and the variance of the short term shock. If the observations are made in the same year but in different seasons, the variance of the long term shock component will be almost the same such that the differences in the variances will mainly capture the variance of the deterministic component in the previous season and the short term shock. Additionally, if the time during which the variance is being estimated is held constant and vary the preceding seasons, the variance of consumption will only depend on the variance of the deterministic consumption of the previous season. This means that the panel whose preceding season is the high consumption and high variance season (harvesting season) will have higher estimates of variance than the panel whose preceding season is a low consumption low variance season (lean season).

4.4 Model specification and estimation

Following the theoretical framework presented in section 4.2, it can be stated that a household's consumption in any given season is a function of the household's income, preferences, and prices of consumption. Household incomes depend on resource endowments, the opportunities provided by the environment, the savings the household holds, and the risks and shocks that are affecting the household. In the inter-temporal framework, the preferences are also intertemporal such that the household decides whether to consume now or in the future, hence saving and de-saving behaviour also influence the consumption level. The presence of preferences and savings in a household consumption equation makes the relationship between household income fluctuations and consumption fluctuations not to follow a one-to-one mapping. Households usually try to protect their desired consumption from income shocks by engaging in consumption smoothing behaviour, after income has been realised (Deaton, 1992; Morduch, 1995; Christiaensen and Subbarao, 2005). Households also reduce their exposure to risk factors that affect the level and variability in their income *ex ante*. It is therefore implied that consumption of a given household in a given season depends on its resource endowments (that determines its desired consumption level), the stochastic nature of risk factors, the capacity to and desire to protect its consumption from shocks (Christiaensen and Subbarao, 2005) and the household's preferences. Simplifying the time sub-scripts as *t* to reflect both season and year, household consumption in any given future time is presented by the following reduced form equation:

$$c_{h,t+j} = c(X_{ht}, S_{h,t-1}, \varphi_{t+j}, \theta_h, u_{h,t+j}) \qquad 4.12$$

where X_{ht} represents a set of observed household and community characteristics and endowments for household h at time t; $S_{h,t-1}$ represents a set of observed covariate and idiosyncratic shocks the household has been faced with in the previous year; φ_{t+j} is a set of parameters that describe the returns to the household and community endowments and the effects of shocks; θ_h is the unobserved time invariant household effects and $u_{h,t+j}$ is the unobserved idiosyncratic shocks. The unobserved time invariant household

effects and the unobserved idiosyncratic shocks contribute to differential welfare outcomes for households that are observationally equivalent.

Estimation of equation 4.12 took the Just and Pope (1979) formulation which has been widely used in production risk analysis (for e.g. Tveterås, 1999 and McCarl et al., 2008) and also in analysing consumption risk analysis mainly as they relate to vulnerability analysis (Chaudhuri et al., 2002; Chaudhuri, 2003; Christiaensen and Subbarao, 2005; and Makoka, 2008). The consumption function in this formulation is a composite of the mean consumption function, $c(.)$ and the variance (risk) function, $h(.)$:

$$c_{h,t+j} = c(X_{ht}, S_{ht}, \varphi_{t+j}, \theta_h) + h^{1/2}(X_{ht}, \alpha)u_{ht+j} \quad 4.13$$

$$\ln c_{h,t+j} = X_{ht}\beta + S_{ht}\gamma + \theta_h + h^{1/2}(X_{ht}\alpha)u_{h,t+j} \quad 4.14$$

with $u_{m,t+j} \sim \mathrm{N}(0, \sigma_u^2)$. This functional form enables a consideration of both the reducing and increasing effects of the explanatory variables on the mean and risk, thereby making it attractive for vulnerability assessment. The formulation allows the household endowments and characteristics to affect both the expected mean consumption and variance of expected consumption. Allowing the variance to depend on household endowments makes the specification heteroskedastic which is a less restrictive specification. Christiaensen and Subbarao (2005) highlighted more attractive features of this specification for vulnerability analysis.

A three step procedure proposed by Just and Pope (1979) is used to obtain the parameter estimates. The first step involves OLS estimation of consistent parameters by regressing $\ln c_{h,t+j}$ on X_{ht} and $S_{h,t-1}$ and obtain the residuals. In the second step, the logarithm of the squared residuals is regressed on the same covariates except the shock variables (see Christiaensen and Subbarao, 2005). The predicted values of the residuals from the second step, which are computed by finding the antilogarithm of the predictions in this equation gives consistent estimates of the variances $\left[\exp(X_{ht}, \alpha)\right]$. In the last step, the

first equation is re-estimated weighted by $[\exp(X_{ht}, \alpha)]^{-1/2}$ which yields efficient estimate of β, γ, and φ.

Panel data estimation techniques were employed to estimate the equations. Using the Breusch and Pagan Lagrange Multiplier test which had a Chi-statistic of 70.30, the one-way random group effect (pooled) model is rejected showing the presence of random effects and fixed effects. However, the Hausman test with a Chi-square statistic of 6.17 showed that the fixed effects were not correlated with the regressors thereby accepting the random effect model. The models were therefore estimated using the random effect estimator.

A number of explanatory variables were included. These variables included household demographic characteristics such as age of the household head, household size, dependency ratio, and education of the household. Age of the household head was assumed to be constant since the changes for all household heads are parallel and it is the cross sectional variances that matter in this case. Education of household head was measured as a dummy variable for whether the household head had attended formal education or not because of very low levels of education in the study area. Per capita values for productive assets and land were used because the dependent variable was also in per capita terms. Household size from the baseline survey was used to compute the per capita values of assets for all the three survey rounds to avoid multicollinearity that may occur if non-varying variables are divided by a common time varying variable. Dummy variables for some of the most important shocks that were reported to have affected the households in the previous one year were also included as regressors. The health shock was captured by considering household heads that lost some of their working days due to an illness three months prior to the April survey. A dummy variable that identified households that resided closer to the major trading town (Hadejia) in the area was included to capture heterogeneities in access to infrastructure and services.

The chapter uses data from all the four surveys (see Chapter 2). Information on household consumption expenditure was from the three follow up surveys. The baseline survey provided information on household endowments and characteristics and also past

shocks. As already stated, the study used consumption expenditure as the measure of wellbeing. This was measured by summing own consumption of crops, livestock products and fish and all market purchases of food and non-food non-durable commodities. The observed (nominal) seasonal consumption expenditure values (E_{mt}) were converted to real values at March 2008 prices for easy comparison as follows:

$$E_{mt}^{R} = \frac{E_{mt}}{CPI_{mt}} * CPI_{March} \qquad 4.15$$

where the superscript *R* reflects real value and *CPI* is the consumer price indices for Jigawa State of the Federal Republic of Nigeria where the study was conducted.

To test the second proposition, a natural experiment was designed from the three follow up surveys. In designing these experiments, it was assumed that there are two panel data sets that have a common second round survey (March 2008 survey) but they differ in the preceding surveys. In the first data set, the August 2007 survey is assumed to precede the March 2008 survey while the second data set, the November 2007 survey is preceding the March 2008 survey. Table 4.1 below gives the outline of natural experimental designs together with the complete panel:

Table 4.1: Design of natural experiment to assess effect of timing and frequency of surveys on vulnerability estimates in the Hadejia-Nguru Wetlands

Survey date	April 2007	August 2007	November 2007	March 2008
Season covered	Whole year	Dry season	Farming season	Harvesting season
Recall period	April 2006 to April 2007	April 2007 to August 2007	August 2007 to November 2007	November 2007 to March 2008
Panel 1				
Panel 2				
Control				

Note: Shaded areas symbolise data from that survey is included in that panel data set

Source: Own illustration

Section 2.3 presents an outline of rainfall patterns and farming calendar which can assist in understanding seasonality in livelihood activities and outcomes better. The survey that was conducted in August collected consumption levels for period between April and August and this is termed dry season because few farming activities take place during this period. This is about 6 months after most households harvested their produce which means that food stocks of many households are depleted this time. The second follow-up survey in November collected consumption values for a period between August and November. This is termed the farming season because it is during this time when the area receives most rainfall and most of the farming activities take place during this period. This period also coincides with an increase in fishing opportunities due to the increase in water levels. The last period is termed the harvesting period because most households in this period are harvesting their farm produce. The recall period is between November and March.

4.5 Results and Discussion

4.5.1 Descriptive statistics

The descriptive statistics of the variables that have been used in this chapter are presented in Table 4.2 below:

Table 4.2: Descriptive statistics for variables used in assessing seasonal vulnerability in the Hadejia-Nguru wetlands, Nigeria

	Dry season		Farming season		Harvesting season	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Real consumption expenditure (Naira)	91.08	83.68	93.83	101.18	113.82	132.42
Age head (years)	42.56	14.46				
Education head (1/0)	0.27	0.44				
HH size	7.30	3.33	7.97	4.07	8.22	4.13
Dependency ratio	0.54	0.18	0.53	0.20	0.51	0.21
Associations	0.62	0.74				
Land holding (ha)	1.06	1.16				
Farming assets (Naira)	2661.61	3550.52				
Fishing assets (Naira)	475.16	1014.61				
Livestock value (Naira)	11593.45	19836.45				
Drought (1/0)	0.08	0.27				
Field pests (1/0)	0.30	0.46				
Health (1/0)	0.50	0.50				
Conflict (1/0)	0.23	0.42				
Flood (1/0)	0.06	0.24				
Hadejia (1/0)	0.30	0.46				
N	260		260		260	

Note: All quantities and amounts are measured in per capita

Source: Own computations based on own data

Most of the variables that are not changing with time have been discussed in the previous chapter. The slight differences in the values are due to the changes in sample

size. However, the general picture has not changed. The real consumption expenditure is found to vary seasonally. The mean consumption expenditure per person per day is lowest during the dry season and highest during the harvesting. The differences in the distribution in household consumption expenditure and income were further explored by applying lowess smoothing on their deciles. Figure 4.1 presents the lowess curves for real per capita consumption while Figure 4.2 presents the lowess curves for real per capita incomes.

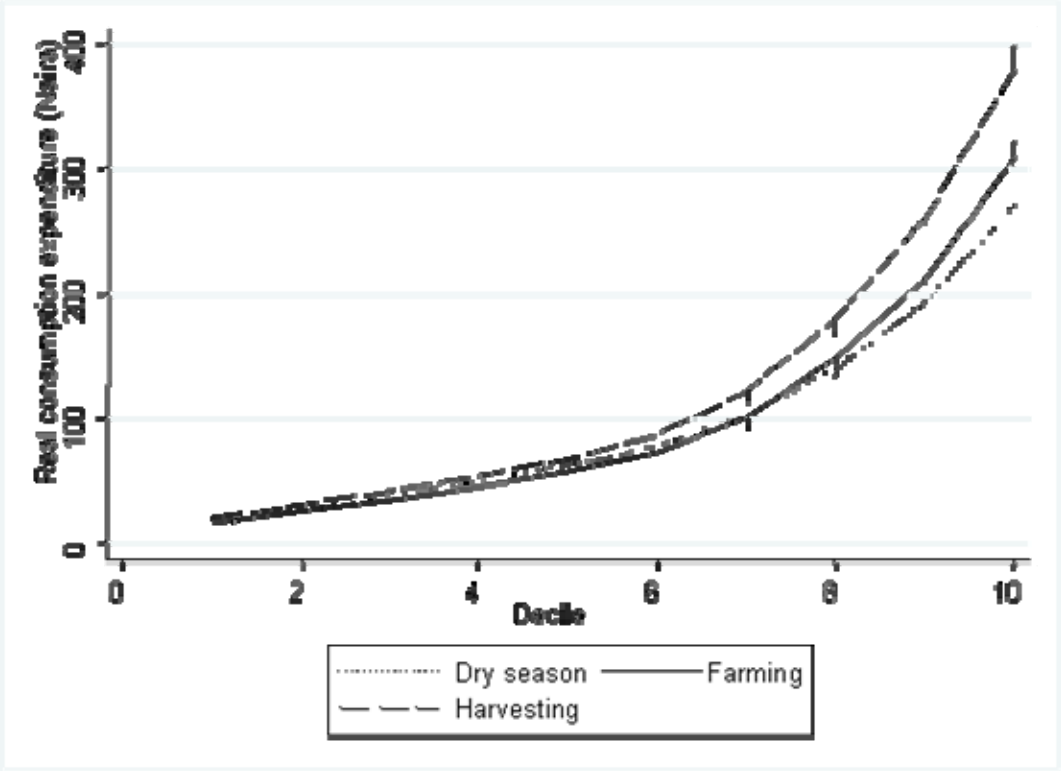


Figure 4.1: Distribution of real household per capita consumption in the Hadejia-Nguru wetlands, Nigeria

Source: Own illustrations based on own data

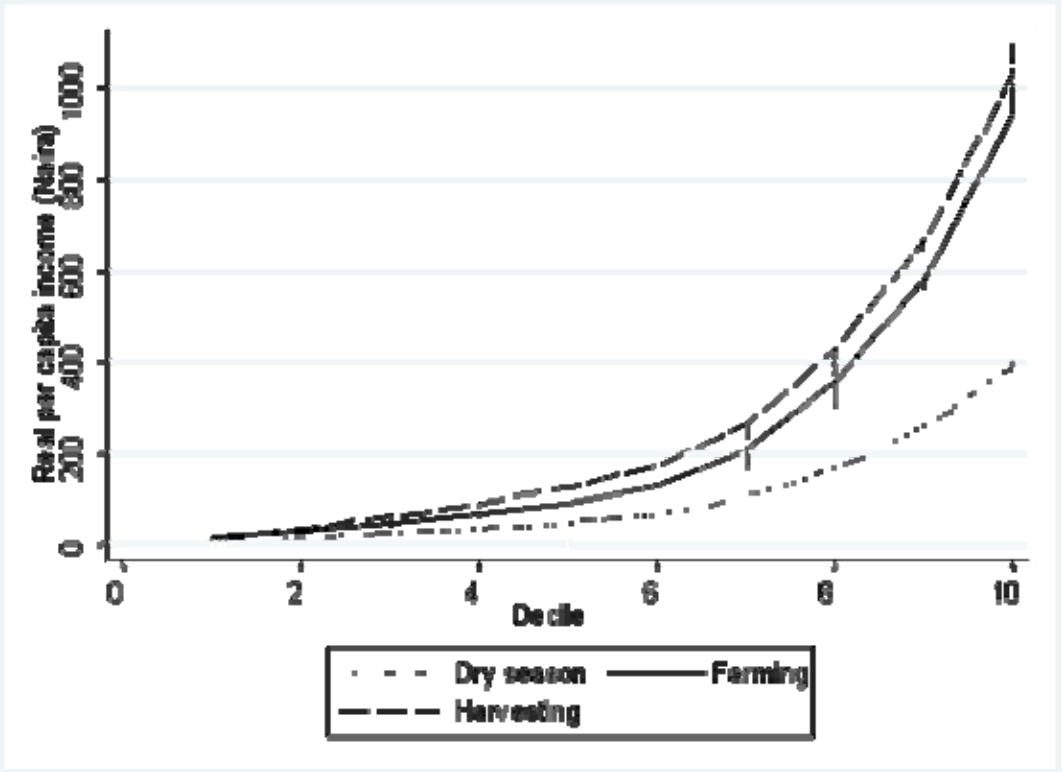


Figure 4.2: Seasonal distribution of real household per capita income in the Hadejia-Nguru wetlands, Nigeria

Source: Own illustrations based on own data

The two figures show that both income and consumption expenditure vary seasonally. The curves show that households obtained lowest levels of income and consumption during the dry season and the highest levels of income and consumption expenditure during the harvesting season. This agrees with the theoretical results which showed that the timing of income affects consumption. The plots in the two figures also show that the differences in the income values between the three periods are higher than the differences in consumption values. This reflects the households' desire to smooth consumption even in the presence of huge income fluctuations and this supports the buffer stock model of consumption. These results are similar to the findings of Chaudhuri and Paxson (2002) in India who found that seasonality in consumption pattern was less pronounced than seasonality in income. In an earlier study in Thailand, Paxson (1993) found little evidence of the responsiveness of seasonal consumption to seasonal income.

4.5.2 Determinants of vulnerability

As shown by equation 4.8 the first and second moments of the expected consumption expenditure are the variables for vulnerability estimation. This means that the factors that influence either one or both of these moments affect the level of household vulnerability. Variables that increase the expected mean consumption are expected to have reducing effect on household vulnerability while variables that increase the variance of expected consumption expenditure are expected to have increasing effects on household vulnerability. It therefore makes sense to look at variables in the mean expected consumption equation (last step of the three -step FGLS) and the variance of expected consumption equation (second step of the three-step FGLS) to understand the determinants of vulnerability. Table 4.3 below presents the FGLS estimation of the mean consumption equation and the OLS estimation of the variance equation.

Table 4.3: Estimated consumption and variance of consumption regression results for households in Hadejia-Nguru Wetlands, Nigeria

Variable	Log (per capita consumption expenditure)		Log (variance of consumption expenditure)	
	Coeff.	z-statistic[a]	Coeff.	z-statistic[a]
Age head	0.0558	4.40***	-0.0172	0.50
Age head squared	-0.0005	3.72***	0.0004	1.09
Education head	0.1999	2.71**	-0.0326	0.14
Associations	0.0750	1.78*	-0.1800	1.36
Family size	-0.1185	19.32***	0.0081	0.33
Dependency ratio	-0.3542	3.08***	-0.3973	0.84
Log (land holding size)	0.0186	2.12**	0.0036	0.13
Log (farming assets)	0.0268	0.66	-0.0035	0.03
Log (fishing assets)	0.0246	2.82**	0.0473	1.75*
Log (livestock value)	-0.0138	1.37	-0.0186	0.60
Drought shock	-0.2337	2.12**		
Pests shock	-0.0543	0.82		
Health shock	-0.1193	1.93*		
Conflict shock	0.1488	1.93*		
Flooding shock	0.2713	2.11**		
Dry season dummy	0.1564	3.38***	0.2810	1.38
Harvesting season dummy	0.1087	2.38**	0.0855	0.42
Location dummy	-0.0234	0.32	0.1376	0.66
Constant	3.7221	12.09***	-3.0706	3.48***
Wald Chi2		618.74***		20.38*
R-sqd		0.44		0.01
N		780		780

Note: [a] z-statistics presented in absolute terms

*** denotes statistical significance at 1%; ** denotes statistical significance at 5%;* denotes statistical significance at 10%.

Source: Own estimations based on own data

As it is the case with similar studies (Christeansen and Subarrao, 2005; Makoka, 2008), the variance of consumption equation has a low explanatory power. On the other hand, the mean consumption equation has high explanatory power. The results show that consumption levels are significantly higher during the farming season and the harvesting season when compared to the dry season. Land holding size and value of fishing assets are the productive assets that have significant positive effects on household consumption. It is also found that households whose heads belong to many associations (more social capital), have attained high formal education, and are more aged have higher expected mean consumption. On the other hand, increase in household size and dependency ratio significantly reduces the expected mean consumption. Households that reported to have suffered from drought and illness of the household head were found to have a lower expected mean consumption than households that did not report to have suffered from these shocks in the previous year. On the other hand, households that experienced social conflict and flooding had high expected consumption.

4.5.3 Evidence of seasonal vulnerability

The US$1.25 per person per day poverty line was adopted to compute the probability that a household will have its consumption below poverty line. Using the PPP exchange rate and consumer price indices this poverty line was converted to March 2008 prices in Nigerian Naira. This resulted in a poverty line of 85.16 Nigerian Naira per person per day. Table 4.4 below presents the static poverty incidence levels and estimated vulnerability levels for different seasons.

Table 4.4: Estimated seasonal poverty and vulnerability levels in Hadejia-Nguru Wetlands, Nigeria

Variable	Season		
	Dry season	Farming season	Harvesting season
Poverty head count (%)	62.3	64.6	59.6
Variance	0.051	0.068	0.057
Expected consumption (Naira)	73.280	73.425	91.506
Vulnerability (%)	69.4[c]	68.6[c]	57.6[a,b]

Note: [a] significantly different from off-farming season; [b] significantly different from the lean season; [c] significantly different from the harvesting season. Statistical significance compared at 10% level

Source: Own estimations based on own data

The results show that observed poverty head count ratio varied between the seasons with highest poverty incidence during the farming season and lowest incidence during the harvesting season. However, these variations are not statistically significant. Variance of consumption is highest during the farming season and lowest during the dry season while expected consumption is highest during the harvesting season and they are almost similar during the dry season and farming season. Although the observed levels of poverty were similar between the three seasons, the estimated expected levels of poverty are found to be different. This shows the advantage of using expected poverty measures over the observed poverty measures. The results show that the mean probability that the household will be consumption poor is significantly lower during the harvesting period than it is during the dry season and farming season. There is no significant difference in the vulnerability levels between the farming season and the dry season. This implies that households are expected to experience lower levels of consumption poverty during the harvesting period when compared with the farming and dry seasons. In absolute terms, the vulnerability level during the harvesting period is still high considering the fact that this is the period when households are expected to have the highest levels of consumption. As shown later in Chapter five of this thesis, the high poverty expectation during the time when households are expected to experience highest consumption level may be indicating that most of the poverty in the study area is due to structural reasons which mean that households fail to produce adequate income because of low asset

holdings. During the two seasons outside the harvesting season (dry season and farming season), similar chances of experiencing poverty exist.

4.5.4 Identifying the seasonally vulnerable households

The results in Table 4.4 give a global picture of the presence of seasonal vulnerability in the study area. However, it may be necessary to identify the households that experience seasonal vulnerability. Seasonal vulnerability values were therefore estimated for households with different livelihood strategies and also for households with different socio-demographic characteristics.

