ASSESSING VULNERABILITY TO POVERTY IN FISHERY DEPENDENT COMMUNITIES IN CAMEROON

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PREAMBLE

This thesis has been produced within the framework of a larger research project entitled "Food Security and Poverty Alleviation through Improved Valuation and Governance of River Fisheries in Africa", which has been implemented in two major river basins in Sub Saharan Africa: the Lake Chad Basin and the Zambezi River Basin (including five countries: Niger, Nigeria, Cameroon, Zambia and Malawi). The project was initiated and coordinated by the WorldFish Center (Cairo), with Dr. Christophe Béné as leading scientist, and the financial support of BMZ (German Federal Ministry for Economic Collaboration and Development).

Alongside with the University of Cape Town, IDDRA and the NARS (National Agricultural Research Systems) from the respective countries, the Institute of Development and Agricultural Economics at the Leibniz University of Hanover was responsible to conduct empirical and methodological research in the Lake Chad Basin (Nigeria and Cameroon).

This study has been implemented under the direct supervision of Prof. Dr. Hermann Waibel, and in close collaboration with Dr. M. Baba and Dr. E. Belal (MINEPIA, Yaoundé) as well as Dr. S. Bouba (MINEPIA, Maroua) from Cameroon.

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ZUSAMMENFASSUNG

Es wird gemeinhin angenommen, dass die Kleinfischerei für das Auskommen von Millionen Menschen in der Welt eine fundamental wichtige Rolle spielt. Vor allem in Entwicklungsländern werden der Kleinfischerei vielfältige Funktionen zugeschrieben, wie zum Beispiel, dass sie einen signifikanten Beitrag zur Wohlfahrt ländlicher Bevölkerungsgruppen leiste, Beschäftigungsmöglichkeiten biete, und die Ernährungssicherheit in vielen ländlichen Gebieten verbessere, weil Fisch eine wichtige Quelle tierischer Proteine darstellt. Zudem werden der Fischerei noch eine Reihe anderer sozioökonomischer und sozio-kultureller Nutzen zugesprochen, unter anderem eine Rolle bei der Reduzierung der Armut und eine Schutzfunktion gegen externe Risiken. Eine quantitative Dokumentation derartiger, durch Marktdaten nicht erfassbarer, Nutzen liegt jedoch bis heute kaum vor, was sich in der Unterrepräsentierung und Marginalisierung der Kleinfischerei auf politischer Ebene auswirkt. Entscheidungen, die auf gesamtwirtschaftlichen Zahlen wie etwa dem Bruttoinlandsprodukt basieren, und grobe ad-hoc Annahmen geben daher oft den ökonomisch stärkeren Sektoren Vorrang, so etwa der Wasserkraftnutzung oder großen Bewässerungsprojekten. Als Folge davon gehen die Kleinfischer oft als Verlierer solcher ländlicher Entwicklungsprojekte aus, weil die Lebensgrundlage vieler Haushalte unwiederbringlich beeinträchtigt (Einkommeneinbußen), Ökosysteme nachhaltig gestört, und die Anfälligkeit der Haushalte für Schocks erhöht wird.

Das Ziel dieser Arbeit ist es, die Beschaffenheit, das Ausmaß, sowie die Ursachen von Armut und Vulnerabilität von Haushalten im Yaéres Überschwemmungsgebiet im Norden Kameruns, einem der wichtigsten Feuchtgebiete in der Tschadsee-Senke, zu untersuchen. Die spezifischen Ziele der Arbeit sind: (1) Zu untersuchen, in welchem Ausmaß Haushalte gegenüber externen Risiken (vor allem Klimarisiken) sowie anderen Makro- und Mikroschocks, die die Produktionsleistung und damit das erwartete Wohlergehen der Haushalte beeinträchtigen können, anfällig sind; (2) Eine Portfolioanalyse der Aktivitäten der Haushalte durchzuführen, und die Einkommens-

Risiko Relation spezifischer Portfoliotypen zu beschreiben; und (3) Eine dynamische Armutsanalyse durchzuführen, d.h. (i) die Armutsanfälligkeit der Haushalte zu schätzen (Vulnerabilität als erwartete Armut), (ii) die Rolle der Fischerei in Bezug auf Risikoreduktion (Verringerung der Vulnerabilität) zu bestimmen, und (iii) die Ursache-Wirkungs-Beziehungen verschiedener potentieller entwicklungspolitischer Eingriffe und der Vulnerabilität zu untersuchen.

Die Haushaltsdaten, auf denen die Ergebnisse diese Arbeit basieren, wurden im Mai und November 2007, sowie im Mai 2008, in einer repräsentativen Stichprobe von 300 Haushalten im Yaéres Überschwemmungsgebiet erhoben. Vor allem die Daten aus der ersten Umfrage (im Mai 2007) als auch Daten aus einem Risikoexperiment (erhoben im Mai 2008) wurden für die Analyse herangezogen.

Methodisch trägt diese Arbeit zu der gegenwärtigen Forschung über Armut und Vulnerabilität durch eine Weiterentwicklung der Vulnerabilitäts-Konzepte bei. Dabei werden zwei Ansätze verfolgt. Erstens wird der allgemeine Vulnerabilitätsansatz dadurch erweitert, dass die Vermögensausstattung der Haushalte besondere Berücksichtigung findet. Dieser Ansatz ist eine Weiterentwicklung des vermögensbasierten Armuts-Konzepts von Carter und Barrett (2006). Zweitens wird eine Gruppe kohärenter Risikomaße, die unteren Teilmomente einer Zufallsverteilung (Lower Partial Moments, LPM), für die Schätzung von Vulnerabilität vorgeschlagen und angewandt. Mithilfe der Portfoliotheorie werden stochastische Einkommensverteilungen für jeden Haushalt berechnet. Anhand dieser Verteilungen wird die Vulnerabilität als Wahrscheinlichkeit sowie als Ausmaß der erwarteten Armut geschätzt. Armut und Vulnerabilität werden folglich aus verschiedenen Blickwinkeln bewertet, wodurch eine vielfältige und facettenreiche Einschätzung der Zusammenhänge zwischen Kleinfischerei und Vulnerabilität ermöglicht wird. Die Ergebnisse dieser Arbeit liefern wichtige Informationen zum Wert der Kleinfischerei, vor allem im Hinblick auf ihren Beitrag zur Risikoreduzierung und damit zur Sicherung einer nachhältigen Lebensgrundlage der Bevölkerung und zur Armutsreduzierung.

Die Ergebnisse zeigen, dass die Haushalte im Untersuchungsgebiet zu einem erheblichen Maß von den natürlichen Ressourcen abhängig sind. Landwirtschaft ist die wichtigste Betätigung für die Mehrzahl der Haushalte, wobei hauptsächlich Sorghum, Hirse und Reis angepflanzt werden. Die Fischerei spielt ebenfalls eine wichtige Rolle, vor allem im Hinblick auf die Ernährungssicherheit und Einkommensgenerierung. Über 60 Prozent der Haushalte sind Fischer. Im Durchschnitt macht das Einkommen aus Fischerei über 28 Prozent des Gesamteinkommens aus, und für 23 Prozent aller Haushalte ist es die wichtigste Einkommensquelle. Andere Einkommensmöglichkeiten sind jedoch sehr beschränkt. So trägt zum Beispiel die außerlandwirtschaftliche Erwerbstätigkeit nur durchschnittlich 1,5 Prozent zum Gesamteinkommen bei.

Die Armuts- und Vulnerabilitäts-Analyse zeigt, dass die Hauptursachen für die hohe Armut in der Region eine ungenügende Ausstattung mit produktiven Vermögensgegenständen und eine hohe Anfälligkeit gegenüber Klimaschwankungen (in Verbindung mit stark korrelierenden Einkommensströmen) sind. Sowohl der vermögensbasierte als auch der LPM-basierte Ansatz zur Messung der Vulnerabilität liefern übereinstimmende Ergebnisse. Insgesamt zeigt sich, dass Fischer höhere Einkommen haben, auch wenn dies mit einer höheren Einkommensvariation einhergeht. Daher sind Fischer am wenigsten von der Armut und Vulnerabilität betroffen, sowohl bei Verwendung einer absoluten Armutsgrenze (von US$1,25 pro Kopf und pro Tag) als auch bei einer relativen (in Höhe von 50% des Durchschnittseinkommens). Außerdem zeigen die Ergebnisse, dass Haushalte, deren Hauptbetätigung die Landwirtschaft ist, stärker von chronischer Armut betroffen sind (vor allem Reis- und Hirseproduzenten), während Fischer dagegen eher in die Kategorie der transitorisch Armen einzuordnen sind (vor allem stochastisch-transitorische Armut). Die Wahrscheinlichkeit als auch das Ausmaß erwarteter Armut (gemessen als erwartete Unterschreitung der Armutsgrenze) sind daher signifikant geringer für Fischer als für andere Bevölkerungsgruppen.

Trotz des signifikanten Beitrags der Fischerei zur Armutsreduzierung, spielen Produktionsrisiken eine nicht-triviale Rolle für alle Haushalte im Untersuchungsgebiet. Die Auswirkungen externer Einflussfaktoren auf die natürlichen Ressourcen sind

erheblich und betreffen erwiesenermaßen sowohl den Ackerbau als auch die Fischerei in derselben Richtung. Es wird daher empfohlen, dass entwicklungspolitische Eingriffe, die die Reduzierung der Armut zum Ziel haben, eher einen multi-sektoralen Ansatz verfolgen sollten, anstatt lediglich einzelne Wirtschaftszweige zu fördern. So sollten zum Beispiel produktivitätssteigernde Eingriffe in der Landwirtschaft (wie etwa die Einführung dürreresistenter Pflanzen und schnell wachsender Getreidesorten, Verbesserung der Bodenqualität, oder kleine Bewässerungsprojekte) von Maßnahmen begleitet werden, die die Vermögensakkumulation und Investitionen der Haushalte unterstützen (z. B. durch Mikrokredite). Zusätzlich sollten alternative Betätigungszweige gefördert werden, um die saisonalen und/oder jährlichen Schwankungen des Einkommens aus Landwirtschaft und Fischerei zu reduzieren. Dadurch könnte der Druck auf die Ressourcen vermindert und die Einkommen erhöht und stabilisiert werden. Beispiele für derartige Eingriffsmöglichkeiten wären die Förderung außer-landwirtschaftlicher Beschäftigungsmöglichkeiten oder aber die Einführung von domestizierter Fischproduktion (Aquakultur).

Schlagwörter: Armut und Vulnerabilität, Portfolio Theorie und Diversifizierung, Kleinfischerei, Afrika südlich der Sahara, Kamerun

ABSTRACT

Small scale fisheries (SSF) are assumed to play a fundamental role in the livelihoods of millions of people worldwide. Particularly in developing countries, SSF are said to significantly contribute to the welfare of rural populations by providing employment opportunities and improving food-security and nutrition, since fish is a major source of animal protein in many rural areas. Besides, many other socio-economic and socio-cultural benefits are attributed to SSF, among others its role in alleviating poverty and providing protection against external risks. However, documented quantification of such non-market benefits is very scarce. This results in the perceived underrepresentation and marginalization of SSF on the political level. Decisions based on GDP figures and rough ad-hoc working assumptions therefore often give preference to economically stronger sectors such as hydropower or large-scale irrigation development. As a result, SSF are often the losers of rural development interventions. The livelihoods of many households are often irreversibly affected (income losses), ecological systems are disrupted, and vulnerability to poverty is increased.

The objective of this thesis is to analyze the nature, extent and causes of poverty and vulnerability to poverty among households living in fishery dependent communities in the *yaéres* floodplain in North Cameroon, a major floodplain in the Lake Chad Basin. The specific objectives of the thesis are: (1) To explore the extent to which households in fishing communities are exposed to adverse external events such as natural hazards (climate risk) as well as to other covariate and idiosyncratic shocks that may affect production output and hence the expected welfare position of households; (2) To analyze portfolio compositions of households and to describe the income-risk relationship of specific types of portfolios; and (3) To conduct a dynamic poverty analysis, i.e. (i) to estimate vulnerability as expected poverty on household level, (ii) to identify the role of fisheries in mitigating risk (low vulnerability) and (iii) to explore the cause-effect relationship of different possible development interventions and vulnerability.

The data used in this thesis were collected in May and November 2007, and May 2008 among a representative sample of 300 households in the *yaéres* floodplain. In particular the baseline data (collected in May 2007) as well as data from a risk assessment experiment (collected in May 2008) were used for analysis.

Methodologically, this work is adding to current research on vulnerability by advancing the vulnerability to poverty approach in two ways: First, by incorporating assets into the general vulnerability framework, based on Carter and Barrett's (2006) asset-based poverty approach; and second, by proposing and applying the class of lower partial moments (LPM) as a coherent risk measure. Drawing on portfolio theory, stochastic income distributions are derived for each household and vulnerability is estimated in terms of the probability and the extent of expected poverty. Hence, household vulnerability has been estimated and analyzed from different angles, which can yield multifaceted and diverse information on the relationship between SSF and vulnerability. The results presented in this thesis provide crucial information on the value of SSF in mitigating risk and thus contributing to sustainable livelihoods and poverty reduction.

Households in the study area are found to be subject to heavy dependence on natural resources. Agriculture is the main activity of the majority of households in the floodplain, being dominated by three major crops: sorghum, millet and rice. Fishing is a major activity for many households in terms of nutrient supply and income generation. Over 60 percent of households are engaged in SSF. On average, fishing accounts for over 28 percent of total gross income, and constitutes the major income source for 23 percent of the sample. Besides these activities, other income generation possibilities (e.g. off-farm work) are very limited, contributing only about 1.5 percent of aggregate household income.

The analysis of poverty and vulnerability shows that the main causes for high poverty prevalence are insufficient productive asset holdings, and high susceptibility to climate variation (in combination with highly covariate income flows from all production activities). Both, the asset-based as well as the lower partial moments (LPM) approach to estimate vulnerability as expected poverty (VEP), yield consistent findings. In general,

fishing households are able to generate higher incomes, albeit at the cost of higher variation in income. As a result, fishermen are the least affected by poverty and vulnerability, whether measured at absolute levels (US$1.25 per capita per day) or applying a relative poverty line (50% of time-mean average household income). Further, results show that households, for whom agricultural activities have a higher priority, are suffering to a larger extent from chronic poverty, in particular rice and millet growers, while fishermen suffer rather from transient poverty (foremost stochastic-transient poverty). Hence, the probability to be poor as well as the extent of poverty (measured as the expected shortfall) is significantly lower for fishers, compared to other livelihood groups.

Despite the significant contribution of fisheries to poverty alleviation, production risk is playing a non-trivial role for all households in the study area. External impacts on resources are found to be large and to affect both, cropping and fishing outputs, in the same direction. It is therefore recommended that meaningful policy interventions that aim at reducing poverty and vulnerability should follow a multi-sectoral approach, rather than focusing on certain sub-sectors or activities. Increasing the productivity of crop production in drought years (and hence reducing the likelihood of crop failure) through e.g. improved soil and water management, small-scale irrigation projects, or through the adoption of drought-resistant, early-maturing millet and sorghum varieties, should be complemented by policies that aim at facilitating asset accumulation by households, for example through increased access to credit (micro-lending systems). In addition, alternative activities should be promoted to complement the seasonal and/or inter-annual income patterns of farming and fishing, in order to reduce the pressure on the resource, smooth income variation and increase income. These could include non-agricultural employment or the introduction of aquaculture initiatives.

Keywords: Poverty and Vulnerability, portfolio theory and diversification, small-scale fisheries, Sub-Saharan Africa, Cameroon

RÉSUMÉ

On admet que les pêches continentales jouent un rôle capital en vue du fondement de vie pour des millions de personnes dans le monde. En particulier dans les pays en voie de développement, les pêches contribuent au bien-être des populations rurales au travers des possibilités d'emploi, d'assurance de la sécurité alimentaire et d´une source majeure de protéine. En plus, les pêches continentales jouent un rôle dans la réduction de la pauvreté et de la prévention des risques économiques et climatiques. Pourtant la quantification et la documentation de ces bénéfices sont clairsemées. C'est pourquoi les pêches sont souvent sous-représentées et marginalisées au niveau politique. Les secteurs plus forts, par exemple les projets hydroélectriques ou les grands projets d´irrigation, contribuent plus au PIB, et sont donc souvent avantagés. Mais les populations qui vivent de la pêche sont souvent les perdants de ce genre de développement.

L'objectif de cette étude est d´analyser la question de la pauvreté et de la vulnérabilité des peuples ruraux qui sont dépendant de la pêche, et d'explorer la nature, l'ampleur et les sources de la pauvreté dans la plaine d'inondation du Logone, Province de l'Extrême Nord, Cameroun. Les objectifs spécifiques sont: (1) Analyser l'ampleur des hasards climatiques qui menacent la base de vie des populations de la plaine ; (2) Analyser les portfolios d'activités, les niveaux de revenu et les relations entre les risques et les revenus de plusieurs catégories de ménages (producteurs de mil blanc, mil rouge, riz, pêcheurs) ; et (3) Effectuer une analyse de la pauvreté dynamique, c'est-à-dire (i) estimer la vulnérabilité des ménages, (ii) identifier le rôle de la pêche en atténuant les risques de la production, et (iii) explorer les effets potentiels des interventions politiques.

Les données pour cette thèse ont été relevées en Mai et Novembre 2007, aussi qu'en Mai 2008, en se fondant sur un échantillon représentatif de 300 ménages dans la plaine d'inondation de *yaéres*, une des plus importantes régions humides dans le bassin du Lac Tchad. Surtout les données de base (Mai 2007) et les données d'un sondage sur l'évaluation de risque (Mai 2008) ont été utilisées pour les analyses.

En termes de méthodologie, cette thèse contribue à la recherche sur la pauvreté et la vulnérabilité dans deux manières: Premièrement, en incorporant les biens productifs dans le concept de vulnérabilité, basé sur l'approche da la pauvreté de Carter et Barrett (2006) ; et deuxièmement, en proposant et appliquant la famille des moments partiels inférieurs (Lower Partial Moments, LPM) comme une mesure cohérente de risque. Se basant sur la théorie de portfolio, les distributions stochastiques du revenu sont calculées pour chaque ménage, et la vulnérabilité est estimée en terme de probabilité et de l'ampleur de la pauvreté attendue. Donc, la vulnérabilité est estimée et analysée sous les angles différents, ce qui permet d'avoir des informations diversifiées sur la relation entre la pêche et la vulnérabilité. Les résultats fournissent des informations signifiantes sur la valeur des pêches continentales dans la plaine du Logone.

L'analyse a montré que les systèmes de production dans la plaine sont particulièrement dépendants des ressources naturelles, et surtout de la pluviosité (qui est imprévisiblement fluctuante et souvent limitée). L'agriculture présente l'activité principale dans la plaine, avec trois produits dominants: mil blanc, mil rouge et riz. Concernant la pêche, on a montré qu'elle joue un rôle important pour la sécurité alimentaire et pour le revenu des ménages. Plus de 60% des ménages enquêtées sont pêcheurs, et pour plus de 23% de la population la pêche fournie la plus grande partie du revenu. En moyenne, 28% du revenu total viennent de la pêche. Les autres activités sont très limitées : les activités non rurales, par exemple, ne contribuent pas plus que 1,5% au revenu total.

L'analyse de la pauvreté et de la vulnérabilité a aussi montré que les sources de la pauvreté sont l'équipement insuffisant par des biens productifs et la haute réceptivité par rapport à la variation climatique (combiné avec les revenus corrélés des différentes activités). L'approche basée sur les biens, et également l'approche basée sur les LPM fournissent des résultats concordants. Les pêcheurs arrivent à avoir un portfolio moins risqué, en sorte que cette partie de la population est la plus riche et la moins vulnérable non seulement au niveau absolu (US$1,25 par tête et par jour), mais aussi en appliquant en seuil de la pauvreté relatif (50% du revenu moyen de la population). Néanmoins, la pauvreté transitoire joue un rôle important, même pour les pêcheurs. Les résultats

montrent aussi que les ménages, pour lesquels l'agriculture a une priorité plus haute, sont plutôt affectés par la pauvreté chronique, surtout les producteurs du riz et du mil rouge. Néanmoins, les pêcheurs souffrent aussi de la pauvreté transitoire (surtout la pauvreté transitoire stochastique). La probabilité d'être pauvre ainsi que l'ampleur attendue de la pauvreté (calculé comme le déficit du revenu) sont donc significativement plus petits pour les pêcheurs que pour les autres ménages.

Malgré la contribution signifiante de la pêche à la réduction de la pauvreté, les risques de production jouent un rôle non trivial pour tous les ménages dans la zone d'étude. Les effets des facteurs externes sur les ressources naturelles sont énormes, et ils concernent l'agriculture et la pêche dans la même manière. Pour assurer la réduction de la pauvreté pour toute la population, il est donc recommandé de poursuivre une stratégie multi-sectorale au lieu de supporter seulement quelques secteurs d'activité préférés. Par exemple, des interventions qui ciblent une croissance de la production agricole (les plantes résistantes à la sécheresse ou bien des petits projets d'irrigation) devraient être accompagné par des efforts d'encourager l'accumulation des biens productifs (micro crédits par exemple). En plus, il faudrait promouvoir des activités alternatives qui visent à réduire la covariation saisonnière ou interannuelle entre les revenus des activités différentes. Ceci pourrait diminuer la pression sur les ressources, et en même temps stabiliser et augmenter les revenus. De tels interventions, par example, peuvent contenir l'appui du secteur non agricole ou bien l'introduction des projets d'aquaculture.

Mots-clé: Pauvreté et vulnérabilité, théorie de portfolio et diversification, pêche artisanale, Afrique au Sud du Sahara, Cameroun

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CGIAR	-	Consultative Group on International Agricultural Research
CVaR	-	Conditional Value at Risk
DARA	-	Decreasing Absolute Risk Aversion
DFID	-	Department For International Development (United Kingdom)
EU	-	Expected Utility
FAO	-	Food and Agriculture Organization of the United Nations
FCFA	-	Franc Communauté Financière Africaine
FGD	-	Focus Group Discussion
FGLS	-	Feasible Generalized Least Squares
FGT	-	Foster-Greer-Thorbecke poverty measures
FSD	-	First order Stochastic Dominance
GDP	-	Gross Domestic Product
HARA	-	Hyperbolic Absolute Risk Aversion
IDDRA	-	Institut du Développement Durable des Ressources Aquatiques
IFAD	-	International Fund for Agricultural Development
IMF	-	International Monetary Fund
LGP	-	Length of Growing Period
LPM	-	Lower Partial Moment
LSMS	-	Living Standard Measurement Survey
MINEPIA	-	MINistère de l'Elevage des Pêches et des Industries Animales
MOTAD	-	Minimization Of Total Absolute Deviations
MRCLP	-	Marginal Risk Constraint Linear Program
NARS	-	National Agricultural Research Systems
NGO	-	Non Governmental Organization
OLS	-	Ordinary Least Squares
PPP	-	Purchase Power Parity
PRSP	-	Poverty Reduction Strategy Paper
RRA	-	Remote Rural Area
SD	-	Stochastic Dominance
SEMRY	-	Société d'Expansion et de Modernisation de la Riziculture de Yagoua
SID	-	Simpson Index of Diversity
SSA	-	Sub Saharan Africa
SSD	-	Second order Stochastic Dominance
SSF	-	Small Scale Fisheries
TSD	-	Third order Stochastic Dominance
USD	-	US Dollar
V^{EP}	-	Vulnerability as Expected Poverty measure
VIM	-	Visual Impact Method

CHAPTER 1

INTRODUCTION

1.1 Background and rationale of the study

Repeatedly, organizations such as the World Bank, the FAO, and CGIAR research centers point out that a mismatch exists between the intrinsic value of fisheries on the one hand and the marginal attention to fisheries in development planning and policy making on the other hand (Dugan *et al.* 2002, World Bank 1991, FAO 2004, FAO 2007, Béné *et al.* 2009, Ratner *et al.* 2004), in particular small scale fisheries (SSF).

Thus, SSF are said to have high socio-economic and socio-cultural importance and to provide "a myriad of benefits to society" (Weithman 1999, Welcomme and Naeve 2001, Pitcher and Hollingworth 2002, Schuyt 2005). They are acknowledged to make an important contribution to national economies by providing employment opportunities and producing low cost supplies of animal protein (World Bank 1991). They also play a significant role in contributing to the nutrition, food security, sustainable livelihoods and poverty alleviation of many countries, and especially developing countries (FAO 2004). According to the FAO (2004), about 78 million people are estimated to directly depend on SSF worldwide, and indirectly even over 234 million people, not including those that are engaged in temporary fishing activities in marine areas and more typically, in rivers, creeks, small lakes and reservoirs, seasonal or temporary ponds, wetlands and floodplains.