Livelihood strategies

Household livelihood strategies were defined as fishing, farming and other off-farm activities if the household obtained most of its income from that activity. The proportions of income were computed on annual basis such that the classification considered a longer term definition of a household livelihood strategy. Livestock rearing households were excluded from this analysis because they were too few to compute reliable statistics. The results are presented in Table 4.5 below:

Table 4.5: Estimated seasonal poverty and vulnerability levels by major income source in Hadejia-Nguru Wetlands, Nigeria

Type of Household	Vulnerability level (%)		
	Dry season	Farming season	Harvesting season
Farming	71[c]	69[c]	56[a,b]
Fishing	54	55	62
Off-farm	72	76	62

Note: [a] significantly different from off-farming season; [b] significantly different from the lean season; [c]significantly different from the harvesting season. Statistical significance compared at 10% level

Source: Own estimations based on own data

Across the different household types, the results show that fishing households are least vulnerable during the dry season and farming season while farming households are least vulnerable during the harvesting season. Households that obtained most of their incomes

from off-farm activities are the most vulnerable in all the three seasons This shows that fishing becomes very important when farming which is the major source of livelihood in the area cannot generate enough income.

Across seasons, the results show that there is no significant variation in vulnerability for fishing households and also households whose main livelihood source is off-farm activity. Significant variations in vulnerability are observed only among farming households. These results show the significant role of fishing in reducing vulnerability both across households and across seasons. The results also show that the dependency on farming is the main source for seasonal variations in vulnerability levels.

Related to the above analysis, the impact of asset holding on seasonal vulnerability which is looking at household livelihood from the input perspective was assessed. A household was defined as having more (less) of a given asset if its asset holding is above (below) the median asset holding in the sample. The results are presented in Table 4.6 below:

Table 4.6: Estimated seasonal poverty and vulnerability levels by household ownership of productive assets in Hadejia-Nguru Wetlands, Nigeria

		Vulnerability level (%)		
Asset type	Amount owned	Dry season	Farming season	Harvesting season
Land	less	70[c]	71[c]	62[a,b]
	More	68[c]	66[c]	53[a,b]
Farming assets	Less	75[c]	73[c]	61[a,b]
	More	64[c]	64[c]	54[a,b]
Fishing assets	Less	63[c]	68[c]	53[a,b]
	More	73[c]	69	62[a]
Livestock	Few	75	74	68
	Many	64[c]	63	48[a]

Note: [a] significantly different from off-farming season; [b] significantly different from the lean season; [c]significantly different from the harvesting season. Statistical significance compared at 10% level

Source: Own estimations based on own data

The results show that household whose land holding size and farming assets are above the sample median levels have lower levels of vulnerability to consumption poverty. However, the amount of land and farming assets a household owns do not make significant differences in seasonal variations in vulnerability level. Significant seasonal variations in vulnerability to consumption poverty are observed for both households with more and less land and farming assets. Households with more or less of these assets are more vulnerable during the dry season and farming seasons than during the harvesting season. Vulnerability levels between the dry and farming seasonal are not statistically different. Additionally the results show that less of fishing assets is associated with lower vulnerability levels within a season but more significant variations in vulnerability between seasons. On the other hand, ownership of more livestock is associated with lower vulnerability levels within a season but significant variations in vulnerability between seasons. These results suggest that seasonality in vulnerability is more related to dependency farming. Further to that, the results show that ownership of off-farm assets such as livestock and fishing assets perform better in reducing intra-season vulnerability but little reduction in seasonal variations in vulnerability.

Socio-demographic status

The relationship between seasonal variations in household vulnerability and some household socio and demographic characteristics was also assessed. These are presented in Table 4.7 below:

Table 4.7: Estimated seasonal poverty and vulnerability levels by household demographic and socio economic characteristics in Hadejia-Nguru Wetlands, Nigeria

Variable	Household type	Vulnerability level (%)		
		Dry season	Farming season	Harvesting season
Formal education	Yes	60	67[c]	53[b]
	No	73[c]	69[c]	59[ab]
Location	Near trading centre	72[c]	76[c]	58[ab]
	Far from trading centre	68[c]	65[c]	58[ab]
Dependency ratio	< 0.50	46[c]	47[c]	34[a,b]
	>= 0.50	78	81[c]	74[b]

Note: [a] significantly different from off-farming season; [b] significantly different from the lean season; [c] significantly different from the harvesting season. Statistical significance compared at 10% level

Source: Own estimations based on own data

Within seasons, the results show that households whose heads had attained some formal education are associated with low levels of vulnerability. Across seasons, the results also show that these households experience less seasonal variations in vulnerability level. This suggests that formal education reduces vulnerability level within a season and it also reduces seasonal variations in vulnerability. On the other hand, the results show that households that lives closer to the nearest trading centre are more vulnerable within seasons but the seasonal variations in vulnerability for households from the two locations are similar. This may mean that the households though at different distances from the main trading centre have access to similar services. In terms of demographic characteristics it is found that households with low dependency ratios have low levels of vulnerability in all seasons, but the level of vulnerability varied more across seasons. Households with high dependency ratios have very high vulnerability levels within seasons and slightly lower variation in vulnerability across seasons. In general, these findings show that the variation consumption levels between seasons also depend on the education level of the household head, household demographic structure and access to infrastructure and services.

4.5.5 Timing and frequency of surveys and precision in vulnerability estimates

The second proposition in this chapter was that seasonality biases vulnerability estimates. This section aims at testing the hypothesis that vulnerability estimates at a given point in time (March 2008) is influenced by the timing of data collection if panel data is used for estimations. Using natural experimental designs presented in Table 4.2, the probabilities that households will be poor in March 2008 were estimated using observations made at different times of the year. Vulnerability levels were estimated using panel data sets 1 and 2 and these are compared to each other and also to the complete panel data set (control).

All the estimation techniques presented in the above sections were used and the regression results of the estimations are presented in Appendix E. In one set of estimations, seasonal dummy variables were used to try to control for seasonality while in the other set, these were not used. To show the sources of the bias, the estimated variances of the expected consumption expenditure and the estimated mean consumption expenditure values have been presented before the vulnerability estimates are finally presented in Table 4.8 below.

Table 4.8: Estimated vulnerability levels under different data collection assumptions in Hadejia-Nguru Wetlands, Nigeria

Data collection assumption and model specification	Description	Mean	Std. Dev.
Variance of log (consumption)			
Control	All survey rounds	0.056	0.024
Panel 1 with season dummy [c,3]	Excluding off-farming season	0.042	0.017
Panel 1 without season dummy [4]	Excluding off-farming season	0.057	0.019
Panel 2 with season dummy [c,1]	Excluding lean season	0.065	0.020
Panel 2 without season dummy [c,2]	Excluding lean season	0.078	0.024
Expected log (consumption)			
Control	All survey rounds	4.331	0.612
Panel 1 with season dummy	Excluding off-farming season	4.333	0.624
Panel 1 without season dummy [c]	Excluding off-farming season	4.208	0.614
Panel 2 with season dummy	Excluding lean season	4.333	0.605
Panel 2 without season dummy [c]	Excluding lean season	4.231	0.599
Vulnerability (%)			
Control	All survey rounds	57.9	41.7
Panel 1 with season dummy	Excluding off-farming season	57.8	43.2
Panel 1 without season dummy [c]	Excluding off-farming season	64.2	40.4
Panel 2 with season dummy	Excluding lean season	57.8	41.0
Panel 2 without season dummy	Excluding lean season	63.4	38.8

Note: [c] denotes that significantly different from the control case, [1]denotes that the values are significantly different from panel data set 1 with dummy variables during estimation, [2] denotes that values are significantly different from panel data set 1 without dummy variables during estimation, [3]denotes that the values are significantly different from panel data set 2 with dummy variables during estimation, [4]denotes that values are significantly different from panel data set 2 without dummy variables during estimation all

Source: Own estimations based on own data

The results show that when one survey round is not included in the panel, the variance of consumption is either underestimated or overestimated. The variance is underestimated when the data from the off-farming season is excluded and it is overestimated when the lean season is excluded. From the results in Table 4.4, it is shown that the variance in the off-farm season is lower than the variance in the lean season. This result is then

consistent with the results from the theoretical model (equation 4.11) since the variance of consumption in the previous period ($\text{var}(E^*_{hm-1,t})$) is what is determining the difference in the predicted variances. The comparison of variance estimates of different pairs of results further tests the proposition. In general, panels that left out the off-farming season produces larger estimates of variances than surveys that left out the lean season. It is also noted that inclusion of time dummy variables does not correct the bias in the variance.

The results also show some significant differences in the expected mean consumption. When the time dummy variables are included in the estimation models, the expected mean consumption expenditures are almost the same for the control and the other two panels. When the dummy variables are not included, the models underestimate the mean consumption values. This means that inclusion of the seasonal dummy variables in the estimations assist in correcting the bias in the predicted values of mean consumption.

The results also show that vulnerability estimates almost the same when season dummy variables are used during estimation. This is like that because seasonal dummy variables have been found to correct the bias in expected consumption. When seasonal dummy variables are not used, vulnerability estimates from both data sets are greater than the estimates from the control. The estimates from the two panel data sets are not different.

In summary, the findings from this section confirm that seasonality in household consumption can result in bias in vulnerability estimates through its effect on estimated mean consumption and its variance. The variance of estimated consumption expenditure is more biased than the mean. The bias in the mean is easily corrected by including time dummy variables. The final effect of the seasonality bias finally depends on the extent of bias in mean and variance. In this study, final vulnerability measures are only overstated when dummy variables are not included but the difference does not depend on the survey that was excluded from the panel.

4.6 Conclusions and policy implications

The findings in this chapter have shown that the probability that a household will have consumption level below the poverty line varies seasonally with high probability levels during the farming and dry seasons and low probability levels during the harvesting period. The extent of seasonal variation in vulnerability levels depend household's major income source and asset holdings, as well as the socio and demographic characteristics of the household. It has also been illustrated that the timing and frequency of survey rounds that constitutes a panel data set affects the precision of vulnerability estimates.

From these findings, it can be inferred that short term variations in consumption in the study area need not to be overlooked by policy makers. On the basis of the results from Chapter Three, where it was indicated that income shocks mainly affect food consumption, the results in this chapter may reflect serious threats of hunger and food insecurity during certain times of the year. The effects of hunger and food insecurity during these periods would result to malnutrition mainly in children which may have long term effects on poverty. Seasonal deprivation in consumption should therefore be targeted in rural development policies. Picking of the right policy interventions requires an understanding of the factors that reduce the variation in the expected consumption poverty between seasons. Since there is some relationship between seasonal income variation and seasonal consumption variations, these interventions should aim at promoting different income generating activities at different times of the year. In general, farming households experience the most variations than fishing households and households that obtained more income from off-farm activities. Diversification of income sources to activities that are less dependent on seasonal weather changes such as off-farm activities is therefore recommended.

From the finding that timing and frequency of survey rounds in panel data affects the precision of vulnerability estimates, important lessons for collecting and handling data can be drawn. The findings show that if one important season is not included in the panel data set, vulnerability measures that are derived are overestimated due to underestimation of the mean consumption and overestimation of the variance of

consumption. The use of seasonal dummy variables assist in reducing the overestimation of the expected mean consumption but the same technique does not correct the bias in the variance of the expected mean consumption.

Most of the studies that estimated vulnerability used either cross section data and applied the innovation by Chaudhuri et al. (2002) or they make use of panel data. The consumption data that is used in these studies is collected by annual recalls with shorter recall periods for frequently purchased commodities such as food. In poor communities, food consumption constitutes a large share of total consumption and food consumption is expected to experience more seasonal variations because of subsistence production systems. This brings the problem of seasonality in annual household consumption surveys which may lead to poverty and vulnerability estimates that are sensitive to the time the surveys were conducted. In general, these findings call for careful considerations in designing surveys aimed that are to be used to assess poverty and vulnerability. Researchers that use already collected data are advised to correct for the effects of seasonality at least in the expected mean by using dummy variables for the seasons.

Chapter 5

Assessing household vulnerability using an asset based approach[5]

5.1 Introduction

The main objective of this chapter is to estimate vulnerability to poverty by the use of a proposed measure that incorporates the idea of asset poverty of Carter and Barrett (2006) into the expected poverty measure of vulnerability. Additionally the chapter aims at identifying the relationship between asset levels and vulnerability; and also between livelihood strategies and vulnerability levels.

Due to the relative remoteness and the poor infrastructure in most small scale fishing areas the productivity is driven by the natural resource base on the one hand and the available private assets of the households (e.g. fishing gear, land, irrigation pump, ploughs) on the other hand. For communities where most people are self-employed and hence heavily depend on their own production assets, Carter and Barrett (2006) argued that poverty indicators based on household income or expenditure are limited in their ability to assess the type and the extent of poverty. They suggest that under these conditions assets and their returns are crucial factors that determine the well being of poor households. Following this insight this chapter incorporates the idea of asset poverty as proposed by Carter and Barrett (2006) into the expected poverty concept to better reflect the temporal nature of poverty. Thereby deriving a new vulnerability measure that is capable of dividing expected poverty of a given population into structural-chronic, structural-transient, and stochastic-transient as well as never poor households.

The rest of the chapter progresses as follows: section 5.2 outlines asset based

[5] This chapter is based on: Chiwaula, LS, Witt, R. and Waibel H. "An asset-based approach to vulnerability: The case of small scale fishing areas in Cameroon and Nigeria". Accepted paper, *Journal of Development Studies*

vulnerability approach. The empirical estimation is presented in section 5.3 while empirical results are presented and discussed in section 5.4 and section 5.5 concludes the chapter.

5.2 The asset based vulnerability approach

The proposed measure introduces risk to the asset based poverty measures by incorporating the variance of income. This also allows for the derivation of expected poverty transitions which permits to distinguish different forms of poverty. Assuming that the asset stock of a given household defines the structural (or expected) income, $\hat{E}(I)$ of the household as shown in Figure 1. In the presence of risk, there will be stochastic variations in a household's income between a lower income bound defined by subtracting the standard deviation of income from the structural income, $\hat{E}(I) - \sqrt{\hat{V}(I)}$, and an upper income bound defined by adding the standard deviation of the income to the structural income, $\hat{E}(I) + \sqrt{\hat{V}(I)}$. Defining vulnerability as the likelihood of poverty in the future household-specific vulnerability measures is estimated as the share of a household's income prospects that fall below the poverty line.

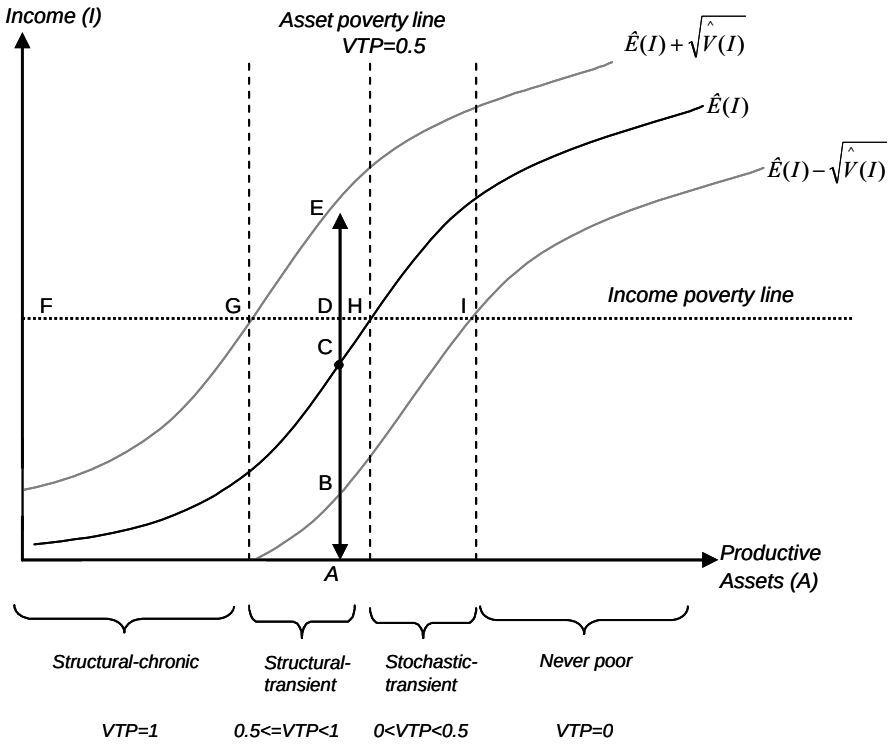


Figure 5.1: Illustration of asset based vulnerability measure

Source: Carter and Barrett (2006), modified

In Figure 5.1, if a household has assets equal to *A*, its structural income equals *C* which is less than the income poverty line implying that this household is expected to be poor. However, due to risks and shocks, the household's income is expected to be varying between *E* and *B* which means that the household can still experience some episodes of non-poverty due to positive shocks such as good weather or increased fishing opportunities, although the household is expected to be poor. Since there are some prospects of non-poverty for this household, its vulnerability level is less than one but greater than zero because it is expected to be poor. Out of all the household income prospects presented by the vertical line *EB,* there exist poverty prospects presented by the distance *DB*. The household vulnerability level is therefore determined by dividing *DB* by *EB*. Formally, the vulnerability measure can be shown as:

$$\upsilon_h = \Pr(I_h \le z) = \begin{cases} 0 & \text{if } \left[\hat{E}(I_h) - \sqrt{\hat{V}(I_h)}\right] \ge z \\ \dfrac{z - \left[\hat{E}(I_h) - \sqrt{\hat{V}(I_h)}\right]}{2\sqrt{\hat{V}(I_h)}} & \text{if } \left[\hat{E}(I_h) - \sqrt{\hat{V}(I_h)}\right] < z < \left[\hat{E}(I_h) + \sqrt{\hat{V}(I_h)}\right] \\ 1 & \text{if } \left[\hat{E}(I_h) + \sqrt{\hat{V}(I_h)}\right] \le z \end{cases} \quad 5.1$$

In Figure 1, when the highest possible income is below the income poverty line, those households are 100 % vulnerable, i.e. they are expected to be structural-chronic poor even in the presence of good luck such as favourable weather conditions. Households between point *F* and *G* belong to this category. When the lowest possible income is above the poverty line, those households are non-vulnerable, i.e. they are expected to be always non-poor even in the presence of bad luck such as for example a severe drought or flood. Households to the right of point *I* belong to this category. Households whose assets lie between *G* and *I*, i.e. when the lowest and highest income prospects are equal to the income poverty line, are vulnerable, i.e. they can be expected to move in and out of poverty (transient poverty) but for different reasons. If their level of vulnerability (υ_h) is above 50% and below 100% ($0.5 \le \upsilon_h < 1$), they are expected to be structural-transient poor (i.e. between *G* and *H*). These are defined as structural-transient poor because the transient poverty they (are likely to) experience is due to insufficient asset levels. Households who are not expected to be poor (i.e. between *H* and *I*) but because of negative shocks end up below the income poverty line some time in the future are called stochastic-transient poor. These households are also vulnerable but their level of vulnerability is below 50%. The frequently used 50% cut-off point is intuitive, and is explicitly applied to identify the difference between structural and stochastic poverty.

In summary, the different poverty groups[6] are defined as:

a) Structural-chronic poor, if $\upsilon_h = 1$

b) Structural-transient poor, if $0.5 \le \upsilon_h < 1$

[6] In theory, it is possible to also distinguish stochastic-chronic poverty. However, this is not possible with cross-section data.

c) Stochastic-transient poor if $0 < \upsilon_h < 0.5$

d) Never poor, if $\upsilon_h = 0$

The categorisation of different poverty groups introduced here is similar to the one done by Ligon and Schechter (2003), who make a distinction between structural and risk-induced vulnerability; as well as Suryahadi and Sumarto (2003), who defined the poverty categories by use of three indicators: (1) expected poverty, (2) observed poverty, and (3) vulnerability level. However, their categorization does not differentiate between the structural-chronic and structural-transient poor (our categories 'a' and 'b'), as well as between the stochastic-transient and the non-poor (our categories 'c' and 'd'). Also, in contrast to Suryahadi and Sumarto (2003), the measure in this study allows differentiating between two categories of transient poverty. This differentiation is important because the two sub-categories of transient poverty require different sets of rural development policies. In principal, category 'b' households require asset accumulation to get out of poverty while category 'c' households require insurance type of policies.

5.3 Empirical estimation

Methods, which use cross-section data for the estimation of expected level and variance of income, make strong assumptions about intertemporal variation of income (Chaudhuri et al. 2002). This assumption has been repeatedly criticized by, for example, Ligon and Schechter (2003) and Calvo and Dercon (2005). Although panel data are preferable for vulnerability estimation, in this study only cross-section data were available. Based on the estimation procedures proposed by Just and Pope (1979), and applied earlier by Chaudhuri et al. (2002) and Christiaensen and Subbarrao (2005) an asset based income equation is specified and this enables the estimation of the expected income $\hat{E}(\ln I_h)$ and variance of income $\hat{V}(\ln I_h)$ by use of a three-step feasible generalised least squares (FGLS) procedure. The assumptions for this estimation procedure are lognormality of the income distribution as well as a heteroscedastic model specification. The

lognormality assumption permits to examine how household characteristics affect the mean and the variance of income. The heteroscedastic specification allows the variance of each household's income to depend on the respective household's characteristics. A translog specification is applied of the income-asset equation because it imposes no restrictions on elasticities of substitution and returns to scale (Kim, 1992). The model is specified as below:

$$\begin{aligned} \ln I &= \ln L + \ln AGR + \ln FISH + \ln LS \\ &+ \frac{1}{2}\left(\ln L \cdot \ln AGR + \ln L \cdot \ln FISH + \ln L \cdot \ln LS\right) + Z + \varepsilon \end{aligned} \qquad 5.2$$

where I denotes the total income per capita per day [in US$PPP], L denotes land holding size [in ha], AGR denotes the value of productive agricultural assets per capita [in US$PPP], $FISH$ denotes the value of productive fishing assets per capita [in US$PPP], LS denotes the value of livestock per capita [in US$PPP], Z denotes the vector of control variables that include household size, dependency ratio, age of household head, education of household head, ethnicity and regional dummies, and ε denotes the error term.