In the same breath it is also noted that SSF suffer from a lack of political attention. They are "undervalued", "overlooked", "overridden", "seldom considered" in rural developing planning, "marginally included" in PRSPs (Poverty Reduction Strategy

Papers), and "frequently ignored" in debates on rural economy (Thorpe *et al.* 2005, Béné *et al.* 2009, Cowx *et al*. 2004). The reason behind the stepmotherly treatment of SSF is certainly not reluctance at the political level, but is rather seen in the dearth of reliable information on the economic, social and ecological value of fisheries (Neiland *et al.* 2002).

"*The absence of detailed records on volumes landed, the lack of or incomplete knowledge regarding costs, prices and benefits, and the absence of mechanisms to take into account unpriced (non-monetary) benefits make it difficult to gain political momentum and support for fisheries management. Policies are often economically driven, and where SSF are insignificant contributors to GDP, they are largely overlooked.*" (Kronen 2007, p.12)

Policy officials, resource managers and other stakeholders have to make decisions on the basis of reliable information and official records. The documented contribution of SSF to GDP is however often very low, partly due either to perceived difficulties of estimating a spatially dispersed fishery, or to limited financial and human resources (Dalzell *et al*. 1996, Gillett and Lightfoot 2002), but also due to difficulties related to data collection in remote rural areas. Besides, because SSF are not explicitly valued in terms of their fundamental importance for social, cultural, and food security reasons, these non-market values are not adequately reflected in national economic statistics. Hence, policy decisions have to make rough working assumptions about the value of this resource. Decision makers value SSF implicitly, which often results in an arbitrary and inconsistent set of prices (Ratner *et al.* 2004, Cowx *et al.* 2004). Hence, SSF often present a weak economic argument because they are undervalued in real terms, and economically strong sectors such as hydropower production or agricultural development through large-scale irrigation projects are often given higher preference (Cowx *et al.* 2004).

This lack of awareness on the true values and functions of many wetlands in developing countries is seen as a big threat to these ecosystems and to the millions of people whose livelihoods depend on them. Ratner *et al.* (2004) suggest that such development trends adversely affect wetlands in many ways. Large-scale irrigation may alter natural flow regimes, reduce downstream water availability, and may even reduce natural flood control functions and increase soil salinity through evaporation. Roads, dams and flood

control infrastructure often interrupt wetland and river systems connectivity, alter seasonal flood regimes and retain sediment needed to maintain the productivity of floodplain agriculture.

In order to reverse this trend, researchers frequently express the urgent need to provide robust, defensible, social and economic valuation of fisheries (Cowx 2002, Béné 2003, Béné *et al.* 2009, McFadyen and Corcoran 2002, FAO 2005, 2006). In particular, it is called for a valuation of benefits that accrue outside the market economy such as nutritional security, stability within the rural environment, or the value of SSF in providing protection against external economic variations, thus reducing risk and vulnerability to poverty (Kronen 2007, Cowx *et al.* 2004).

This thesis addresses the latter of the above mentioned benefits of SSF. Until today, some of the fundamental mechanisms of SSF and their contribution to poverty alleviation and risk mitigation remain poorly understood. For example, the extent to which poverty in a fishing community reflects the overall poverty conditions affecting rural populations or is the result of specific mechanisms intrinsic to the sub-sector is unclear. Often, poverty is attributed to endogenous factors within the fisheries sector, suggesting that people are poor, because they are fishers. Others refer to SSF as a "safety net" and an "activity of last resort", suggesting that people become fishers because they are poor. As pointed out by Béné (2003) and Béné *et al.* (2009), this conventional perception that fisheries and rural poverty are intimately correlated (see Béné 2003 for a review) has been recently challenged (Allison and Horemans 2006, Allison *et al.* 2006).

In a dynamic view, it is assumed that SSF may play an important fall-back position in the case of some adverse events (Kronen 2007). They are assigned the role of a "bank in the water" (Béné *et al.* 2009). If crop yields are low, households are assumed to be able to countervail income losses through ancillary incomes from fishing. Including SSF in the activity portfolio is supposed to serve as a risk-coping mechanism, which can serve to stabilize income flows, thus smoothing consumption over time and improving the welfare position of households. Other authors argue to the contrary, namely that fishermen may be instead the most vulnerable, due to the high-risk nature of external production

conditions in remote rural areas (RRAs) which usually form the habitat of this socio-economic group (Allison *et al.* 2006). As such, RRAs are characterized as being marginalized, having low provision of services and infrastructure, dysfunctional transport and communication systems and very limited access to markets (Jalan and Ravallion 1998, World Bank 2000, IFAD 2001, Ruben 2005). Zeller *et al.* (2007) argue that the marginalization of SSF communities is still aggravated due to the undervaluation of SSF.

"*The importance of fisheries to a country's economy, if only based on reported commercial statistics, may be considerably undervalued in cases where small-scale and non-commercial fisheries are significant, yet underreported. This adds further to the marginalization of small-scale fisheries, often already disadvantaged by their socioeconomic, physical, and political remoteness from urban centers.*" (Zeller *et al.* 2007, p.356).

Hence, this thesis constitutes a step forward, towards a better understanding of the extent, nature, and causes of poverty and vulnerability in fisheries-dependent communities in the Lake Chad Basin. Addressing these issues can help to critically assess the current paradigm for development policy, taking into account the nature and characteristics of SSF, and to answer the question whether SSF are a useful entry point for the alleviation of poverty, and if yes, how to intervene best, in order to address the problem and not only the symptoms.

1.2 Research objectives

The overall research objective of this thesis is to quantify the benefits of SSF in Sub-Saharan Africa (SSA) in one specific aspect: To estimate the contribution of fishing activities to the well-being of households over time. The time-dimension of well-being is implemented in the general economic welfare analysis by the concept of vulnerability. This approach implies a number of issues, which are addressed in the specific objectives outlined below.

Risk is a pivotal point in the analytical approach proposed in this thesis. Based on Chicken and Posner (1998), risk is defined as a function of hazard and exposure, where hazard is 'the way in which a situation can cause harm', and exposure is 'the extent to which the likely recipient of the harm can be influenced by the hazard', implying the notions of frequency and probability. That already points at the importance of hazards, such as limited and erratic rainfall with high inter- and intra-annual variability, pests and diseases, nutrient-poor soils and other natural calamities (Ellis 1993, Hardacker *et al*. 1997, Townsend 1994, Kinsey *et al.* 1998, Affognon 2006, Dercon 2002). Although the adverse effects of these hazards on agricultural output are prevalent in most parts of the world, they are particularly burdensome to rural households in developing countries (Hazell and Norton 1986, Reilly 1995, Smith and Skinner 2002, Tingem and Rivington 2009, IFAD 2008).

In particular, the strong dependence on seasonal rainfall patterns in many parts of SSA implies a strongly correlated effect on farming and fishing likewise. A low rainfall level not only means that crop yields are threatened, it also results in low water levels in the water bodies, which affects the reproduction of fish during the inundation period, and therefore reduces fish catch volumes and income from farming. Ellis (1993) and Dercon (2002) point out that production uncertainty is pervasive and serious for these households due to the unpredictable nature of climatic conditions. In combination with prevailing poverty, the outcome of uncertain events makes households vulnerable to serious hardships and "may make a difference between survival and starvation" (Ellis 1993, p.82).

> The first specific objective of this thesis is therefore, to explore the extent to which households in fishing communities are exposed to adverse external events such as natural hazards (climate risk) as well as to other covariate and idiosyncratic shocks that may affect production output and hence the expected welfare position of households.

The analysis particularly focuses on the relationship between vulnerability and livelihood choices of households. Although fishing is recognized to be a key element in the economic portfolio of the rural population in SSA, case studies have shown that fishing is part of a

flexible and strongly seasonal matrix of various and diversified activities (Sarch 1997, Neiland *et al.* 2000). The rural populations are alternatively or simultaneously fishers, herders, and farmers, and "each piece of land is potentially a fishing ground, a grazing area and a cultured field, depending on the period in the flood cycle" (Béné *et al.* 2003a, p.20). Hence, a large variety of livelihood options exists for the households in the study area. Fishing is mostly accompanied by supplementary activities, such as crop production, livestock rearing, or off-farm employment (or fishing itself constitutes a complementary activity to other activities). The differences in the activity portfolio partly result from external constraints such as access to resources, but may also be outcomes of individual decisions based on productivity considerations.

To achieve the goal of determining the value of fishing, it is therefore absolutely essential to consider all livelihood activities of households. An accurate assessment of one activity (such as fishing) needs always to be done in relative terms if the true contribution of that activity to the general level of households' well-being is to be determined. Considering fishing alone will always result in a biased picture. A holistic economic study is therefore important to explain the relationship between livelihood choices and poverty dynamics.

> The second specific objective is, to analyze portfolio compositions of households and to describe the income-risk relationship of specific types of portfolios.

The analysis in this thesis is concerned with improving fisheries valuation by applying economic principles and suggesting some appropriate approaches and methodologies that could be used to elicit information on the worth of inland fisheries in Africa. In this sense, the analysis is confined to the economic value of SSF in terms of their role in vulnerability reduction on household level. Up to now, very few studies on fisheries have been conducted on the household level (for example Béné *et al.* 2003a, 2003b, Giné and Klonner 2006), the majority mainly focusing on macroeconomic and market analyses (Turpie *et al.* 2003, Tallec and Kébé 2006, FAO 2007, Neiland and Béné 2008). Repeatedly, development organizations have therefore called for the generation of adequate

information and assessment of the extent, nature, causes and dynamics of poverty in fishery-dependent communities (McFadyen and Corcoran 2002, FAO 2005, 2006).

Scientific research on poverty to date displays many different approaches, each focusing on certain aspects and characteristics of poverty. One important factor that has been incorporated into poverty analysis is its dynamic nature. In the past, the FGT measures (Foster *et al.* 1984) have been widely used in many studies. However, these measures are static and do not account for the time dimension of poverty. But introducing time into poverty measurement and analysis is a major conceptual challenge (Addison *et al.* 2009). A steadily developing strand of literature has been dealing with vulnerability to poverty. Vulnerability is mostly defined as the *ex ante* probability that a household will be poor in the future, which is generally assumed to depend on the exposure to risks and the household's ability to cope with these risks.

> The third specific objective of the thesis is therefore, to conduct a dynamic poverty analysis, i.e. (1) to estimate vulnerability as expected poverty on household level, (2) to identify the role of fisheries in mitigating risk (low vulnerability) and (3) to explore the cause-effect relationships of different possible development interventions and vulnerability.

Answering the question, how different livelihood choices affect vulnerability, and what role SSF play in this respect, can yield valuable recommendations for the design and implementation of development projects in a large number of regions with comparable settings.

1.3 Outline of the thesis

This thesis is organized as follows:

Chapter 2 presents the analytical approach that has been applied for the valuation of SSF in Cameroon. In particular, section 2.1 gives an introduction to the general analysis framework, i.e. the household approach and the concept of vulnerability, and section 2.2 points out in which way this thesis is contributing to current research.

Chapter 3 provides a detailed description of the sampling procedure and survey design, as well as an account of the challenges encountered during survey preparation and data collection, and the lessons learnt.

In chapter 4, an overview of the livelihoods in the study area is given, supported by selected descriptive statistics, which are based on baseline data and additional secondary data on climate risks. In particular, section 4.1 describes the ecological conditions; section 4.2 presents information on household and production characteristics; section 4.3 illustrates the extent of adverse natural hazards that may have a negative impact on household welfare, as well as a number of shocks reported by the households for the past 10 years; and section 4.4 gives some facts on activity diversification among the sampled households, as well as the distribution of income. Section 4.5 concludes with suggestions for research.

Chapter 5 contains the asset-based approach to vulnerability assessment, inspired by Carter and Barrett (2006). The analysis in chapter 5 is based on cross-sectional data collected during the baseline survey in May 2007. The asset-based framework requires an econometric estimation of the asset-income functional relationship, which in this case is specified in the form of a three-step feasible generalized least squares model (Just and Pope 1979). The sample size is 295 households.

Chapters 6 and 7 deal with vulnerability as Lower Partial Moments (LPM), where chapter 6 constitutes a preparatory analysis of diversification and risk by use of portfolio theory, and chapter 7 presents the methodology and application of the LPM approach based on data from a risk-assessment interview. The data set used in chapters 6 and 7 is different from the baseline data (see chapter 3 on data collection; Appendix D shows the households that are included in the respective data sets.). Here time-mean data from 238 households is used for analysis. These data were collected based on the requirements for portfolio analysis. Hence, the income distribution parameters presented in chapter 5 are not directly comparable to those in chapters 6 and 7.

Chapter 8 provides a synthesis of this thesis, summarizing the results and drawing conclusions and recommendations.

CHAPTER 2

ANALYTICAL APPROACH

2.1 General framework

2.1.1 The household approach

The type of information collected for the evaluation of fisheries can be categorized in two basic approaches to valuation: (1) the market (or sector) approach, and (2) the household approach. The market approach can basically be summarized as a "value chain" approach, where the different steps in the value adding process are analyzed from producer (fisher) to the final consumer. This involves a detailed analysis of all the steps in-between, such as processing, trade etc. Previous studies on SSF have mostly focused on the analysis of the sub-sector, i.e. applying the market approach. While this approach is particularly attractive for value chain analyses, it has a number of weaknesses if it comes to the valuation of non-market benefits of SSF. Market analyses are unsuitable for the assessment of welfare among a given population, since only a fraction of total welfare is considered. Hence, the relative importance of a sub-sector can only be shown in aggregated market values but not on the household level. As it has been argued before, such figures systematically ignore the benefits that accrue outside the market economy such as nutritional security, stability within the rural environment, or the value of SSF in providing protection against external economic variations, thus reducing risk and vulnerability to poverty. In addition, market approaches ignore the interrelationships between different activities. Comparing the market value of SSF with other sectors often implies a conflictive relationship. However, different activities performed by the

household with the goal of income generation and risk mitigation rather suggest a complementary relationship between fisheries and crop production, for example.

In contrast to the market approach, the household approach has a different objective. It is particularly practical for the analysis of social welfare in general. Data on all economic aspects of a household allow the assessment of household well-being by use of different welfare indicators, e.g. consumption, income or assets, and hence a detailed analysis of different activities and their interrelation. As such, the household approach concentrates on all the activities that are performed by a household for income generation. In a simple framework four basic types of inputs can be assumed as factors of production: land, labor, capital, and knowledge (Figure 1). Each household undergoes a decision-making process that results in the allocation of production factors to different activities or processes, such as crops, fishing, livestock and off-farm enterprises. In making decisions on how to allocate their inputs in producing one or more products, households have to make decisions that involve using their knowledge to come as close as possible to fulfilling the goals for which they are striving. These goals may vary from household to household (e.g. maximizing their income, producing enough food to feed the family, etc.). Livelihood strategies are comprised of the range and combination of activities and choices that people undertake in order to achieve their livelihood goals. The resulting combination (portfolio) of products they are producing with their inputs depends on the production system they have adopted. This has to be understood as a dynamic process in which people combine activities to meet their various needs at different times and on different geographical or economical levels. Their direct dependence on asset status and transforming structures and processes becomes clear through the position they occupy within the framework. A changing asset status may further or hinder other strategies depending on the policies and institutions at work.

Hence, there is a clear difference between the two approaches. While the market approach focuses on just one economic activity from producer to consumer, the household approach combines all different activities (not just fishing) – no matter where the

household finds himself on the value chain. Very often households are producers, processors, traders and consumers at the same time.

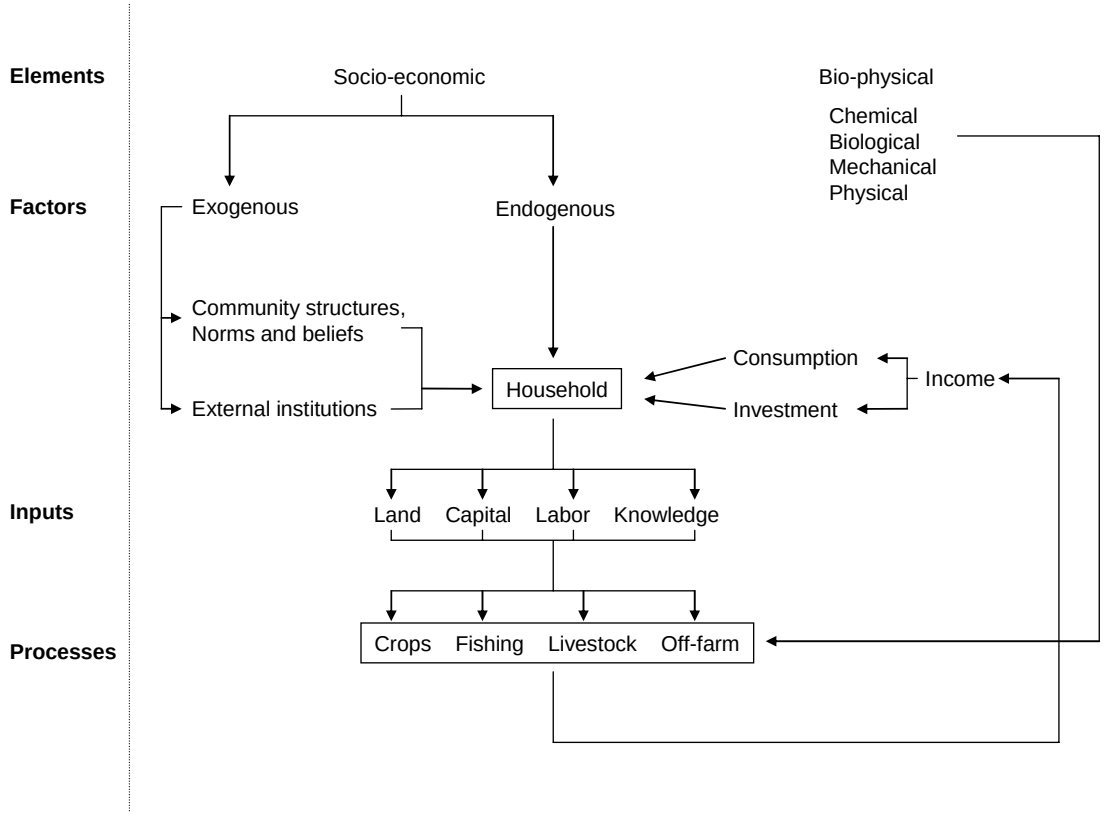

Figure 1: Schematic presentation of the household system

Source: Based on Norman *et al.* (1982), modified

Up to now, surveys on the fishing sub-sector in SSA have concentrated merely on market-level analyses, i.e. aggregated catch levels, value-chain analysis, or the contribution of the fisheries sector to GDP. While in the market approaches it is possible to derive the "market value", the household approach goes beyond that market value and evaluates the different contributions that fishing plays for the local economy. Data on household level, however, are fairly sparse. Although it is assumed that small-scale fisheries can generate significant profits and make considerable contributions to poverty alleviation and food security, little information exists about their actual contribution to livelihoods and household economics in Africa (FAO 2005, 2006). The household approach is therefore

applied in this thesis with the aim to assess the value of the SSF sub-sector in its contribution to poverty and vulnerability alleviation.

2.1.2 The concept of vulnerability

Scientific research on poverty has long acknowledged that poverty is a multidimensional and dynamic phenomenon. Although it has been widely recognized that health, education, social affiliation and other factors are important when dealing with poverty, for reasons of measurement and comparability, economists have largely adopted the welfarist approach, which measures poverty in monetary terms, i.e. consumption or income. The methodology of economic poverty analysis has been advancing in different ways. For example, it has been acknowledged that the time dimension has to be incorporated into poverty analysis, since the well-being of households is always subject to uncertainty and hence to fluctuations over time. Thus, research on poverty has stressed that a difference has to be made between population groups that are only temporarily affected by negative welfare outcomes (transient poverty), and those that are permanently under spell (chronic poverty) (see Figure 2). Some examples of methodological and empirical research on chronic and transient poverty can be found in Gaiha and Deolaiker (1993), Lipton and Ravallion (1993), Jalan and Ravallion (2000), Baulch and Hoddinott (2000), McKay and Lawson (2003), Duclos *et al.* (2006), Dercon and Calvo (2007), and Foster and Santos (2009).

In terms of policy implications, it is assumed that chronically poor households do not have the capacity to get out of poverty and require safety net programs combined with asset accumulation policies to avoid the poverty trap. On the other hand, transiently poor households need to be protected from negative income shocks.

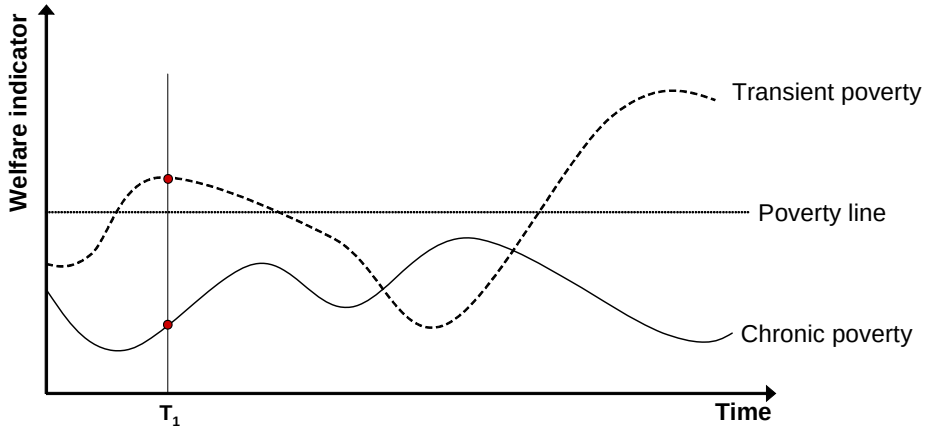

Figure 2: Illustration of dynamic poverty concepts

Source: Own illustration

Another steadily developing strand of literature has been dealing with poverty dynamics by capturing the effect of adverse shocks on the well-being of a household. In particular, the concept of vulnerability has recently become quite prominent in theoretical and empirical research. Vulnerability is a dynamic *ex ante* assessment of poverty, taking into account the variation in well-being over time due to some unexpected negative events (shocks) affecting the productive asset base, income, or consumption of a household. Inspired by Ravallion (1988), vulnerability is mostly defined as expected poverty (V^{EP}). Methodologically, V^{EP} measures extend the static Foster-Greer-Thorbecke (FGT) poverty measures to make predictions on the probability of being poor in the future. Some examples of this approach can be found in Pritchett *et al.* (2000), Chaudhuri *et al.* (2002), Christiaensen and Subbarao (2005), Günther and Hattgen (2006, 2009), Günther and Maier (2008), and Béné (2009)[1].

In general, the concept of dynamic welfare measurement and vulnerability introduces uncertainty about future levels of welfare. In the presence of risk and uncertainty, it is possible to differentiate between the observed welfare status and the expected welfare status of a household. The expected welfare status is dependent on the household's resource endowment and other household specific factors, while the realized welfare status is mostly subject to some (positive or negative) stochastic events. Moreover,

[1] For a comprehensive overview of vulnerability approaches see chapter 5.2: Concepts of poverty and vulnerability.

vulnerability is mainly concerned with the negative side of income variation, i.e. with downside risk. Vulnerability estimates are always based on two parameters of the stochastic distribution of welfare: The expected mean, and the variance of a pre-defined welfare indicator, e.g. consumption or income. These parameters are then employed in different ways to estimate the magnitude of the "threat" of poverty, measured *ex ante*, before the veil of uncertainty is lifted (Calvo and Dercon 2005). In this sense, vulnerability measures the resilience against a shock, or "the likelihood that a shock will result in a decline in well-being" (World Bank 2001, p.139), independent of the person's current poverty or welfare status (Christiaensen and Subbarao 2005).

The level of vulnerability is typically assumed to depend on the exposure to risks and the household's ability to cope with these risks. Coping with risk, households have to consider production uncertainty *ex ante* in making decisions on their activities portfolio (Barrett *et al.* 2001, Di Falco and Chavas 2009). These different aspects of vulnerability analysis will be addressed in this thesis.

Besides the empirical contribution of this work to the valuation of non-market benefits of SSF (as specified in the objectives), the next section will briefly discuss how the analytical framework, developed for the purpose of this study, is contributing to current research on poverty and vulnerability.

2.2 Contribution of this thesis to current research

2.2.1 Data collection for vulnerability assessment in Sub-Saharan Africa (see Chapter 3)

The endeavor to collect economic data in small-scale fisheries in Sub-Saharan Africa (SSA) is challenging, as patterns and constraints of resource use vary considerably (spatially, seasonally and over time) which makes high demands on the type of data required for poverty and vulnerability assessment. Data needs for economic poverty assessment and the evaluation of SSF's contribution to a reduction in poverty and vulnerability are enormous. Detailed information on income, including different income sources such as agricultural production, fishing, livestock rearing, off-farm work etc, is

demanded. Also, data on the stock and value of productive and convertible assets, as well as on the distribution of consumption expenditures need to be elicited. In addition, information on control variables, e.g. ecological, economic or social shocks that have occurred in the past, subjective risk assessments, debts and liabilities, household composition, and others, is required. However, data on small-scale fisheries in Africa is very scarce (FAO 2005, 2006) due to the difficulties to collect data, such as remoteness and inaccessibility (which is a major survey constraint especially during the rainy season) and high variability in production and natural resource conditions.

For preparation and implementation of a survey in SSA researchers can draw upon similar studies in other parts of the world concerning survey methodology, questionnaire design, and interview procedure, e.g. the World Bank's LSMS questionnaire. However, many peculiarities of rural communities in SSA require an adapted and elaborated approach. The data required for poverty and vulnerability assessment make an accurate survey methodology inevitable, if data quality is expected to be adequate for a robust econometric analysis. This thesis contributes to general survey research, especially with the aim to conduct poverty and vulnerability analyses, by identifying the typical constraints that are determining empirical work in Sub-Saharan Africa. It is discussed on how different challenges have been resolved by an adequate sampling and survey design. These lessons could prove to be useful for researchers in designing appropriate socio-economic surveys in comparable settings.

2.2.2 Analysis of agricultural diversification by applying portfolio theory (see Chapter 6)

Diversification is often assumed to be an effective income-increasing or income-smoothing mechanism. For example, a number of studies have analyzed cross-section or panel household data, investigating the effects of diversification on mean income or the inequality of income distribution by use of econometric models. These approaches allow the identification of the contribution of, for example, farm or off-farm activities to overall increases in income (e.g. Reardon *et al.* 1992, Crole-Rees 2002, Béné *et al.* 2009). However, numerous empirical studies have shown that farmers behave in a risk-averse way (Ellis

1993). As such, profit maximization is not the guiding principle for these households. Instead, rural households typically pursue the overall goal of utility maximization (Brown *et al.* 2006, Norman *et al.* 1995, Valdivia *et al.* 1996, Block and Webb 2001, Little *et al*. 2001). Under the weak assumptions of rational behavior and risk aversion, maximizing utility is often equalized to achieving an optimal combination of mean income and risk. A central proposition in applied economics is that optimal diversification through combining activities with low positive covariance and income-skewing effects is a primary risk reducing strategy, i.e. reducing the risk of the overall return by selecting a mixture of activities whose net returns have a low or negative correlation (e.g. Di Falco and Chavas 2009, Just and Pope 2003, Dunn 1997, Thomas *et al.* 1972). In other words, households spread risk by diversifying the allocation of productive assets among various income-generating activities, often preferring farm plans that provide a satisfactory level of security even if this means sacrificing income on average (Ellis 1993, Crole-Rees 2002).

Empirical studies on households' motivation to diversify the activity portfolio suggest that the motivation to reduce uncertainty and risk ranks first among other possible motives (e.g. Barbieri and Mahoney 2009). Repeatedly, recommendations for policymakers therefore stress the need to support diversification to reduce rural poverty and help households to cope with increased uncertainty about possible futures (Slater *et al.* 2007, CGIAR 2005, IFAD 2008, Tingem and Rivington 2009, Molua and Lambi 2006b). Particularly, in remote and marginalized areas, where non-farm activities are extremely limited, the safety net function of small-scale fisheries is important.

To measure diversification, several indicators such as the Simpson Index of Diversity (SID) are often applied. Albeit some desirable properties of such indicators, they do not tell us much about the risk-mitigating effect of diversification due to, for example, a combination of activities with low or negative correlation. For socio-economic analyses, where risk plays a key role, it is mandatory to explicitly incorporate such effects into the analysis of diversification. Developed by Markowitz in the 1950s, the portfolio theory is particularly suitable for risk analysis of asset or activity portfolios. The fundamental intuition of portfolio theory is that the risk of a combination of assets is not equal to the

sum of single asset risks, depending on the correlation structure of asset returns. Many studies have adopted the portfolio theory to agricultural farm planning models, which determine risk-efficient portfolios of production activities. This theory permits to identify the relative effect of single income generating activities to total income risk, and to identify utility-maximizing combinations of activities.

To the author's knowledge, portfolio theory has never been applied in the framework of vulnerability estimation. Hence, the approach suggested in this study may contribute to facilitate and improve the estimation of stochastic household welfare distributions.

2.2.3 Approaches to vulnerability assessment

The asset-based approach (see Chapter 5)

In most poverty and vulnerability studies, well-being is defined in the space of consumption or income. However, Carter and Barrett (2006) argued that these standard welfare indicators are limited in their ability to understand poverty in livelihood systems which are heavily dependent on natural resources such as agriculture and fisheries. Under these conditions, assets and their returns become crucial and therefore standard poverty measures should rather be defined over the asset space instead of consumption expenditures or income. In this thesis a dynamic asset-based framework is presented which allows the identification of different poverty concepts, namely structural-chronic, structural-transient and stochastic-transient poverty. Distinguishing between different components of a poverty profile allows developing more precise recommendations for the design and implementation of development projects in regions with comparable conditions. Due to the heavy dependence on natural resources, and the role of asset endowments for income generation, an asset-based approach is used in the assessment of poverty of these communities. This approach contributes to current research by advancing the concept of vulnerability, drawing from the asset based poverty concept of Carter and Barrett (2006) and incorporating it into the expected poverty measures (e.g. Chaudhuri *et al.* 2002). Hence it also allows the identification of the relationship between livelihood choices and vulnerability.

The lower partial moments approach (see Chapter 7)

A second contribution to vulnerability research is addressing the issue of risk aversion, attributed to the V^{EP} measures. For example, some authors (e.g. Ligon and Schechter 2003, Calvo and Dercon 2005) have been arguing that the V^{EP} measure seems to be ill-suited to represent household risk attitudes. However, it fulfills many desirable properties which are also inherent to the FGT poverty measures, including symmetry, replication invariance, subgroup consistency and decomposability. In particular, the V^{EP} is fulfilling the focus axiom, which states that vulnerability measures should focus on downside risk only, since favorable outcomes in good states of the world do not necessarily ensure lower vulnerability (Calvo and Dercon 2005).

To address the critique of implicit risk attitude assumptions of the V^{EP}, it is suggested here that the general concept of vulnerability, defined as an *ex ante* risk measure based on stochastic welfare distributions, is not different from risk analysis concepts as they have been widely applied in the finance world since the 1950s, for example to pricing, hedging, portfolio optimization or capital allocation. In particular, it is proposed to use the Lower Partial Moments (LPMs) as a measure of vulnerability as expected poverty. Without explicitly referring to the LPMs, this approach has also been applied in a slightly modified specification by Christiaensen and Subbarao (2005). The LPMs are one class of coherent measures of risk, introduced by Fishburn (1977) and Bawa (1975, 1978), which are measures of downside or shortfall risk, where only negative deviations from a target outcome are taken into consideration. In contrast to symmetrical risk measures, the LPMs capture the common notion of risk as a negative, undesired characteristic of an alternative (Brogan and Stidham 2005, Albrecht and Maurer 2002, Unser 2000), which is also in line with the focus axiom. Further, LPMs have a number of convenient characteristics. First, they are consistent to the ordering of distributions derived from stochastic dominance rules and utility maximization for risk-averse households. Second, LPMs are coherent risk measures, satisfying the axioms of subadditivity, positive homogeneity, monotonicity and translation invariance (Artzner *et al.* 1999, Cheng *et al.* 2004, Acerbi *et al.* 2001, Acerbi and Tasche 2002, Peracci and Tanase 2008). This set of axioms has been widely accepted and regarded as a landmark in the field of risk theory (Cheng *et al.* 2004). Third, analogous to

the FGT measures, the LPMs are additively decomposable, so that vulnerability can be measured not only on individual or household level, but also be aggregated for different population groups. And finally, LPMs are intuitively interpretable - an attribute that is of eminent importance in view of policy advise. Analogous to the class of FGT poverty indicators, the LPMs not only identify the vulnerable, but also show how pronounced vulnerability is in terms of consumption or income under downside risk.

This chapter is an extended version of:
Witt, R., D.E. Pemsl and H. Waibel (2009): „Collecting data for poverty and vulnerability assessment in remote areas in Sub-Saharan Africa".
Accepted for publication in *Survey Methodology* in November 2009

CHAPTER 3

DATA COLLECTION

3.1 Sampling

This study has been conducted in the Logone floodplain in the Far-North province of Cameroon (called *yaéres* in local language[2]), which is located between 10°50′ and 12°10′ North latitude within the Lake Chad basin (Figure 3). In total, the floodplain covers about 8,000 km² and is part of the bigger Logone-Chari sub system in the Lake Chad Basin, which supplies 95% of Lake Chad's total riverine inputs and has a basin area of approximately 650,000 km² (UNEP 2004).

Within this vast area a representative region was defined in collaboration with national experts and other key informants, while considering the accessibility and logistic feasibility of the study. The study area covers about 2,400 km², spreading from the Maga Lake in the south to Ivyé village in the north, where the Logomatya joins the Logone River. This area is relatively densely populated and is characterized by rich fish stocks and intensive fishing, fish processing and fish trading.

[2] The names „Logone" and „*yaéres*" will be used alternatively in this thesis.

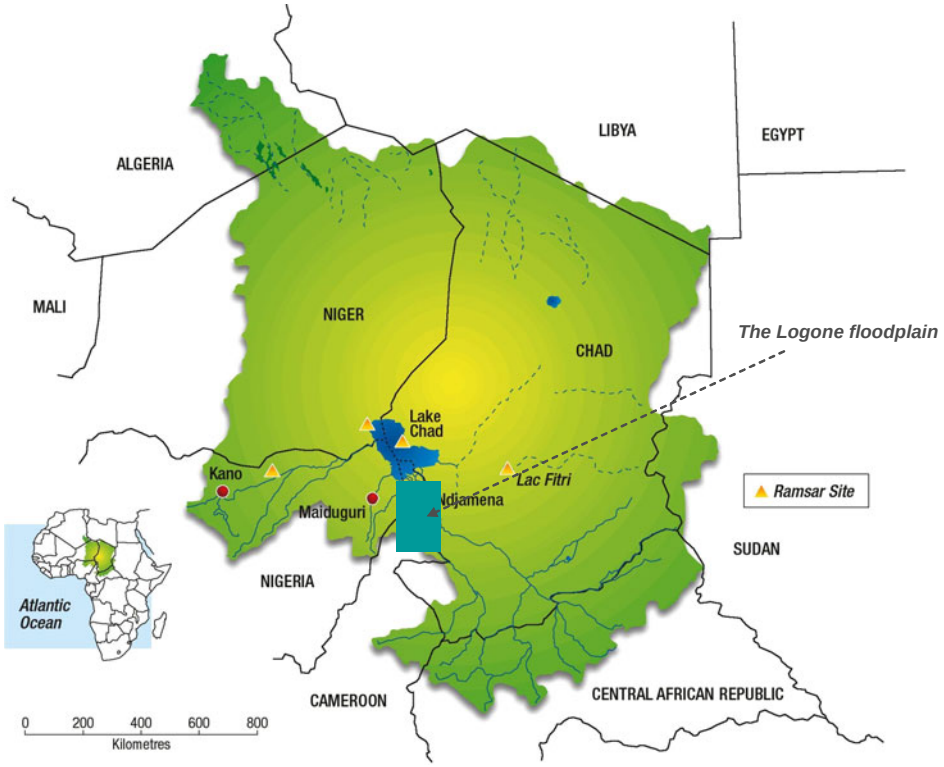

Figure 3: The Lake Chad Basin and the Logone floodplain in Cameroon

Source: WWF (2003)

The livelihoods of the rural population in this area are particularly exposed to harsh climatic conditions, such as limited and erratic rainfall, which result in a large variation of production outcomes from year to year[3] and thus considerable income risk. However, the impact is different between the sub-regions of the study area. Based on Neyman (1938), as cited in Rao (2005), a stratified random sampling procedure was therefore considered most effective. To draw a representative sample of households in the study area while accounting for different production conditions (such as access to fish resources), a stratification of the study site into different agroecological zones was undertaken. It was assumed that under different ecological and production conditions the role of fisheries in terms of income generation would differ. This procedure allowed capturing the whole continuum of fishing intensity (from specialized/full-time fishermen to purely agriculture/livestock rearing oriented households). Hence, based on the criterion of access

[3] In this respect, the study area is representative for many similar rural settings, particularly in the Sudano-Sahelian zone of Sub-Saharan Africa.

to fish resources, three zones have been identified in the Logone floodplain (Figure 4): the Lake Maga area (zone 1), the Logone and its tributaries (zone 2), and the arid, only short-term flooded area in the western part of the *yaéres* (zone 3).

Households living at the northern shore of the artificial Maga Lake (Zone 1) have access to government-owned rice irrigation schemes, which allow up to two cropping seasons per year. Fishing is possible in the Maga Lake during nine months in the year and in the nearby Logone River. Zone 2, the floodplain per se, is characterized by rainfed rice, sorghum and millet production, as well as extensive fishing in the Logone, its tributaries and in the seasonal ponds and lakes after the inundation period. Fishing in zone 2 is possible during about five months (from September to January, but the time period changes from year to year). The western part of the floodplain (Zone 3) is a rather arid area, where the only possibilities for income generation are millet and sorghum production, or livestock rearing.

In a second step, a complete list of villages in the study area (N=88) was compiled, based on information from different sources (detailed map of the study area provided by World Forest Watch, and a number of maps from previous studies in the area, provided by MINEPIA: Ministère de l'Elevage, des Pêches et des Industries Animales). These villages served as the primary sampling unit. A sample size of 300 households, which equates to a sampling ratio of 7% of the total population (estimated at 20,000 by MINEPIA), was chosen proportional to the size of the village populations.

Following the recommendations of local fisheries experts 14 villages were selected proportional to the total number of villages per zone, i.e. two villages in zone 1; nine in zone 2; and three villages in zone 3. The geographic distribution of the sampled villages is shown in Figure 4. Three out of the 14 villages had to be replaced after consulting local key informants. This has become necessary due to a civil unrest that took place shortly before the start of the study, which had left a number of villages uninhabited. In order to assure the sample being representative, villages of similar size and geographical location were selected in the same zone.

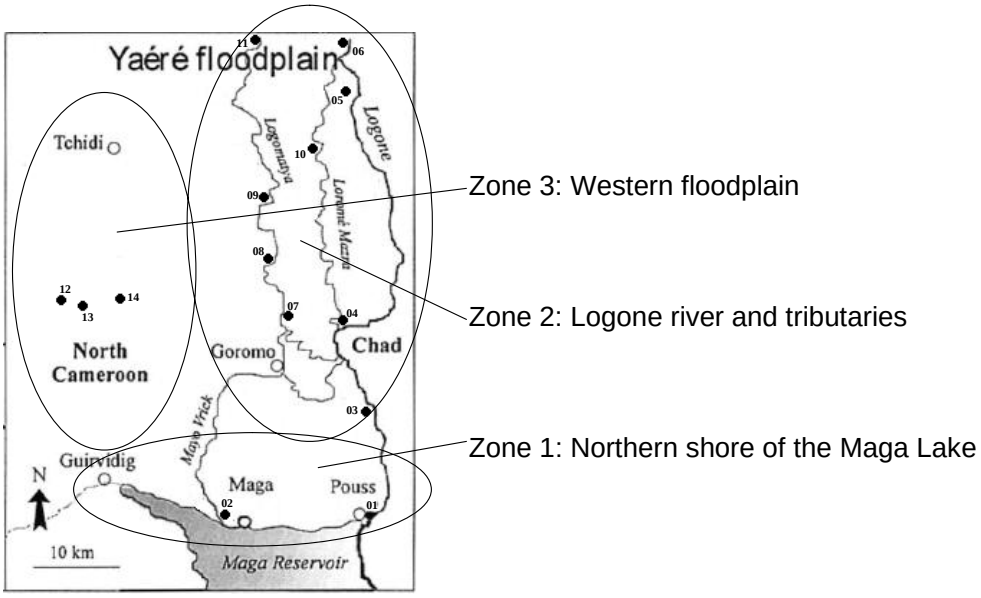

Figure 4: Map of the study area, the zones, and the 14 villages selected for the study

Source: Adapted from Béné *et al*. 2003a

Within villages every second household was chosen randomly from household lists established by the village headman. The average village size in the floodplain (study area) is about 45 households, with a range of 15 to 100 households.

3.2 Survey design and data collection procedure

All selected villages were visited before commencing the household level survey with the aim to establish contacts between the researcher and the village headmen and conduct focus group discussions (FGDs) with the village leaders. The objective of the FGDs was twofold. First, some general information was collected on village size, infrastructural facilities, remoteness to fish resources, markets and the like. Second, complete household lists for every selected village had to be compiled, since no official statistical information existed. For this study, a household was defined as an economically independent unit consisting of the household head, spouse(s), children and other directly dependent members, living with the household or elsewhere. The household size varies from 2 (i.e. normally husband and spouse) to more than 15. Large households are common for Northern Cameroon, dominated by polygamy; hence household heads often live together

with up to four wives. Mostly, households do not live separately from other kin households, but usually form a clan, living together in a larger compound although these are independent from other households in the compound). During the visits special attention was paid to list the names of individual household heads and not only the compound/clan leaders. The additional information collected during the FGDs was necessary to get a first understanding of the livelihood options and constraints in the study area, which proved to be helpful for the development of the household questionnaire. In the last step, the compiled household lists were used for a weighted random sampling of the 300 sample households.

Figure 5 presents an overview of the different steps in the planning and design of the survey:

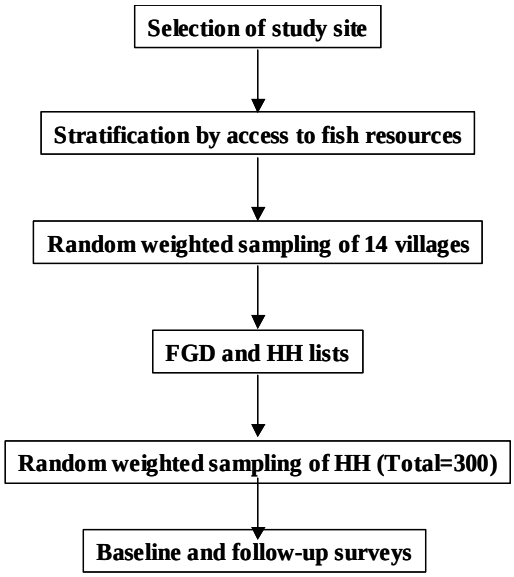

Figure 5: Outline of the sampling design

Source: own illustration

Seasonality is an important characteristic of the livelihood conditions in the Logone floodplain. Therefore, in order to capture seasonal variations, the survey was designed to yield a two-period panel data set (2006 – 2007), with an additional third survey six months after conducting the baseline survey (see Figure 6). The baseline survey was accomplished right at the end of the dry season, when income-generating activities are extremely

limited, and the financial resources, generated during the rainy season in 2006, are being used up. The period covered in the baseline survey was basically the past year (May 2006 – April 2007), constituting a stock check of average income flows, consumption expenditures, and an asset inventory taking. The first follow-up survey then captured the busy time of the year, where expenditures rise due to investments (e.g. purchase of new fishing nets and other productive assets), and variable production costs in agriculture and fishing. Finally, the second follow-up covered the second half of the survey year, giving account of the economic household activities in this period. This approach is supposed to improve the accuracy of data on livelihood activities, and to make sure to capture seasonal variation in income and consumption.

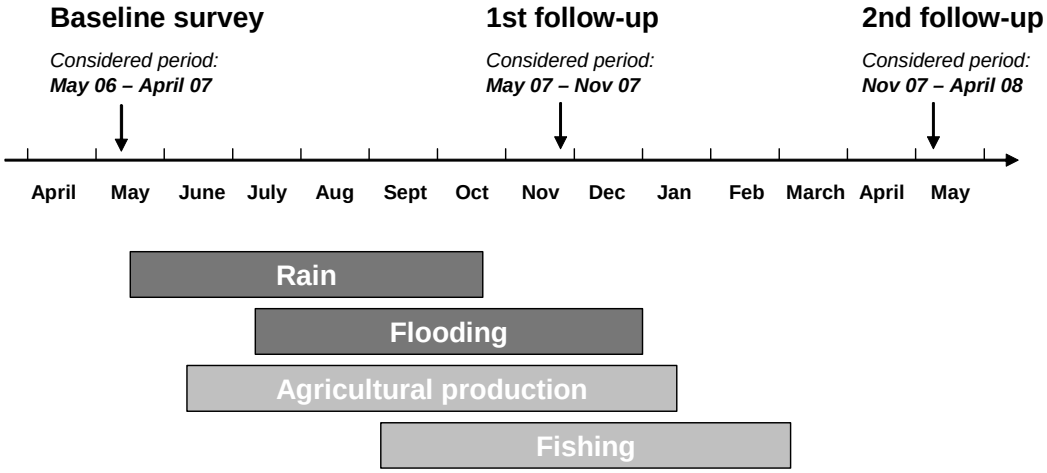

Figure 6: Livelihood options in the study area and design of the survey

Source: Own illustration

The baseline questionnaire covered different aspects of the livelihoods, especially aiming at collecting information on household economics (

Table 1). The questionnaire was divided into four sections: (1) household composition, shocks and health, (2) production data including agriculture, fisheries, livestock and non-farm work, (3) housing, productive and convertible assets, and (4) food and non-food expenditures. The occurrence of shocks was recorded for the last ten years.

Table 1: Structure and contents of the baseline household questionnaire

Section	Sub-section	Type of information
Household roster and shocks	List of HH members	Gender
		Relation to head
		Education
		Primary/secondary occupation
	Information on absent HH members	Gender
		Relation to head
		Education
		Duration of absence
		Reason of absence
	Illnesses	Type of illness
		Costs of illness
		Lost work days due to illness
	Shocks in the past 10 years	Type of 3 major shocks
		Estimated loss due to shock
		Coping activities
		Value of coping activities
Production	Agriculture	Production options (access to resources
	Fishing	e.g. land, fishing grounds)
	Fish trade	Variable production costs
	Livestock	Yield, gross revenue
	Off-farm	Self-consumption (crops, fish and livestock)
Assets	Housing	Quality and estimated value
	Productive assets	Inventory taking (number and value of items)
	Convertible/consumption assets	Changes in the last year (sale / purchase)
	Debts/Receivables	Inventory taking (liabilities and receivables)
	Savings	Changes (repayment / indebtedness)
Expenditures	Non-food	Education, hygiene, clothing etc.
	Food expenditures	Food items
		Consumption patterns (frequency of consumption)
		Monthly expenditures
		Number of proper meals per day
		Days of hunger

Source: Own compilation

The follow-up questionnaires entailed more detailed questions on production decisions, and changes in the key variables, covering a six-month period each, in order to detect seasonal patterns of expenditures, income and thus (dynamic) poverty. For full version of the questionnaires see Appendices A to C.

During the third survey, a special section on risk assessment has been included in the questionnaire (see Appendix C), where data on crop yields, prices, and income flows from fishing in different states of the world, as well as the subjective probabilities were collected for the past 10 years. For this exercise a visual impact method (VIM) has been applied, based on Hardacker *et al.* (1997). VIM is an approach to elicit subjective probabilities for stochastic outcomes, as long as the number of possible outcomes is not too great. In this case the states of the world were delimited to S=3, i.e. "bad year", "normal year" and "good year". In a risk assessment interview, three rectangles were drawn on the soil, designating the three states of the world. After enquiring about the household's main income generating activity, each respondent (usually the household head) was then asked to report how often out of the past ten years (covering the period 1998-2008) they had encountered a bad, normal or good year in this primary activity. For this exercise they were given ten stones and asked to allocate them among the three rectangles. The relative number of stones in each state of the world represents the subjective probability of facing a certain climatic event (either normal, adverse or favorable). Referring to this probability distribution, several questions followed concerning the average yield levels for the primary crop (as well as for all complementary activities carried out by the household) in each state of the world. The data that was generated through this exercise was used to derive probability density functions for each activity, as well as the correlation coefficients between the activities.

Before the start of each survey, enumerator workshops of three to four days had been conducted, including pre-testing of the questionnaire in order to detect weaknesses and the necessity to eliminate, rephrase or add additional questions. The baseline pre-test was carried out in two villages of zone 1 and 2, in order to test the suitability of the questionnaire for different livelihood conditions. The baseline study was carried out within three weeks in May 2007 by four enumerators, working in a team, and accompanied and directly supervised by the researcher. This procedure gave the opportunity for immediate cross-checking for missing information, and also enabled the author to directly check on interview techniques and immediately discuss problems or

questions. The first follow-up was conducted in November 2007, and the last survey in May 2008.

Due to the relative remoteness of the villages and difficulties of access, a careful logistical planning was necessary. The field trips often covered several days, and it was inevitable to spend the nights in the villages. Hence, the survey procedure adopted was as follows: the whole team arrived in a village, presenting itself to the village chief, who had been previously informed about the arrival date of the team during the FGD visit. The chief then called the heads of the selected households to a central meeting place, usually under a tree in front of the chief's house. After the interview, which normally took about one hour, the respondent was given a small present as a compensation for his time (a package of sugar and a bag of tea), and the next household head was called to sit down. Working in a group enabled the team to finish a village in about one or two days and proceed to the next one. That course of action strongly motivated and encouraged the enumerators for security and psychological reasons. The interview time, and hence the time planned to be spent per village, was held flexible, so that careful cross-checking for consistency and plausibility of responses was ensured. Hence, during the enumerator training workshops and throughout the data collection process, special emphasis was placed on the ultimate primacy of data quality.