This specification presents a form of a short-run household level 'production function' that captures the livelihood activities (agriculture, fishing and livestock rearing) in the natural resource based production system dealt with in this study. In this model assets are differentiated by (income generating) livelihood activities. Thus it is possible to control for differences in asset endowments and their respective contributions to household income. Hence, four distinct variables have been considered, (1) land size (2) the value of other productive assets in agricultural production, (3) the value of productive fishing assets (for example a canoe, fishing nets and so forth) and (4) the value livestock. The value of productive assets was computed by assigning the reported market value of each asset item.

Household size and dependency ratio have been included to capture the household's demographic structure. Dependent household members were defined as those individuals who are younger than 14 years old. In addition, a number of control variables have also been included in the model, such as the education level of the

household head, the age of the household head, and dummy variables for different regions and ethnic groups. A detailed description of the implementation of the three-step feasible generalised least squares technique that was used is presented in Chapter 4.

While the use of cross-section data can only predict short-term poverty transitions based on the asset endowment of a household, panel data would have allowed a long-term dynamic analysis of poverty, which has been analysed e.g. in Lybbert et al. (2004), Barrett et al. (2006) and Barrett (2008). However, a static asset-based poverty and vulnerability assessment still can provide important insights about the longer time picture since in many remote rural communities the growth in asset level can take a long time (Carter and Barrett, 2006).

Empirical application made use of data from the baseline survey only (see Chapter 2) and a total of 267 households are used for the analysis. The absolute poverty line of U$1.25 per capita per at 1993 consumption purchasing power parity (PPP), adjusted for inflation using the national consumer price indices of April 2007 was used. Consumer price indices data was obtained from the IMF's International Financial Statistics. The calculated PPP exchange rate is 127.55 Naira. All the monetary values were converted to US dollars in purchasing power parity. This is done because the chapter is based on a paper that compared two countries (see footnote number 4).

5.4 Results and Discussion

5.4.1 Description of variables

Table 5.1 below presents descriptive statistics of the variables used in the analysis in this chapter.

Table 5.1: Descriptive statistics for variables used to estimate the asset-based vulnerability measure in the Hadejia-Nguru wetlands, Nigeria

Variable	Mean	Std. Dev.
HH Characteristics		
HH size	7.35	0.21
Dependency ratio (%)	0.50	0.01
Age of HH head (years)	42.14	0.89
Education of HH head [0-2]	0.33	0.04
Production Characteristics		
Value of fishing assets (USD PPP)	26.50	3.59
Value of agriculture assets (USD PPP)	127.58	8.31
Value of livestock (USD PPP)	661.73	65.72
Land holding size (ha)	6.90	0.41
Income from fishing per capita (USD PPP)	119.32	294.41
Income from agriculture per capita (USD PPP)	321.61	381.35
Income from livestock per capita (USD PPP)	25.38	63.24
Income from other activities per capita (USD PPP)	101.70	119.40
HH income per capita (USD PPP)	568.00	581.13
N	267	

Source: Own computations based on own data

The household demographic characteristics are as discussed in chapters 2 and 3. Educational attainment for household heads is here measured as an ordinal variable that ranges from zero for household heads that did not have any formal education, 1 for household heads that had attained primary education and 2 for household heads whose educational attainment was beyond primary education. The household incomes from the

respective activities are presented in per capita values in order to account for differences in the demographic structure of households. The income distribution between activities shows the same pattern as for the asset endowments.

5.4.2 Results of income and variance estimation

Table 5.2 below presents the results of the second stage (variance regression) and the last stage (income regression) of the 3-FGLS.

Table 5.2: Results of the estimated household income and variance of income equations in the Hadejia-Nguru Wetlands, Nigeria

	Log (Per capita income)		Log (Residual squared)	
Variable	Coeff.	t-statistic[a]	Coeff.	t-statistic[a]
Log (Land)	0.2983	3.70***	-0.1025	0.25
Log (AssetAGR)	0.1169	6.13***	-0.1672	1.73*
Log (AssetFISH)	0.2094	8.75***	-0.0586	0.45
Log (Herd)	0.0068	0.50	0.0305	0.42
Log (Land) x log (AssetAGR)	0.0653	1.59	0.1270	0.61
Log(Land) x Log(FISH)	-0.1979	3.35***	0.2470	0.76
Log (Land) x Log (Herd)	0.0328	1.06	0.0111	0.07
HH size	-0.0104	1.13	0.0402	0.86
Dependency ratio	-0.3000	2.02**	-0.5903	0.77
Age of Head	-0.0037	1.85*	-0.0007	0.06
Education of Head	0.0541	1.28	0.2355	1.06
Ethnicity	-0.1586	2.58**	0.6098	1.91*
Hadejia	0.0096	0.16	-0.7763	2.43**
Constant	6.0550	43.59***	-1.9143	2.63**
F-statistic	33.69***		1.41	
R-squared	0.37		0.07	
N	267		267	

Note: [a]t-values in absolute terms
***denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.
Source: Own estimations based on own data.

The results of the income models are consistent with both theoretical and empirical expectations and the models have good explanatory powers. It is found that productive assets used for different income-generating activities such as fisheries, agriculture and livestock rearing, have a significant positive impact on household income. This confirms earlier findings, that fishing is part of a diversified portfolio of activities (Sarch, 1997; Neiland et al., 2005b; Béné et al., 2003). Important productive assets in the area include land, agricultural assets, and fishing assets. Although most households own livestock, this has not been found to significantly influence household income. This shows that different livelihood strategies are important in the study area despite the fishing community tag to the area. The coefficients of the variance equation show that the reduction in income variation is significantly influenced by the value of agricultural assets. This may mainly be attributed to ownership of irrigation pumps that enables households to practice irrigation during the dry season and also in years when the area experiences lack of rains. From these equations, the expected income and the variance of the expected income which were used to estimate household-specific vulnerability levels were predicted.

To check the validity and consistency of the proposed vulnerability measure with the vulnerability as expected poverty measures (using the standard normal distribution to estimate the probability to be poor) the comparison between the two measures is shown in Figure 5.2.

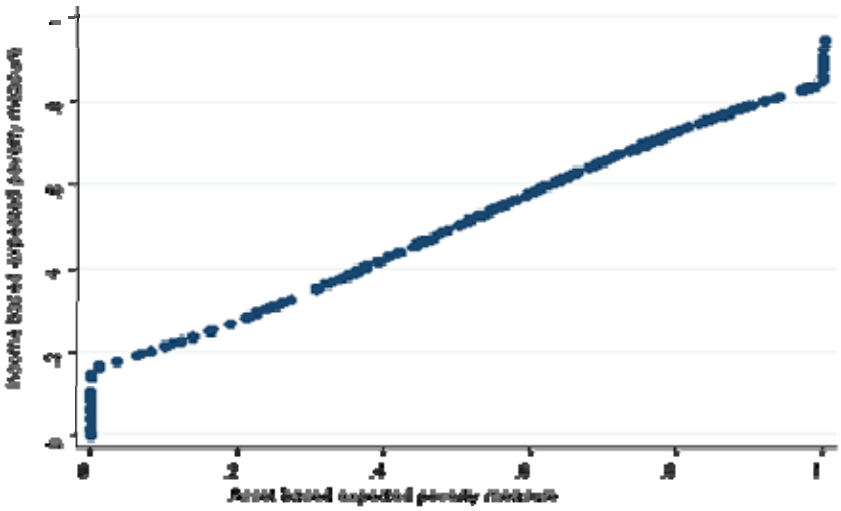


Figure 5.2: Comparing the proposed measure of vulnerability with the income based expected poverty measure

Source: Own illustration based on own data

Figure 5.2 shows that the vulnerability estimates from the approach proposed in this paper are consistent with the findings of the commonly used income based expected poverty measure of vulnerability as used in Chapter 4 and also other authors such as Suryahadi and Sumarto (2003), Christiaensen and Subbarao (2005), and others. The difference in the two measures is observed in the tails of the plot which clearly identifies the 100 % vulnerable, i.e. chronically poor and the non vulnerable (non- poor) households within a population.

5.4.3 Poverty and vulnerability levels

The estimated mean and variance of expected income are presented in Table 5.3.

Table 5.3: Estimated poverty and vulnerability profiles of households in the Hadejia-Nguru Wetlands, Nigeria

Variable	Mean	Std. Dev.
Observed income [USD PPP]	568.00	581.13
Expected income [USD PPP]	460.94	270.04
Observed PHCR (%)	54.00	50.00
Expected PHCR (VHCR) (%)	62.00	49.00
Standard deviation of income	0.37	0.10
Average vulnerability level (%)	59.00	39.00
Structural-chronic poverty (%)	30.00	46.00
Transient poverty (%)	51.00	50.00
Structural-transient (VTP>0.5) (%)	32.00	47.00
Stochastic-transient (VTP<0.5) (%)	19.00	40.00
Never poor (%)	19.00	39.00

Source: Own estimations based on own data

The study finds that the average vulnerability level for the area is very high. On average, households have a 59 percent chance that they will be poor in the short term. The decomposition of this vulnerability status shows that the expected transient poverty is more prevalent with 51 percent of the households expected to be transiently poor (i.e. structural-transient plus stochastic-transient poverty). However, most (62 percent) of the poverty that is expected is due to structural reasons (i.e. structural-chronic plus structural-transient poverty). The proportion of households that is expected to be poor because of stochastic negative events is also significant. This implies that asset accumulation should be a major policy intervention for poverty reduction in the Hadejia-Nguru Wetlands but insurance against negative stochastic events should also be included in designing these policies.

The different poverty statuses were assessed for households with different livelihood strategies. Livelihood strategies were defined in terms of income contribution as in Chapter 4. The categories include farming, fishing and off-farming households. These results are presented in Table 5.4 below.

Table 5.4: Estimated poverty and vulnerability profiles of households with different livelihood strategies in the Hadejia-Nguru Wetlands, Nigeria

Type of vulnerability	Type of household		
	Farming	Fishing	Off-farm
Structural-chronic (%)	29	14	51
Transient (%)	51	62	46
Structural-transient (%)	29	38	38
Stochastic-transient (%)	21	24	8
Never poor (%)	20	24	3
N	182	42	39

Source: Own estimations from own data

For households that obtained most of their incomes from off-farm activities, structural-chronic poverty is expected to be more prevalent. About 51 percent of these households are expected to remain in poverty in the short run. Only 3 percent of these households are expected to remain non-poor in the short run. Additionally, only 8 percent of these households are expected to be transiently poor because of negative stochastic events. This means that the majority of poverty among these households is caused by structural reasons. Households with off-farm activities as a major source of income expect lower income levels because they have low asset holdings.

The results also show that households that obtained most of their income from farming and fishing are expected to be transiently poor (i.e. structural-transient plus stochastic-transient). Structural-transient poverty is expected to be greater than stochastic transient poverty for both groups of households. However, fishing households are expected to be better off than farming and off-farming households because fewer fishing households are expected to be structural-chronically poor and a larger proportion of them are never

expected to be poor.

5.5 Conclusions

Incorporating the asset-based poverty model into the expected poverty concept advances the standard vulnerability as expected poverty measures by yielding probability estimates and also predicts the future welfare position of households based on their respective asset endowments. While most studies on vulnerability only distinguish between structural and risk induced vulnerability, this approach enables the decomposition vulnerability to poverty into structural-chronic, structural-transient, and stochastic-transient vulnerability. The methodology used here is straightforward in its application and can provide useful information for policy makers.

Results show that high levels of vulnerability are found in the Hadejia-Nguru Wetlands, while only a small percentage of households are expected to be out of poverty in the short term. The majority of households are vulnerable for structural reasons, i.e. their asset base is so low that even if favourable production conditions would occur or risk reducing measures would be introduced they are unlikely to be able to move out of poverty permanently.

Fishing households are expected to be better off than farming and off-farming households because fewer fishing households are expected to be structural-chronically poor and a larger proportion of them are never expected to be poor. The majority of households that obtain most of their income from off-farm activities are expected to be poor and the majority of poverty among these households is caused by structural reasons.

The findings also illustrate that productive assets in fisheries, agriculture and livestock have a significant positive impact on mean and a negative impact on variance of household income which suggests that the accumulation of productive assets results in both increasing income and decreasing variance of income. It has been suggested that different forms of poverty demand different policy strategies, for example risk prevention for the transiently poor and financial help for the structurally poor (Lipton

and Ravallion, 1995; Jalan and Ravallion, 2000; Duclos et al., 2006). However, it has been shown that transient poverty can be either structural or stochastic. For such groups, simply reducing risk would not have a lasting impact on their well being in terms of income or consumption. Instead, there is a need to strengthen the accumulation of productive assets and their productivity, for example by better technology and improving knowledge.

Future research should address the issue of estimating expected welfare levels as well as intertemporal variance by use of longer term panel data, which would make vulnerability estimates more robust. In addition, panel data would help to explore in more details the dynamics of asset accumulation and poverty traps, as has been suggested, for example, by Lybbert et al. (2004) and Barrett et al. (2006). Further research should also consider incorporating information on future risks expected by household decision makers (e.g. as proposed by Calvo and Dercon, 2005), to improve the predictive power of the vulnerability estimates.

Chapter 6

Livelihood choices in rural small scale fishing areas

6.1 Introduction

There is growing evidence that small scale fisheries contribute significantly towards poverty reduction, employment generation, and food security in rural poor communities of developing countries (Neiland et al., 2000; Béné et al., 2003; Béné and Neiland, 2007; Béné, 2009; and Béné et al., 2009). Despite these contributions, small scale fisheries and rural poverty are said to be intimately correlated and this has led to two famous adages in fisheries literature that states that 'fishermen are the poorest of the poor' and that 'fishing is the activity of last resort' (see Smith, 1979; Béné, 2003). The two assertions may imply that small scale fishing leads to poverty or keeps the poor in poverty (i.e. failure of small scale fisheries to alleviate poverty) or poverty pushes households to small scale fishing (i.e. safety net role of small scale fisheries) which reflects different roles of small scale fisheries on poverty reduction. In principal, if an increase in household income is found to decrease time allocation to fishing, it would be concluded that fishing is playing the "safety net" role. On the other hand, if time allocation to fishing is found to relate positively with shadow wages in fishing and negatively with shadow wages in other production activities, it would be concluded that fishing is a normal activity like other production activities such as farming and can be used to get households out of poverty. A comparison of the relative magnitudes of shadow wages of fishing and other production activities can also be used as a basis for assessing the role of small scale fisheries in poverty reduction.

Recent studies have disputed these two hypotheses (Béné, 2003; Allison et al., 2006; Béné, 2009; Béné et al., 2009). However the relationship between fishing decisions and household poverty remains unclear. As of now, it is not known as to whether fishing decisions are induced by poverty and whether these decisions respond normally to changes in economic opportunities. Yet this information is important for rural development policy and management of small scale fisheries. This study attempts to fill

this information gap by estimating a system three household labour supply models. The main objective is to assess how economic opportunities affect household time allocation to fishing and other income generating activities in small scale fishing communities. This will assist in explaining the relationship between household poverty and small scale fishing decisions.

Following earlier theoretical work in modelling household labour supply (for e.g. Becker, 1965; Chayanov, 1966; Nakajima, 1969), more recent studies are mostly focused on the determination of shadow wages and shadow incomes which are key variables in estimating labour supply functions (Jacoby, 1993; Skoufias, 1994; Abdulai and Regmi, 2000; Barrett et al., 2008; Le, 2009). Because of the imperfection of the labour markets in rural communities of developing countries observed market wages diverge from shadow wages which means that there is need to measure shadow wages. Measuring shadow wages of labour supply in different activities can also help to provide a better picture of the marginal productivity of labour in households in fisheries communities. However, the measurement of shadow wages is challenged by limited participation of households in the labour market and the predominance of self-employed households. Limited participation results in selection bias while self-employment makes it difficult to determine wages for the production of non-marketed output. Over the years, there have been a number of innovations on how to handle these problems. For example, Jacoby (1993) developed a methodology for estimating structural time allocation models for self-employed households and Heckman (1979) developed a selection correction procedure that can be used in cases where few households participate in an activity. This study has applied both Jacoby's methodology and the Heckman's procedure to estimate wage rates for different livelihood activities that are then used in a system of labour supply models.

The rest of the paper is organized as follows: Section 2 presents the data issues. Section 3 presents the empirical model while section 4 presents the estimation techniques. Empirical results are presented in section 5 and the conclusions are in section 6.

6.2 Theoretical model

The standard agricultural household model (Singh, et al., 1986) is used to derive household labour supply functions. It is assumed that the households are obtaining utility from consumption of agricultural staples (c_a), fish (c_f), market purchased goods (c_m), and leisure time (t_l).

$$U = u(c_i, t_l; Z) \qquad i = a, f, m \qquad 6.1$$

where *u(.)* denotes the household utility function, and *Z* denotes the vector of exogenous household attributes that can affect preferences and tastes of the households. Assuming that households can allocate their time to agricultural production (t_a), fishing (t_f), off-farm employment (t_o), or leisure (t_l), the household time constraint can be given as:

$$t_l = T - t_a - t_f - t_o \qquad 6.2$$

Where *T* is the total time the household is endowed with. The time constraint implies that the household cannot allocate more time to leisure and production than total time the household is endowed with. Household utility maximization is also constrained by the production technology given by:

$$x_i = x_i(t_i, v_i; K_i) \qquad i = a, f \qquad 6.3$$

Where K_i denotes physical capital that is used in the production of commodity *i*. Finally, the utility maximization is constrained by the cash income constraint:

$$p_{vi} v_i + p_m c_m = \sum_i p_i (x_i - c_i) + w t_o + A \qquad i = a, f \qquad 6.4$$

where p_{vi} denotes the vector of prices of variable inputs for production of commodity *i*; v_i denotes a vector of quantities of variable inputs for production of commodity *i*; p_i

denotes prices of production output; x_i denotes total production of commodity i out of which c_i is consumed within the household and the surplus is sold at market prices; w denotes the market wage rate; and A denotes exogenous (non-labour) income which may include remittances and transfers.

Substituting the time constraint (Equation 6.2) and production constraint (Equation 6.3) into the cash income constraint (Equation 6.4) yields the following full income constraint:

$$\sum_i p_i c_i + w t_l = A + wT + \sum_i \pi_i = Y \qquad i = a, f, m \qquad 6.5$$

where $\pi_i = p_i x_i(t_i, v_i; K_i) - w t_i - p_v v_{iv}$ is the profit obtained from production activity i and Y is the household full income. Maximisation of the household utility function (6.1) subject to full income constraint (6.5), would result in the following obtain the following first order conditions:

$$p_i \partial x_i / \partial t_i = w_i \qquad 6.6.1$$

$$p_i \partial x_i / \partial v_i = p_{vi} \qquad 6.6.2$$

$$\partial u / \partial c_i = \lambda p_i \qquad 6.6.3$$

$$\partial u / \partial t_l = \lambda w \qquad 6.6.4$$

$$p_m c_m + p_a c_a + p_f c_f + w t_l = A + wT + \pi_a + \pi_f \qquad 6.6.5$$

where λ is the Lagrange multiplier associated with full income constraint. The system of equations from (6.6.1) through (6.6.5) imply that households make both production and consumption decisions. Equations (6.6.1) and (6.6.2) are optimality conditions for household production decisions while equations (6.6.3) and (6.6.4) are optimality conditions for household consumption decisions. The solution to the production side decision (equations 6.6.1 and 6.6.2), together with the production technology, results in labour supply functions and demand for other production inputs as a function of prices and technology:

$$t_i = t_i(p_i, w_i, p_v; K_i) \qquad 6.7$$

The solution to the production optimisation problems results in maximised profits and full income. Solving the consumption side of the problem (i.e. equations 6.3 and 6.4) together with maximized full income, Y^* yield demand function for leisure and other consumption goods as a function of prices and maximized full income:

$$t_l = t_l(p_i, p_m, w, Y^*; Z) \qquad 6.8$$

Equations 6.7 and 6.8 imply that households decide on how much time to allocate to leisure and production activities. The allocation of total family labour to different production activities depends on relatives shadow wages of the different activities. The following Slutsky equations show how the changes are shadow wages would affect household time allocation to different production activities:

$$\frac{\partial t_i}{\partial w_i} = \left.\frac{\partial t_i}{\partial w_i}\right|_{Y^*} + \frac{\partial t_i}{\partial Y^*}\frac{\partial Y^*}{\partial w_i} \qquad 6.9$$

The Slutsky equation above shows the expected change in time allocation if the activity's shadow wage increases. The first term of the equation give the substitution effect while the second term is the income effect. The substitution effect is expected to be positive because the increase in a wage will imply high returns from that activity and

this will result in more time allocation to that activity. On the other hand, the income effect is likely to be negative since the increase in income that is caused by the wage increase results in higher demand for leisure which implies the reduction in labour supply. This means that own wage effects can be positive or negative (i.e. forward bending or backward bending labour supply functions) depending on the relative magnitudes of the income and substitution effects. For cross-wage effects, the following Slutsky equation can be used to analyse the likely response:

$$\frac{\partial t_i}{\partial w_j} = \left.\frac{\partial t_i}{\partial w_j}\right|_{Y*} + \frac{\partial t_i}{\partial Y*}\frac{\partial Y*}{\partial w_j} \qquad i \neq j \qquad 6.10$$

The substitution effect in the cross wage Slustky equation is expected to be negative because the increase in the wage of one activity would imply more time allocation to that activity and less time allocation to the activity in question. As above, the income effect is expected to be negative. This means that cross wage effects are expected to be negative.