3.3 Challenges in data collection and lessons learnt

This section describes some challenges and constraints in data collection, which have been encountered during this study, but which are not limited to the study region. Similar settings are found in many wetlands and floodplains in SSA, and the lessons learnt in this study may prove helpful for comparable data collection endeavors.

3.3.1 Seasonality

When collecting data in rural fisheries-dependent communities in SSA, the seasonal nature of the livelihood systems and the ecological constraints need to be taken into consideration. Very often, villages are spatially marginalized and access is extremely

difficult during certain periods of the year. For example, in the Logone floodplain in North Cameroon, access to the villages is very restricted during several weeks twice a year due to the annual flood cycle. At the beginning of the flooding season, and during the deflooding period, access is not possible, neither by vehicle, nor by boat. Hence, the placing of the survey periods needs to be adapted to these conditions. For example, although it would have been more reasonable to place a follow-up survey at the end of the production cycle in January, thus better capturing agricultural production and fishing harvests, this procedure proved to be unfeasible. From mid December to end of February access to the sampled villages was not possible at all. The research team decided for a compromise, collecting data in November, even if this falls in the midst of the harvesting season. The missed data on yields and income was then recollected during the second follow-up. Similar problems arise in other major inland fisheries such as the Hadejia-Nguru Wetlands in Nigeria or the Lower Shire river basin in Malawi.

3.3.2 Defining time periods

For recall surveys and particularly for panel surveys (i.e. the research team is repeatedly revisiting the same households) it is important to assure a common understanding of the time period that is considered in the questionnaire. Different notions of the time span may result in biased information concerning income or consumption flows and can flaw the results and conclusions drawn from the study. In order to assure a common understanding of the requested time period, the respective cultural understanding of time needs to be taken into account. It was found that in the Logone floodplain, people do not think in time units such as weeks or months. Hence, questions such as: "How much did you spend on food items in the last six months?" were not appropriate. In this case, it proved instrumental to refer to certain region-wide acknowledged social events or celebrations. For example, the survey in November coincided with the Tabaski festivities, so that it was easy for the respondents to delimit the time period considered in the second follow-up survey.

3.3.3 Selection of enumerators and their cultural competence

Perhaps the most important factor in empirical work is the choice of enumerators. To achieve good data quality, enumerators must not only provide the needed skills and knowledge, but also dispose over additional soft skills, such as mastering of languages, social competence, and the will to work under severe conditions. Several problems had to be considered for the case study in Cameroon, first of all, the multitude of different languages, mounting to over 320 patois spoken in Cameroon. Although the study site was comparatively small, it was found, that four languages were spoken in the 14 selected villages, Mousgoum, Kotoko, Fulfuldé and Arab. The questionnaire was therefore produced in French, since the translation of the questionnaire into all the languages was considered to be not cost-effective. A second problem was the long lasting ethnic conflict between the people of Mousgoum and the Kotoko. Occasionally, this conflict culminates in violent hostilities. Just a couple of weeks before the start of the baseline survey, several people had been killed on both sides, and whole villages burned. Third, the study area had already been visited a couple of times by other research teams, so that people displayed a certain degree of tiredness of answering questions. Trust into the project needed to be built up by the enumerators.

The lack of sufficiently educated interviewer personnel in the Far-North Province in Cameroon presented a serious constraint. Enumerators and development assistants working for different NGOs were first considered as suitable to conduct the survey. Following standard procedure that aimed at quality, the enumerator training was designed as a selection process to identify adequate personnel. While the training was able to select higher qualified people, their true motivation to participating became apparent. They regarded the project as an opportunity to gain money, since development projects which often conduct surveys generally pay higher than research organizations such as universities.

As a consequence, a team of five enumerators from MINEPIA staff, who work as government officials in the survey area, was recruited. While this can have serious disadvantages due to reservations by the respondents to provide information to

government officers, the more important factor was that the survey team represented the two ethnic groups of the study area. Also enumerators spoke the languages of the region, they had a year-long experience with the local peculiarities, and were used to the conditions in the field. In addition, the households' willingness to provide information was actually encouraged in expectations of a follow up governmental support.

Another advantage of the selected enumerators was awareness and sensitivity towards ethnic tensions. Enumerators were careful not to take sides with one of the party, and avoided offensive statements. This was important with regard to the panel nature of data collection with revisits of villages in follow-up surveys. Any disaccord between respondents and enumerators would have resulted in significant attrition and the need to drop entire villages from the sample.

Religious factors of the Muslim culture also demanded tactfulness and respect. For example, in a number of villages only men could be interviewed. In cases where the household head was not present at the time of the visit, it was not possible to interview the woman (or one of the women) instead. An adult male household member had to be chosen to provide the required information. Interviews were not allowed to take place in the house of the respondents. For the sake of compliance to these cultural norms, the interview procedure had to be adapted. Instead of visiting the chosen households one by one, all sampled household representatives in each village were called to a central meeting place by the village chief (usually in front of the chief's house). The enumerators then seated themselves at a distance of about three to five meters from each other, calling the respective respondent to be interviewed in private, while the others were waiting for their turn. Experiences during the pre-test had also shown that interviewees tended to hide certain information (e.g. expenditures on certain consumption goods, or income figures), or refused to answer some questions sensitive to intra household resource division. Thus, it was decided to interview just one or two household members (usually the household head) in order to establish a private atmosphere during interviews and to encourage the respondent to honestly answer the questions. If the household head was not present, another adult member of the household (usually male) was interviewed.

3.3.4 Sample attrition

A particular challenge of panel surveys in general is to maintain the size of the sample over time (Jäckle and Lynn 2008, Laaksonen 2007). However, in reality, attrition can be high due to several reasons. For example, in some cases the household head has died, the whole household has moved away, or the respondents lose interest to participate especially if no or not enough incentives are provided. The loss of willingness to participate in a follow-up survey caused a problem during the second visit. Due to budget constraints it was decided by the survey team not to compensate the participants for their time, as it has been done at the baseline survey, where each respondent received a box of sugar and a package of tea (which turned out to be a strong extrinsic incentive). When households realized that no remuneration had been foreseen at the second visit, all in all 69 households (23% of the total sample) announced that they were "too busy" to participate. Considering this reaction, compensation was again offered at the third survey, so that most of the lost households could be regained. They were even willing to respond to both questionnaires (1st and 2nd follow-up). Thus the missing data could be completed during the last survey round albeit at the cost of lower reliability due to memory bias. This respondent behavior is also consistent with findings by Jäckle and Lynn (2008), who report significant positive effects of continued incentive payments on attrition, bias and item nonresponse. At the end of the surveys, 22 households (7.3%) have been lost during follow-ups due to permanent migration or other reasons (see also Appendix D).

3.4 Summary and conclusions

Data collection for poverty and vulnerability analysis in SSA is a challenging endeavor. Often, cultural, ecological and economic constraints push researchers to put up with a compromise between data quality and feasibility of the study. On the other hand, collection of such data is important because little is known about poverty and vulnerability of marginalized groups such as fisheries communities in remote areas of SSA. In this chapter the approach has been outlined, which has been taken in the course of this study on poverty and vulnerability in the Logone floodplain, which is a major fishing

area in Northern Cameroon. Typical constraints that are often determining empirical work in SSA have been identified, and it was shown how different challenges can be overcome by an adequate sampling and survey design. Major constraints were the difficulties to access the target population, limitations in finding qualified enumerators and high demand for cultural sensitivity of the research team.

Of eminent importance is a close collaboration with local authorities and experts in the respective field of research, as well as a good understanding of and compliance with local cultural norms and values. Learning from the local population and empathizing with its peculiar ways of living before starting the survey per se has been found to be a key success factor for surveys in that region. Summing up, it can be concluded that despite a number of difficulties, quantitative data collection in rural Sub-Saharan Africa is a task that can be completed with satisfying results. Taking care of an appropriate survey design and interview procedure in collaboration with local staff and experts can assure adequate data quality needed for economic poverty and vulnerability analysis.

This chapter is based on:
Witt, R., D.E. Pemsl and H. Waibel (2008): „Small-scale inland fisheries in Africa: How to collect data for poverty assessment ".
Paper presented at the *Annual Conference of "Verein für Socialpolitik: Research Committee Development Economics"*, Zürich, 30-31 May 2008

CHAPTER 4

THE LIVELIHOODS IN THE *YAÉRES*

In order to get a first understanding of the livelihoods of the rural population in the *yaéres*, this chapter is presenting information on a number of aspects. As a point of departure, section 4.1 will give a brief description of the general ecological conditions in the study area. Section 4.2 will present information on the household and production characteristics of the sampled households. Section 4.3 presents some facts on climate risk in the yaéres as well as on a number of shocks that have occurred in the period of 1997-2007, as reported by the sampled households. It can be supposed that households in the study area are particularly vulnerable to natural hazards. Production risks, in combination with other adverse events may imply a high variation in well-being within the population and over time. However, economic theory suggests that diversification may be an effective strategy for coping with risk. Building on these facts, section 4.4 will descriptively explore in which way households have diversified their activity portfolio. Preliminary conclusions on the relationship between diversification (in particular diversification in fisheries) and exposure to risks will be drawn in section 4.5.

4.1 Ecological conditions in the yaéres

Ecologically, the *yaéres* floodplain is characterized by Sudano-Sahelian climate and vegetation. It is mostly covered by fluvio-lacustrine deposits which have given rise to

hydromorphic sandy clays and vertisols (Ramsar wetlands). However, barren soils constitute about 30% of the surface area (Molua and Lambi 2006a).

Annual average temperatures in this region vary from a minimum of 21.41 to a maximum of 34.47°C. Temperatures are highest in April (monthly average is 32.6°C) and lowest in January with 24.5°C on average (measured over the period 1961-1990, National Oceanic and Atmospheric Administration 2007). Rainfall in this area ranges between 400 and 900mmy^{-1} with a rainy season of about five months – from mid-May to mid-October. The rest of the year is marked by a pronounced dry season which persists long enough so that for at least three months most soils are dry making cropping activities impossible (Molua and Lambi 2006a, Kouokam *et al.* 2004). The hot dry Harmattan wind blows across the floodplains during this dry season and particularly towards the north, the shortage of water is remarkable.

There is a dense hydrographic network made up of seasonal and permanent rivers which crisscross the zone. The main river in this area is the Logone which is fed mainly by tributaries from the Adamawa high plateau and the Mandara mountains, and forms the Cameroon/Chad border over a distance of 350 km until it discharges into Lake Chad (Molua and Lambi 2006a). During the rainy season, the Logone overflows the banks causing the annual flood regime that characterizes the *yaéres* plain. The flooding usually occurs during the peak period of rainfall in August-September. However, the pattern of flooding and the depth of the flood vary from year to year. In normal years, a large area of the plain is flooded to a depth of 1m, with maximum depths of 3m, but a series of droughts in the 1970s and 80s have brought a devastating ecological imbalance in the region resulting in minimal flooding and the drying of many waterholes (Ramsar wetlands).

According to Molua and Lambi (2006a) this zone is threatened by desertification as a result of low and spatially and temporally unevenly distributed rainfall, land degradation, high population pressure (2.19% population growth rate in Cameroon, CIA World Fact Book 2009), and poor management of protected areas. This process results in an increasing pressure on natural resources, the effects of which are deforestation and

overfishing, among others. Human intervention through grazing and bush fires has been adding to the climatic variation. One of the man-made ecological changes in the study area has been the construction of the Maga dam on the Logone in the 1970s, which resulted in the Maga Lake with a water surface of 39,000ha. The dam was created for the establishment of two large rice irrigation schemes (SEMRY: Société d'Expansion et de Modernisation de la Riziculture de Yagoua) on an area of 12,000ha. One consequence of this development is that the traditional flooding cycle has been disrupted for an area as large as 59,000ha, which lies behind a dike constructed along the left bank of the Logone to protect the irrigation project. Further, another 100,000ha outside the dyke have been ecologically affected (Ramsar wetlands). Agricultural as well as fishing activities in the floodplain north of the Maga Lake are often subject to the control of the water flows of the Logomatya and Loromé Mazra (tributaries of the Logone) by the SEMRY.

The livelihoods of the people living in the *yaéres* (mainly based on subsistence agriculture and small-scale fisheries) are heavily dependent on natural resources and climate conditions. Due to the increasing aridification and increased frequency of droughts and floods, agricultural production in this area has been shifting to grain crops which require little rainfall and have a short growing season, such as sorghum and millet, which are hardy plants with relatively low water requirements with an annual rainfall minimum of about 500mm for sorghum and 250mm for millet. Rice is mainly cultivated in the irrigated plots of the SEMRY, but rainfed rice varieties are also grown in some parts of the floodplain. Fishing is a major activity for many households in terms of nutrient supply and income generation. It is carried out by almost every conceivable means (lines, nets and a variety of traps). In the past two decades many households have intensified fishing by digging long channels inland from the Logone and the Logomatya (up to 10 km) trapping the fish that is migrating from the floodplain back to the rivers after reproduction at the end of the inundation period. Thus many juveniles are caught, increasing the pressure on the fish stock (Ramsar wetlands). Annual catch volumes in the floodplain have been estimated as low as 2,000 tonnes in the 1980s (Drijver and Marchand 1985) but have decreased since then.

4.2 Household and production characteristics

This section gives some general information on demographic characteristics and production activities in the three zones.

Table 2 shows that households are on average larger in zone 1 and smallest in zone 3. The dependency ratio and age of household head is however comparable in all three zones. A striking difference exists in the education level of the household head (on a scale of 0 to 2). This is mainly due to a considerably better infrastructure in zone 1. The relative proximity to Maroua, the provincial capital, facilitates the access to schools and higher education facilities ('collège' and 'lycée'). Zone 3 is also particular in the ethnic composition of the population. While in the two other zones the majority of households is from the Mousgoum ethnic group, and a smaller share of the Kotoko (which creates a lot of ethnic tensions), the population in zone 3 consists mainly of the Shuwa Arabs and the Fulbé, which had been nomadic tribes in former centuries.

Due to the difficult climatic conditions in zone 3, cropping is more difficult and fishing almost impossible in this area. Hence, despite higher land endowment for these households, income from agricultural production and fishing is relatively low. This is being compensated by sale of livestock, which is primarily used as an income buffer, as anecdotal evidence suggests.

Households in zone 1 have to bear higher fixed costs for agricultural production, because most households are renting irrigated plots on the SEMRY rice irrigation scheme. Hence, despite higher value of agricultural production, the net income is lower for these households as compared to zone 2 (where rainfed sorghum and millet production dominates).

Table 2: Household and production characteristics in the *yaéres*, by zone

	Zone 1 N = 52		Zone 2 N = 166		Zone 3 N = 77	
Household characteristics	Mean	*Std. Dev.*	Mean	*Std. Dev.*	Mean	*Std. Dev.*
Household size	5.38	*2.82*	4.96	*3.01*	3.27	*1.54*
Dependency ratio	0.20	*0.19*	0.21	*0.31*	0.19	*0.28*
Age of HH head [years]	46.65	*15.35*	43.69	*14.62*	43.78	*17.75*
Education HH head [0-2]	0.71	*0.70*	0.44	*0.53*	0.16	*0.37*
Mousgoum [%]	0.83	*0.38*	0.89	*0.32*	0.26	*0.44*
Kotoko [%]	0.15	*0.36*	0.10	*0.30*	0.00	*0.00*
Land [ha]	2.30	*2.64*	2.41	*2.94*	8.10	*26.02*
Agricultural production [in USD PPP]						
Rent for land	308.1	*238.3*	12.5	*72.7*	33.7	*77.8*
Variable production costs	888.7	*701.3*	346.4	*387.3*	252.7	*244.5*
Value of production	1033.9	*935.4*	423.1	*548.0*	222.7	*465.8*
Value of auto-consumption of crops	500.9	*432.4*	408.3	*419.8*	308.7	*375.3*
Value of stocks	90.5	*147.6*	125.5	*351.4*	104.4	*212.8*
Total income from agriculture	1635.1	*1277.3*	958.1	*960.5*	638.8	*874.0*
Gross margin	746.4	*915.6*	611.7	*823.1*	386.1	*769.0*
Fishing [in USD PPP]						
Variable production costs fishing	233.1	*305.7*	328.3	*247.1*	10.8	*66.6*
Variable production costs fish trade	11.8	*30.3*	6.6	*32.0*	0.0	*0.0*
Value of production, fresh fish	625.1	*1137.9*	72.9	*504.0*	3.7	*28.5*
Value of production, dried fish	66.7	*334.9*	371.2	*415.9*	3.2	*24.5*
Value of production, smoked fish	64.0	*230.4*	73.0	*278.0*	12.4	*83.4*
Value of self-consumed fish	155.8	*313.3*	11.5	*70.0*	2.6	*22.6*
Income from fish trade	210.4	*529.8*	126.8	*450.8*	0.0	*0.0*
Total income from fishing, fish processing, fish trade	1122.0	*1386.9*	655.4	*809.6*	21.9	*124.6*
Gross margin	877.1	*1220.1*	320.6	*734.0*	10.8	*70.7*
Other activities [in USD PPP]						
Value of livestock	1313.0	*2059.2*	1562.7	*2392.1*	3574.9	*5373.7*
Income from sale of livestock	228.0	*383.0*	270.9	*550.9*	626.5	*841.2*
Purchase of livestock	59.8	*162.2*	79.8	*274.2*	30.2	*121.7*
Off-farm income	28.7	*137.0*	20.5	*83.5*	16.4	*60.8*

Source: Data from baseline survey 2007

Average income from fishing, however, is much higher for households in zone 1 than in zone 2 (although fewer households are engaged in fishing, as will be presented in section 4.4). The reason lies in different infrastructural endowments in these zones. First,

households in zone 1 have a better access to the Maga reservoir (allowing longer fishing possibilities within the year). In addition, a well-functioning fish market (mainly fresh fish) exists at the northern shore of the Maga Lake, mainly supplying the market in Maroua, the capital city of the Extreme-North province of Cameroon at a distance of about 80 km. Commercial traders are buying fish in big quantities and transporting it to Maroua. The high demand for fresh fish in Maroua has also a positive effect on prices. Contrary to zone 1, the villages in zone 2 are cut off from markets, particularly during the inundation period (which coincides with the fishing season), where roads are impassable, and transportation only happens by pirogues. Since conservation of fresh fish over a couple of days is difficult, fish is either sold at the local (village) market achieving a lower price, or conserved by smoking or drying, which also enormously lowers the price.

The information presented here gives a first impression of the livelihood conditions in the survey area. The next sections are presenting more details on the external risks and shocks as well as the households' responses. Section 4.4 will particularly deal with portfolio decisions of households, giving also some explanation on the reasons for the differences in the role that fisheries play for the livelihoods of households in the *yaéres*.

4.3 Climate risk and shocks

Rural households in the Sudano-Sahelian zone of Sub-Saharan Africa are often subject to heavy dependence on natural resources, limited and erratic rainfall with high inter- and intra-annual variability, pests and diseases, nutrient-poor soils and other natural calamities (Ellis 1993, Hardacker *et al*. 1997, Townsend 1994, Kinsey *et al.* 1998, Affognon 2006, Dercon 2002). A study on vulnerability to climate risk in Africa by Thornton *et al.* (2008), for example, identifies mixed rainfed arid-semiarid systems in the Sahel as the highest vulnerable region with possibly severe LGP (length of the growing period) losses. For the rural population in this zone, whose main sources of livelihood are agriculture and fishing, the unpredictable climate has a more severe impact on the poor than for the better-off households, reinforcing social differentiation and holding a bleak prospect for agricultural production (Ellis 1993, Molua and Lambi 2006a). Numerous studies on

climate change suggest that climate variability is expected to increase in the next few decades, and that it is likely to be severe for tropical areas. Extreme events, such as floods and droughts will increase in frequency, thus increasing the probability of income shocks having a larger impact on the poor (Kurukulasuriya and Mendelsohn 2008, Iwasaki *et al.* 2009, Shewmake 2008, Slater *et al.* 2007, Tingem and Rivington 2009). Molua (2006) and Molua and Lambi (2006b) observe that estimates based on climate data from Cameroon (1961 to 2001) indicate pronounced seasonality. Rainy seasons have become wetter and dry periods dryer. Based on a comprehensive survey across eleven African countries, Hassan and Nhemachena (2008) report that over 50 percent of farmers perceive an increase in temperature and a decline in annual precipitation.

Although most farmers have traditional knowledge of rainfall patterns (e.g. interpreting the height of an ant nest in trees, or the color of frogs to make forecasts on the onset and cessation of the rainy season and quality of rain (Molua 2006), they are often surprised by changes in the 'normal' rainfall patterns, particularly if a run of wet years is followed by one of dry years. However, decision-making choices on the allocation of land, capital and labor can often hardly be altered during the cropping period as a response to climate conditions. Also, climate predictions by use of models are unlikely to be able to project climate changes due to many unknown parameters such as the time of onset of seasonal rainfall and the prevalence of dry spells within seasons (Slater *et al.* 2007). Coping with risk, households have therefore to consider production uncertainty *ex ante* in making decisions on their activities portfolio (Barrett *et al.* 2001, Di Falco and Chavas 2009).

The closest meteorological station in the study area that recorded climate data over the past decades is Maroua-Salak (10.4°N, 14.2°E, 423m), which can be taken as the southern border of the Logone floodplain. Data on rainfall (Figure 7) show that total annual precipitation volumes vary considerably from year to year. The average negative deviation from the historical mean of 805.33mmy^{-1} is -105.3 percent and the average positive deviation is 120.9 percent. In the 1980s Cameroon faced a prolonged drought with rainfall as low as 487.4mmy^{-1}, and shorter less pronounced droughts in 1996-98 and 2004-06. Abrupt changes in rainfall are however a general phenomenon for this area (e.g.

1993-94 or 2006-07), which may contribute to a high variation of outputs from agricultural production and fishing activities.

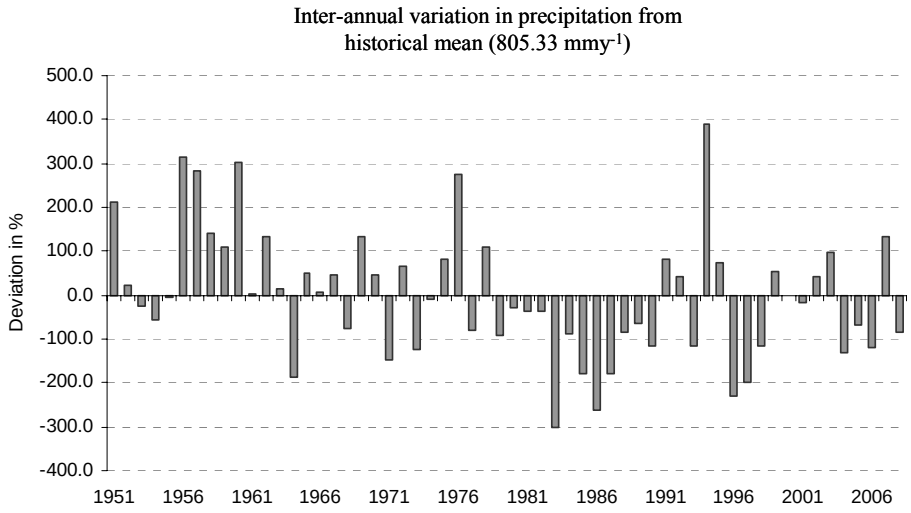

Figure 7: Evolution of annual rainfall in the study area

Source: The Royal Netherlands Meteorological Institute (KNMI) for data from 1951 to 1982 and the Direction de la Météorologie Nationale du Cameroun: Service Régional de la Météorologie de l'Extrème Nord for data from 1983 to 2008.

In addition, the uncertain nature of climate is manifested not only in the total annual rainfall values but also in the irregularity of rainfall within the year, which is an important factor for outcomes of agricultural production. Even if there is sufficient rain, its irregularity can affect yields adversely if rains fail to arrive during the crucial growing stage of the crops (Ellis 1993, Molua and Lambi 2006a, McCarl *et al.* 2008). Figure 8 shows exemplarily the evolution of rainfall for two years, 1984 and 1986. In 1986 total annual precipitation was lower than in 1984. However, in 1984 rainfall was abundant only during the planting season in Mai, but failed to arrive in the crucial growing period in June. Production data from Cameroon show that e.g. sorghum and millet yields decreased by up to 40 percent below average[4] in that year, while in 1986 sorghum yields were at 59 percent above average.

[4] Historical average was calculated based on yield data from 1961 to 2005 (FAOSTAT).

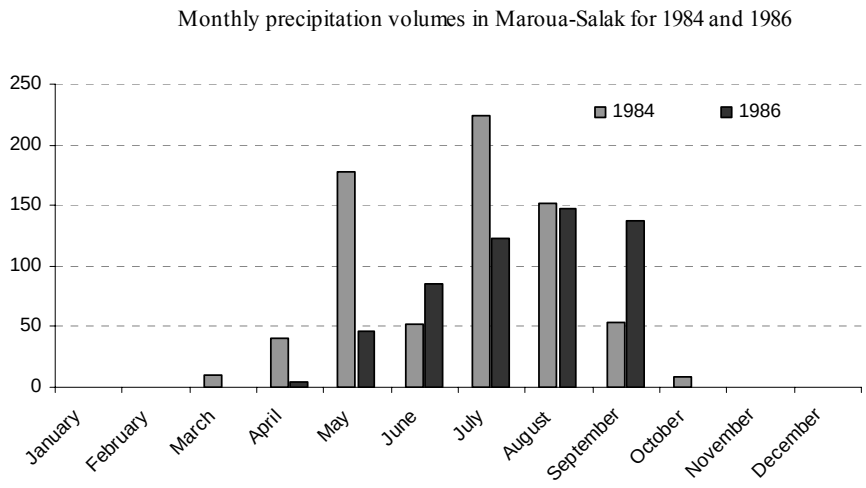

Figure 8: Evolution of intra-annual rainfall in the study area for 1984 and 1986

Source: Direction de la Météorologie Nationale du Cameroun: Service Régional de la Météorologie de l'Extrème Nord

Such adverse climate effects are supposed to be reflected in people's perceptions of favorable or unfavorable years concerning agricultural activities and fishing. In the risk assessment interview, on average, farmers reported subjective probabilities of facing a bad, normal or good year of 38, 34 and 28 percent, respectively. The probabilities were elicited with respect to the primary crop. No significant difference regarding probabilities of states of the world can be observed between different production systems, showing that risk perception is consistent among the population, and that the exposure to natural hazards is overall comparable between different livelihood systems.

Apart from the climate component in the risk vector, households also reported on events that were perceived as negative shocks, which had an impact on the welfare level of households. All respondents were asked to report three major unexpected negative events that affected the household in the past ten years. Table 3 gives an overview of the reported cases, by strata (zones 1 to 3). Over 90 percent of the households experienced at least one serious shock in the past. The most frequent calamities faced by the households are demographic shocks such as heavy illness of an adult or death of an adult household member. Also, 45 households (10.4%) reported to have suffered a loss of productive assets

(e.g. destruction of a pirogue or other fishing/agricultural materials, or confiscation of unauthorized fishing gear by state officers), which is also the third important shock in terms of total value of losses due to the respective shock (see Figure 10).

Table 3: Number of households that reported social, economic and ecological shocks in the past 10 years

Type of shock	zone 1	zone 2	zone 3	Total	Percent
No shock	3	22	17	42	9.7%
Heavy illness of an adult	29	77	27	133	30.9%
Death of an adult	24	26	6	56	13.0%
Heavy illness of a child	4	19	4	27	6.3%
Death of a child	11	9	6	26	6.0%
Loss of money	2	2	0	4	0.9%
Fire	0	0	2	2	0.5%
Loss of productive assets	4	27	14	45	10.4%
Drought	3	12	8	23	5.3%
Too much rain or flooding	1	10	0	11	2.6%
Crop pests	13	30	13	56	13.0%
Livestock diseases	2	3	1	6	1.4%
Total	96	237	98	431	100.0%
No of sampled HH per zone	55	166	78		
Average number of shocks per HH	1.75	1.43	1.26		

Source: Data from baseline survey 2007

Adverse climatic events such as drought or too much flooding were not reported to be a major problem in the study area (only 7.9% of households), which might be due to the risk perception of the respondents. Climatic variation might be perceived as "normal", and was therefore not classified as a shock. Also, households in zone 1 are relatively well protected from flooding by the Maga dam; and due to the irrigation system of the SEMRY, drought can not be considered as a considerable risk in this zone. In the two other zones, those ecological phenomena have to be taken more seriously. However, crop pests were reported by a large share of households (13% on average). Due to the short time frame for agricultural production in zones 2 and 3, the destruction of fingerlings by pests or birds, some weeks after sowing, can result in the total loss of agricultural production for the respective season, since often it is too late to resume the cultivation of

crops. This forgone revenue, plus production costs, had been included in the estimation of losses due to these shocks.

Cattle diseases, on the contrary, are a rather rare incident. Only six households (1.4%) reported to have suffered from this shock, and only once in zone 3. The implied average losses (medication of animals and in some cases loss of animals, valued at the market price), however, are highest (Figure 9).

In general, demographic shocks entail relatively low average losses. The estimated value of loss due to a shock (Figure 9), such as illness or death of an adult/child, is calculated as the sum of costs for medical treatment and funeral, respectively. This, of course, is an underestimation of the true damage of demographic shocks. For example, opportunity costs from lost labor force, and income, are not included. Economic shocks, such as fire and loss of productive assets seem to also cause considerable losses in terms of forgone income and/or replacement costs.

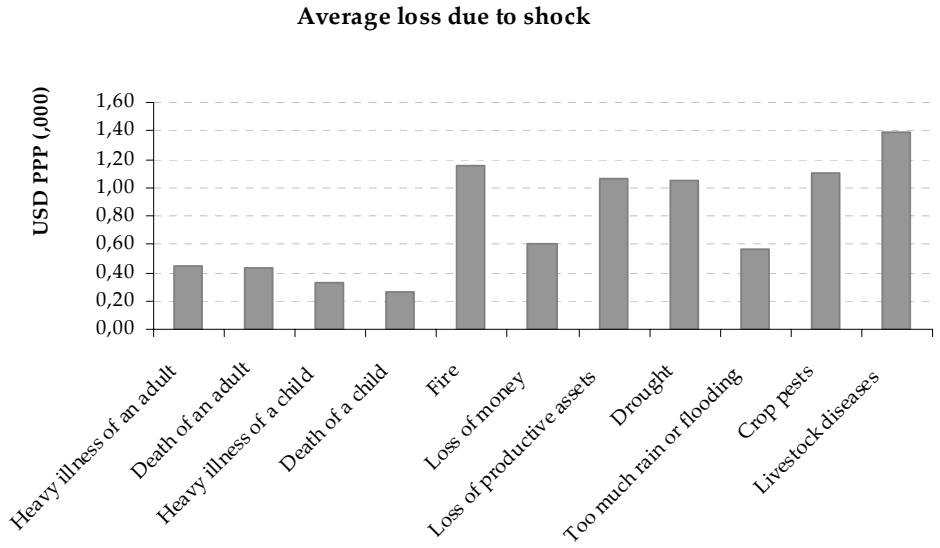

Figure 9: Average shock losses in USD PPP by type of shock

Source: Data from baseline survey 2007

The picture changes dramatically, if aggregating losses from shocks of the same kind over all households, thus determining the effect of the respective shock on the total sampled population (Figure 10). Three major shocks can be identified, which is crop pests, heavy

illness of an adult, and loss of productive assets (ranked by induced losses). If compared to the aggregated gross household income over all households, all shock losses in the period covered by the baseline study (May 06 – April 07) would have used up 23.2 percent of total aggregated household income, which again shows the vulnerability of the households living in the study area.

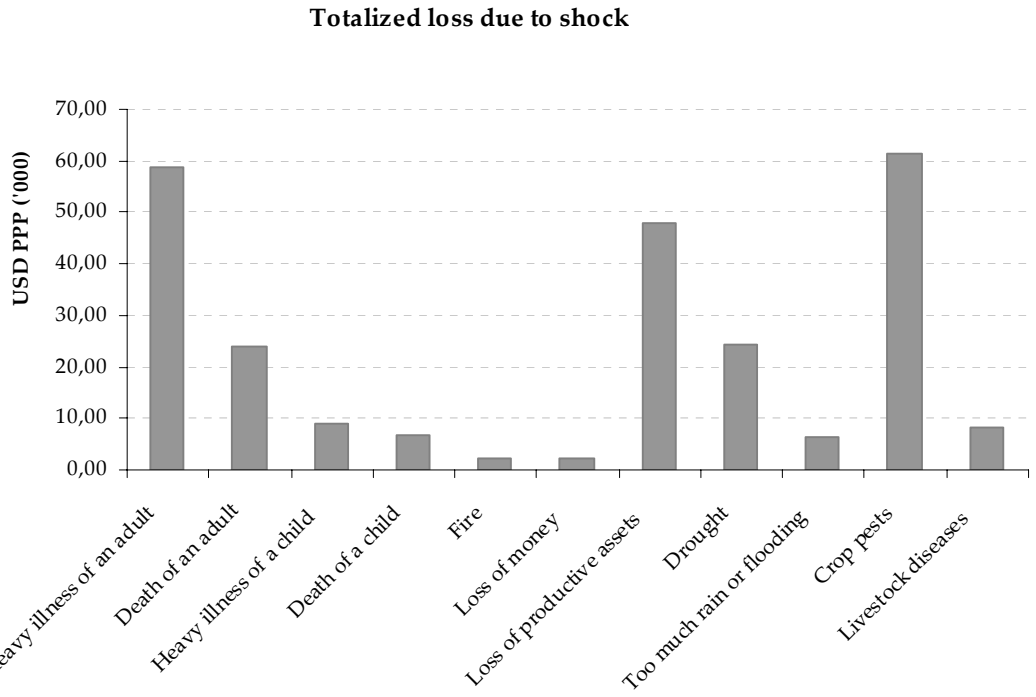

Figure 10: Total losses from shocks in USD PPP by type of shock

Source: Data from baseline survey 2007

Concerning *ex post* coping activities, working harder and sale of assets (livestock and other assets) are the two most frequent ways to deal with losses. If taking the total value of respective coping activities, sale of assets is the incontestable means to counter shock losses, making up about 50% of total coping value. Whether divestment is an effective strategy will be investigated in Chapter 5. It is assumed that assets are crucial for income generation and may determine where a household finds himself within the entire welfare distribution, and whether poverty is a result of structural or rather stochastic reasons.

All coping activities, as reported by the households, are *ex post* reactions to shocks. This information, however, does not yield insights into how households cope with risk *ex ante*,

for example through diversification as suggested by economic theory. Empirical studies suggest that the motivation to reduce uncertainty and risk through diversifying the activity portfolio ranks first among other possible motives (e.g. Barbieri and Mahoney 2009). The next section will explore the question whether shocks and climate risks are somehow reflected in the activity portfolios of households, with respect to labor allocation and income.

4.4 Activity diversification

Diversification of production as a risk-management strategy can only be pursued in the space of possible activities. Chaplin (2000) notes that there might be multiple reasons for varying levels of specialization and diversification, one of which is the availability of resources (i.e. soil type, local climate, water availability, etc.) that affect the opportunities of income diversification. For example, irrigated rice cultivation depends on existing infrastructure and fishing can be taken up only by those households who have access to water bodies. Hence, portfolio decisions may differ between households, depending not only on subjective utility-maximizing considerations, but also depending on external factors, such as access to fishing resources or irrigation facilities.

The analysis of baseline as well as the follow-up data reveals that generally five livelihood activities exist in the study area, namely agriculture, livestock rearing, fishing, fish trade and off-farm work (commerce, carpentry, herdsmen, etc.). Table 4 displays the proportion of households that are engaged in one of the mentioned activities, as well as the average number of activities per household. The results are given per zone, showing the variation in specification/diversification strategies of households.

Agriculture as well as livestock rearing are basic activities, taken up by more than 88 percent of interviewed households[5]. While off-farm work is playing an equally minor role

[5] A note on the conceptual treatment of livestock rearing is necessary here. Within the production systems framework, livestock can be regarded as both, a production activity as well as an investment decision. Anecdotal evidence from the Logone floodplain suggests that livestock is used as an income buffer. Households accumulate livestock in favorable years where income

in all three zones, considerable differences exist concerning engagement in fishing activities. As expected, only 5 percent of households in zone 3 are fishing. In contrast, 86 percent are dependent on fisheries in zone 2 (Logone river and tributaries). It is noteworthy that a high share of households in the first zone does not fish, despite all-year fishing possibilities in the Maga Lake and the Logone River, which may indicate a higher specialization in agriculture. An explanation of this portfolio decision is that the villages in zone 1 have access to the governmental rice-irrigation scheme. Irrigated rice production allows up to two cropping seasons per year, unlike the rain fed rice, sorghum and millet cultivation, prevalent in zones 2 and 3. The use of irrigated rice fields is costly, which is reflected in high rent costs for land and higher production costs in agriculture (two cropping seasons, instead of one, costs for electric pumps etc., see also Table 2). Given these high investment costs and limited labor force, many households in zone 1 prefer to specialize in rice production, which results in a relatively low share of fishing households.

Table 4: Proportion of households engaged in different livelihood activities, by zone

	Zone 1		Zone 2		Zone 3	
	Mean	*Std. Deviation*	Mean	*Std. Deviation*	Mean	*Std. Deviation*
HH engaged in fishing	0.58	*0.50*	0.86	*0.35*	0.05	*0.22*
HH engaged in fish trade	0.20	*0.40*	0.13	*0.34*	0.00	*0.00*
HH engaged in livestock rearing	0.95	*0.23*	0.95	*0.23*	0.95	*0.22*
HH engaged in agriculture	0.91	*0.29*	0.98	*0.15*	0.88	*0.32*
HH with off-farm work	0.11	*0.31*	0.13	*0.34*	0.12	*0.32*
Number of activities	2.75	*0.80*	3.05	*0.61*	2.00	*0.60*

Source: Data from baseline survey 2007

Agricultural production in the study area is dominated by three major crops in terms of input allocation (labor and land) and income: sorghum, millet and rice. Other crops such

from agriculture and fishing is high, and sell it in bad years in order to smooth income. This behavior is confirmed by the analysis of the data from the risk assessment interviews. On average, income from livestock over the years is around zero, because expenditures for livestock (in good years) and income through livestock sales (in bad years) cancel each other out. Livestock is therefore considered as an insurance and income-smoothing mechanism, which does not affect production decisions in the first place, i.e. income through livestock sales is treated here as an ex-post coping action, not as production output.

as maize or green beans are rarely grown and compose on average less then one percent of total income.

Fisheries-related activities make a significant contribution to the livelihoods of the people in the *yaéres* floodplain, including fishing, fish processing and fish trade. On average, 28% of household income is derived from fishing related activities.

Concerning off-farm work possibilities, the data suggests that these are very limited. Only about eleven percent of all households report incomes from off-farm occupation, with an average contribution to household income of 1.5 percent. For the analysis of production systems these activities are therefore considered as insignificant.

The different livelihood strategies in the three zones are also reflected in the average number of activities per household. Other than in zone 1 and 3, households in zone 2 take up more than three activities on average. This suggests that the relatively risky production conditions in zone 2 have forced households to diversify their activity portfolio, so as to spread income risk. Households in zone 3, however, had to specialize in agricultural production and livestock keeping. As already discussed above (see footnote 5), livestock is considered as a major risk-coping asset for households in zone 3, because crop yields are heavily under threat in this arid and relatively sparsely populated zone through large bird swarms coming from the nearby Waza National Park, and invading the area every year.

Because livestock is an income buffer, and off-farm occupations are insignificantly contributing to household income over time, the following four activities are considered as major portfolio components: Cropping (sorghum, millet and rice cultivation) and fishing. In zone 3, fishing is not considered as part of the production portfolio since only three households are sporadically engaged in fishing and fish trade does not exist at all because the captured fish is either self-consumed or directly sold to consumers. Figure 11 shows the preferences that households give to the respective activity. The bars indicate the share of households who have taken up the respective agricultural activity as their primary (major share of labor allocated to the activity) or secondary occupation.

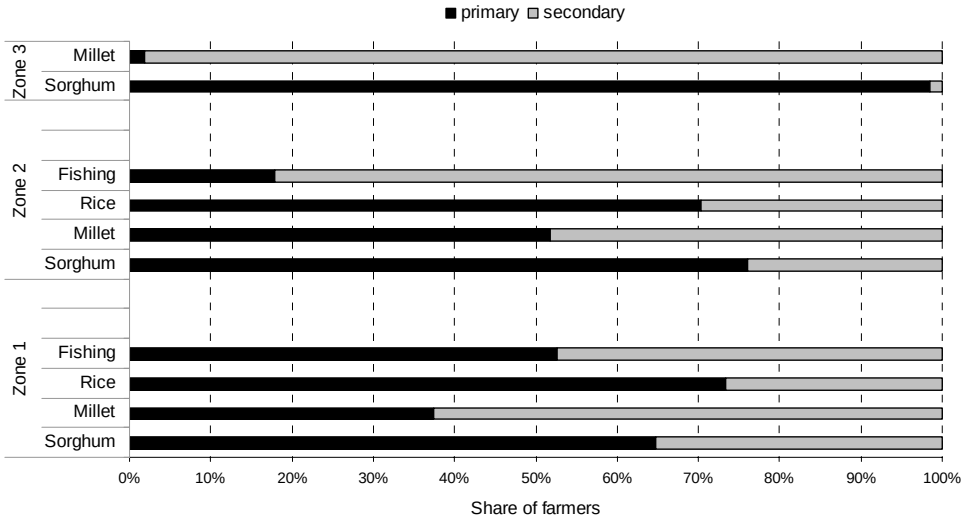

Figure 11: Distribution of activities as primary or secondary, by zone

Source: Labor input data from 2nd and 3rd follow-up surveys

While portfolio decisions are comparable in zones one and two, zone three shows a clearly different pattern with sorghum as the exclusive primary agricultural activity and millet as a complementary activity. Generally, rice and sorghum production are primary activities, while millet is mostly grown as a secondary crop. Fishing is mainly a complementary activity except in zone 1, where more than 50% of households derive the major part of their income from fishing. In zone 2 more households are engaged in fishing (see Table 4) but mainly as a secondary activity, which confirms the findings presented in Table 2.

Under the weak assumption of rational behavior, the allocation of labor between possible activities is supposed to depend on efficiency considerations[6]. Hence, the preferences for a given activity are expected to be correlated with the average productivity of labor. Figure 12 shows the allocation and the productivity of labor (measured as value of

[6] It has been remarked that households often follow traditional and cultural norms with respect to their activities. As such, the Kotoko people understand themselves as fishers, since they have been occupying the floodplain for many generations. To the contrary, the Mousgoum have a rather flexible background, being fishers or farmers, depending on the circumstances. Nonetheless, it can easily be argued that households may change their preferences, if changes in external conditions such as crop failures or persistent droughts result in consumption shortfalls.

production per man-day) by zone and activity. The results suggest that rice is the most productive activity in the areas where rice production is possible (zones 1 and 2). Due to the irrigated rice scheme in zone 1, returns to labor for rice are highest in this zone. Also, productivity of sorghum and millet is slightly higher in zone 1 as compared to the other zones. To the contrary, fishing is a more efficient activity in zone 2. Due to difficult production conditions in zone 3, labor productivity (sorghum and millet) is relatively low for households living in that area.

The allocation of labor to the different activities confirms the assumption of rational behavior. As shown in Figure 12, the relative weights of labor input closely follow the distribution of labor productivity.

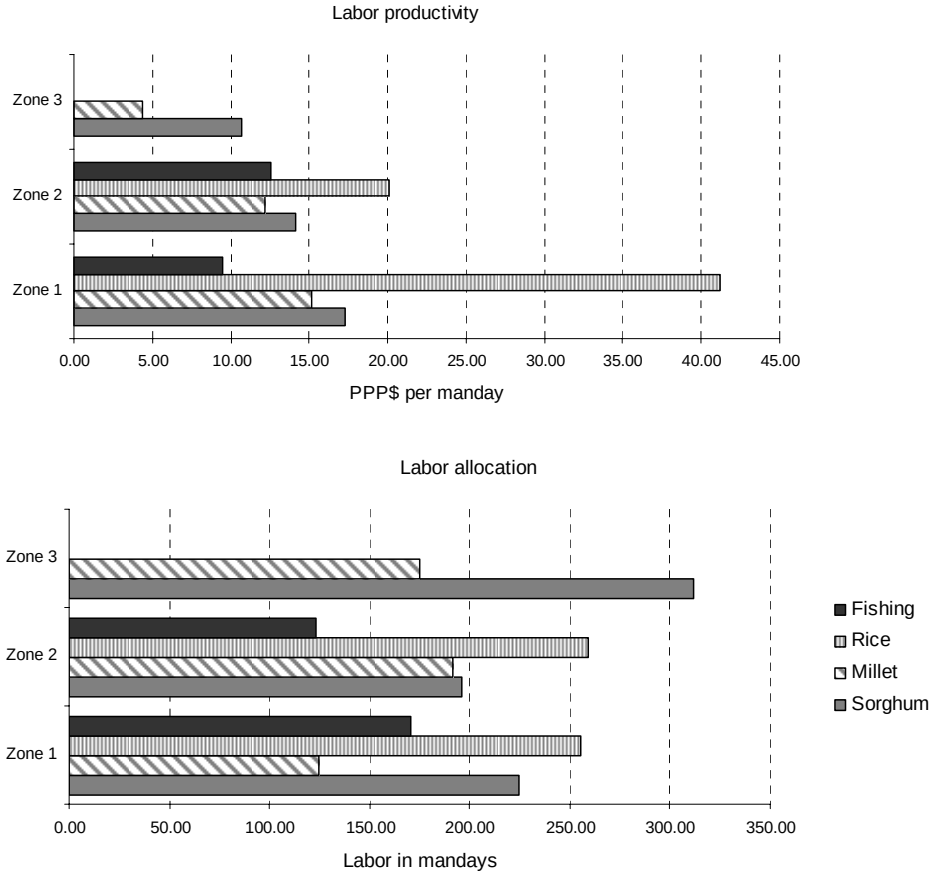

Figure 12: Labor productivity and allocation of labor by zone and activity

Source: Labor input data from 2nd and 3rd follow-up surveys (for labor allocation); and own data from risk assessment interview

The distribution of labor also supports the results presented in Table 4 and Figure 11. Although less households are engaged in fishing in zone 1 (only 58 percent of fishing households in zone 1, compared to 86 percent in zone 2), for many of them fishing is a primary activity with relatively high labor shares allocated to fishing. In zone 2, households consider fishing rather as a complementary activity. Higher returns to labor for fishing in this area are in line with the law of decreasing marginal productivity.

All in all, households in zone 1 are advantaged by better access to natural resources, markets and infrastructural facilities, as well as by a relative proximity to urban centers. To the contrary households in zone 3 can be considered as the most remote and marginalized. Income levels from agriculture and fishing are significantly lower as compared to zone 1. A breakdown of gross household income in the three zones is supporting this point, as shown in Figure 13.

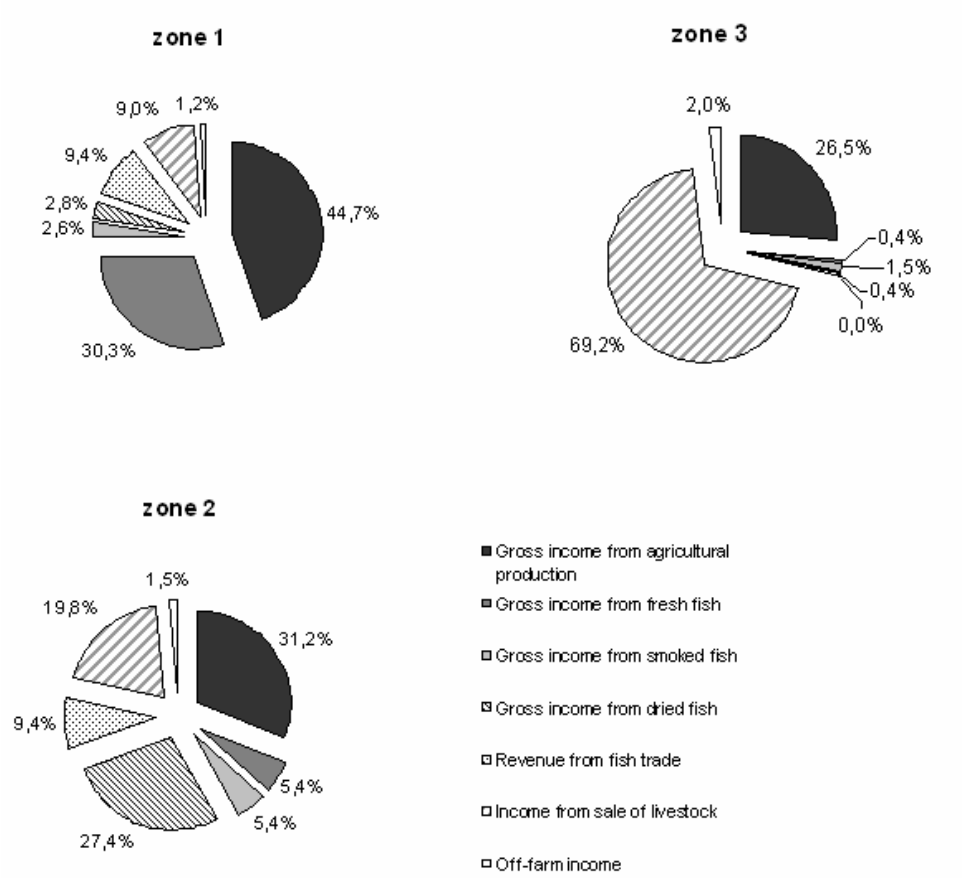

Figure 13: Income portfolio of households in 2006-2007, by zone

Source: Data from baseline survey 2007

It becomes obvious, that households in zone 2 have developed the most diversified portfolio. This can be an indication for diversification as a coping strategy to external livelihood conditions, while households in zone 3 can be considered as depending on livestock assets as a risk-coping mechanism. Hence, this portfolio decision is not necessarily the result of particularly favorable conditions for livestock rearing, but rather the result of significant constraints regarding other income generating activities.