It is acknowledged here that a positive income effect can be obtained under certain circumstances. This may mainly be in activities that are recreational in its nature such as fishing and in societies where there are few options for recreation exist. In such cases, households can allocate the time that was meant for leisure productive activities as a result of an increase in income.

Empirical application is based on data that was collected from 255 households that were observed in all the four waves of surveys (Refer Chapter 2). Time allocation data was collected from household members who were 14 years and above. Individuals were asked about their detailed time allocation two weeks prior to the survey date (see follow up survey questionnaire in Appendix C). Household time allocation to a given activity was therefore the summation of time allocated to that activity by all household members.

6.3 Empirical model

6.3.1 Estimating shadow wages

Since the wages were not directly observed for all households, the empirical estimation, first involved the estimation of shadow wages and earnings, and then these were used to estimate the system of earnings share equations from which wage and earnings elasticity of labour supply were computed. Different techniques were used to estimate shadow wages for farming, fishing, and off-farm activities.

To compute shadow wage in farming, a procedure that was developed by Jacoby (1993) and had been used in other farm labour supply studies (Abdulai and Regmi, 2000; Shively and Fisher, 2004; Fisher et al., 2005) was used. The procedure begins by estimating a production function from which marginal products that are used to reflect shadow wages are estimated. A Cobb-Douglas specification was used to estimate the production function. A Cobb-Douglas specification was used because it was straight forward (see equation 6.16 below) to compute the shadow wages of labour unlike in more flexible specifications such as the translog specification that have more than one parameters that are attributed to the influence of given factor of production. The log of total monetary value of crop production was regressed on logarithms of the cost[7] of variable inputs plus some control variables. To make the log transformation of observations with zeros definable, an arbitrary 1 was added to all the variables in the production function. Costs of irrigation, fertilizer and hired labour were thought to be potentially endogenous and instrumental variables technique was used to correct for possible endogeneity. Instrumental variables included distance to the nearest river, a dummy variable for household heads whose age was greater than mean age, a dummy variable for whether the village is inaccessible due to flooding at some seasons of the year, whether the family is polygamous or not, and distance to the nearest local government headquarters. All the instrumental variables were tested for the exclusion restriction, i.e. correlated to the endogenous variables but not the dependent variable.

[7] Family labour was measured as total labour hours while hired labour was measured as total cost of hired labour. Hired labour included cost of tractor hiring for tilling the land.

Cost of pests was assumed to be exogenous because total cost on pests is largely influenced by stochastic presence of pests in the farm although some farmers still buy precautionary quantities of pesticides. Land holding size and farming assets were also considered exogenous because land in the present study area is mainly acquired through inheritance and both land and farming assets were mostly acquired in the past which means that they were less related to production decisions in the study year.

According to Jacoby (1993) the shadow wage of family labour on the farm is computed from the production function as follows:

$$MPL_h = \frac{\hat{\beta}\hat{Y}}{L_h} \qquad 6.11$$

where $\hat{\beta}$ is the coefficient on log of family labour hours and $\hat{Y}$ is the predicted value of farm income and the subscript *h* identifies a household.

The shadow wages for fishing and off-farm activities were estimated differently because not all households participated in fishing and off-farm activities. Fishing participation was defined if a wage was observed, that is, both revenue and time allocation was observed. It is found that 30% of the households participated in fishing during the first follow up survey, 27% in the second follow up survey and 19% in the last follow up survey. Following a similar definition of participation, 73% of the households participated in off-farm activities during the first follow-up survey while about 80% participated in off-farm activities during the second and third follow-up surveys. The observed wages for participating households in these activities can be assumed to reflect their shadow wages for that activity. On the other hand, it is likely that the shadow wages of households that are not participating exceeds the observed market wage. In that case, either omitting the non-participating households or imputing their returns at predicted market rates would bias the estimate of aggregate labour supply response (Shively and Fisher, 2004; Fisher et al., 2005). The selection correction procedure for panel data models was used (see Wooldridge, 1995; Wooldridge 2002; Dustmann and Rochina-Barrachina, 2007) to control for selectivity bias. The procedure modifies the Heckman technique (Heckman, 1979) in a way that inverse mills ratios are estimated for

each of the panels of data. The wage equations for fishing and off-farm activities were specified as follows:

$$\log(w_{hit}) = x_{hit}\beta + \alpha_{ih} + \varepsilon_{hit}; \quad h = 1..., N; \;\; i = a, f, m; \;\; t = 1,..., T \qquad 6.12$$

$$d^*_{hit} = z_{hit}\delta + \eta_{ih} + u_{hit}; \qquad d_{hit} = 1\left[d^*_{hit} > 0\right] \qquad 6.13$$

where w_{hit} is the observed market wage for household h at time t for activity i which is only observed when $d_{hit} = 1$, x_{hit} and z_{hit} are vectors of explanatory variables. Some of the elements in the two vectors of explanatory variables may be common to both vectors but there is still need for some exclusion restrictions such that some of the elements in z_{hit} are not in x_{hit} and vice versa. β and δ are the estimated parameters. Following Wooldridge (1995) the selection correction proceeded as follows: (i) estimate equation (6.13) for each of the survey rounds $t = 1,...,3$ using standard probit models and then obtain the Inverse Mills Ratio (λ_{hit}); and (ii) run a pooled OLS of equation (6.12) on the selected sample in which the inverse Mills Ratio are included as regressors, as shown below:

$$\log(w_{hit}) = x_{hit}\beta + d1\lambda_{hi1}\rho_1 + ... + dT\lambda_{hi3}\rho_T + \alpha_{ih} + \varepsilon_{hit} \qquad 6.14$$

where *d1* through *dT* are time dummy variables. The t-statistics on the selection correction term ρ_h are used as tests for selection bias. Since equation (6.14) uses variables that were estimated in the first stage, the last stage of the procedure involves correcting the asymptotic variance of the estimator. Although this is necessary for testing the significance of the parameters that influence the wages, it should be stated that the consistency of the parameter estimates from which the shadow wages are estimated is of primary importance in this study. The asymptotic properties of the variance were obtained by using the bootstrapping technique. Bootstrapping is a re-sampling method that can be used as an alternative to asymptotic approximations for obtaining standard errors, confidence intervals, and p-values for test statistics (see

Wooldridge, 2002; Horowitz, 2001). A total of 2000 replications were conducted and 25 was the seed number.

6.3.2 Estimating the system of shadow labour share income equations

Since time allocation to fishing is not independent of time allocation decisions to other livelihood activities, labour supply equations were estimated jointly as a system. The system of labour supply models was estimated by using the Almost Ideal Demand System (AIDS) that was proposed by Deaton and Muellbauer (1980) because of its strong link to microeconomic theory. Originally, the AIDS model was used to assess consumer behaviour but has also been used in labour supply studies for Dutch farmers by Kooreman and Kapteyn (1985) and Thijssen (1988) and has also been used in labour supply studies in recent years by Shively and Fisher (2004) and Fisher et al. (2005). The AIDS model involves the estimation of a system of share equations of closely related commodities. To be consistent with the original AIDS model, the system of labour income share equations and not a system of labour share equations as was done by Shively and Fisher (2004) and Fisher et al. (2005). Estimating a system of labour earnings equations makes it possible to derive wage and earnings elasticity estimates which are more important in assessing the likely responses of households to changes in wages and expected earnings than just coefficients in labour share equations. Suppressing household and time subscripts for convenience sake, the system of labour income share equations is specified as follows:

$$s_i = \alpha_i + \sum_{j=1} \gamma_{ij} \log(w_j) + \beta_i \log\left(\frac{Y}{W}\right) + \varphi_i Z + u \qquad 6.15$$

where

$$s_i = \frac{wt_i}{Y} \text{ and}$$

$$Y = \sum_i w_i t_i$$

s_i is the share of shadow earnings from activity i, Y is the total shadow earnings, and Z is a vector of control variables. α, β, γ, and φ are the estimated parameters. W is a non-linear wage index but its linear approximation is used in this study because it is easy to estimate (see Deaton and Muellbauer, 1980; Alston et al., 1994; Matsuda, 2006; Chiwaula and Kaluwa 2008). The Stone Price Index is used to obtain the linear approximation of the wage index:

$$\log(W) = \sum_i s_i \log(w_i) \qquad 6.16$$

Economic theory requires the adding up (equation 6.17.1), homogeneity in prices [wages] (equation 6.17.2), and a symmetry (equation 6.17.3) restriction to hold and this implies the following restrictions on the parameters:

$$\sum_{i=1} \alpha_i = 1 \qquad \sum_{i=1} \gamma_{ji} = 0 \qquad \sum_{i=1} \beta_i = 0 \qquad \sum_{i=1} \varphi_i = 0 \qquad 6.17.1$$

$$\sum_{i=1} \gamma_{ij} = 0 \qquad \forall j \qquad 6.17.2$$

$$\gamma_{ij} = \gamma_{ji} \qquad 6.17.3$$

These restrictions were imposed during the estimation of the system of equations. The system was estimated using the nonlinear least squares technique. By invoking the iterative feasible generalized nonlinear least square (IFGNLS) option the estimation procedure is similar to the maximum likelihood estimation thereby producing efficient estimates. The equation for off-farm activities and also the wage for off-farm activities were not included during the estimation to avoid the singularity of the covariance matrix but these parameters were computed by imposing the adding up restrictions after estimation.

Following Alston et al. (1994), the wage elasticity of labour supply is defined as:

$$\varepsilon_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i}{w_i} w_j \qquad 6.18$$

where $\delta_{ij} = 1$ for $i = j$ and $\delta_{ij} = 0$ for $i \neq j$. On the other hand, the earnings elasticity of labour supply is defined as:

$$\eta_i = 1 + \left(\frac{\beta_i}{w_i} \right) \qquad 6.19$$

The standard errors for the computed coefficients and also the standard errors of the elasticity estimates were obtained by using the delta method. The delta method is an intuitive technique for approximating the moments of functions of random variables (Oehlert, 1992). The nonlinear combinations of estimator (nlcom) in Stata uses this method to compute point estimates, standard errors, test statistics, significance levels, and confidence intervals for nonlinear combinations of parameter estimates after any Stata estimation command[8]. This is the command that was used in this study to obtain the standard errors.

[8] See online stata help on: http://www.stata.com/help.cgi?nlcom

6.4 Results and Discussion

6.4.1 Descriptive statistics

Table 6.1: Descriptive statistics for variables used in assessing livelihood choices in the Hadejia-Nguru wetlands, Nigeria

	August 2007		November 2007		March 2008	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Formal education (0/1)	0.27	0.45				
Associations (Count)	0.64	0.74				
Region dummy (0/1)	0.29	0.46				
Ethnicity (0/1)	0.68	0.47				
Polygamy (0/1)	0.37	0.48				
Land holding (ha)	6.84	6.82				
Farming assets (Naira)	15992	17562				
Male adults (Count)	2.79	1.92	2.80	1.93	3.03	2.01
Female adults (Count)	2.79	1.92	2.80	1.71	3.12	1.85
Fertilizer (Naira)	5658	7743	10948	12814	5682	7936
Hired labour (Naira)	7113	15466	10192	18873	3256	8533
Pesticides (Naira)	751	2138	1699	3923	1003	3158
Irrigation (Naira)	3100	6470	7453	29583	3732	8696
Farming labour (hours)	127.63	114.24	113.64	123.75	61.87	63.23
Fishing labour (hours)	12.95	26.29	9.69	23.81	8.04	20.50
Off-farm labour (hours)	50.42	70.13	54.17	51.04	54.79	57.31
Farming income (Naira)	240442	206063				
Off-farm income (Naira)	20809	68351	26057	115064	19829	83298
Fishing income (Naira)	10304	30973	7852	14942	4280	13576
N	255		255		255	

Note: variables that are assumed to be time invariant are only presented for the August Survey. The same values hold for the other two surveys

Source: Own computations based on own data

Table 6.1 shows that there were not many changes in household demographic structures within the year. For example, numbers of adult male and female members of the households stayed stable within the year. Expenditures on production inputs show that most of the inputs were purchased in the period between August and November which is the peak farming period. In terms of time allocation, the results show that households allocated most of their time to farming in all the three survey periods. Time allocation to off-farm activities is almost stable throughout the year while time allocated to farming and fishing show significant variations between the surveys.

By definition, income from farming was not allowed to vary between the surveys. Because of the lags between agricultural production decisions, execution and realization of returns, it was assumed that the shadow wage for agricultural activities is stable within a year. This assumption is reasonable because farming decisions are made at the beginning of the growing season and these are implemented throughout the year until harvesting. Time spent on farming at the beginning of the growing season, for example, cannot be attributed to the zero output during that time but the output at the end of the growing season. In this case, it is reasonable to assume that households make time allocation decisions based on expected returns at the end of the year. The use of an annual aggregated crop output level therefore help to solve this. For fishing and off-farm activities, the returns are almost instant and individuals respond to the current returns. The returns for these two activities were therefore allowed to vary within the year. Fishing was explicitly referring to the activity of catching fish from the flood plain. On the other hand, off-farm activities included a wide range of activities such as wage employment, large businesses (e.g. operating a pick up or a minibus), petty trading, and collection of other goods from natural resources such as potash, fuel wood and doum palm as well as other fishing related activities like fish trading, processing, transportation and gear and equipment making.

6.4.2 Estimation of shadow wages

This section presents and discusses the regression results from which shadow wages were estimated. Firstly, estimated crop production function that was used to estimate

shadow wage of labour in farming are presented. The production function was estimated by using the OLS and the 2SLS. The results of the OLS are presented to show the improvements that are attained when the 2SLS is used and the results are presented in Table 6.2 below.

Table 6.2: Estimated crop production function in the Hadejia-Nguru Wetlands, Nigeria (Dependent variable: Log (Crop income))

Variable	Coef.	t-statistics[b]	Coef.	t-statistics[b]
Log (Irrigation)	0.0091	0.52	0.0055	0.12
Log (Fertilizer)	0.0291	1.25	-0.0325	-0.38
Log (Hired labour)	0.0631	3.45***	0.1964	1.85*
Log (Pesticides)	0.0282	1.89*	0.0258	1.24
Log (Family labour)	0.3153	3.40***	0.3614	3.45***
Log (Land)	0.1172	2.16**	0.1160	1.86*
Log (Farm assets)	0.0286	2.19**	0.0215	1.07
Associations	0.1035	1.46	0.1432	1.69*
Education head	0.1827	1.51	0.1457	1.00
Region dummy	-0.4302	-3.83***	-0.4003	-3.15***
Constant	8.3451	11.90***	7.5036	7.55***
Adj R-squared		0.27		0.10
F-statistic		10.33***		7.21***
Wu-Hausman F				2.51*
Durbin-Wu-Hausman $\chi 2$				7.73*
N	253		253	

Note: [a]Log(irrigation), log(fertilizer), and log(hired labour) were treated as endogenous. Instrumental variables included distance to the nearest river and local government headquarters; and dummy variables for old household head, inaccessibility of the village, polygamy
[b]t-values in absolute terms.
***denotes significance at 1%; ** denotes significance at 5%; and * denotes significance at 10%.

Source: Own estimations based on own data

The model F statistic rejects the null hypothesis that all coefficients are together equal to zero. The Wu-Hausman F test and the Durbin-Wu-Hausman Chi-squared test for endogeneity of the instrumented variables reject the endogeneity of instrumented variables which implies that any bias that would have been there has been controlled for

by instrumenting these variables. There are also significant differences between the model estimated by OLS and the one that was estimated by 2SLS. For example, the point estimate of the parameter on family labour is found to increase from 0.32 in the OLS estimation to 0.36 in the instrumental variable estimation which means that the results from the OLS estimation may underestimate the shadow wage of family labour. The results from the 2SLS were therefore used to estimate the shadow wages for family labour in farming by applying equation 6.11.

Applying the selection bias correction procedure presented above, probit models for participation in fishing activities were estimated for each of the survey rounds to estimate inverse mills ratios. The results of estimated probit models are presented in Table 6.3 below:

Table 6.3: Estimated probit models for household participation in fishing in the Hadejia-Nguru Wetlands, Nigeria

	First survey		Second survey		Third survey	
Variable	Coef.	z-stat[a]	Coef.	z-stat[a]	Coef.	z-stat[a]
Ln(fishing assets)	0.1663	5.77***	0.1618	5.27***	0.1309	4.16***
Fishers ratio	1.7706	3.81***	2.2111	4.62***	1.6057	3.32***
Age head	-0.0056	0.82	-0.0143	1.93*	-0.0089	1.13
Dependency	-0.4099	0.86	-0.4160	0.79	0.4818	0.85
Ethnicity	-0.7219	3.20***	-0.5969	2.50**	-0.2130	0.87
Region	-0.0592	0.26	0.3874	1.66	-0.0398	0.16
Constant	-1.3576	2.76**	-1.5491	2.86***	-2.1792	3.63***
Log Likelihood		-116.79		-108.15		-100.63
LR Chi $\chi 2$		78.81***		81.47***		5.39***
N		255		255		255

Note: [a]z-values in absolute terms
***denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The results of probit models show that household decisions to fish are correlated with a number of factors. It is shown that households that have more fishing assets are more

likely to be engaged in fishing throughout the year. The results also found that the increase in the proportion of fishing households in the village where the household resides increases the probability that a household will be involved in fishing. The proportion of fishing households in a village can be used to reflect the availability of fishing opportunities. Villages that are close to fishing opportunities would have more fishing households. In that case, the results of the probit models suggest that households are more likely to be involved in fishing in villages that have more fishing opportunities. Age of the household head and ethnicity dummy are also found to significantly influence the probability that a household will be involved in fishing at sometimes of the year. The inverse mills ratios that were estimated for each of the seasons were then used in the fishing wage regression to correct for selection bias. The results of the fishing wage regression are presented in Table 6.4 below.

Table 6.4: Estimated fishing wage equation in the Hadejia-Nguru Wetlands, Nigeria (Dependent variable: Log (Fishing wage))

Variable	Coefficient	Z-statistic[a]
Education head	0.2423	1.31
Associations	0.2685	2.29**
Fishers proportion	-1.4736	2.31**
Male adults	0.0892	1.86*
Lambda1	-0.7104	2.05**
Lambda2	-0.3200	0.94
Lambda 3	-0.7475	2.86***
Constant	5.1787	8.33***
Adj R-squared		0.12
Wald $\chi 2$		44.17***
N		194

Note: [a]t-values in absolute terms
***denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The results above show that there is selection bias in the first and last survey rounds. This is consistent with expectations because there may be households who could

potentially be involved in fishing during the first and last survey but they are not due to limited fishing opportunities. In that case, the observed wage for such households in such periods, which is zero underestimate their shadow wage. The results of the wage equation shows that the wage from fishing increases with the number of associations a household head belongs and number of male adult members of the household. On the other hand, the proportion of fishing households in the village significantly reduces the wage which may reflect law of supply. When there are more fishers in a village, the supply of fish is expected to be high and this would reduce the prices of fish holding all other things constant. The linear prediction of the results in Table 6.4 above yielded the estimated shadow wages of family labour in fishing. A similar procedure was followed to estimate the shadow wage of family labour in off farm activities. Firstly the results of probit models for household participation in off-farm activities are presented in Table 6.5 below:

Table 6.5: Estimated probit models for household participation in off-farm activities in the Hadejia-Nguru Wetlands, Nigeria

	First survey		Second survey		Third survey	
Variable	Coef.	z-stat[a]	Coef.	z-stat[a]	Coef.	z-stat[a]
Dependency	0.6111	1.45	0.8056	1.83*	0.7525	1.67
Loan	0.0000	1.81*	0.0000	0.56	0.0000	0.03
Local govt	-0.0053	-0.62	0.0225	2.14**	0.0209	2.09**
Constant	0.3095	1.19	0.1447	0.52	0.2196	0.80
Ln Likelihood	-144.31		-123.65		-122.68	
LR $\chi 2$	9.14**		7.91**		7.04*	
N	255		255		255	

Note: [a]z-values in absolute terms
***denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The results of probit models for participation in off-farm activities shows that very few factors could explain decisions to be engaged in an off-farm activity. The variables that were included are the ones that showed some explanatory power at some time within the

year. The inverse mills ratios that were obtained from these probit models were used in the off-farm wage regression whose results are presented in Table 6.7 below:

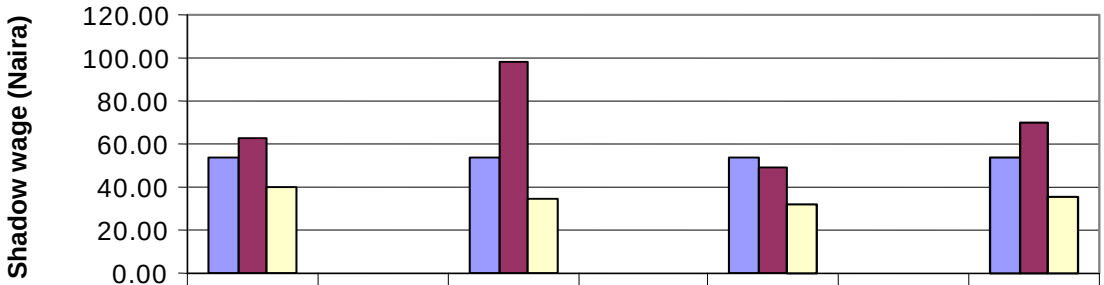
Table 6.7: Estimated off-farm wage equation in the Hadejia-Nguru Wetlands, Nigeria (Dependent variable: Log (off-farm wage)

Variable	Coef.	z-statistic[a]
Education head	0.2169	1.81*
Ethnicity	0.1713	1.42
Polygamy	-0.2429	2.21**
Region dummy	-0.1358	0.99
Lambda1	-0.1022	0.22
Lambda2	-0.5627	1.01
Lambda3	-0.8107	1.46
Constant	3.6791	16.86***
Wald $\chi 2$	16.78**	
N	595.0	

Note: [a]t-values in absolute terms
***denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The results in the table show that selection bias does not exist for off-farm wage in the study area. This may be the case because a large proportion of households are involved in off-farm activities. Additionally, the diversity of off-farm activities included in this category of activities in this study may mean that observed differences in the wages reflect the differences in the returns to different activities and not differences in shadow wages and market wages. As expected, the shadow wage of off farm activities is found to significantly increase with higher formal education of the household head. The findings also show that the shadow wage from off farm activities is significantly low in polygamous families than in monogamous families. The mean of the estimated shadow wages are described in Figure 6.1 below:



	April to Aug	Aug to Nov	Nov to Mar	Annual Average
Farming	53.96	53.96	53.96	53.96
Fishing	63.10	98.37	48.92	70.13
Off-farm	40.06	34.59	31.91	35.52

Figure 6.1: Shadow wages of family labour in different activities at different times of the year in the Hadejia-Nguru Wetlands, Nigeria

Source: own computations based on own data

The shadow wage of family labour in farming is not changing over different seasons of the year because it was assumed so. On average, fishing has the highest shadow wage of family labour of 70.13 Nigerian Naira per hour while off-farm activities has the lowest shadow wage of family labour of 35.52 Naira per hour. The shadow wage of family labour in fishing is highest in the period between August and November. This is the time when there is a lot of water and fishing opportunities have increased implying that shadow wages of fishing increases with the increase in fishing opportunities. Between November and March, when households have harvested their farm output, the shadow wage of family labour in farming becomes highest relative to fishing and off-farm activities.