4.5 Summary and conclusions for research

Some indication can be drawn from these descriptive statistics that it is difficult to categorize households in distinct types. There are no pure farmers, fishers or livestock breeders, but diversification of various income sources is a major means to adapt to the risky environment. At the same time considerable differences exist between the three zones, in terms of production conditions, such as the access to fish resources, or agricultural production possibilities. The analysis of data collected during the baseline survey has shown that portfolio decisions are likely to be made on the basis of risk perceptions. Reliable conditions, like for example the rice irrigation system in zone 1, which protects farmers from the risk of drought or inundation, encourage household to concentrate financial and human capital on the cultivation of rice. Where the variability of returns to capital and labor is high, as it is the case in zone 2, a much more diversified income portfolio has been adopted.

On the other hand, portfolio decisions are not only made because of the subjective perception of risk. Access to resources (or the lack of it) is a key factor for households in zone 3. While households in zone 1 and 2, which do not engage in fishing, for example, have deliberately chosen to do so, due to some individual considerations concerning expected returns, variability of returns, or for other economic or social reasons, households in zone 3 have no other choice than limit their income sources to livestock rearing and agriculture.

Shocks that had appeared in the past, as well as during the period covered by the follow-up surveys are expected to have an impact on the economic situation of households. The

ability to cope with those shocks in the form of *ex ante* strategies and *ex post* coping activities has to be identified. In addition, the nature and exact sources of vulnerability to poverty need to be investigated in order to present empirically documented information, which could prove useful for policy makers in designing appropriate policies for poverty reduction and prevention in SSF.

The next chapter is presenting an econometric approach to estimate vulnerability at household level, drawing on the asset-based poverty framework.

This chapter is a modified version of:
Chiwaula, L.S., R. Witt and H. Waibel (2009): „An asset-based approach to vulnerability: The case of small scale fishing areas in Cameroon and Nigeria.
Accepted for publication in the *Journal of Development Studies* in October 2009

CHAPTER 5

VULNERABILITY TO POVERTY — AN ASSET-BASED APPROACH

5.1 Introduction

Fishing in inland water bodies (lakes, rivers, inundated wetlands) is recognized to be a key element in the economic portfolio of the rural populations. Case studies mainly conducted in Africa have shown that small scale fishing is part of a flexible and highly seasonal matrix of income generating activities (Sarch 1997, Neiland *et al.* 2000, Béné *et al.* 2003b). However, small scale fishing communities have been associated with high levels of poverty for a long time (Béné *et al.* 2003a, Béné 2009) which implies poverty persistency in fishing communities. Unfortunately, there has been very little detailed poverty research in such areas which can be used in designing poverty reduction strategies. Up to now, studies conducted at the household level are scarce (Béné 2009), the majority being conducted at village level (for example, Béné *et al.* 2003a, 2003b, 2009, Neiland *et al.* 2005) and others focusing on macroeconomic and market analyses (Turpie *et al.* 1999, Tallec and Kébé 2006, FAO 2007b, Neiland and Béné 2008). The dearth of poverty related information has seen these communities being marginalised and ignored in national and regional development programs. For example, Thorpe (2005) found that the Poverty Reduction Strategy Papers (PRSPs) in many African countries included fisheries just as a short remark. In many cases fishing communities are also the losers of agricultural development projects due to negative externalities of infrastructure investments such as irrigation dams (Jackson and Marmulla 2001, Neiland and Béné 2006, Wetlands International 2007).

To raise the profile of small scale fisheries in development policy agendas, development organizations have repeatedly called for the generation of information about the extent, nature, causes and dynamics of poverty in fishery-dependent communities (McFadyen and Corcoran 2002, FAO 2005, 2007a). This chapter therefore aims at generating this information for small scale fishing communities of the Lake Chad Basin. The objectives are: (1) To estimate vulnerability to poverty in fisheries communities in Cameroon by use of a proposed measure that incorporates the idea of asset poverty of Carter and Barrett (2006) into the expected poverty measure of vulnerability; and (2) To identify the relationship between asset levels and vulnerability.

Due to the relative remoteness and the poor infrastructure in most small scale fishing areas, 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, the analysis in 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. Thus it is possible to derive a new vulnerability measure that is capable of dividing expected poverty of a target population into structural-chronic, structural-transient, and stochastic-transient as well as never poor.

5.2 Concepts of poverty and vulnerability

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. 1*984). These measures compare the well-being of

individuals, households or populations with an exogenously defined poverty line and these 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 to which individuals fall below the poverty line at a given point in time. The disadvantage of 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. Therefore, recent empirical studies have concentrated on measuring the extent of chronic versus transient poverty (Gaiha and Deolaiker *1993*, Lipton and Ravallion *1993*, Jalan and Ravallion *2000*, Baulch and Hoddinott *2000*, McKay and Lawson *2003*, Duclos *et al. 2006*, Dercon and Calvo *2007*). These studies are mostly based on panel data.

As pointed out by Carter and Barrett (2006), while dynamic *ex post* poverty analysis is helpful in identifying differences in the nature and causes of poverty, these measures fail to distinguish between different types of poverty transitions, namely structural and stochastic transitions. Structural transition refers to a situation when households move in and out of poverty due to a change in asset level, while stochastic transition refers to cases when households move in and out of poverty due to positive (for example commodity price increases or abundant rainfall) as well as 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. Distinguishing between structural and stochastic poverty better identifies the

causes of poverty and incorporates risk into poverty measurements for the design of more effective poverty reduction strategies.

As noted by Carter and Barrett (2006), the asset based poverty measures are related to vulnerability measures as both give likely poverty prospects of households. Vulnerability introduces an element of risk into poverty analysis. The growing literature on vulnerability has produced a multitude of approaches without reaching a consensus on the most superior measure. Perhaps the four most well-known ones are: a) Vulnerability as *uninsured exposure to risk and shocks* (e.g. Jalan and Ravallion 1999, Dercon and Khrishnan 2000, Elbers and Gunning 2003, 2006, Morduch 2005); b) Vulnerability as *expected poverty*, measured as the probability that a household will be below the poverty line in some future period (e.g. Pritchett *et al.* 2000); c) Vulnerability as a *low level of expected utility*, i.e. a shortfall of a household's expected utility below some threshold level (Ligon and Schechter 2003, Günther and Maier 2008); and d) Individual vulnerability to poverty (Calvo and Dercon 2005), defined as an index of *expected deprivation*, which accounts for the probabilities of negative future events and their severity. Most recently Béné (2009) developed a more heuristic measure of vulnerability. In empirical studies the expected poverty measures are dominant (Pritchett *et al.* 2000, Chaudhuri *et al.* 2002, Christiansen and Subbarao 2005, Calvo and Dercon 2005, Günther and Harttgen 2009).

Taking the insights from the different fields of poverty research into account, a vulnerability measure is proposed here that incorporates the asset poverty concept of Carter and Barrett (2006) into the expected poverty measure of vulnerability.

5.3 An asset based vulnerability approach

The proposed measure introduces risk to the asset based poverty measure by incorporating the variance of income. It also allows to derive expected poverty transitions which permits to distinguish different forms of poverty. It is assumed that the asset stock of a given household defines the structural (or expected) income, $\hat{E}(I)$, of the household as shown in Figure 14. 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 are estimated as the share of a household's income prospects that fall below the poverty line.

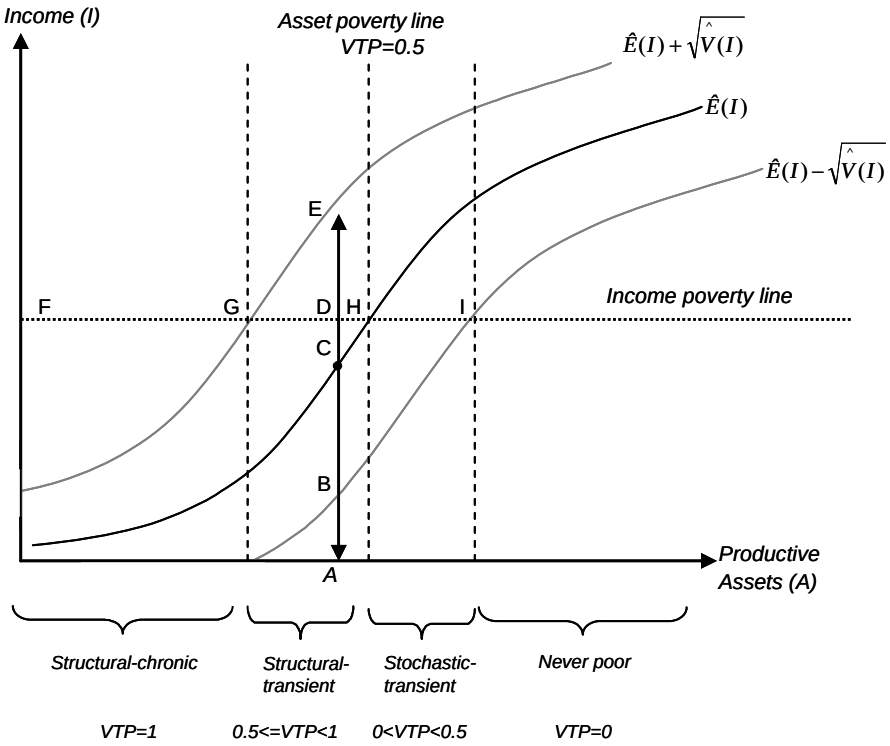

Figure 14: Illustration of asset based vulnerability measure

Source: From Carter and Barrett (2006), modified

In Figure 14, 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*, poverty prospects are represented by the distance *DB*. The household vulnerability level is therefore determined by dividing *DB* by *EB*. Formally, the vulnerability measure can be shown as:

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

When the highest possible income is below the income poverty line, those households are 100% vulnerable, i.e. they are expected to be structural-chronically 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*). They 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 here to identify the difference between structural and stochastic poverty. In summary, the different poverty groups[7] are defined as:

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

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

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 (categories 'a' and 'b'), as well as between the stochastic-transient and the non-poor (categories 'c' and 'd'). Also, in contrast to Suryahadi and Sumarto (2003), this measure 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 principle, category 'b' households require asset accumulation to get out of poverty while category 'c' households require insurance type of policies.

5.4 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

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

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 that allows to estimate the expected income $\hat{E}(\ln I_h)$ and the 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 of the income-asset equation is applied because it imposes no restrictions on elasticities of substitution and returns to scale (Kim *1*992). The model is specified as below:

$$\ln I = \ln L + \ln AGR + \ln FISH + \ln LS + \frac{1}{2}(\ln L \cdot \ln AGR + \ln L \cdot \ln FISH + \ln L \cdot \ln LS) + Z + \varepsilon, \quad (2)$$

where

I = total income per capita per day [in US$PPP]

L = land size [in ha]

AGR = value of productive agricultural assets per capita [in US$PPP]

FISH = value of productive fishing assets per capita [in US$PPP]

LS = value of livestock per capita [in US$PPP]

Z = vector of control variables that include household size, dependency ratio, age of household head, education of household head, ethnicity and regional dummies

ε = 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[8]) 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 of livestock. The value of productive assets was computed by assigning the reported market value to 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.

The first step of the 3-FGLS involves OLS estimation of equation (2), and this yields consistent estimates of the parameters affecting income generation, as well as non-independent residuals. The disturbance term from the OLS model is assumed to account for the unexplained variance in income, capturing idiosyncratic shocks that contribute to different income levels for households that are otherwise observationally equivalent[9]. Hence, in the second step the log of the squared residuals is regressed on the same variables as in the first step. This yields consistent estimates of the effect of household characteristics on the variance of income. The last step corrects for inefficiency of the OLS

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[8] As noted in chapter 4, livestock is not regarded as a production activity, but rather as an income smoothing asset. Due to the assumed variance reducing effect of this asset, the value of livestock is included as an explanatory variable in the model.

[9] The effect of idiosyncratic shocks on the variance of household income might be overstated due to omitted variable bias. However, this is not considered as a major problem in this study because the study area is rather homogenous in the factors that determine livelihood outcomes.

model by weighting it with the square root of the predicted values of the second step (Just and Pope *1979*, Christiaensen and Subbarao *2005*).

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 analyzed 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*).

5.5 Data

The data used for this analysis was extracted from the baseline data collected in May 2007. Poverty was defined in absolute terms using the $1.25 per capita per day poverty line at 1993 consumption purchasing power parity (PPP), adjusted for inflation using the national consumer price indices of April 2007. Consumer price indices data was obtained from the IMF's International Financial Statistics. The calculated exchange rate is 281.88 FCFA per $US in purchasing power parity.

5.6 Results

5.6.1 Demographic and productive characteristics

Table 5 presents some demographic and productive characteristics that have been included in the income estimation model. The household demographic characteristics show that household size is on average 4.5. The dependency ratio is comparatively small with 0.2, and educational attainment for household heads is very low. Figures on the value of productive assets suggest that households in the study area rather focus on fishing and livestock rearing, or that agricultural production is highly labor-intensive and does not demand significant physical capital. Although fishing is often considered as a

low-investment activity, evidence suggests that in order to achieve a significant contribution to household income, fishing-related assets (such as linen, nets, boat etc.) have to be purchased by the households.

Table 5: Demographic and productive characteristics included in the income model

	Mean	Std. Err.
HH Characteristics		
HH size	4.57	0.16
Dependency ratio (%)	0.20	0.02
Age of HH head (years)	44.29	0.91
Education of HH head [0-2]	0.42	0.03
Production Characteristics		
Simpson diversification index	0.46	0.01
Value of fishing assets (USD PPP)	310.81	28.48
Value of agriculture assets (USD PPP)	80.30	11.11
Value of livestock (USD PPP)	2,066.67	206.26
Land holding size (ha)	3.91	0.81
Income from fishing per capita (USD PPP)	146.63	263.02
Income from agriculture per capita (USD PPP)	251.96	271.10
Income from livestock per capita (USD PPP)	98.14	205.69
Income from other activities per capita (USD PPP)	11.93	43.31
HH income per capita (USD PPP)	508.66	490.61
N	295	

Source: Data from baseline survey 2007

The income distribution between activities confirms this assumption. Household income from the respective activities (presented in per capita values in order to account for differences in the demographic structure of households) shows, that the highest share of total income is derived from agriculture (about 50%), with fishing and livestock as complementary activities, on average. However, the econometric model proposed here is taking care of different production systems. For example, the functional relationship between agricultural assets and income is estimated, simultaneously controlling for other

asset types. By including region dummies (designating the three strata) it is also possible to control for differences in external production conditions.

5.6.2 Poverty and vulnerability

As already hypothesized, observed income levels are assumed to contain a stochastic element, resulting from changing external conditions such as rainfall, quality of production inputs and other factors. In order to predict expected (or structural) income levels a 3-FGLS model has been applied to both data sets. The results are presented in Table 6.

Table 6: Results of the 3-FGLS income estimation model for $\hat{E}[\ln I]$ and $\hat{V}[\ln I]$

	lnI		lnResid²	
Variable name	Coef.	P>|t|	Coef.	P>|t|
lnL	0.0082	0.87	-0.0531	0.82
lnAGR	0.0249	0.39	0.0111	0.95
lnFISH	0.0986***	0.00	0.1184	0.31
lnLS	0.2599***	0.00	-0.2882***	0.00
lnL x lnAGR	0.0275	0.19	0.0648	0.52
lnL x lnFISH	-0.0528***	0.00	0.0897	0.18
lnL x lnLS	0.0578***	0.00	-0.0868	0.20
Age of HH head	-0.0022	0.28	0.0172*	0.08
HH size	-0.0885***	0.00	0.0744	0.18
Education head	0.1170**	0.02	0.5306*	0.06
Dependency ratio	0.0453	0.63	0.0436	0.94
Ethnicity	0.1154	0.25	0.1087	0.84
Region dummy 1	0.9843***	0.00	-2.5299***	0.00
Region dummy 2	0.3179**	0.01	-2.3544***	0.00
Constant	4.3258***	0.00	-0.5488	0.43
F-statistic	49.91***		2.77***	
R^2	0.45		0.12	
N	294		294	

Note: *, **, *** denote significance at 10%, 5% and 1%, respectively
Source: Own calculations based on data from baseline survey 2007

The results of the income models are consistent with expectations and the models have good explanatory powers. It is found that productive assets used for different income-generating activities such as fisheries 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.* 2000, Béné *et al.* 2003b). The coefficients of the variance equation also show that livestock holdings have a significant income-increasing and risk-decreasing effect. This confirms that livestock is used as a buffer against income fluctuations. From these equations, the expected income and the variance of the expected income were predicted which were used to estimate household-specific vulnerability levels.

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)[10] the comparison between the two measures is shown in Figure 15. The figure shows that the vulnerability estimates from the approach proposed in this chapter are consistent with the findings of the measure by 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.

[10] The alternative vulnerability measure is computed as $v_h = P(\ln \hat{I}_h < \ln z) = \Phi\left(\frac{\ln z - \ln \hat{I}_h}{\sqrt{V(\hat{I}_h)}}\right)\perp$

where Φ(.) denotes the cumulative density of the standard normal distribution.

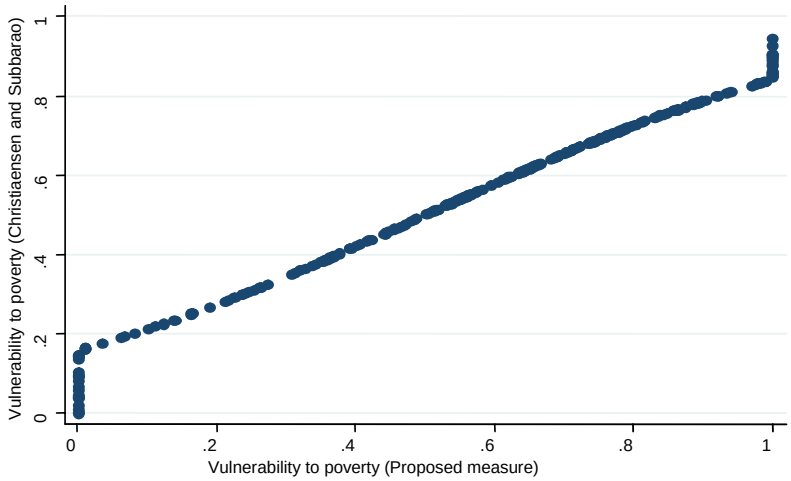

Figure 15: Scatter plot for the proposed and Christiaensen and Subbarao (2005) measures of vulnerability

Source: Illustration based on data from baseline survey 2007

Table 7 presents the poverty profiles for three groups of households, (1) households for which fishing is a primary income source[11] ($income\,share\,from\,fishing \geq 50\%$), (2) households who are engaged in fishing as a complementary activity ($0 < income\,share\,from\,fishing < 50\%$), and (3) households for which fishing is not part of their income portfolio.

In general, like in other studies on vulnerability, the results show that the vulnerable-poor ratio is greater than one, i.e. more people are vulnerable than poor (e.g. Pritchett *et al.* 2000, Chaudhuri *et al.* 2002, Makoka 2008). Due to lower expected income and the variance of income, the expected poverty head count ratio (equal to the vulnerable head count ratio with a threshold of 0.5) is higher than the observed head count ratio. Apparently, the cross-section data was collected in a relatively favorable year resulting in high observed income levels.

Table 7 also shows that poverty and vulnerability indicators are improving across the board with increasing dependence on fishing. For the non-fishing households (group 3), low expected income levels and high variation of income result in more pronounced poverty, particularly structural poverty. Adding up the structural-chronically poor and

[11] Income from fishing includes all fisheries-related activities, i.e. fishing, fish processing and fish trade.

the structural-transiently poor, over 77 percent of non-fishing households are found to be asset-poor. Households in group 2 also have a high share of chronically poor. However, 25 percent of this livelihood group are estimated to be non-poor, i.e. adverse stochastic events (as captured by the variation of the residual in the estimation model) are not supposed to push these households below the poverty line. Finally, fishing-oriented households (group 1) rank lowest in the poverty distribution. About 46 percent are estimated to be non-poor or at worst, stochastically poor. These results provide a strong argument for the value of SSF, concerning their function as a risk-mitigating and hence vulnerability reducing activity.

Table 7: Poverty profiles in the study area by fishing intensity

	Fishing as primary income source N = 68		Fishing as secondary income source N = 111		Non-fishing N = 115	
	Mean	*Std. Dev.*	Mean	*Std. Dev.*	Mean	*Std. Dev.*
observed income PC [USD PPP]	624.78	*586.74*	523.56	*465.37*	426.68	*437.60*
expected income PC [USD PPP]	467.49	*309.66*	451.68	*308.25*	342.46	*291.64*
observed PHCR	0.49	*0.50*	0.57	*0.50*	0.68	*0.47*
expected PHCR (VHCR)	0.54	*0.50*	0.67	*0.47*	0.77	*0.43*
log SD of income	0.33	*0.11*	0.33	*0.14*	0.53	*0.30*
average vulnerability level	0.57	*0.43*	0.64	*0.44*	0.75	*0.34*
structural-chronic poverty (a)	0.35	*0.48*	0.47	*0.50*	0.48	*0.50*
transient poverty	0.43	*0.50*	0.28	*0.45*	0.44	*0.50*
structural-transient (VTP>0.5) (b)	0.19	*0.40*	0.20	*0.40*	0.29	*0.46*
stochastic-transient (VTP<0.5) (c)	0.24	*0.43*	0.08	*0.27*	0.15	*0.36*
never poor (d)	0.22	*0.42*	0.25	*0.44*	0.08	*0.27*

Source: Data from baseline survey 2007

By plotting the first and second moments of the income distribution (expected income and standard deviation) on the log value of fishing assets, the negative relationship between fishing intensity and vulnerability becomes clearer (Figure 16).

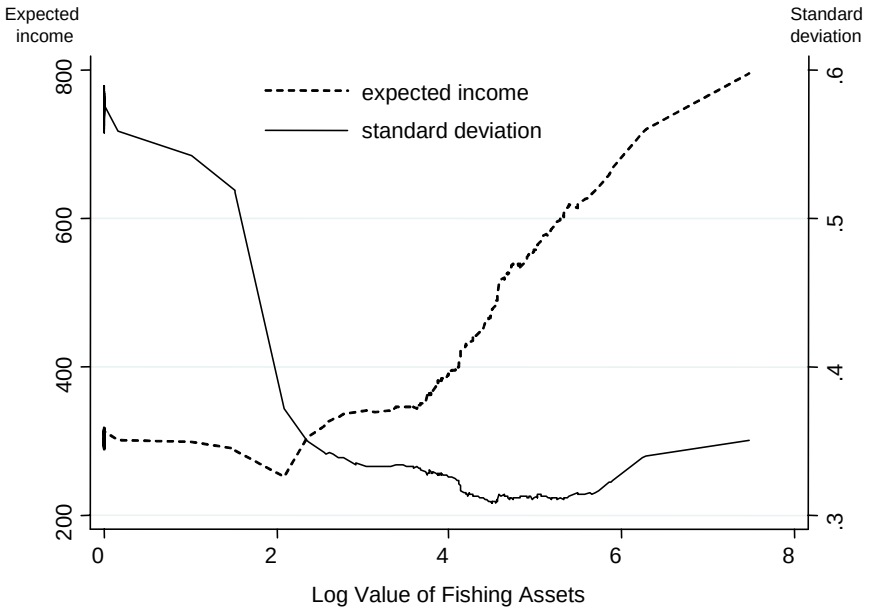

Figure 16: Lowess curves of expected income and standard deviation of log income on the log value of productive fishing assets

Source: Own illustration based on data from baseline survey 2007

The graph concurs with apriori expectations concerning the functional relationship of income and productive assets presented in the theoretical framework. The level of asset value not only affects expected income, but also the variance of income. Again these results confirm that asset accumulation is an effective means of poverty alleviation, assisting households to move to the right hand side of the entire welfare distribution through the risk-reducing and income-increasing effect. In particular, the lowess graphs suggest that initial investments in fishing-related assets first and foremost reduce the variability of income (income smoothing), while the expected income reacts quite inelastic to increases in assets. Since labor has to be diverted from other activities to fishing, income increases are not tangible at the outset. However, income positively reacts to increases in fishing assets at a higher level.