6.4.3 Estimated earnings share equations

The estimated shadow wages were used to estimate shadow labour incomes from each of the activities by multiplying the total time allocated to that activity with the shadow wage. These were added within a household to estimate the total household shadow labour income. These values were used to compute shares of labour incomes which were

used as dependent variables in the system of equations. The results of the estimated system of shadow labour income share equations are presented in Table 6.6 below:

Table 6.8: Estimated shadow labour income share equations in the Hadejia-Nguru Wetlands, Nigeria

Variable	Share of labour income from farming		Share of labour income from fishing		Share of labour income from off-farm	
	Coef.	Z-stat	Coef.	Z-stat	Coef.	Z-stat
Constant	0.5105	5.00***	0.0426	0.62	0.4469	4.89***
Log (labour income)	0.0143	1.13	-0.0156	-1.87*	0.0013	0.12
Log (farming wage)	0.0765	9.46***	-0.0230	-4.55***	-0.0535	-7.82***
Log (fishing wage)	-0.0230	-4.55***	0.0594	7.40***	-0.0364	-4.42***
Log (off-farm wage)	-0.0535	-7.82***	-0.0364	-4.42***	-0.0171	-1.60
Region dummy	-0.0141	-1.10	0.0006	0.07	0.0135	1.25
Education head	-0.0539	-3.92***	-0.0165	-1.76*	0.0705	5.82***
Age head	0.0005	1.24	-0.0004	-1.27	-0.0002	-0.49
Round 2	0.0141	1.00	-0.0397	-4.03***	0.0256	2.09**
Round 3	0.0282	2.03**	-0.0164	-1.77*	-0.0118	-1.00
N		765		765		765

Note: *** denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The parameter estimates on the control variables show important results that education of the household head increases the share of shadow labour income from off-farm activities and reduces the share of shadow labour income from fishing and farming implying that attainment of formal education by household head increases opportunities off-farm activities. The results also show that households total household shadow labour income reduces the share of labour income from fishing and this is not significant in the farming and off-farming share income equations. Own price effects are positive while cross price effects are negative as expected.

6.4.4 Wage and earnings elasticity estimates

Using the estimated parameters presented in Table 6.6 above, equations (6.14) and (6.15) were applied to estimate total labour earnings elasticity and wage elasticity of family labour supply. These are presented in Table 6.7 below:

Table 6.7: Estimated total labour income and wage elasticity of family labour in the Hadejia-Nguru Wetlands, Nigeria

	Farming	Fishing	Off -farm
Total labour income	1.0174***	0.6636***	1.0098***
Farming wage	-0.9215***	-0.2197	-0.4212***
Fishing wage	-0.0287***	0.2986*	-0.2817***
Off-farm wage	-0.0671***	-0.7425***	-1.1331***

Note: *** denotes significance at 1 percent; ** denotes significance at 5 percent; and * denotes significance at 10 percent.

Source: Own estimations based on own data

The results of the total shadow labour income elasticity estimates of family labour supply show that an increase in expected total labour income increases family labour supply in all the three activities but in different magnitudes. The labour income elasticity of family labour supply in farming and off-farming activities are equal to unity which imply that a 1 percent increase in total labour income increases time allocation to these activities by almost the same percentage. On the other hand, the results show that the labour income elasticity of family labour supply in fishing is less than unity which means that a 1 percent increase in total labour income increases time allocation to fishing by less than 1 percent. This implies that time allocation to fishing is less sensitive to expected labour income than other income generating activities. In relation to poverty, these results imply that as household labour income increases, households allocate more time to farming and off-farming activities than they do to fishing. This finding partially explains the old observation that small scale fishing is closely associated with poverty (Smith, 1979). The current result imply that households that expect lower income

(expect to be poor) spend more time in fishing. Fishing is therefore fulfilling the "safety net role" for the poor households.

The own wage elasticity estimates of labour supply in farming and off-farm activities are negative implying that increases in their shadow wages reduce labour allocation in these activities. The negative signs of own-wage elasticity estimates show the existence of backward-bending labour supply curves in these activities. This may mean the presence of greater income effect than substitution effect which may mean that there is a greater dissatisfaction associated with working on the farm and in off-farm activities. Similar results have been found in empirical labour supply studies (see Skoufias, 1994; Shively and Fisher, 2004; Barbier, 2007). The own wage elasticity of labour supply in farming is less than unity which shows that a percent increase in shadow wages in farming reduces labour supply by less than 1 percent. On the other hand, the own wage elasticity of off-farm activities is greater than unity which would imply a greater negative income effect. The own wage elasticity of labour supply in fishing has the expected positive sign which imply that an increase in shadow wages in fishing increases family labour supply to this activity. This means that the returns to fishing are responsible for pulling households into fishing. The presence of the "forward bending" labour supply curve in fishing also suggest that there is less dissatisfaction associated with fishing such that households do not necessarily substitute fishing time for leisure when household incomes increase due to an increase in fishing wage.

The cross wage elasticity estimates on the other hand, show that an increase in shadow wage of off-farm activities reduces labour allocation to farming by a greater proportion than the increase shadow wage for fishing. This means the substitution effect of the fishing wage on farming is smaller than the substitution effect of off-farm wage. One way to look at this result is that the fishing wage is highest at the time when labour demands on farming are also high and households substitute less of time to farming because of the importance of farming in the area. On the other hand, labour demand in farming between April and August when the wage for off-farm activities is highest is relatively low and households can manage substitute more of the labour from farming to this activity when the returns to this activity increases. The estimates also show that change in farming wage does not significantly influence labour supply in fishing. On the

other hand, a unit increase in the wage of off-farm activities is found to reduce labour supply to fishing by about half a unit. This suggests that that farming compliments fishing activities while off-farm activities substitutes fishing activities. Finally fishing and farming are found to substitute off-farm activities.

6.5 Conclusions

This chapter aimed at understanding household decisions in choosing livelihood activities. Empirical estimation involved the estimation of shadow wages of family labour, labour income share equations, and wage and labour income elasticities. Probit models of participation in fishing show that availability of fishing opportunities and ownership of fishing gear are major determinants of household decision to fish. The estimated shadow wages for family labour show that on average, households have highest shadow wages in fishing followed by farming. The highest returns to fishing are found when there are more fishing opportunities. The shadow wage of farming was not allowed to change between seasons but this was found to be highest compared to fishing and off-farm activities during harvesting period.

The main result from the estimated labour income share equations is that education level of the household head is very important in determining the composition of total household earnings. The more educated the household head is, the further the labour income moves away from natural resource based sources such as fishing and farming. This clearly show the potential of education policies easing the pressure on natural resources and reducing the probability of facing natural resource related income shocks as indicated in Chapter three.

The estimated labour income elasticity of labour supply show that households allocate more time to all the three activities when expected income increases. However, the findings show that time allocation to fishing is less sensitive to expected labour income than the time allocated to farming and off-farming activities. This implies that households that expect lower labour incomes (expect to be poor) move allocate more time to fishing. Fishing is therefore fulfilling the “safety net role” for the poor households and it may be necessary to leave the fisheries open to act as a fall back position for the poor.

However, the own wage elasticity of labour supply in fishing suggest that the returns in fishing induces households to go for fishing. Additionally, the wage in agriculture does not influence fishing decisions but the increase in wage in off-farm activities reduces labour allocation to fishing showing that the two activities are substitutes. These results provide policy makers with tools for understanding the expected behavioural and welfare effects of different policies. For example, a policy that aims at increasing returns to labour in farming such as new technologies would not influence labour allocation to fishing and off-farm activities but will reduce time allocation to farming which imply that households will end up increasing leisure time if returns to farming increases. The welfare implications of such a policy may be marginal. Effective fisheries management policies on the other hand can be attained through policies that aim at increasing the returns from off-farm activities. An increase in the returns to off-farm activities would reduce time allocation to fishing. On the other hand, policies that would aim at increasing returns to fishing would increase fishing effort and reduce time allocated to both farming and off-farm activities.

Chapter 7

Summary, Conclusions and Recommendations

7.1 Summary

The main objective of this thesis was to assess household poverty and vulnerability in small scale fishing communities of the Hadejia-Nguru Wetlands in Nigeria. The thesis uses primary data that was collected in four waves of household surveys. These were conducted between April 2007 and March 2008. A two-stage random sampling procedure was used to identify sample households. A total of 282 households were interviewed during the first survey and this reduced to 263 in the last survey due to sample attrition. The analysis yielded some important results in view of the research objectives, which are summarized in the following paragraphs.

Chapter three identifies important negative shocks and assesses their impact on household livelihood outcomes. This is done by estimating consumption expenditure functions in which measures of income shocks are used as explanatory variables. The findings show that important negative income shocks in the area are death of an adult member, drought, crop pests and social conflict. It is also shown that income shocks affect food consumption more significantly than they affect non-food consumption implying that negative income shocks mostly threaten household food security. Income poor households are mainly affected by drought while non-poor households are mainly affected by crop pests. Additionally, farming dependent households suffer more from social conflicts; fishing households suffer more from drought.

Chapter four assesses the seasonal variability in household vulnerability to poverty and how seasonally sensitive data biases vulnerability estimates. Vulnerability is defined as the probability that a household's consumption expenditure will fall below the poverty line. The findings show that on average, households experience low levels of probability of becoming poor during the harvesting period and high levels in other periods of the year. Considering the finding that income shocks mainly affect food consumption, these

results reflect serious threats of hunger and food insecurity during certain times of the year. The effects of hunger and food insecurity during these periods would result to malnutrition mainly in children which may have long term effects on poverty. The findings also show that households that obtained more income from fishing have low probabilities of experiencing consumption poverty during the seasons away from the harvesting period while households that obtained more income from farming and also possessed more farming assets were found to have low probability of being poor during the harvesting period. Significant variations in vulnerability levels between seasons were only observed for households that obtained most of their incomes from farming. Households that obtained most of their incomes from fishing and off-farm activities did not experience significant variations in the probability of becoming poor. Additionally low dependency ratio and formal education for the household head are negatively associated with vulnerability level within a season and also variations in vulnerability level across seasons.

The assessment of the bias in vulnerability estimates due to seasonality in the panel data confirms what Pritchett et al. (2000) observed. However, these authors found a bias of up to 17 percent which is very large probably because there are other things that were not controlled for in their study. The findings in this thesis show that if one important season is missed in the panel, vulnerability measures are overestimated mainly due to underestimation of the mean consumption and overestimation of the variance of consumption. The use of seasonal dummy variables assist in reducing the bias in vulnerability estimates that comes from the overestimation of the expected mean consumption but the same technique does not correct for the bias in the variance of the expected mean consumption.

In chapter five, the asset-based poverty model is incorporated into the expected poverty concept to derive a vulnerability measure that is capable of decomposing expected poverty into structural-chronic, structural-transient, and stochastic-transient. This approach yields a clear picture of the extent, nature and causes of poverty among fishery dependent households. The findings show that transient poverty is expected to be more prevalent and very few households are expected to be non-poor in the short term. The

majority of households are vulnerable to poverty because their asset base is so low that even if favourable production conditions would occur or risk reducing measures would be introduced they are unlikely to be able to move out of poverty permanently. Fishing households are expected to be better off than farming and off-farming households because fewer fishing households are expected to be structural-chronic poor and a larger proportion of them are never expected to be poor. The majority of households that obtained most of their income from off-farm activities are expected to be poor mainly because of structural reasons (i.e. structural-chronic and structural-transient).

Lastly, Chapter six assesses how economic opportunities affect household time allocation to fishing in small scale fishing areas of the Hadejia-Nguru Wetlands in Nigeria. A system of shadow labour income share equations is estimated in the Almost Ideal Demand System (AIDS) framework and wage and labour income elasticity estimates are derived. The estimated system of the shadow labour income share equations show that education level of the household head is very important in determining the composition of total household shadow labour income. Households with heads that have formal education obtain a large share of labour income from off-farm activities and lower share of labour income from fishing and farming. The labour income elasticity estimates of labour supply suggest that time allocation to fishing is less sensitive to expected labour income than the time allocated to farming and off-farm activities. This implies that households that expect lower labour incomes (expect to be poor) move allocate more time to fishing. Fishing is therefore fulfilling the "safety net role" for the poor households. On the other hand, the own shadow wage elasticity of family labour supply in fishing suggest that increases in the shadow wage of family labour in fishing induces households to engage in fishing. Additionally, the shadow wage of family labour in agriculture is found not to influence fishing decisions but the increase in the shadow wage in off-farm activities is found to reduce labour allocation to fishing showing that the two activities are substitutes.

7.2 Conclusions and recommendations

The findings from this study leads to a number of conclusions and recommendations. Poverty levels in the study area are very high. The national statistics classifies the state where this study was conducted as the poorest in Nigeria. Using consumption expenditure data from the baseline survey, it has been shown that about 79 percent of the households are poor while consumption expenditure from the monitoring surveys showed that about 60 per cent of the households are poor. The high poverty levels are caused by both low levels of asset holdings and stochastic negative events. Up to 62 per cent (30 per cent structural-chronic and 32 per cent structural-transient) of the households are expected to be poor due to low asset levels. In other words, if there is no change in asset holdings, these households are expected to continue to be trapped in poverty. This advocates for rural development policies that aim at building asset base for these households to attain significant poverty reduction. Since, land, agricultural assets, and fishing assets are the types of assets that have been found to significantly increase structural incomes of households and hence reduce structural poverty (both structural-chronic and structural-transient), policies should aim at building these types of assets for the households. Such policies can include land reform programs which would ensure that the landless have improved access to land, credit programs that would enable households to acquire the necessary assets, and improvement in infrastructure that would make access to product and input markets easier which would likely induce the productivity of the assets.

Equally important is the proportion of households that are poor due to negative stochastic events. Different types of negative income shocks require different interventions to deal with. For example, social conflict can be prevented by building the conflict resolution capacity of the traditional institutions. On the other hand, drought and pests can not necessarily be prevented but their effects can be mitigated. Unfortunately, the construction of dams that were aimed at easing some of the problem of droughts by initiating irrigation projects are said to have brought some problems. For example, an earlier hydrological study in the Hadejia-Nguru Wetlands showed that the benefits of the wetlands in terms of agriculture, fishing and fuel wood were over five times that of a

formal irrigation scheme (Thompson and Hollis, 1995). Additionally, Goes (2002) states there is an increase in the dry season flow of water after the construction of the two dams along the Hadejia river and this created a conducive environment for macrophyte (*typha* grass) development. This weed reduces the fishing ground, covers cultivatable land, and provides a good breeding space for waterfowl which is the major pest to crops. In this case, good water management should be a better solution in areas where the dams have already been constructed. The release of water from the dams should mimic the natural flooding regimes of the area. In places where such development projects have not been implemented, it is advisable to look at these negative externalities seriously before the projects are implemented.

The finding that reduction in food consumption seem to be a mostly likely response of households when they are faced with these negative shocks, suggest that negative income shocks threatens household food security. In this case, governments and development agencies should consider food based interventions such as the food for work programs when these shocks affect the households.

Although it has been shown that poverty incidence is high in this fishing community, it should be noted that fishing households themselves are not the poorest as has been reported in some sections of the fisheries literature. Different measures of welfare that have been used in this study find that households that depended more on fishing were least poor. This means that fishing has the potential of taking households out of poverty. Additionally, the study of factors that determines household livelihood choices has shown that household poverty is not the major factor that determines whether households will be engaged in fishing or not. However, households that obtained most of their incomes from off-farm activities are found to be the most poor. On the other hand, it has been shown that households that obtained most of their incomes from off-farm activities experienced least variations in the probability of becoming poor between seasons. It is therefore concluded that each of the livelihood activities have a specific role to play in poverty reduction strategies and policy makers should not promote one activity at the expense of others. This calls for promotion of diversified livelihood strategies.

To derive desired household responses policy makers can make use of the results of the livelihood choices study. For example, a policy that aims at increasing returns to labour in farming such as new technologies would not influence labour allocation to fishing and off-farm activities but will reduce time allocation to farming which imply that households but increase time allocated to leisure. The welfare improvements of such a policy would be marginal if the other two important livelihood activities are not considered. Effective fisheries management policies on the other hand, can be attained through policies that aim at changing the opportunity cost of time allocated to fishing and off-farm activities. An increase in the opportunity cost to off-farm activities would reduce time allocation to fishing therefore reducing overexploitation of the fisheries resources. On the other hand, policies that would aim at increasing returns to fishing would increase fishing effort and reduce time allocated to both farming and off-farm activities.

Most of the studies that have estimated vulnerability used either cross section data and applied the innovation by Chaudhuri et al. (2002) or they make use of panel data that are based on annual recalls with the recall period of frequently purchased commodities such as food having shorter recall periods like seven days. Unfortunately, in poor communities, food consumption constitutes a large share of total consumption. This brings the problem of seasonality in annual household consumption surveys which may lead to poverty and vulnerability estimates that are sensitive to the time the surveys were conducted. Despite being seasonal, the interpretations in most of these studies assume that the values reflect annual averages and most researchers do not de-seasonalise the data. The only common practise is to consider seasonal price changes but not the changes in consumption. When a panel study is being designed to collect data for vulnerability assessment, it is here recommended that data should be collected in such a way that all the important seasons in the study areas are well captured. When using already collected data, it is necessary to try to de-seasonalise the data.

In general the study has confirmed that poverty incidence in fishing communities is high. Poverty and vulnerability are mainly caused by insufficient productive asset holding by households and incidence negative stochastic events. This is exacerbated by

seasonality in the flow of incomes and inability of households to spread the income throughout the year. Rural development goals in the area should therefore aim at building asset base of households, building the capacity of households to cope with the effects of shocks and reduce intra-year variations in consumption. These goals can be attained by implementing a number of interventions such as technological innovations and their diffusion, provision of employment during the dry season, diversification of income sources, introduction of poor friendly credit programs, provision of infrastructure and improvements in the output, input, and labour markets. None of these interventions can bring sustainable poverty reduction single-handedly. A policy mix is therefore recommended.

Further research need to be done on some aspects of this study mainly related to the empirical estimation of the proposed asset based vulnerability measure. The use of cross section data in this study limits the predictive ability of the results. Results generated from cross section data reflect short run predictions of vulnerability because asset levels are considered constant. This method can therefore yield long term predictions if a long panel data set is used.

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Appendices

Appendix A: Focus group discussion guide

Poverty Alleviation and Food Security Through Improved Valuation and Governance of River Fisheries in Africa

Poverty Alleviation and Food Security Role of Small Scale Inland Fisheries in Northeast Nigeria

Focus Group Discussion Guide

To the FGD Team

Before you begin with the focus group discussion, you should make sure that you form a team of at least three members. You are required to share responsibilities as follows: One of you should be a moderator or facilitator. The main role of this team member is to guide the direction of the discussion. The second member of the team should be a reporter. This member reports on every activity that is done and explanation that is made. The last member of the group acts as an observer. This is an equally important member of the team because s/he makes sure that the reporter is not missing points and the facilitator is also doing what he/she is supposed to do. The observer can also take notes that can be compared with the notes taken by the reporter. Finally, the observer is supposed to take note of participants' attitudes, feelings and other nonverbal expressions. This assists in the interpretation of the results.

It is necessary that all of you be familiar with our objective that is to find out the relationship between small-scale fisheries and poverty. At the end of the discussion, the whole team should compile a report that will be submitted to the principal investigator.

Invitation and Selection of participants

The village headman should be asked to invite people who have more knowledge about the village and activities of the village to the meeting few days before the discussions. Number of invited participants should be between 8 and 12. Both men and women should be invited to the meeting.

Agenda for FGDs

Welcome, prayer, introductions, explanation of purpose of meeting, agree on ground rules, discussion, wrap up.

Questions for discussions

Overview of the village

Ethnic groups, religions, household listing, major livelihood strategies.

Access to resources

Ask participants to list all natural resources that are important to the livelihood of the village. Ask participants to indicate rules and regulations that govern use of the resource.

Resource	Access rules and regulations

Use pairwise matrix to rank the resources according to their contribution to livelihood security in the village.

Format of pairwise matrix

	Resource 1	Resource 2	Resource 3	Resource 4	Frequency	Rank
Resource 1						
Resource 2						
Resource 3						
Resource 4						

Poverty assessment

Let the participants define poverty (i.e. who is the poor and non poor in their own words) and categorize households in the village in terms of poverty status (i.e. poorest, poor, rich (non poor), etc).

Shocks, risks and risk sharing arrangements

Let the participants list the shocks (unfavourable events) that affected their livelihoods in the last 20 years.

- How many times did this occur and in which years in the past 20 years
- How did it affect the livelihoods of the households in the village
- What did households do to cope with this?
- Do households assist each other in times like these? How (gifts, loans, labour,)? Trends in village risk sharing over the past 20 years (any change in any of the ways of sharing risk)

Fishing and fishing related activities

Describe fishing activities in the village (Description of fishers, proportion of households with fishers, fishing gear, fishing seasons/calendar, number of landing sites).

Importance of fish to the village

Description of the fish value chain (i.e. how fish normally moves from the river to the consumer, who benefits more along the chain?).

Relative importance of fish over time (Is fish more important now, than it was in the past?)

Thank the participants after the discussion

Appendix B: Baseline survey questionnaire

NATIONAL INSTITUTE FOR FRESHWATER FISHERIES RESEARCH (NIFRR), NEW BUSSA, NIGER STATE, NIGERIA

Questionnaire Number ☐

Poverty Alleviation and Food Security Through Improved Valuation and Governance of River Fisheries in Africa

Poverty Alleviation and Food Security Role of Small Scale Inland Fisheries in Northeast Nigeria

Household Questionnaire
Baseline Survey
April 2007

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INTRODUCTION
(Spoken by the enumerator)

My name is _____. I am representing the National Institute for Freshwater Fisheries Research Institute in Niger state, the University of Hannover in Germany and the World Fish Centre in Egypt. The three institutions are conducting research in the Hadejia –Nguru wetland that is looking at how fish and fishing activities affect the living conditions of people and how these can be promoted. Some households have been selected to participate in this survey regardless of whether they are involved in fishing or not and your household happen to be one of them. There are no wrong and right answers to these questions. I would like to assure you that your answers will be handled with strict confidentiality. The interview will take about 2 hours. We are planning to interview your household for five times in the year to collect the information we are looking for.

Are you willing to participate in the survey?

[1] Yes
[2] No

(Proceed with interview if the respondent says yes)

IDENTIFICATION

Interviewer ID Number		Date of interview	
State Government ID		Local Government ID	
Village ID		Household ID	
Name of key respondent		Respondent ID	
Time Interview starts		Time Interview ends	

SECTION A: ROSTER

I will start by asking you about the composition of the household

Please give me a list of all individuals you consider members of this household

ID	1. Name	2. Relationship to head Codes *1…Head* *2…Spouse* *3…Child* *4…Brother/sister* *5…Parent* *6…In-law* *7…Other (specify)*	3. Sex Codes *1… Male* *2…Female*	4. Age in years *State age for under fives in months* *>5yrs*	*<5Yrs*	5. Ethnic group Codes *1…Hausa* *2…Kanuri* *3…Bade* *4…Fulfude* *5…Other (specify)*	6. Marital status Codes *1… Single* *2…married* *3…divorced* *4…separated* *5…widowed* *6…Other (specify)*	7. Is this member presently staying with the household Codes *1—yes* → skip questions 8 to 10 *2—no*	8. When did member leave the household? *State month and year*	9. Where did he/she go? Codes *1… within the village* *2… other village within LG* *3…other LG within state* *4…Other state* *5…Other country*	10. Reasons for leaving Codes *1—Marriage* *2—Employment* *3—Studies* *4—Fishing* *5—pasture land* *6---Other (specify)*
01											
02											
…	…										

SECTION B: EDUCATION AND OCCUPATION

I will now ask you about the educational attainment of the household members and their occupations

1. ID No.	**2.** Number of years of schooling	**3.** Highest education attainment **Codes** *0—none* *1—Arabic* *2—primary school* *3—Secondary school* *4—NCE/OND/HND* *5—University degree* *6--Other (specify)* *99 – not yet in school*	**4.** Number of languages member can read and write	**5.** Number of associations and groups to which member belong	**6.** Primary occupation **Codes** *1--Farming* *2—Livestock rearing* *3--Fishing* *4—Fish monger* *5--fish processor* *6--Formal employment* *7—Housewife* *8—business/ petty trading* *9--student* *10—underage* *11---other (specify)*	**7.** Secondary Occupation **Codes** *1--Farming* *2—Livestock rearing* *3--Fishing* *4—Fish monger* *5--fish processor* *6--Formal employment* *7—Housewife* *8—business/ petty trading* *9--student* *10—underage* *11---other (specify)*
01						
02						
…	**…**					

SECTION C: RISKS AND SHOCKS

I will now ask you about the unfavourable events that have occurred to the household since 1997 to this date

	1. Since 1997 to this day, was the household negatively affected by any of the following events Codes *1---yes* *2---no* →**go to next event** **Codes**	2. Rank the three most significant shocks you experienced - put (1) for most severe, (2) for second most severe, and (3) for third most severe	3. In which year(s) did this occur?		4. How big was the impact? **Codes** *1. High* *2. Medium* *3. Low* 4. *No impact*	5. Estimate the value of the loss due to the event *Naira*	6. What did the household do to cope with this? *Use the codes below the table*	7. How many months did it take for the household to come back to normal after the shock? *Months*
1	Drought			QUESTIONS TO THE RIGHT SHOULD BE ASKED ONLY FOR THE THREE MOST SEVERE SHOCKS AS NOTED IN QUESTION 2				
2	Flooding							
3	Pests or diseases that affected almost all crops before harvest							
4	Pests or disease attack that led storage losses							
5	Pests or diseases for livestock							
6	Theft of livestock							
7	Theft of production tools and equipment							
8	Theft of cash							
9	Destruction of housing							
10	Death of adult members							
11	Disablement of adult household member							
…..	……							

Codes for question 6

1. Reduced consumption	*2. Work harder*	*3. Took up additional occupation*	*4. Household migrated to search for job*	*5. Took children out of school*	*6. Use savings*
7. Sold assets	*8. Sold livestock*	*9. Sold land*	*10. Sold crops*	*11. Formal insurance*	*12. Borrow from moneylender*
13. Borrow from relatives relatives	*14. Borrow from non-relatives*	*15. Borrow from commercial bank*	*16. Gift from relatives*	*17. Gift from non-relatives*	*18. Help with labour from*
19. *Help with labour from non-relatives*		*20. Help from government*	*21. Help from NGOs*	*22. Help from mosque/church*	*23. Other (please specify)*

SECTION D: SICKNESSES AND INJURIES

I will now ask about illnesses and injuries household members have suffered from since the beginning of January this year

ID	1. Since January 2007, did this member of the household suffer from any illness or injury? Codes *1---yes* *2---no →Skip questions 2 to 6*	2. What was the illness or injury? Use codes for sicknesses and injuries in the next column			3. What action was taken to find relief from the illness? Codes 1…*did nothing* *2…Took drugs that were available in the house* *3…Buy drugs from pharmacy* *4...seek care at government hospital* *5…seek care at private hospital* *6…Took traditional medicine* *7…seek care from traditional healer* *8…other (specify)*		4. How much money was spent in total on this individual for all illnesses and injuries? Naira	5. Did the member stop doing what he/she normally does due to the illness? Codes 1---*yes* *2---no → skip questions 6*	6. How many days did the member stay away from normal activities due to the illness? *Days*
		Problem 1	Problem 2		Problem 1	Problem 2			
1				Codes for question 2 *1--Malaria, fever* *2—Diarrhoea* *3--Stomach ache* *4--Respiratory problems* *5—STI* *6—Asthma* *7--Head ache* *8--Fainting, mental problems* *9--Skin disease* *10--Dental problem* *11—Eye/ear problem* *12--Back ache* *13--Heart problem* *14—Maternity problems* *15--Other (specify)*					
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

SECTION E: DEATH IN THE FAMILY

I will now ask you about bereavement in the household in the past five years

1. If you have experienced death in this family since March 2002, list the names of the deceased.	2. Deceased's relationship to head of the household Codes *1…Head* *2…Spouse* *3…Child* *4…Brother/sister* *5…Parent* *6…In-law* *7…Other (specify)*	3. State the year in which the member died	4. What was the age of the deceased at the date of death *State age in months if under five years old* Years / Months		5. What was the cause of the death Codes *1--- disease (please specify type of disease)* *2--- car accident* *3---other accident* *4---child birth complications* *5---witch craft/sorcery* *6---not known* *7---other (specify)*

SECTION F1: LAND HOLDING AND UTILISATION

I will now ask questions about land utilisation and crop production, if a different household member is more conversant with this in the household, he/she can answer questions in this section.

Plot ID.	1. List the agricultural plots the household cultivated since March 2006 *List by name*	2. List the household members who worked on this plot since March 2006 to this date? *Start with major decision maker for this plot*	3. Size of plot *Unit Codes* *1…ha* *2…acre* *3…m2* *4... Other (specify)* *Area* / *Unit*		4. Tenure status Codes *1…given by chief* *2…inherited* *3…Purchased* *4…lease* *5…rent* *6…Free borrowing* *7…other (specify)*	5. Time taken to walk from house to this plot *Put time in minutes*	6. Location of plot *Codes* *1---upland fields* *2---fadama fields* *3 -- other (specify)*	7. Source of water supply *Codes* *1--- rain fed* *2---irrigation* *3 --- both* *4--- other (specify)*	8. Number of harvests since March 2006 to this date	9. Estimate cost of production on this plot since March 2006 to this date Naira *Seeds* / *Fertiliser* / *Hired Labour* / *Irrigation* / *Others (specify)*				
1														
2														

SECTION F2: CROP PRODUCTION AND YIELD UTILISATION

I will now ask you about crop yield and how you use the yield

Plot ID	10 Crops harvested on this plot since March 2006 to this date *Use crops codes listed below*	11 Crop yield from this plot since March 2006 to this date Unit codes *1---bags (100kg maize)* *2---kilograms* *3---Baskets* *4—number* *5---other (specify)*		12. Quantity of this yield the household has today in its storage Unit codes *1---bags (100kg maize)* *2---kilograms* *3---Baskets* *4—number* *5---other (specify)*		13 Quantity of this yield the household sold Unit codes *1---bags (100kg maize)* *2---kilograms* *3---Baskets* *4—number* *5---other (specify)*		14 Amount of money obtained from yield sales *Naira*	15 Cost of harvesting, processing, and transporting the yield *Naira*
		Quantity	*Unit code*	*Quantity*	*Unit code*	*Quantity*	*Unit code*		
1									

Crops Codes: *1--- Maize, 2---Rice, 3---Sorghum, 4---Millet, 5---Wheat, 6---Groundnuts, 7---Beans, 8----Soya beans, 9---Cassava, 10---Sweet potatoes, 11---Irish potatoes, 12---Sesame, 13---Pigeon peas, 14---Tomatoes, 15----Pepper, 16---Onions, 17---Leaf vegetables, 18---water melons, 19---sugarcane 20-----other (please specify)*

SECTION F3: LIVESTOCK REARING

I will now ask questions about livestock rearing, if a different household member is more conversant with this activity in the household, can he/she answer questions in this section?

Livestock type	1. Household member (s) who takes care of this livestock type *Start with major decision maker. State ID(s)*	2. Number of animals of this type bought since March 2006 to this day	3. Total cost of purchasing animals since March 2006 to this day *Naira*	4. Number of animals of this type born since March 2006 to this day	5. Number of animals of this type sold since March 2006 to this day	6. Total amount of money obtained from livestock sales since March 2006 to this day *Naira*	7. Number of livestock of this type slaughtered for home use since March 2006 to this day	8. Estimated cost (feeds, drugs, labour, etc) of rearing this livestock type since March 2006 to this day *Naira*	9. Total number of animals of this type the households has today	10. Estimated value of the herd of this livestock type if all animals are sold *Naira*
Chicken										
Ducks/goose										
Guinea fowls										
Pigeons										
Goat										
Cattle										
Sheep										
Rabbits										
Horses										
Camel										
Donkey										
Other (specify)										

Animal Products

	11. How much of each of the following animal products was harvested since March 2006 to date?	12. How much money did the household obtain from sales of this animal product since March 2006?
Milk and milk products		
Eggs		
Hides		
Other (specify)		

SECTION G1: FISHING

1. Since March 2006, was any member of the household involved in fishing?

1---yes

2---no → **go to next section**

If yes, let the member(s) answer the following questions, if no go to the next section

1. Household members involved State IDs *Start with the major decision maker*	2. Since March 2006 to this date, how frequent did the member fish? Codes *1…daily* *2…weekly* *3…monthly* *4…. quarterly* *5…annually* *6…other (specify)*	3. Number of times you caught fish per period given in question 2	4. Normally how much did you catch per given fishing activity? Unit Codes *1---basin* *2---baskets* *3---Other (specify)*		5. Normally how much of the catch in question 4 is sold? Unit Codes *1---basin* *2---baskets* *3---Other (specify)*		6. Normally how much money did you get when you sale the quantity stated in question 5? *Naira*	7. Estimate the cost you incur per a single fishing activity? *Naira*
			Quantity	Unit Code	Quantity	Unit Code		

SECTION G2: FISHING RELATED ACTIVITIES

I will now ask questions about fishing related activities, if a different household member is more conversant with this activity in the household, can he/she answer questions in this section?

Activity	1. Since March 2006 to this date was any household member involved in …? Codes *1---yes* *2---no* → skip questions 2 to 8	2. Member (s) involved *State member ID* *Start with major decision maker*	3. How frequent was the member involved in this activity? Codes *1…daily* *2…weekly* *3…monthly* *4….quarterly* *5…annually* *6…other (specify)*	4. How many times did the member do this activity per period given in question 3	5. How much fish was normally bought/acquired to be processed or traded per given time? Unit Codes *1---basin* *2---baskets* *3---Other (specify)*		6. Normally how much of the fish in question 5 was sold Unit Codes *1---basin* *2---baskets* *3---Other (specify)*		7. Normally how much money was obtained per activity *(fish sales in case of processing and trading*) *Naira*	8. Estimate total cost (fish, labour, firewood, fuel, transport, other, etc) incurred per one activity since March 2006 to this date *Naira*
					Qty	Unit Code	Qty	Unit code		
Fish processing										
Fish trading										
Fish transportation					XXX	XXX	XX	XXX		
Casual labour in fishing					XXX	XXX	XX	XXX		
Equipment making and repair for sale					XXX	XXX	XX	XXX		
Other (please specify)					XXX	XXX	XX	XXX		

SECTION H: INCOME FROM OTHER SOURCES

I will now ask about income household members obtained from other activities apart from farming, livestock sales, asset sales, and fishing. Let the member who were involved in a given income generating activity answer questions on that activity

Source of income	1. In the previous year, did any of the household member(s) obtain money through (state source)? Codes *1…yes* *2…No* → skip questions 2 to 5	2. List the member(s) who obtained money from this source? *State member ID(s)*	3. Normally the member (s) obtained money from this source at which frequency? Codes *1…daily* *2…weekly* *3…monthly* *4…. quarterly* *5…annually* *6…other (specify)*	4. How many times did the member obtain money from this source per given period stated in question 3? *Please put number of times*	5. How much money does the member obtain per given time? *(Naira)*
Hawking, petty trading, etc					
Formal employment					
Casual work					
Remittances from relatives					
Gifts from non relatives					
Cash for work					
Loan					
Mechanic, tailor, gold smith, etc					
Other sources (specify)					

SECTION I: ASSETS

I will now ask you about the household asset acquisition and disposal (sell or discarding of assets)

Asset	1. Member of household who owns this asset *State ID*	2. Number of assets owned	3. Year asset was acquired	4. Cost of asset at date of acquisition *Naira*	5. How much money have you spent to repair the asset since March 2006 *Naira*	6. How much can you sell it today? *Naira*		7. Since March 2006 to date, did the household sell any of this asset type? Codes *1…. Yes* *2… No* → skip question 8	8. How much money was obtained from the sell of this asset type? *Naira*
House									
Tables									
Chairs									
Beds									
Mattresses/mats									
Radio/ Tape recorder							ASK QUESTIONS 7 AND 8 AFTER ASKING QUESTIONS 1 TO 6 FOR ALL ASSETS		
Bicycle									
Motorcycle									
Motor Car									
Tractor									
Oxcart									
Hand cart									
Canoe									
Boats									
Fishing gear									
Smoking oven									
Plough									
Pesticide sprayer									
Water pump									
Grocery shop									
Gourd									
Power generator									
Sewing machine									
Other (specify)									

SECTION J: ACCESS TO NATURAL RESOURCES

I will now ask you about household access to different natural resources that affect the livelihood of the household

Natural resources	**1.** How much time does it take you to walk to where you or other villagers normally…? Unit codes *1---minutes* *2---hours* *3---other (specify)*		**2.** State any rules and regulations that govern the use of this natural resource	**3**. Since March 2002, how can you describe the availability of this natural resource? Codes ***1---Decreasing*** ***2---Increasing*** ***3---Constant*** ***4---Other (specify)***		**4.** How have you responded to these changes? Codes ***1---Use more labour to exploit the resource*** ***2---Switch to other livelihood activities*** ***3---use improved equipment*** ***4---make more hay/silage*** ***5---go to other areas to seek for the resource*** ***6---do nothing*** ***7---other (specify)***
	Amount of time	*Unit Code*				
Fish				Fish		
Graze your animals				Pasture		
Collect firewood				Firewood		
Collect dump palm products				Dump palm		
Collect potash				Potash		
Collect gum Arabic				Gum Arabic		
Other (specify)						

SECTION K: ACCESS TO SERVICES AND INFRASTRUCTURE

I will now ask you about access to services and infrastructure

Services/ Infrastructure	**1.** How do you normally go to….? Codes ***1---walking*** ***2---bicycling*** ***3---motor cycling*** ***4---motor car*** ***5---other (specify)***	**2.** How much time do you normally take to reach this service /infrastructure? ***Write time in minutes***	**3.** Is access to this service or infrastructure free? Codes ***1---yes*** → skip question 4 ***2---no***	**4.** If no to 3, what types of restrictions or regulations are there?
Hospital				
Primary school				
Produce market				
Fish market				
Water point				
Tarmac Road				
Other (specify)				

SECTION L: FOOD CONSUMPTION, PURCHASES AND SHORTAGES

I will now ask you about food consumption, expenditures and shortages in the family. The household member who is more familiar may answer the questions.

1. What is the main staple food for this household?
   1….Maize
   2….Sorghum
   3…Millet
   4…Rice
   5…wheat
   6… other (specify)

2. How do you normally acquire this food?
   1….Own production
   2…. Buying →**go to question 7**
   3…. Other (specify)

3. If you produce your own food, in which month did you have your most recent harvest?
   State month: _____

4. Do you still have this food in your storage?
   1…yes → **go to question 8**
   2…No

5. If no, in which month did the food finish?
   State month:_____

6. Since your food finished, what do the household do to survive?
   1…Purchasing
   2…reduce quantities of food consumed
   3…reduce number of meals
   4…eat other non-traditional wild foods
   5…participate in food for work programs
   6…casual work
   7…gifts from friends
   8…transfers from government and NGOs
   9…Other (specify)

7. If you buy, what is the major source of money?

   1… Sale of livestock
   2… Sale of other household assets
   3… fishing
   4… Casual work
   5…. Formal employment
   6… Cash for work programs
   7…. Other (specify)

8. Beginning from this time yesterday to present, did you or anyone in your household consume…?

Eating occasion	**Yes**	**No**
Any food before a morning meal		
A morning meal		
Any food between morning and midday meals		
A midday meal		
Any food between a midday meal and evening meals		
An evening meal		
Any food after evening meal		

9. Beginning from this time yesterday to present did you or anyone in your household consume any of the following food types?