5.7 Conclusions

The main objective of this chapter was to analyze vulnerability to poverty in fishery-dependent communities in Cameroon, and to determine the relationship between

livelihood choices and vulnerability. Incorporating the asset-based poverty model into the expected poverty concept advances the standard vulnerability as expected poverty measures in that it not only yields probability estimates but 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, the approach developed here allows to decompose 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.

In terms of the value of SSF, the results suggest that fishing forms a fundamental part of the livelihoods in the Logone floodplain. It has been shown that total household income per capita is higher for this group of households, and that poverty is less persistent among this group, as compared to other households.

For example, it is found find that structural-chronic poverty is more prevalent for non-fishing households, but that transient poverty is an issue for fishing-oriented as well as for non-fishing households likewise. Further disaggregating transient poverty gives a better insight into the causes of poverty. While a major part of the transiently poor in the non-fishing group is suffering from low expected income (structural-transient poverty), about one fourth of the fishing households is transiently poor due to temporary variation in income (stochastic-transient). This can be interpreted as susceptibility to negative shocks, although their expected income is above the poverty line. For households with fishing as a secondary occupation, income is more unequally distributed, with a large share of structural-chronically poor, but at the same time about 25 percent of households being non-poor.

The differentiation between different types of poverty has important policy implications. 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 1993, Jalan and Ravallion 2000, Duclos *et al.* 2006). This study, however, shows that transient poverty can also be structural. For this group, simply

reducing risk would not have a lasting impact on poverty reduction. Instead, there is a need to strengthen the accumulation of productive assets and their productivity by better technology and improving knowledge. The stochastic-transiently poor households to the contrary, mainly require policies that protect them from negative income shocks.

The econometric approach applied in this chapter has two shortcomings. First, the model is based on cross-section data, and makes a strong assumption, namely that intertemporal variation in income is reflected in the cross-sectional variation, controlling for household and production characteristics. The impact of negative events on income is hence assumed to be captured by the variation in the error term. The second, closely related, shortcoming is that household income is treated as an aggregated variable. The variation of income is not explicitly explained, but rather treated as a "black box". Idiosyncratic shocks are assumed to somehow result in different income levels for households that are otherwise observationally equivalent. The following two chapters are explicitly dealing with income variation and in particular with downside risk. Chapter 6 presents a simple approach to derive the stochastic distribution of income by applying portfolio theory. In particular, the income distribution is calculated as a combination of uncertain incomes from single activities, which a household is engaged in. Also, instead of relying on cross-sectional data, the mean and variance of income are derived from an outcome-activity matrix and respective probabilities, covering ten years. On the basis of the portfolio incomes derived in chapter 6, chapter 7 introduces the class of Lower Partial Moments to measure vulnerability.

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CHAPTER 6

PORTFOLIO DECISIONS UNDER CLIMATE RISK

6.1 Introduction

Climate is a major factor that determines the productivity of biological production systems. The effectiveness of rainfall for crop and fish production is a function of the temperature values which affect evaporation and transpiration. These affect the productivity of biophysical production factors, for example the soil's moisture and nutrient status. Adverse climate effects can influence biological production outputs at any stage from cultivation through the final harvest. Even if there is sufficient rain, its irregularity can affect crop yields adversely if rains fail to arrive during the crucial growing stage of the crops (Ellis 1993, Molua and Lambi 2006a). McCarl *et al.* (2008), for example, have shown that precipitation intensity (i.e. periods with high amounts of rain while the rest of the year is relatively dry) and droughts in US agriculture are harmful for the crops and are of greater concern than the annual amount of precipitation alone. Although the adverse effects of these hazards on agricultural output are prevalent in most parts of the world, they are particularly burdensome to small-scale farmers in developing countries (Hazell and Norton 1986, Reilly 1995, Smith and Skinner 2002, Tingem and Rivington 2009, IFAD 2008). Ellis (1993) and Dercon (2002) point out that production uncertainty is pervasive and serious for these households due to the unpredictable nature of climatic conditions. In combination with prevailing poverty the outcome of uncertain events makes households vulnerable to serious hardships and may "make a difference between survival and starvation" (Ellis 1993, p.82).

As outlined in chapter 4.3, climate risk and increasing variability in precipitation expose households to substantial production uncertainty. Numerous empirical studies have shown that farmers behave in a risk-averse way (Ellis 1993). As such, profit maximization is not the guiding principle for these households. Instead, rural households typically pursue the overall goal of utility maximization (Brown *et al.* 2006, Norman *et al.* 1995). Under the weak assumptions of rational behavior and risk aversion, maximizing utility is often equalized to achieving an optimal combination of mean income and risk. A central proposition in applied economics is that optimal diversification through combining activities with low positive covariance and income-skewing effects is a primary risk reducing strategy, i.e. reducing the risk of the overall return by selecting a mixture of activities whose net returns have a low or negative correlation (e.g. Di Falco and Chavas 2009, Just and Pope 2003, Dunn 1997, Thomas *et al.* 1972). In other words, households spread risk by diversifying the allocation of productive assets among various income-generating activities, often preferring farm plans that provide a satisfactory level of security even if this means sacrificing income on average (Ellis 1993, Crole-Rees 2002). Empirical studies on farmers' motivation to diversify the activity portfolio also suggest that the motivation to reduce uncertainty and risk ranks first among other possible motives (e.g. Barbieri and Mahoney 2009). Repeatedly, recommendations for policymakers therefore stress the need to support diversification to reduce rural poverty and help households to cope with increased uncertainty about possible futures (Slater *et al.* 2007, CGIAR 2005, IFAD 2008, Tingem and Rivington 2009, Molua and Lambi 2006b).

In assisting policymakers to design better intervention strategies that are capable to stabilize the incomes of the poor and decrease vulnerability, it is mandatory to have a good understanding of the livelihoods of rural populations, and the risks they are facing. Although macro-level studies on climate risk and nation-wide yield forecasts are an important instrument to raise awareness of the coming risks, there is a need for higher-resolution system studies, which can suggest development interventions adapted to local needs and conditions. Thornton *et al.* (2008, p.41) argue strongly "against large 'magic bullet' approaches, and in favor of smaller, better targeted local approaches and interventions". Reidsma *et al.* (2009) point out that in order to project impacts of future

climate change on agriculture, current farm management strategies as well as their influence on current production need to be considered.

This chapter presents an approach to measuring climate risk and its impact on livelihood outcomes in fishery-dependent communities in the *yaéres* floodplain (Far North Province of Cameroon). A visual impact method (Hardacker *et al.* 1977) has been used to collect data on risk in agricultural and fisheries production for a representative sample of 238 households. As analytical instruments the portfolio theory (Markowitz 1952) and stochastic dominance rules are applied. The focus of the analysis is put on the question, how portfolio decisions of households affect income and risk in different production systems. This approach allows the identification of the relative role of different livelihood activities in the income portfolio. Assuming possible future scenarios it is possible to derive approximate predictions of the effects of climate change and rural development interventions on income and the 'riskiness' of different activity portfolios, and draw useful conclusions for policy makers with regard to sustainable rural development and poverty alleviation in Sub-Saharan Africa.

6.2 Approaches to risk and diversification

Empirical studies on diversification and risk can be broadly divided into two fields. One approach focuses on the analysis of cross-section or panel household data, investigating for example the effects of diversification on mean income by use of econometric models. These approaches allow the identification of the contribution of, for example, farm or off-farm activities to overall increases in income (e.g. Reardon *et al.* 1992, Crole-Rees 2002). A second approach is explicitly dealing with risk, employing a wide variety of formal risk analysis instruments that have been developed in the last decades in order to come up with effective risk-management strategies for rural households. Such farm planning models that are designed to find an optimal combination of production activities of a representative farm are based on the portfolio theory (Markowitz 1952), which has its analytical foundation in Von Neumann and Morgenstern's expected utility theory under uncertainty (Varian 2006). One strand of agricultural economics literature has

concentrated on optimization methods with mathematical programming techniques to model farm decision problems and to find the portfolio of activities which maximizes expected utility (EU) under risk. Among others, these comprehend the application of expected utility theory on the treatment of optimal farm plans by use of the mean-variance (E-V) criterion with quadratic programming models (Markowitz 1959, Tew *et al.* 1992, Scott and Baker 1972). The solution of the optimization problem yields a bundle of efficient portfolios, i.e. the household rationally restricts his choice to those farm plans for which the associated income variances are minimum for given expected income levels (e.g. Hazell and Norton 1986). Given a set of efficient farm plans the choice of a particular plan will depend on the household's preferences among various expected income and associated variance levels. Assuming that a utility function with a specific risk-aversion coefficient is given, a unique utility-maximizing farm plan can be rigorously identified. However, quadratic utility functions have been largely dismissed due to implied increasing absolute and relative risk aversion (Brogan and Stidham 2008, Elton and Gruber 1991, Unser 2000).

Other approaches deviate from the use of the E-V criterion and instead use target-related risk criteria with linear programming, such as the MOTAD model by Hazell (1971), the Target MOTAD by Tauer (1983) and Teague *et al.* (1995), or the MRCLP model by Chen and Baker (1974). Recent applications of linear programming models in Africa can be found in Adesina and Ouattara (2000) for Côte d'Ivoire, Kuyiah *et al.* (2006) for Kenya, or Umoh (2008) for Nigeria.

Despite the normative appeal of EU theory, the use of utility functions to derive an optimal farm plan has been disputed due to several reasons. The main argument is that the assumption of certain risk aversion parameters is often arbitrary, and the difficulty and vagueness in the process of eliciting utility functions by use of aggregate data renders empirical applications little more than illustrative exercises (Unser 2000, Just and Pope 2003). Besides, Tew *et al*. (1992) show that different assumptions concerning the utility function and the risk aversion parameter result in quite pronounced differences in the EU approximations. Also, Lence (2009) strongly suggests that the use of typical production

data is unlikely to allow the identification of the risk-aversion structure, and that the quality of utility parameters is very poor. In a critical review of formal risk analysis models, Pannell *et al.* (2000, p.76) argue that "for decision problems most commonly modeled by agricultural economists, the extra value of representing risk aversion is commonly very little", and that the identification of the optimal farm plan is often of secondary importance in determining how farms are managed, since a normatively plausible theory does not inevitably lead people to apply its implications (Unser 2000).

Therefore, in the following analysis no assumptions are made concerning a utility function. Since the specific form of the utility function is irrelevant if returns follow a normal probability distribution, the complexity of decision is reduced by using the moments of income distributions in describing the return to assets for different activities and associated risk levels. Applying stochastic dominance rules to compare the performance of different livelihood systems yields the same result as maximizing expected utility for risk-averse households (Unser 2000). Moreover, instead of using a typical farm representing the type of production systems found in the study region as is usually done in mathematical optimization models, income distributions are generated for each individual household.

6.3 Methodology

Developed by Markowitz (1952), the portfolio theory was particularly designed for risk analysis of financial asset portfolios. The fundamental intuition of portfolio theory is that, depending on the correlation structure of asset returns, the risk of a combination of assets is not equal to the sum of single asset risks. As a measure of risk, traditional portfolio optimization uses the standard deviation or variance of returns. An overwhelming number of publications have since been devoted to the development of risk measures, the analysis of portfolio risk, and particularly to optimization problems which aim at establishing expected value-variance approximations that produce maximum or nearly maximum expected utility (for a comprehensive overview of this topic see e.g. Bruns and Meyer-Bullerdiek 2008).

In the portfolio analysis framework each asset is treated as a random variable with its specific returns and risk (represented by mean and variance of returns), instead of just looking at the mean and variance of total return. Asset-specific performance measures are then combined in a general portfolio mean and variance. The computation of the portfolio mean is the sum of the mean returns of assets i (μ_i), weighted by the share of the budget allocated to the ith asset (w_i), with $i = 1,...,N$.

$$\mu_P = \sum_{i=1}^{N} w_i \mu_i \ .$$

Portfolio variance is composed of the weighted variances and covariances of single assets:

$\sigma_P^2 = \sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma_{ij}$, where σ_P^2 is the portfolio variance, and σ_{ij} is the asset variance (for $i = j$) or the covariance between assets (for $i \neq j$)

The combination of assets in a portfolio results in the diversification effect, which is increasing with decreasing correlation between asset returns (ρ_{AB} is the correlation coefficient). Figure 17 shows the diversification effect graphically in a two-asset case.

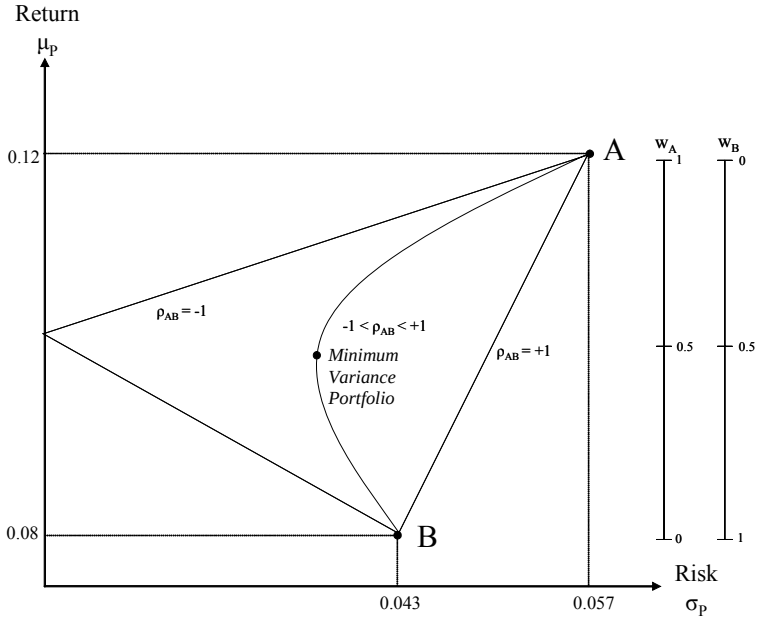

Figure 17: Risk reduction through diversification in a two asset case and different correlation coefficients

Source: Adapted from Kruschwitz (2005)

In the case where the correlation coefficient of returns is equal to 1, there is a perfect linear relationship between the assets, so that no risk-reducing effect can be achieved by combination of the two assets. The other extreme case where correlation is -1, risk can be completely eliminated through a certain combination of assets. In the case of more than two assets, portfolio theory therefore provides a simplification of the decision problem. The selection problem can be reduced to a set of „efficient portfolios" where risk is minimal for a given portfolio return or where return is maximal for given risk levels.

Many studies have adopted the portfolio theory to agricultural planning models since the 1970s (e.g. Thomas *et al.* 1972, Scott and Baker 1972, Tew *et al.* 1992, Umoh 2008). These models determine risk-efficient portfolios of production activities for a homogeneous group of subsistence farmers. The portfolio theory permits to identify the relative effect of single income generating activities to total income risk, and to identify utility-maximizing combinations of activities.

In this chapter portfolio decisions of rural households living in fishery dependent communities are analyzed by applying the general portfolio theory. For the analysis of activity portfolios the following assumptions are made:

1. Decision makers behave in a rational way, i.e. productive assets are allocated among the different activities in order to maximize total utility.
2. The relative weight of each activity in the portfolio is represented by the share of assets allocated to this activity: $w_i = \sum_{a=1}^{m} \frac{x_{a,i}}{X}$, where a denotes the productive assets or input factors (a = 1,…,m), and i denotes the income generating activities (i = 1, …,n) a household is engaged in. In particular, for simplification reasons labor is assumed to be the limiting factor. Income generating activities in the study region such as crop production or fishing are characterized by high labor intensity. In addition, the substitutability of capital and labor is very limited. The input factors can therefore be reduced to one single input variable, labor, and hence

income of activity i is a function of labor input: $I_i = f(L_i)$ and $w_i = \frac{l_i}{L}$, where L is total labor available to the household, measured in mandays.

3. Labor is fully utilized among the different activities in the portfolio of a given household. $\sum_{i=1}^{n} w_i = 1$.

4. Linear production functions are assumed for each activity, i.e. marginal productivity is constant with increasing labor input: $\frac{\partial I_i}{\partial L_i} = const > 0$ and $\frac{\partial^2 I_i}{\partial L_i^2} = 0$

5. The returns to labor for each activity are computed as the maximum possible income if all labor would be assigned to the respective activity. The portfolio income then results from the allocation of labor to the different activities.

In the analysis of production systems it is important to differentiate between the concepts of uncertainty and risk. While uncertainty is typically defined as a situation where it is not possible to identify a set of events and their respective probabilities, risk is restricted to situations where the analysis of decision-making choices can be done subject to the (objective or subjective) probabilities of identifiable states of the world (Ellis 1993). Chicken and Posner (1998) state, that any definition of risk is likely to carry an element of subjectivity, depending upon the nature of the risk and to what it is applied. As such, they define risk as a function of hazard and exposure, where hazard is 'the way in which a situation can cause harm', and exposure is 'the extent to which the likely recipient of the harm can be influenced by the hazard', implying the notions of frequency and probability. Within the setting of agricultural production of rural households in developing countries, risk can hence be best captured by analyzing the impact of adverse climatic situations on production outputs (crop yield and fish catches), price, and income (as a combination of the two).

The stochastic distribution of returns for each activity results from yield and price variations between years with different climatic conditions. Denote $s = (1,...,S)$ the set of

states of nature, and assume it is finite. Then $E(I_i)$ and $V(I_i)$ are functions of the probabilities γ_s, yield $Y_{i,s}$ and price $P_{i,s}$. More precisely:

$$E[I_i] = \sum_{s=1}^{S} \gamma_s \cdot Y_{i,s} \cdot P_{i,s},$$

$$V[I_i] = \sum_{s=1}^{S} \gamma_s \cdot (Y_{i,s} \cdot P_{i,s} - E[I_i])^2, \text{ and}$$

$$Cov[I_i, I_j] = \sum_{s=1}^{S} \gamma_s \cdot (Y_{i,s} \cdot P_{i,s} - E[I_i]) \cdot (Y_{j,s} \cdot P_{j,s} - E[I_j]) \text{ for all } i \neq j \in n.$$

The mean and variance of the portfolio is then:

$$E[I_{PF}] = f(\vec{w}_i, E[I_i|\gamma_s, Y_s, P_s]) = \sum_{i=1}^{n} w_i E[I_i],$$

$$V[I_{PF}] = f(\vec{w}_i, V[I_i], Cov[I_{i,j}]) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij}^2.$$

The two moments of the distribution of portfolio income describe the stochastic nature of production, depending on the uncertain outcomes of the single activities.

In order to compare different income portfolio compositions in terms of utility maximization, stochastic dominance (SD) rules are applied. An advantage of SD is that it does not require the assumption of a specific risk-utility function. The knowledge of a concrete function is replaced by assumptions about properties of a function, thus simplifying the decision problem by sorting out dominated alternatives (Brandes and Odening 1992, Unser 2000).

As such, distribution B is said to dominate distribution A stochastically at order α if $D_A^\alpha(x) \geq D_B^\alpha(x)$ for all $x \in R$, where $D_A^\alpha(x) = \frac{1}{(\alpha-1)!}\int_0^x (x-y)^{\alpha-1} dF(y)$ (Davidson and Duclos 2000). Under the weak assumption of risk aversion SD can be embedded into general utility theory as follows (Schmid and Trede 2006, Unser 2000):

- For all $u(x) \in U_1 \equiv \{u(x)|u'(x) > 0\} \Leftrightarrow FSD\ (\alpha = 1)$,

- For all $u(x) \in U_2 \equiv \{u(x) | u'(x) > 0 \, and \, u''(x) < 0\} \Leftrightarrow SSD \ (\alpha = 2)$,
- For all $u(x) \in U_3 \equiv \{u(x) | u'(x) > 0; u''(x) < 0 \, and \, u'''(x) > 0\} \Leftrightarrow TSD \ (\alpha = 3)$.

Probability distributions of income can therefore easily be compared among each other. In particular, it is possible to identify income portfolios that are more appropriate to cope with climate variability against other alternatives.

6.4 Data

The data used for this study was taken from the risk assessment exercise during the third survey (see description of data collection procedure in chapter 3.2). By applying the visual impact method, data were collected on crop yields, prices, and income flows from fishing for the past 10 years, together with subjective probabilities of different states of the world.

6.5 Results

6.5.1 Climate risk and agricultural production

Production risk, as a function of hazard and exposure, is reflected in the stochastic distribution of yield levels[12]. Figure 18 shows the cumulative density functions for sorghum, millet and rice yields and prices over the period of 10 years (based on data from the risk assessment exercise), as well as the income distributions. In general, the analysis of yield distributions confirms empirical findings that higher output is often associated with higher risk. Average yield is lowest for sorghum with 526kgy^{-1} (sd = 272) and highest for rice with 1712kgy^{-1} (sd = 650). In terms of yields, rice is clearly dominating millet and sorghum by first-order stochastic dominance.

[12] Concerning fishing catch levels, it turned out to be impossible to collect reliable recall data on the quantity of fish production due to the large diversity of fish species, fish sizes and catchment levels varying from day to day. Farmers however could report the revenues from fishing, which have been incorporated into the analysis of portfolio income.

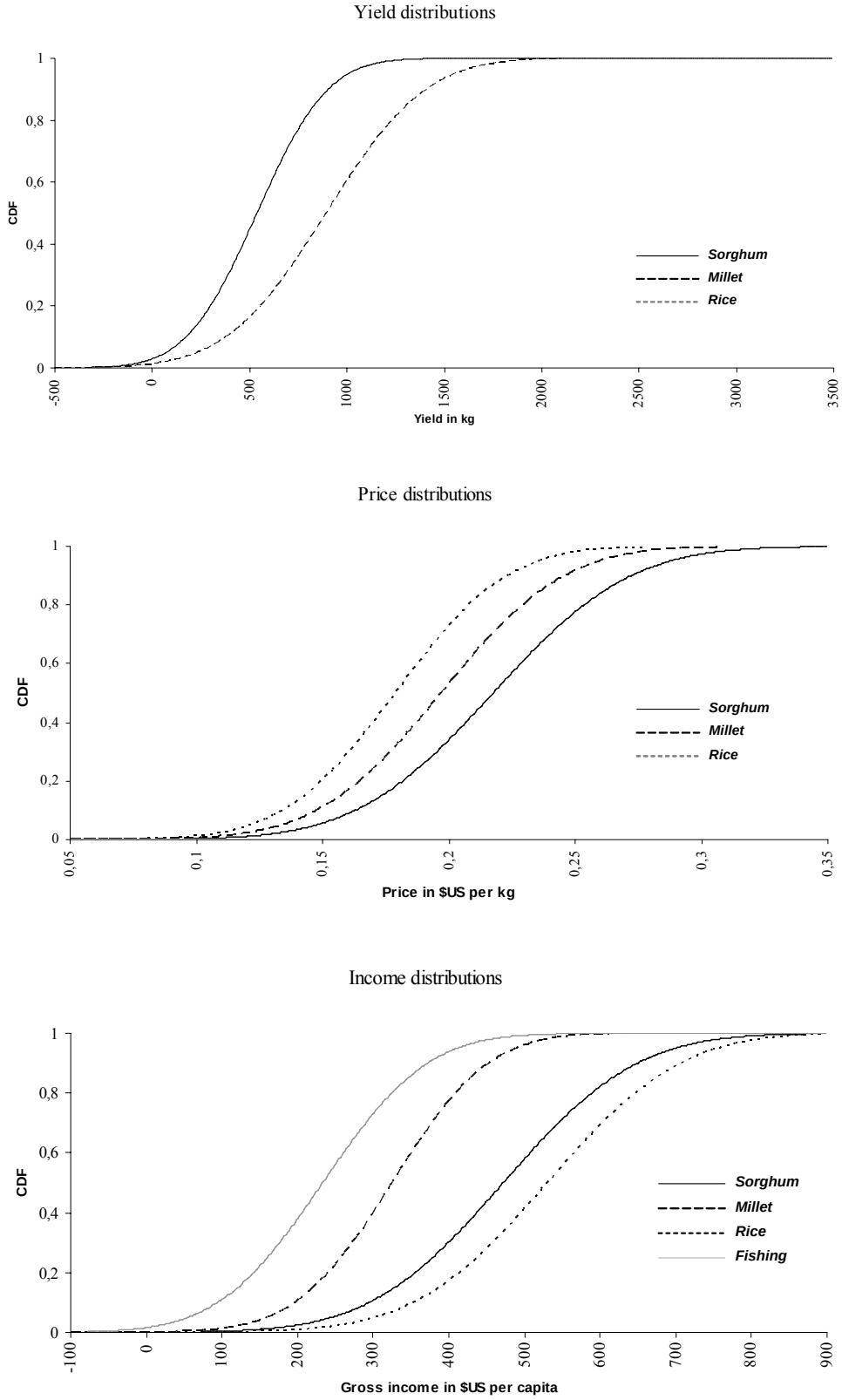

Figure 18: Cumulative distribution curves of yield, price and income levels for the major activities

Source: Own data from risk assessment interview

Since the price for the major agricultural commodities - sorghum, millet and rice - is a function of the overall supply in the regional markets, a considerable variation in price can be expected due to a supply shortage in bad years and an oversupply in good years. The variation of price is therefore depending on aggregate supply and demand, and hence on the sensitivity of crop yields to climate variations. Overall, it can be observed that prices for all three crops have comparable distributions, although prices for sorghum are highest and display the lowest variation, while rice is the cheapest cereal with the highest variation in price. The reverse order of stochastic dominance between prices and yields suggests that the variation in yield is partly compensated by inversely proportional variation in prices. Despite the countervailing effect of prices on the variation of yield levels, the value product, measured as gross income per capita, shows that incomes from cropping and fishing are also highly stochastic. By first-order stochastic dominance, rice is dominating other crops, while fishing income is being dominated by farming activities.