Food group	**Yes**	**No**
Cereals		
Roots/tubers		
Legumes		
Milk/milk products		
Eggs		
Meat/offal		
Fish/seafood		
Oil/fat		
Sugar/honey		
Fruits		
Vegetables		
Other (specify)		

FOOD PURCHASES

10. Since March 2006 to this day, did the household spend money on the following food items? **Codes** *1…yes* *2…No→* **go to next item**		11. If yes, how frequent were these purchased? **Codes** *1…daily* *2…weekly* *3…monthly* *4…. quarterly* *5…annually* *6…other (specify)*	12. Number of purchases per period? Put the number of times	13. How much money was normally spent per each purchase? *Naira*
Item	*Code*			
Maize, maize flour,				
Rice				
Millet				
Yams				
Wheat, wheat flour, etc				
Vegetables, Tomato,				
Sugar, tea, coffee, etc				
Salt, Spices, etc				
Cooking oil, margarine, butter, etc				
Cassava, sweet potatoes, fruits, etc				
Beans, peas,				
Fish				
Meat				
Milk, Nono, etc				
Fruits				
Pulp				
Other (specify)				

SECTION J: NON FOOD EXPENDITURES

I now would like to ask you about non-food expenditures. Let the member who has made the purchase give the monetary value

1. Did the household spend money on the following items since March 2006? **Code** *1…yes* *2…No→* **go to next item**		2. If yes, how frequent were these purchased? **Codes** *1…daily* *2…weekly* *3…monthly* *4….quarterly* *5…annually* *6…other (specify)*	3. Number of purchases per period? Put the number of times	4. How much money is normally spent per each purchase? *Naira*
Item				
Electricity (bills, light bulbs, etc)				
Batteries				
Firewood				
Charcoal				
Petrol /diesel				
Kerosine				
Candles, matches, etc				
Security				
Telephone (calls, handsets, recharge, repair, etc)				
Transport				
General body hygiene (Soap, Lotions, Robb, etc)				
Make up and hair dressing				
Shaving, nail cleaning, etc				
School fees				
Uniform				
Pocket money				

1. Did the household spend money on the following items since March 2006? **Code** *1…yes* *2…No→* **go to next item**		2. If yes, how frequent were these purchased ? **Codes** *1…daily* *2…weekly* *3…monthly* *4….quarterly* *5…annually* *6…other (specify)*	3. Number of purchases per period? Put the number of times	4. How much money is normally spent per each purchase? *Naira*
Writing materials				
Father's clothes and shoes				
Mother's clothes and shoes				
Children's clothes and shoes				
Clothes and shoes on others				
Pots				
Plates, spoons,				
Cups				
Baskets				
Loan repayment				
Remittances				
Gifts				
Religious Offerings				
Wedding ceremony expenses				
Funeral expenses				
Dowry				
Entertainment				
Other (please specify)				

Among all household members, which three members are most important in bringing income and food to the family?

*State their IDs*_____

CONCLUDING REMARKS

Thank you very much for your time. I will appreciate if you will allow me to interview again in the next time.

Do you have any question?

_____

_____

_____

Enumerator's Remarks

_____

_____

_____

Appendix C: Follow-up Survey Questionnaire

NATIONAL INSTITUTE FOR FRESHWATER FISHERIES RESEARCH (NIFFR), NEW BUSSA, NIGER STATE, NIGERIA

Questionnaire Number ☐

Poverty Alleviation and Food Security Through Improved Valuation and Governance of River Fisheries in Africa

Poverty Alleviation and Food Security Role of Small Scale Inland Fisheries in Northeast Nigeria

Household Questionnaire
Closing Survey
March 2008

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INTRODUCTION

(Spoken by the enumerator)

My name is _____. I am representing the National Institute for Freshwater Fisheries Research Institute (NIFFR) in Niger State, the University of Hannover in Germany and the World Fish Centre in Egypt. The three institutions are conducting research in the Hadejia –Nguru wetlands that are looking at how fish and fishing activities affect the living conditions of people and how these can be promoted. We have been interviewing you since last year and this is our last interview. The interview will take about 40 minutes.

IDENTIFICATION

Interviewer ID		Date of interview	
State Government ID		Local Government ID	
Village ID		Household ID	
Name of key respondent		Respondent ID	
Time Interview starts		Time Interview ends	

SECTION A: HOUSEHOLD STRUCTURE

I will start by confirming the names of all household members you have been telling us

1. Give us the names of all individuals who have been members of this household at any time since you were last interviewed	2. Relationship to household head Codes 1*...Head* *2...Spouse* *3...Child* *4...Parent* *5...Parent in-law* *6...Other (specify)*	3.Sex *Codes* *1...Male* *2...Female*	4. Age *(Years)*	5. Has this member just joined the family after you were interviewed last time? Codes *1—yes* *2—no*	6. If yes to question 5, state the reason for joining the household Codes *1—newly born baby* *2—marriage* *3—rejoining family from studies* *4—rejoining family from marriage* *5—rejoining family from other activities (specify activities)* *6—seeking employment and other opportunities* *7—other (specify)*	7. Has this member left the family after you were interviewed last time? Codes *1—yes* *2—no*	8. If yes to question 7, what is the reason for leaving the household Codes *1—Marriage* *2-- Divorce* *3—Got a job* *4—Studies* *5—Looking for fishing opportunities* *6—Looking for pasture land* *7---Death* *8---Other (specify)*

SECTION B: SICKNESSES AND INJURIES

I will now ask about illnesses and injuries household members have suffered from in the **last two weeks**

1. During the past 14 days, did any member of the household suffer from any illness or injury? Codes 1---yes 2---no →go to next section	2. If yes, name of household member	**3.** What was the illness or injury? Use codes in the next column			4. What action was taken to find relief from the illness? Codes *1…Did nothing* *2…Took drugs that were available in the house* *3…Buy drugs from pharmacy* *4...Seek care at government hospital* *5…Seek care at private hospital* *6…Took traditional medicine* *7…Seek care from traditional healer* *8…other (specify)*		**5.** How much money was spent in total on this individual for all illnesses and injuries in the last 14 days? Naira
		Problem 1	Problem 2	Codes for question 3 1--*Malaria, fever* *2—Diarrhoea* *3--Stomach ache* *4--Respiratory problems* *5--Sexually Transmitted Infections* *6—Asthma* *7--Head ache* *8--Fainting, mental problems* *9--Skin disease* *10--Dental problem* *11—Eye/ear problem* *12--Back ache* *13--Heart problem* *14--Maternal problems* *15—Meningitis* *16---Yellow fever* *17—Typhoid fever* *18--- High blood pressure* *19---Injuries (Please specify)* *20--- Measles* *21---Broken leg, arm, etc* *22---Rheumatism* *23---other (specify)*	Problem 1	Problem 2	

SECTION C: RISKS AND SHOCKS

I will now ask you about the unfavourable events that may have occurred to the household since you were last interviewed

	1. Since you were last interviewed, has the any of the following negative shocks occurred to the household?	Codes *1---yes* *2---no*	2. How big was the impact of this negative shock? Codes *1---High* *2---Medium* *3---Low* *4---No impact*	3. Estimate the value of the loss due to the event *Naira*	4. What did the household do to cope with the impact of this negative shock? *Use the codes below the table*
1	Drought				
2	Flooding				
3	Pests or diseases that affected almost all crops before harvest				
4	Pests or disease attack that led storage losses				
5	Pests or diseases for livestock				
6	Theft of livestock				
7	Theft of production tools and equipment				
8	Theft of cash				
9	Destruction of housing				
10	Death of adult members				
11	Disablement of adult household member				
12	Disablement of other household members				
13	Decrease in output prices				
14	Increase in input prices				
15	Job loss by household member				
16	Communal clash				
17	Fire outbreak				
18	Other (specify)				

Codes for question 4

2. Reduced consumption	2. Work harder	3. Took up additional occupation	4. Household migrated to search for job	5. Took children out of school	6. Use savings
7. Sold assets	8. Sold livestock	9. Sold land	10. Sold crops	11. Formal insurance	12. Borrow from moneylender
14. Borrow from relatives relatives	14. Borrow from non-relatives	15. Borrow from commercial bank	16. Gift from relatives	17. Gift from non-relatives	18. Help with labour from
20. Help with labour from non-relatives		20. Help from government	21. Help from NGOs	22. Help from mosque/church	23. Other (please specify)

SECTION D: FUTURE EXPECTATIONS

	In the coming 5 years, what changes do you expect on the following situations? 1--- very high 2--- moderately high 2---no change 3---slightly low 4— very low
Amount of rainfall	
Frequency of droughts	
Frequency of floods	
Level of agricultural yield	
Quantity of fish catch	
Prevalence of crop pests and diseases	
Prevalence of livestock pests and diseases	
Household income	
Communal clash with Fulani ethnic group	
Prices of agricultural inputs (fertiliser, seeds, pesticides, etc)	
Prices of farm outputs (maize, rice, sorghum, pepper, etc	

SECTION E: HOUSEHOLD ASSETS

Assets	Has the household own this asset(s) 1—yes 2—no	How much can you sell this asset today? Naira
House		
Tables		
Chairs		
Beds		
Mattresses/mats		
Radio/ Tape recorder		
Bicycle		
Motorcycle		
Motor Car		
Tractor		
Oxcart		
Hand cart		
Canoe		
Boats		
Fishing gear		
Smoking oven		
Plough		
Pesticide sprayer		
Water pump		
Grocery shop		
Gourd		
Power generator		
Sewing machine		
Other (specify)		

SECTION F: TIME USE AND LABOUR

I will now ask you about the way family members used their time in the **last 14 days**

1. Make a list of household members who are more than 14 years old	In the last 14 days, for how many hours did this member spend…..? Put zero if member did not spend time on the activity							
	2. Farming activities	3. Livestock rearing	4. Fishing	5. Fish processing and trading	6. Household domestic activities	7. Petty trading/hawking/business	8. Formal employment	9. Other (specify)

SECTION G: HOUSEHOLD PRODUCTION INPUTS

I will now ask you about items you bought for production purposes **since you were last interviewed**

Type of production input	1. Since you were last interviewed, has the household make purchases/expenses on the following items? Codes 1…yes 2…no → go to next input	2. If yes, how much of this was bought? Codes 1….kilograms 2….bags 3….packets 4….days of hired labour 5….litres 6….bottles 7….tablets 8….bundles 9….trips 10…mudu 11….others (please specify)		3. What is the price of this production input? Codes 1….kilograms 2….bags 3….packets 4….days of hired labour 5….litres 6….bottles 7….tablets 8….bundles 9….trips 10…mudu 11…others (please specify)	
		Quantity/Amount	Unit	Price (Naira)	Unit
Seeds for all crops					
Fertiliser for all crops					
Hired labour in farming					
Hired labour in livestock rearing					
Hired labour in fishing					
Firewood for fish processing					
Fuel for irrigation					
Drugs for treating animals					
Chemicals for treating crops					
Transportation of farm produce					
Livestock feeds					
Others (please specify)					

SECTION H: CROP PRODUCTION AND UTILISATION

I will now ask questions about crop production and utilisation **since you were last interviewed**

1. Which crops do you grow? Use codes listed below	2. Since you were last interviewed, how much of your own yield of this crop has been consumed in your household? Codes 1…kilograms 2…bags 3…baskets 4…number 5…others (specify)		3. Since you were last interviewed, how much of this crop has been harvested from your farms? Codes 1…kilograms 2…bags 3…baskets 4…number 5…others (specify)		4. Since you were last interviewed, how much of this crop have you sold? Codes 1…kilograms 2…bags 3…baskets 4…number 5…others (specify)		5. What was the price per unit quantity sold? Codes 1…kilograms 2…bags 3…baskets 4…number 5…others (specify)	
	Quantity	Unit	Quantity	Unit	Quantity	Unit	Price (Naira)	Unit

Crops Codes: 1--- Maize, 2---Rice, 3---Sorghum, 4---Millet, 5---Wheat, 6---Groundnuts, 7---Beans, 8----Soya beans, 9---Cassava, 10---Sweet potatoes, 11---Irish potatoes, 12---Sesame, 13---Pigeon peas, 14---Tomatoes, 15----Pepper, 16---Onions, 17---Leaf vegetables, 18---water melons, 19---sugarcane 20-----Okra 21---pumpkin 22---Gourd 23---Cotton 24---cucumber 25---Other (please specify)

SECTION I: LIVESTOCK REARING

I will now ask questions about what has happened to your livestock **since you were last interviewed**

Livestock type	1. Do you have the following types of livestock? 1…yes 2…no → go to next input	2.Number of animals of this type bought since you were last interviewed	3.Total cost of purchasing these animals Naira	4. Number of animals of this type born since you were last interviewed	5. Number of animals of this type sold since you were last interviewed	6. Amount of money obtained from livestock sales since you were last interviewed Naira	7. Number of animals slaughtered for home use since you were last interviewed	8. Number of animals died due to diseases and parasite attack since you were last interviewed	9. Total number of animals the household has today	10. How much can you sell all your animals of this type today? Naira
Chicken										
Ducks/goose										
Guinea fowls										
…										

SECTION J: FISHING AND FISHING RELATED ACTIVITIES

I will now ask questions about fishing and fishing related activities that have been done by the household since you were last interviewed

Fishing activity	1. Since you were last interviewed was any household member involved in (*state activity*)? Codes 1---yes 2---no → skip questions 2 to 6	2. Name of household member(s) involved	3. Species of fish caught, processed, or traded?	4. Quantity of fish caught, processed, or traded by this member since you were last interviewed? Unit Codes 1---basin 2---baskets 3---other (specify)		5. Cost of fish traded or processed. Put zero if the fish is from own catch or just given	6. Quantity of fish sold Unit Codes 1---basin 2---baskets 3---other (specify)		7. Price at which fish was sold Unit Codes 1---basin 2---baskets 3---other (specify)		8. Quantity of fish consumed Unit Codes 1---basin 2---baskets 3---other (specify)		9. How much would you sell the fish that was consumed?
				Qty	Unit	Naira	Qty	Unit	Price	Unit	Qty	Unit	Naira
Fishing						XXX							
Fishing						XXX							
Fishing						XXX							
Fishing						XXX							
Fish processing													
Fish trading													
Fish transportation			XXX	XXX	XX	XXX		XX	XXX				
Casual labour in fishing			XXX	XXX	XX	XXX		XX	XXX				
Equipment making and repair for sale			XXX	XXX	XX	XXX		XX	XXX				
Other (please specify)			XXX	XXX	XX	XXX		XX	XXX				

SECTION K: INCOME FROM OTHER SOURCES

I will now ask about incomes household members obtained from other activities **since you were last interviewed**.

Source of income	1. **Since you were last interviewed**, did any of the household member(s) obtain money through the following sources? Codes 1…yes 2…no → skip questions 2 to 5	2. List the member(s) who obtained money from this source?	3. How much money was obtained from this source since you were last interviewed? Naira
Hawking, petty trading, etc			
Formal employment			
Temporary work			
Remittances from relatives			
Gifts from non relatives			
Loan			
Mechanic, tailor, gold smith, etc			
Weaving			
Motorcycle riding			
Selling firewood			
Canoe operator			
Meat processing			
Other sources (specify)			

SECTION M: FOOD CONSUMPTION, PURCHASES AND SHORTAGES

1. Do you still have food you produced in your house?

1…yes → *go to question 5*
2…No

2. If no, in which month did the food finish?

State month:_____

3. Since your food finished, how do the household cope?

1…purchasing
2…reduce quantities of food consumed
3…reduce number of meals
4…eat other non-traditional wild foods
5…participate in food for work programs
6…casual work/piece works
7…gifts from friends
8…transfers from government and NGOs
9…other (specify)

4. If you purchase food, what is the major source of money?

1…. sale of livestock
2…. sale of other crops
3…. sale of other household assets
4…. fishing
5…. temporary work
6…. formal employment
7…. business
8…. achaba (motorcycle rider)
9…. selling firewood
10….selling dump palm products
11….other (specify)

5. Beginning from this time yesterday to present, did you or anyone in your household consume…?

Eating occasion	**Yes**	**No**
Any food before a morning meal		
A morning meal		
Any food between morning and midday meals		
A midday meal		
Any food between a midday meal and evening meals		
An evening meal		
Any food after evening meal		

6. Beginning from this time yesterday to present did you or anyone in your household consume any of the following food types?

Food group	**Yes**	**No**
Cereals (rice, maize, sorghum, millet, etc)		
Roots/tubers (cassava, yams, sweet potatoes, etc)		
Legumes (beans, peas, groundnuts, etc)		
Milk/milk products		
Eggs		
Meat/offal		
Fish/seafood		
Oil/fat/Butter/Margarine		
Sugar/honey		
Fruits (Banana, Orange, Dibino, watermelon, Guava, etc)		
Vegetables		
Other (specify)		

SECTION N: FOOD PURCHASES

1. From the day you were last interviewed to this day, has any member of the household spent money on the following items? Codes 1…yes 2…No→ go to next item		2. If yes, how much money has been spent?
Item	Code	Naira
Maize, maize flour,		
Rice		
Millet		
Yams		
Wheat, wheat flour, etc		
Vegetables, Tomato,		
Sugar, tea, coffee, etc		
Salt, Spices, etc		
Cooking oil, margarine, butter,		
Cassava, sweet potatoes		
Beans, peas,		
Fish		
Meat		
Milk, Nono, etc		
Fruits		
Pulp		
Other (specify)		

SECTION O: NON FOOD EXPENDITURES

I now would like to ask you about non-food expenditures since you were last interviewed.

1. Has the household spent money on the following items from the day you were last interviewed to this day? Code 1…yes 2…No → go to next item		2. If yes, how much money has been spent?
Item	Code	Naira
Electricity (bills, light bulbs, etc)		
Batteries		
Firewood		
Charcoal		
Petrol /diesel (***not for irrigation)***		
Kerosine		
Candles, matches, etc		
Security		
Telephone (calls, handsets, recharge, repair, etc)		
Transport		
Soap, Lotions, and general body hygiene		
Make up and hair dressing		
Robb		
Shaving, nail cleaning, etc		
School fees		
Uniform		
Pocket money		
Writing materials		
Father's clothes and shoes		
Mother's clothes and shoes		
Children's clothes and shoes		
Clothes and shoes on others		
Pots		
Plates, spoons,		
Cups		
Baskets		

1. Has the household spent money on the following items from the day you were last interviewed to this day? Code 1…yes 2…No → go to next item		2. If yes, how much money has been spent?
Loan repayment		
Remittances		
Gifts		
Religious Offerings		
Wedding ceremony expenses		
Baby naming ceremony		
Funeral expenses		
Dowry		
Entertainment		
Other (please specify)		

CONCLUDING REMARKS

Thank you very much for your time. I will appreciate if you will allow me to interview again in our last survey.

Do you have any question?

_____

_____

_____

Enumerator's Remarks

_____

_____

_____

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Appendix D: Village Questionnaire

NATIONAL INSTITUTE FOR FRESHWATER FISHERIES RESEARCH (NIFFR), NEW BUSSA, NIGER STATE, NIGERIA

Poverty Alleviation and Food Security Through Improved Valuation and Governance of River Fisheries in Africa

Village Questionnaire

March 2008

Name of interviewer(s): ……
Name of village:…….
Village ID:……..

Section A: Roster of informants

Make a complete list of informants	Sex	Age (Years)	For how many years have you lived in this village?

Section B: Access to basic facilities

1.How far is this village to the nearest tarred road (km)?	
2. How many months does the village become inaccessible by cars in a year?	
3. What is the name of the nearest local government headquarters?	
4. How far is the nearest local government headquarters (km) from this village?	
5.What is the transport cost from here to the nearest local government headquarters by bus (Naira)?	
6. What is the distance from this village to the nearest weekly market (km)?	
7. What is the distance from this village to the nearest government primary school (km)? Put zero if there is a primary school in the community	
8. What percentage of children in the age range 5 to 14 from this village attends school?	
9. Is there a *chemist* shop in this village? 1= yes 2= no	
10. What is the distance to the nearest government health centre /clinic (km)? Put zero if there is a primary school in the community	
11. What is the most common source of credit in this village?	
12. How many protected drinking water points do you have in this village?	
13. What is the distance from the village to the nearest river (km)?	
14. What is the distance from the village to the nearest forest (km)?	
15. What is the distance from this village to the nearest grazing area (km)?	

Section C: Economic Activities

1. Which activities are most important sources of employment in this village? *List at least three*	
2. Do people in this village leave temporarily during certain times of the year to look for work?	
3. Where do they mostly go?	
4. What type of work do they mostly look for?	
5. Do people come to this village temporarily during certain times of the year to look for work?	
6. Where do they mostly come from?	
7. What type of work do they mostly look for?	

Section D: Changes

Compare the village to the last 5 years, how have the following changed?	Codes 1--- much worse 2---moderately worse 3---about the same 4---better 5---much better 6---not applicable
1. Soil fertility	
2. Availability of pasture for livestock	
3. Availability of fish in the river	
4. Availability of water for irrigation	
5. Flooding regimes	
6. Agricultural yields	
7. Revenue from cash crop sales	
8. Revenue from livestock sales	
9. Revenue from fish sales	
10. Non-agricultural income earning opportunities	
11. Development activities by government (local, state or federal)	
12. Availability of credit from relatives and friends	
13. Availability of credit from other sources	
14.Access to transportation	
15. Level of trust in the community	
16. Willingness of community members to help each other	
17. Number of deaths of under five children	
18. Number of deaths of pregnant women	
19. Availability of food in the homes	
20. Availability of food in the market	
21. Proportion of poor people in the village	
22. Incidence of diseases	
23. Access to primary education	
24. Access to health care	
25. Clashes with the nomadic *Fulani*	

Thank you for your cooperation and time

Appendix E: Regression Results for the Natural Experiments

Estimation results from the control data set

Variance equation

```
xtreg lnresidsqd agehead  education associations fsize dependency lnland lnfarm
lnfish lnherd hadejia round2 round3, re

R-sq:  within  = 0.0053                         Obs per group: min =         3
       between = 0.0616                                        avg =       3.0
       overall = 0.0270                                        max =         3
Random effects u_i ~ Gaussian                   Wald chi2(12)      =     19.15
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0849
------------------------------------------------------------------------------
  lnresidsqd |      Coeff.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0196669   .0067424     2.92   0.004      .006452    .0328819
   education |  -.0390364   .2315119    -0.17   0.866    -.4927914    .4147187
associations |  -.1891826   .1318371    -1.43   0.151    -.4475785    .0692134
       fsize |   .0095881   .0241731     0.40   0.692    -.0377904    .0569666
  dependency |  -.4013434   .4740031    -0.85   0.397    -1.330372    .5276856
      lnland |   .0292432   .1191432     0.25   0.806    -.2042732    .2627596
      lnfarm |   .0498901   .0269817     1.85   0.064    -.0029931    .1027733
      lnfish |  -.0182733   .0308394    -0.59   0.553    -.0787175    .0421709
      lnherd |  -.0020802   .0265029    -0.08   0.937    -.0540249    .0498646
     hadejia |   .1348826   .2099849     0.64   0.521    -.2766803    .5464456
      round2 |   .2799107   .2039002     1.37   0.170    -.1197264    .6795478
      round3 |   .0839862   .2055747     0.41   0.683    -.3189328    .4869052
       _cons |  -3.864097   .5007592    -7.72   0.000    -4.845567   -2.882627
-------------+----------------------------------------------------------------
     sigma_u |  .63743499
     sigma_e |  2.3170792
         rho |  .07035684   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Consumption expenditure regression

```
xtregre2 lnrpce agehead ageheadsqd education associations fsize dependency
lnland lnfarm lnfish lnherd drought67 fieldpests67 healthshock conflict67
flooding67 hadejia round2 round3 [aweight=1/sigma]

Random-effects GLS regression                   Number of obs      =       780
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.4473                         Obs per group: min =         3
       between = 0.4399                                        avg =       3.0
       overall = 0.4476                                        max =         3
Random effects u_i ~ Gaussian                   Wald chi2(18)      =    616.12
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
------------------------------------------------------------------------------
      lnrpce |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0570777    .012076     4.73   0.000     .0334093    .0807461
  ageheadsqd |  -.0004985   .0001226    -4.06   0.000    -.0007388   -.0002581
   education |   .1986115    .073599     2.70   0.007     .0543601    .3428628
associations |   .0748828   .0420687     1.78   0.075    -.0075703    .1573359
       fsize |  -.1180726   .0061273   -19.27   0.000     -.130082   -.1060633
  dependency |  -.3536212   .1152462    -3.07   0.002    -.5794996   -.1277427
      lnland |   .0294794   .0400796     0.74   0.462    -.0490751    .1080339
      lnfarm |   .0245556   .0086852     2.83   0.005     .0075329    .0415783
      lnfish |  -.0137134   .0100463    -1.37   0.172    -.0334037     .005977
      lnherd |   .0187993   .0087434     2.15   0.032     .0016626     .035936
   drought67 |  -.2280598   .1097823    -2.08   0.038    -.4432291   -.0128905
fieldpests67 |  -.0579861   .0659902    -0.88   0.380    -.1873245    .0713523
 healthshock |  -.1175498   .0618927    -1.90   0.058    -.2388573    .0037577
  conflict67 |    .148986   .0768294     1.94   0.052    -.0015968    .2995688
  flooding67 |   .2681777   .1276559     2.10   0.036     .0179768    .5183786
     hadejia |  -.0199343     .07374    -0.27   0.787    -.1644621    .1245934
      round2 |   .0418117   .0463608     0.90   0.367    -.0490538    .1326771
      round3 |   .2506483    .045724     5.48   0.000     .1610308    .3402658
       _cons |    3.54578   .2968955    11.94   0.000     2.963875    4.127684
-------------+----------------------------------------------------------------
     sigma_u |  .37146851
     sigma_e |  .52586673
         rho |  .33288453   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Estimation results from the panel data set 1 with seasonal dummy variables

Variance regression

```
xtreg lnresidsqd1 agehead  education associations fsize dependency lnland
lnfarm lnfish lnherd hadejia round2 round3 if round!=2, re

note: round2 dropped due to collinearity
Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.0127                         Obs per group: min =         2
       between = 0.0348                                        avg =       2.0
       overall = 0.0248                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(11)      =     12.21
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.3477
------------------------------------------------------------------------------
 lnresidsqd1 |      Coeff.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0125767   .0081074     1.55   0.121    -.0033135    .0284668
   education |   .0314531   .2783121     0.11   0.910    -.5140286    .5769347
associations |  -.2403543   .1585739    -1.52   0.130    -.5511534    .0704448
       fsize |  -.0256805   .0299268    -0.86   0.391    -.0843359     .032975
  dependency |   -.872894   .5700129    -1.53   0.126    -1.990099    .2443107
      lnland |   .0792632     .14302     0.55   0.579    -.2010509    .3595772
      lnfarm |  -.0007485   .0324666    -0.02   0.982    -.0643818    .0628848
      lnfish |  -.0166034   .0371826    -0.45   0.655    -.0894798    .0562731
      lnherd |   .0024571   .0319887     0.08   0.939    -.0602395    .0651538
     hadejia |  -.0067321   .2517338    -0.03   0.979    -.5001213    .4866571
      round3 |  -.2422963   .2001287    -1.21   0.226    -.6345412    .1499487
       _cons |  -2.678119   .6012509    -4.45   0.000    -3.856549   -1.499689
-------------+----------------------------------------------------------------
     sigma_u |  .81921918
     sigma_e |  2.2394226
         rho |  .11802748   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Consumption expenditure regression

```
xtregre2 lnrpce agehead ageheadsqd education associations fsize dependency
lnland lnfarm lnfish lnherd drought67 fieldpests67 healthshock conflict67
flooding67 hadejia round2 round3 [aweight=1/sigma1]if round!=2

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.5057                         Obs per group: min =         2
       between = 0.4243                                        avg =       2.0
       overall = 0.4572                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(17)      =    448.12
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
------------------------------------------------------------------------------
      lnrpce |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0668722   .0126989     5.27   0.000     .0419829    .0917615
  ageheadsqd |  -.0005847   .0001269    -4.61   0.000    -.0008335   -.0003359
   education |   .2747423   .0810865     3.39   0.001     .1158157    .4336688
associations |   .0625526   .0456807     1.37   0.171    -.0269799    .1520851
       fsize |  -.1198151   .0073421   -16.32   0.000    -.1342053    -.105425
  dependency |  -.2959198    .143502    -2.06   0.039    -.5771786    -.014661
      lnland |    .037282   .0440292     0.85   0.397    -.0490137    .1235776
      lnfarm |   .0218379   .0097555     2.24   0.025     .0027176    .0409583
      lnfish |  -.0093194   .0110118    -0.85   0.397    -.0309022    .0122634
      lnherd |   .0236623    .009544     2.48   0.013     .0049565    .0423682
   drought67 |  -.2206854   .1228406    -1.80   0.072    -.4614485    .0200777
fieldpests67 |  -.0048466   .0725816    -0.07   0.947    -.1471039    .1374107
 healthshock |  -.1234028    .067753    -1.82   0.069    -.2561963    .0093907
  conflict67 |   .1756511   .0850278     2.07   0.039     .0089997    .3423025
  flooding67 |    .274963   .1398571     1.97   0.049     .0008481    .5490779
     hadejia |  -.0416395   .0792199    -0.53   0.599    -.1969076    .1136286
      round2 |  (dropped)
      round3 |   .2619615   .0448569     5.84   0.000     .1740435    .3498794
       _cons |   3.220347   .3226298     9.98   0.000     2.588004     3.85269
-------------+----------------------------------------------------------------
     sigma_u |  .38975705
     sigma_e |  .50247224
         rho |  .37565461   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Estimation results from the panel data set 1 without seasonal dummy variables

Variance regression

```
xtreg lnresidsqd2 agehead education associations fsize dependency lnland lnfarm
lnfish lnherd hadejia if round!=2, re

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.0000                         Obs per group: min =         2
       between = 0.0362                                        avg =       2.0
       overall = 0.0196                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(10)      =      9.10
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.5224
------------------------------------------------------------------------------
 lnresidsqd2 |      Coeff.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |  -.0012771   .0078328    -0.16   0.870    -.0166291    .0140748
   education |  -.0967828   .2688811    -0.36   0.719    -.6237801    .4302145
associations |  -.2683886    .153206    -1.75   0.080    -.5686668    .0318896
       fsize |  -.0110641   .0286329    -0.39   0.699    -.0671835    .0450553
  dependency |  -.2500017     .54785    -0.46   0.648    -1.323768    .8237645
      lnland |     .07433   .1381765     0.54   0.591    -.1964909    .3451509
      lnfarm |   .0327572   .0313667     1.04   0.296    -.0287204    .0942348
      lnfish |  -.0528428   .0359239    -1.47   0.141    -.1232523    .0175667
      lnherd |   -.010185   .0309048    -0.33   0.742    -.0707573    .0503873
     hadejia |  -.1175162   .2432016    -0.48   0.629    -.5941826    .3591502
       _cons |  -2.321564   .5727622    -4.05   0.000    -3.444157   -1.198971
-------------+----------------------------------------------------------------
     sigma_u |  .75932574
     sigma_e |  2.1857745
         rho |  .10768688   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Consumption expenditure regression

```
xtregre2 lnrpce agehead ageheadsqd education associations fsize dependency
lnland lnfarm lnfish lnherd drought67 fieldpests67 healthshock conflict67
flooding67 hadejia [aweight=1/sigma2] if round!=2

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.4417                         Obs per group: min =         2
       between = 0.4348                                        avg =       2.0
       overall = 0.4396                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(16)      =    395.32
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
------------------------------------------------------------------------------
      lnrpce |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0665712   .0123654     5.38   0.000     .0423355    .0908069
  ageheadsqd |  -.0005789   .0001211    -4.78   0.000    -.0008161   -.0003416
   education |   .2885657   .0816168     3.54   0.000     .1285998    .4485317
associations |   .0643885   .0451281     1.43   0.154     -.024061    .1528379
       fsize |  -.1129459   .0076307   -14.80   0.000    -.1279019     -.09799
  dependency |  -.4050152   .1447989    -2.80   0.005    -.6888158   -.1212145
      lnland |   .0255123   .0438526     0.58   0.561    -.0604372    .1114618
      lnfarm |   .0230245    .009667     2.38   0.017     .0040775    .0419716
      lnfish |   -.008592   .0111012    -0.77   0.439    -.0303499    .0131658
      lnherd |   .0265764   .0096983     2.74   0.006     .0075681    .0455847
   drought67 |  -.2154014   .1225546    -1.76   0.079     -.455604    .0248011
fieldpests67 |   .0008086   .0726692     0.01   0.991    -.1416205    .1432376
 healthshock |  -.1051364   .0676236    -1.55   0.120    -.2376763    .0274034
  conflict67 |   .1932163   .0853148     2.26   0.024     .0260023    .3604302
  flooding67 |   .2769955   .1385711     2.00   0.046     .0054012    .5485898
     hadejia |  -.0522872   .0782187    -0.67   0.504    -.2055931    .1010186
       _cons |   3.306904   .3203634    10.32   0.000     2.679003    3.934804
-------------+----------------------------------------------------------------
     sigma_u |  .36611973
     sigma_e |  .53469492
         rho |   .3191954   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Estimation results from the panel data set 2 with seasonal dummy variables

Variance regression

```
xtreg lnresidsqd3 agehead  education associations fsize dependency lnland
lnfarm lnfish lnherd hadejia round2 round3 if round!=1, re

note: round3 dropped due to collinearity
Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.0227                         Obs per group: min =         2
       between = 0.0323                                        avg =       2.0
       overall = 0.0278                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(11)      =     14.31
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.2165
------------------------------------------------------------------------------
 lnresidsqd3 |      Coeff.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0062489   .0074533     0.84   0.402    -.0083593    .0208571
   education |  -.2290532    .256005    -0.89   0.371    -.7308139    .2727074
associations |   .0135338   .1454983     0.09   0.926    -.2716377    .2987054
       fsize |   .0194199   .0260907     0.74   0.457     -.031717    .0705567
  dependency |  -.4892537   .5233475    -0.93   0.350    -1.514996    .5364886
      lnland |   .0743318   .1324014     0.56   0.575    -.1851701    .3338337
      lnfarm |   .0576896   .0298257     1.93   0.053    -.0007677    .1161469
      lnfish |  -.0177522   .0340518    -0.52   0.602    -.0844926    .0489881
      lnherd |    .015254   .0293527     0.52   0.603    -.0422762    .0727842
     hadejia |   .0258937   .2334693     0.11   0.912    -.4316977    .4834851
      round2 |    .416716   .1849305     2.25   0.024     .0542589    .7791732
       _cons |  -3.262803   .5363515    -6.08   0.000    -4.314033   -2.211574
-------------+----------------------------------------------------------------
     sigma_u |  .68111698
     sigma_e |  2.1021502
         rho |   .0950081   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Consumption expenditure regression

```
xtregre2 lnrpce agehead ageheadsqd education associations fsize dependency
lnland lnfarm lnfish lnherd drought67 fieldpests67 healthshock conflict67
flooding67 hadejia round2 round3 [aweight=1/sigma3]if round!=1

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.3953                         Obs per group: min =         2
       between = 0.4986                                        avg =       2.0
       overall = 0.4577                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(17)      =    408.03
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
------------------------------------------------------------------------------
      lnrpce |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0640099   .0121661     5.26   0.000     .0401647     .087855
  ageheadsqd |  -.0005747   .0001208    -4.76   0.000    -.0008116   -.0003379
   education |   .1825541   .0771702     2.37   0.018     .0313033    .3338049
associations |   .0662112   .0451617     1.47   0.143    -.0223042    .1547265
       fsize |  -.1103471   .0078477   -14.06   0.000    -.1257283    -.094966
  dependency |   -.447862   .1534045    -2.92   0.004    -.7485294   -.1471947
      lnland |  -.0100404   .0422612    -0.24   0.812    -.0928709    .0727901
      lnfarm |    .035891   .0089744     4.00   0.000     .0183015    .0534804
      lnfish |  -.0193983   .0105118    -1.85   0.065     -.040001    .0012045
      lnherd |   .0148771   .0090498     1.64   0.100    -.0028603    .0326144
   drought67 |  -.2067373    .115431    -1.79   0.073    -.4329779    .0195033
fieldpests67 |   .0127263   .0689418     0.18   0.854     -.122397    .1478497
 healthshock |  -.1561844   .0644736    -2.42   0.015    -.2825504   -.0298184
  conflict67 |   .1478441   .0809538     1.83   0.068    -.0108225    .3065107
  flooding67 |   .3151185   .1343069     2.35   0.019     .0518819    .5783552
     hadejia |  -.0664911   .0768671    -0.87   0.387    -.2171478    .0841657
      round2 |  -.2061484   .0515014    -4.00   0.000    -.3070892   -.1052075
      round3 |  (dropped)
       _cons |   3.631889   .3104571    11.70   0.000     3.023404    4.240373
-------------+----------------------------------------------------------------
     sigma_u |    .279909
     sigma_e |    .580446
         rho |  .18867168   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Estimation results from the panel data set 2 without seasonal dummy variables

Variance regression

```
xtreg lnresidsqd4 agehead education associations fsize dependency lnland lnfarm
lnfish lnherd hadejia if round!=1, re

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.0007                         Obs per group: min =         2
       between = 0.0273                                        avg =       2.0
       overall = 0.0144                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(10)      =      7.19
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.7076
------------------------------------------------------------------------------
 lnresidsqd4 |      Coeff.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0058994   .0079336     0.74   0.457    -.0096501     .021449
   education |  -.0471771   .2725097    -0.17   0.863    -.5812863     .486932
associations |  -.1394062   .1548724    -0.90   0.368    -.4429506    .1641382
       fsize |   .0091307   .0285883     0.32   0.749    -.0469014    .0651628
  dependency |  -.3807832   .5753291    -0.66   0.508    -1.508408    .7468412
      lnland |   .1542015   .1410001     1.09   0.274    -.1221537    .4305566
      lnfarm |    .012561   .0317462     0.40   0.692    -.0496603    .0747824
      lnfish |   .0132998   .0362416     0.37   0.714    -.0577325    .0843322
      lnherd |   .0405243    .031246     1.30   0.195    -.0207168    .1017654
     hadejia |   .0662065   .2486659     0.27   0.790    -.4211697    .5535827
       _cons |  -3.002464   .5678578    -5.29   0.000    -4.115444   -1.889483
-------------+----------------------------------------------------------------
     sigma_u |  .46812645
     sigma_e |  2.3736836
         rho |  .03743773   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Consumption expenditure regression

```
xtregre2 lnrpce agehead ageheadsqd education associations fsize dependency
lnland lnfarm lnfish lnherd drought67 fieldpests67 healthshock conflict67
flooding67 hadejia [aweight=1/sigma4] if round!=1

Random-effects GLS regression                   Number of obs      =       520
Group variable (i): questnum                    Number of groups   =       260
R-sq:  within  = 0.3626                         Obs per group: min =         2
       between = 0.4958                                        avg =       2.0
       overall = 0.4484                                        max =         2
Random effects u_i ~ Gaussian                   Wald chi2(16)      =    391.93
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
------------------------------------------------------------------------------
      lnrpce |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     agehead |   .0610772   .0118488     5.15   0.000     .0378539    .0843005
  ageheadsqd |  -.0005444   .0001169    -4.66   0.000    -.0007734   -.0003154
   education |   .1625043   .0776608     2.09   0.036      .010292    .3147167
associations |    .078282   .0440172     1.78   0.075    -.0079901    .1645541
       fsize |  -.1071603   .0078136   -13.71   0.000    -.1224747    -.091846
  dependency |   -.526625   .1560346    -3.38   0.001    -.8324472   -.2208028
      lnland |  -.0130038   .0421318    -0.31   0.758    -.0955806    .0695731
      lnfarm |   .0360964   .0090788     3.98   0.000     .0183023    .0538905
      lnfish |  -.0192972   .0104327    -1.85   0.064    -.0397448    .0011505
      lnherd |   .0115929   .0088195     1.31   0.189    -.0056929    .0288788
   drought67 |  -.2161154   .1170746    -1.85   0.065    -.4455774    .0133465
fieldpests67 |  -.0002787   .0689914    -0.00   0.997    -.1354993    .1349419
 healthshock |   -.148334   .0644704    -2.30   0.021    -.2746936   -.0219744
  conflict67 |    .137088   .0812882     1.69   0.092    -.0222339      .29641
  flooding67 |   .3278955   .1337806     2.45   0.014     .0656903    .5901007
     hadejia |  -.0599951   .0769945    -0.78   0.436    -.2109015    .0909113
       _cons |   3.626351   .3056426    11.86   0.000     3.027302    4.225399
-------------+----------------------------------------------------------------
     sigma_u |  .25645495
     sigma_e |  .60278101
         rho |  .15326726   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix F: Stata command for estimating the system of labour income share equations and elasticity estimates

```
nlsur (w1= {a1}+{b1}*lnexp+{g11}*lnp1+{g12}*lnp2+{r21}*round2 +
{r31}*round3 + {h1}*hadejia+{e1}*edn+{y1}*agehead) (w2= a2}+{b2}*lnexp+
{g12}*lnp1+{g22}*lnp2+{r22}*round2 + {r32}*round3
+{h2}*hadejia+{e2}*edn+{y2}*agehead) , ifgnls


nlcom (a1:_b[/a1]) (a2:_b[/a2])                              ///
      (a3:1-_b[/a1]-_b[/a2])                                 ///
      (b1:_b[/b1]) (b2:_b[/b2])                              ///
       (b3:-_b[/b1]-_b[/b2])                                 ///
      (g11:_b[/g11]) (g12:_b[/g12])                          ///
       (g13:-_b[/g11]-_b[/g12])                              ///
      (g22:_b[/g22])                        ///
       (g23:-_b[/g12]-_b[/g22])                              ///
      (g31:-_b[/g11]-_b[/g12])                               ///
      (g32: -_b[/g12]-_b[/g22])                              ///
       (g33:-(_b[/g11]-_b[/g12]) -                           ///
        (_b[/g12]-_b[/g22]))                                 ///
      (r21:_b[/r21])(r22:_b[/r22])                           ///
      (r23:- _b[/r21]- _b[/r22])                             ///
(r31:_b[/r31])(r32:_b[/r32])                          ///
      (r33:- _b[/r31]- _b[/r32])                             ///
(h1:_b[/h1])(h2:_b[/h2])                              ///
      (h3:- _b[/h1]- _b[/h2])                         ///
(e1:_b[/e1])(e2:_b[/e2])                              ///
      (e3:- _b[/e1]- _b[/e2])                         ///
(y1:_b[/y1])(y2:_b[/y2])                              ///
      (y3:- _b[/y1]- _b[/y2])                         ///
(x1:1+_b[/b1]/0.8242611)                              ///
(x2:1+_b[/b2]/0.0463057)                                     ///
(x3:1+[-_b[/b1]-_b[/b2]]/0.1294333)                          ///
(p11:-1+_b[/g11]/0.8242611-_b[/b1])                   ///
(p22:-1+_b[/g22]/0.0463057-_b[/b2])                   ///
(p33:-1+ [-[_b[/g11]-_b[/g12]] - [_b[/g12]-_b[/g22]]]/0.1294333-[-
_b[/b1]-_b[/b2]])       ///
(p12:[_b[/g12]]/0.8242611-[_b[/b1]]/0.8242611*0.0463057)
            ///
(p13:[-_b[/g11]-_b[/g12]]/0.8242611-[_b[/b1]]/0.8242611*0.1294333)
            ///
(p21:[_b[/g12]]/0.0463057-[_b[/b2]]/0.0463057*0.8242611)
            ///
(p23:[-_b[/g12]-_b[/g22]]/0.0463057-[_b[/b2]]/0.0463057*0.1294333)
      ///
(p31:[-_b[/g11]-_b[/g12]]/0.1294333-[-_b[/b1]-
_b[/b2]]/0.1294333*0.8242611)             ///
(p32:[-_b[/g12]-_b[/g22]]/0.1294333 -[-_b[/b1]-_b[/b2]]/.1294333
*0.0463057)             ///



log close, replace
```