Nevertheless, the question remains, how combinations of different activities in a specific portfolio may contribute to risk reduction or utility maximization of rural households.

Diversification of production as a risk-management strategy can only be pursued in the space of possible activities. Chaplin (2000) notes that there might be multiple reasons for varying levels of specialization and diversification one of which is the availability of resources (i.e. soil type, local climate, water availability, etc.) that affect the opportunities of income diversification. The income distributions displayed in Figure 18 compose the space of possible diversification decisions for households in the study region. Distributing labor among the possible activities results in a portfolio income and associated risk, measured by the standard deviation of income. Portfolio theory suggests that substantial risk-mitigating effects can be achieved by combining activities with low correlation of returns. However, the strong dependence on seasonal rainfall patterns in the study area implies a low diversification effect (Table 8). A low rainfall level not only means that crop yields are threatened, it also results in low water levels in the water bodies which affects the reproduction of fish during the inundation period, and therefore reduces fish catch volumes and income from farming.

Table 8: Pearson correlation coefficients for income between activities

	Sorghum	Millet	Rice	Fishing
Sorghum	1.00	0.74	0.86	0.93
Millet		1.00	0.91	0.87
Rice			1.00	0.85
Fishing				1.00

Source: Own data from risk assessment interview

Nonetheless, households are observed to diversify their income portfolio. Table 9 shows the share of labor allocated to the primary activity, the average portfolio income, the average standard deviation of income, the average number of activities, and the Simpson Index of Diversity (SID)[13]. Total portfolio income is derived by combining the moments of the distribution of single activities, weighted by the labor share allocated to the respective activity. The mean and variance of portfolio income now not only depend on the distribution characteristics of income from each activity but particularly on the specific combination of activities. The diversification effect, as suggested by portfolio theory, is expected to be low due to high correlation coefficients. Nonetheless, it is hypothesized that differences in labor allocation might significantly affect household income and risk liability.

Table 9: Diversification and income distribution indicators, by livelihood group

	Sorghum growers	Millet growers	Rice growers	Fishermen
N	91	27	90	30
Percent of sample	0.382	0.113	0.378	0.126
Average labor allocation to primary activity (in percent of total labor)	0.491	0.365	0.532	0.319
Mean portfolio income (in $US)	408.1	276.0	247.7	579.4
SD of income	151.4	69.7	54.3	176.1
No of activities	1.96	2.56	2.10	2.77
SID	0.66	0.78	0.62	0.82

Source: Own data from risk assessment interview

[13] The SID is computed as: $1-\sum_i w_i^{\,2}$, where w_i is the labor share allocated to activity *i*.

Although there is a multitude of possible combinations of the four activities, sorghum, millet, rice and fishing, and the specific portfolios are different for every household, for simplification and comparison reasons, households are classified into four livelihood systems considering the activity with the highest labor allocation (measured in mandays) as the primary activity. Hence households were classified as (1) Sorghum growers, (2) Millet growers, (3) Rice growers, and (4) Fishermen. Income distributions for these four livelihood groups show the following order by second-degree stochastic dominance:

Fishermen $\succ$ Sorghum growers $\succ$ Millet growers $\succ$ Rice growers (Figure 19).

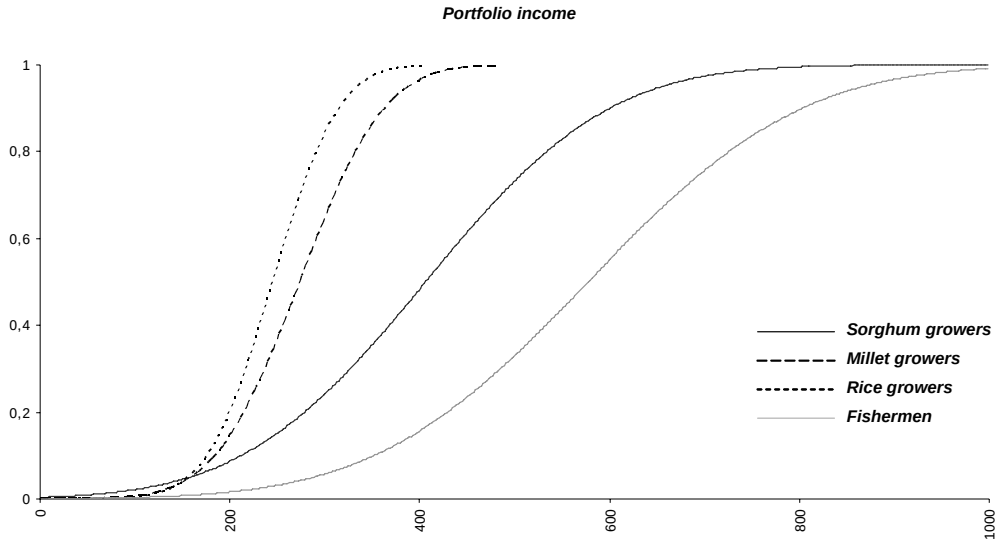

Figure 19: Cumulative distribution curves of portfolio income, by livelihood group

Source: Own data from risk assessment interview

This result shows that despite the fact that income from fishing was clearly dominated by rice (see Figure 18), fishermen excel in the overall portfolio income distribution by combining fishing with other activities. This indicates that livelihood choices may have an impact on risk liability.

6.5.2 Scenario analysis

In order to test, how certain hypothetical interventions would affect income and risk, a scenario analysis has been conducted based on research findings and policy propositions, which are described below.

Following forecasts on climate change it can be assumed that extreme events, such as flooding and drought will occur more often in the future. As exemplified by McCarl *et al.* (2008) higher variance in climate conditions tends to lower average crop yield and increase the variability of crop yield distributions. In combination with ongoing aridification and desertification of the study area, it can be presumed that the probabilities of extreme events will increase in the future. To simulate such changes on the portfolio outcomes, a shift of probabilities is assumed from a "normal" year to "good" and "bad" years in the subjective probabilities distribution by 50% respectively. The first scenario therefore shows the trend in income and risk changes due to climate change.

Addressing climate risks, autonomous adaptation strategies, such as changing crop varieties, altering the timing or location of cropping activities, or diversification, are highly relevant for smallholder farmers (IFAD 2008). Certainly, in the context of agricultural production under water stress and increasing climate variability, a promising adaptation method is improved crop and soil water management (Giorgis *et al.* 2006, Molua 2008). According to Ellis (1993), perhaps the most obvious policy response to rainfall variability is that of irrigation, which may not only alleviate the risk of drought but also smooth out within-season fluctuations of water supply. A number of qualitative and quantitative studies have shown that irrigation is an effective means to countervail the adverse effects of climate variability, such as loss of rainfall and high temperatures (e.g. Molua 2008, Hassan and Nhemachena 2008, Carsky *et al.* 1995). Kurukulasuriya and Mendelsohn (2006), for example, examine how climate affects the net revenues of dryland and irrigated land controlling for the endogeneity of irrigation. They find that precipitation has virtually no effect on the net revenues of irrigated farms, implying that irrigation serves as a buffer against rainfall variation. Similar findings are provided by Kurukulasuriya and Mendelsohn (2008). A trial experiment in the Maroua-Salak region

by Carsky *et al.* (1995) demonstrated, that the response of dry season sorghum to supplemental irrigation is substantial with up to 60 percent yield increases. They therefore suggest that research should focus on improvements in soil moisture availability. For the second scenario the effects of a project on improved irrigation in sorghum production is therefore tested as a model case for other similar development projects. Based on Carsky *et al.* (1995) a 55% increase in sorghum yields is assumed for bad years by improved soil moisture. Apart from the income-increasing effect such an improvement in sorghum cultivation would also most certainly result in lower correlation of sorghum yields with other crops.

Another proposition to address the problem of poverty and vulnerability is to provide additional income for the poor through diversification in fish production (CGIAR 2005). However, a major obstacle to risk-reduction via diversification is the almost perfect correlation of crops and fishing activities for the sample population. If the dependency of fishing on climatic conditions such as rainfall could be alleviated, income variation from fishing could be disconnected from the variation in agricultural income. This effect is assumed to be best achieved through aquaculture and bringing new small bodies of freshwater into fish production (CGIAR 2005). Similar to the effect of irrigation, which smoothes crop yields, fish production through aquaculture is assumed to significantly reduce the dependence on rainfall and the reproduction rates of the fish stock in the Maga Lake, the Logone and its tributaries, and would hence particularly address the problem of high correlation of income. Since making assumptions concerning the income-increasing effect of an aquaculture project would be elusive, this scenario simply estimates the risk-reducing effect of decreasing covariation between fish and crop production by setting the correlation factor to zero. The results of the scenario analysis are presented in Table 10.

In general the findings show significant differences in mean and standard deviation between intervention scenarios and the original scenario. Under the extreme events scenario, where more frequent occurrence of good and bad years is assumed as compared to an average year, risk (i.e. the variation in portfolio income) is increasing for all

livelihood groups by up to 23 percent. While slight income increases can be realized under this scenario, the difference is non-significant except for sorghum growers.

Table 10: Mean and standard deviation of portfolio income for different scenarios, by livelihood group

		Sorghum growers	Millet growers	Rice growers	Fishermen
N		91	27	90	30
Percent of sample		0.382	0.113	0.378	0.126
SID		0.66	0.78	0.62	0.82
Mean and standard deviation of income					
Original scenario	Mean	408.1	276.0	247.7	579.4
	SD	151.4	69.7	54.3	176.1
Extreme events scenario	Mean	431.6***	280.9	246.9	605.6
	SD	186.6***	82.1***	65.1***	214.5***
Sorghum increases scenario	Mean	443.79***	276.25	248.62**	584.37***
	SD	132.37***	69.53	53.66**	172.79***
Aquaculture project scenario	Mean	408.1	276.0	247.7	579.4
	SD	150.0**	64.4***	50.6***	155.6***
Change in percent (relative to the original scenario)					
Extreme events scenario	Mean	5.77	1.75	-0.34	4.53
	SD	23.24	17.84	20.04	21.78
Sorghum increases scenario	Mean	8.75	0.08	0.37	0.86
	SD	-12.57	-0.18	-1.10	-1.88
Aquaculture project scenario	Mean	0.00	0.00	0.00	0.00
	SD	-0.91	-7.58	-6.75	-11.63

Source: Own data from risk assessment interviews
Note: *, **, *** indicate significance levels of difference in mean to original scenario at 0.1, 0.5 and 0.01, respectively (paired T-test).

As for the sorghum irrigation scenario, the results show sorghum growers may potentially profit from improved soil moisture. Under this scenario an income increase of about nine percent and at the same time a 12.6 percent decrease in variation of income may contribute to improved livelihoods of this group. The effects for other livelihood groups are comparatively small since sorghum makes up only a small fraction of income for these households. For the aquaculture project scenario, the result confirm the hypothesis, that decreasing correlation of income flows from fishing and agriculture may result in lower risk. For all groups, but especially for households who mainly depend on fishing, income risk would be significantly reduced by such an intervention. Of course,

the feasibility and economic efficiency of aquaculture projects in Cameroon need to be evaluated and debated, which is however out of scope of this thesis.

6.6 Conclusions

The objective of this chapter was the identification of the effect of climate variability on livelihood systems as well as the potential impact of certain policy interventions on income and risk. Susceptibility to climate risk is supposed to vary between different livelihood systems, and projects targeting at the reduction of poverty and vulnerability may need to consider the effects that these will have on different sub-populations.

Small-scale farmers and fishers in Sub-Saharan Africa often have a low adaptive capacity due to dependence on natural resources, constraints in human and physical capital, and poor infrastructure (Shewmake 2008). Repeatedly, some authors therefore express the need of governmental support in the adaptation process of small-scale farmers (e.g. Giorgis *et al.* 2006, Molua and Lambi 2006b, Molua 2008, Hassan and Nhemachena 2008, Deressa *et al.* 2009). As such, higher diversification of natural resource dependent systems, improved crop patterns, the cultivation of crops with lower water requirements, and improved irrigation mechanisms are supposed to ease water constraints and enhance productivity.

To investigate the susceptibility of production systems to climate variation in the *yaéres*, one of the major floodplains in Cameroon, portfolio theory has been applied to the analysis of income risk for 238 rural households. The results show that households often face a large variation in incomes due to climate risk despite diversification into crops and/or fishing. As in many similar settings in SSA, where livelihoods depend on natural resources, the reason is found to be a high covariation of crop and fishing incomes. It can be concluded that for subsistence households living in remote areas, diversification across crops is less likely to be an effective strategy of risk reduction. Despite the low diversification effect, farmers are nonetheless observed to engage in different activities. However this may be due to other reasons. For example, in a study on coping and adapting strategies to climate variability of Bolivian rural families, Valdivia *et al.* (2003)

concluded that indigenous knowledge on climate and the ability to make forecasts can even be undermined as a result of income diversification. It has also been argued that agricultural diversification is pursued by rural households not as a risk management strategy but rather due to economies of scope and/or to satisfy own demand for diversity in consumption (Barrett *et al.* 2001, Omamo 1998).

Concerning policy implications, sensitivity analysis suggests that climate change, i.e. increasing frequency of extreme events, will worsen the situation of high production risk for the surveyed households. However, it has been shown that development intervention strategies, which particularly aim at changing the covariation structure of income flows, are most successful in reducing risk, and potentially increasing income. This is in line with other findings. For example, Ito and Kurosaki (2009), show that off-farm employment is used by Indian farmers to stabilize income in the face of production risk. They therefore recommend policy interventions to promote sectors whose wages are less correlated with farm production shocks. Literature suggests that off-farm employment is an adequate diversification strategy, since it shows little or no price correlation between activities thereby stabilizing the variability in agricultural income (Barlett 1991, Kimhi and Bollmann 1999). Despite the theoretical attractiveness of such diversification strategies, implementing off-farm labor in the analysis proved not to be possible, since off-farm activities are extremely limited for the households in the surveyed area. However, irrigation projects show a promising effect on income and risk reduction. It is argued that small-scale irrigation projects are of a more sustainable nature since large-scale irrigation project as the SEMRY have proven to be damaging to the ecosystem and to the livelihoods of the people in the *yaéres* floodplain.

Taking the common notion of risk as a negative undesired characteristic of an alternative in account, and going beyond a mean-variance analysis, would make the analysis of income distributions more powerful (suggested by e.g. Brogan and Stidham 2005, Albrecht and Maurer 2002, Unser 2000, Cheng *et al.* 2004, and Di Falco and Chavas 2009). The next chapter expands the analysis of income portfolios under risk by use of a more sophisticated measure of downside risk, the class of lower partial moments.

This chapter is a modified version of:
Witt, R. and H. Waibel (2009): „Lower Partial Moments as a Measure of Vulnerability to Poverty in Cameroon ". Working paper, Leibniz University of Hannover

CHAPTER 7

CLIMATE RISK AND VULNERABILITY TO POVERTY

— A LOWER PARTIAL MOMENTS APPROACH —

7.1 Introduction

Research on poverty has more and more acknowledged that uncertainty and risk need to be considered in measuring the welfare position of households. In particular, the concept of vulnerability has recently become quite prominent in theoretical and empirical research. Inspired by Ravallion (1988), vulnerability is mostly defined as expected poverty (V^{EP}). Methodologically, V^{EP} measures extend the static Foster-Greer-Thorbecke (FGT) poverty measures to make predictions on the probability of being poor in the future. Some examples of this approach can be found in Pritchett *et al.* (2000), Chaudhuri *et al.* (2002), Christiansen and Subbarao (2005), Kamanou and Morduch (2001), Günther and Hattgen (2006, 2009), Günther and Maier (2008), and Béné (2009).

Although some authors (e.g. Ligon and Schechter 2003, Calvo and Dercon 2005) have been arguing that the V^{EP} measure seems to be ill-suited to represent household risk attitudes, it fulfills many desirable properties which are also inherent to the FGT poverty measures, including symmetry, replication invariance, subgroup consistency and decomposability. In particular, the V^{EP} is fulfilling the focus axiom, which states that vulnerability measures should focus on downside risk only, since favorable outcomes in

good states of the world do not necessarily ensure lower vulnerability (Calvo and Dercon 2005[14]).

To address the critique of implicit risk attitude assumptions of the V^{EP}, it is suggested that the general concept of vulnerability, defined as an *ex ante* risk measure based on stochastic welfare distributions, is not different from risk analysis concepts as they have been widely applied in the finance world since the 1950s, for example to pricing, hedging, portfolio optimization or capital allocation. In particular, the use of the Lower Partial Moments (LPMs) is proposed here as a measure of vulnerability as expected poverty. Without explicitly referring to the LPMs, this approach has also been applied in a slightly modified specification by Christiaensen and Subbarao (2005). The LPMs are one class of coherent measures of risk, introduced by Fishburn (1977) and Bawa (1975, 1978), which are measures of downside or shortfall risk, where only negative deviations from a target outcome are taken into consideration. In contrast to symmetrical risk measures, the LPMs capture the common notion of risk as a negative, undesired characteristic of an alternative (Brogan and Stidham 2005, Albrecht and Maurer 2002, Unser 2000), which is also in line with the focus axiom. Further, LPMs have a number of convenient characteristics. First, they are consistent to the ordering of distributions derived from stochastic dominance rules and utility maximization for risk-averse households. Second, LPMs are coherent risk measures, satisfying the axioms of subadditivity, positive homogeneity, monotonicity and translation invariance (Artzner *et al.* 1999, Cheng *et al.* 2004, Acerbi *et al.* 2001, Acerbi and Tasche 2002, Peracci and Tanase 2008). This set of axioms has been widely accepted and regarded as a landmark in the field of risk theory (Cheng *et al.* 2004). Third, analogous to the FGT measures, the LPMs are additively decomposable, so that vulnerability can be measured not only on individual or household level, but also be aggregated for different population groups. And finally, LPMs are intuitively interpretable, an attribute that is of eminent importance in view of policy advise. Analogous to the class of FGT poverty

[14] As already mentioned in chapter 5, Calvo and Dercon (2005) define vulnerability to poverty as an index of *expected deprivation*, which accounts for the probabilities of negative future events and their severity. In their paper they specify a set of axioms that need to be fulfilled by a vulnerability measure.

indicators, the LPMs not only identify the vulnerable, but also show how pronounced vulnerability is in terms of consumption or income under downside risk.

A related question that is also addressed here is, how to derive a stochastic distribution of welfare, particularly income. This issue is critical for vulnerability assessment, since vulnerability measures are always based on the estimated mean and variance of a welfare indicator. However, panel data of sufficient length do virtually not exist for most developing countries. Thus, some authors have suggested to apply econometric models such as the 3-step FGLS model (Just and Pope 1979), which assumes that intertemporal variation is reflected in the cross-sectional variation of the error term (see chapter 5). A possible alternative is a simple risk assessment method, which is fully sufficient do derive an outcome-activity matrix as suggested by portfolio theory (see chapter 6).

This chapter is organized as follows: In the next section the LPM risk measures will be briefly introduced and their properties discussed. Section 7.3 presents an empirical application on data from 238 rural households in Northern Cameroon in 2008. The chapter closes with a short conclusion.

7.2 Theoretical framework

Departing from the early portfolio models which were simply based on variance (or standard deviation) as a risk measure, it has been argued that the variance of an outcome variable is a dubious measure of risk, since making decisions on production or investment in a risky environment is mostly concerned with expected losses rather than expected gains. Due to the symmetrical nature of variance, this measure assigns the same weight to positive as to negative deviations from the expected value and hence does not capture the common notion of risk as a negative, undesired characteristic of an alternative, nor does it account for fat tails of the underlying distribution (Cheng *et al*. 2004, Jarrow and Zhao 2006, Brogan and Stidham 2005, Albrecht and Maurer 2002, Unser 2000). An experimental study by Unser (2000) shows that symmetrical risk measures can be clearly dismissed in favor of shortfall measures like LPMs. Hence, some recent risk assessment approaches have been using Lower Partial Moments (LPM) to describe investments in financial assets

(for example Nawrocki 1999, Schubert and Bouza 2004, Ballestro 2007). Qui *et al*. (2001), Liu *et al.* (2008) and Webby *et al.* (2008) applied the framework of partial moments (upper partial moments, or the Conditional Value-at-Risk (CVaR) which is a special case of the LPM measures) on agricultural production decisions in an uncertain environment.

The Lower Partial Moment of the lth order is defined as:

$LPM_l(x,u) := E\left[((x-u)^+)^l\right] = \int_{-\infty}^{x}(x-u)^l\, f(u)du$, where x is a target separating gains and losses, u is a random variable (e.g. income) and $f(.)$ is a probability distribution function. The reference point x can be specified as a fixed target, e.g. a given income poverty line which applies to all households equally, or as a moving target, i.e. the target is not fixed but depends on the household specific distribution of the random variable (Brogan and Stidham 2005). Schubert (1996) shows that for a normally distributed variable, the LPM of the lth order can be computed as:

$$LPM_l = \frac{1}{\sqrt{2\pi\sigma}}\int_{-\infty}^{x}(x-u)^l \cdot e^{\frac{-(u-\mu)^2}{2\sigma^2}}\, du\,.$$

Setting $l = 0$ yields the target shortfall probability[15]. The LPM of the order $l = 1$ is the target shortfall mean, often also called expected loss or expected shortfall. The LPM of order $l = 2$ is known as the target shortfall variance or target semi-variance. In this case risk is measured by squared deviations below the target x.

Applying LPMs as a measure of income risk is appealing in that there is no need to explicitly assume an arbitrary risk aversion parameter since LPMs are consistent to the ordering of distributions derived from stochastic dominance rules and utility maximization for risk-averse households (Bawa and Lindenberg 1977). Unser (2000) shows that for F to be preferred to G it is necessary and sufficient that:

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[15] The LPM_0 is equivalent to the definition of vulnerability as the probability to be poor (e.g. Chaudhuri *et al*. 2002). Under the assumption of normal distribution, vulnerability is defined as:

$$v_{ht} = \Pr(u \le x) = \Phi\left[\frac{(x-\hat{E}(u)}{\sqrt{\hat{V}(u)}}\right].$$

- For all $u(x) \in U_1 \equiv \{u(x) | u'(x) > 0\} := LPM_{0,F} \leq LPM_{0,G} \Leftrightarrow FSD$,
- For all $u(x) \in U_2 \equiv \{u(x) | u'(x) > 0 \, and \, u''(x) < 0\} := LPM_{1,F} \leq LPM_{1,G} \Leftrightarrow SSD$,
- For all $u(x) \in U_3 \equiv \{u(x) | u'(x) > 0; u''(x) < 0 \, and \, u'''(x) > 0\} := LPM_{2,F} \leq LPM_{2,G} \Leftrightarrow TSD$.

Hence, the concerns raised relating to the implicit assumption of unrealistic risk attitudes by V^{EP} measures are invalid for the class of LPMs. LPM_1 is consistent with the HARA, and LPM_2 is consistent with the DARA class of utility functions (Persson 2000).

Given the assumption of normal distribution, LPMs can be easily computed by creating a standardized variable $m = \frac{x - \mu}{\sigma}$, so that:

- $LPM_0 = F(x) = \Phi(m)$,
- $LPM_1 = (x - \mu)\Phi(m) + \sigma \varphi(m)$,
- $LPM_2 = \left[(x - \mu)^2 + \sigma^2\right]\Phi(m) + \sigma(x - \mu)\varphi(m)$.

Analogous to the FGT poverty indicators, which are defined as $P_\alpha(z) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z - y_i^*}{z}\right)^\alpha$, LPMs can be used to implement the risk dimension in measuring welfare (Table 11).

Table 11: Analogy between FGT and LPM indicators

FGT			LPM		
Order	Indicator	Interpretation	Order	Indicator	Interpretation
α=0	Poverty incidence	Headcount ratio	l=0	Shortfall probability	Probability that expected income will be lower than target
α=1	Poverty depth	Poverty Gap Index = average shortfall of living standards from the poverty line	l=1	Expected Shortfall	Expected negative deviation from target
α=2	Poverty severity	Weighted sum of poverty gaps (e.g. Squared Poverty Gap Index)	l=2	Target Semi-Variance	Squared deviations below the target.

Source: Own illustration

Setting the target x equal to a given poverty line, FGT poverty measures and LPMs can be directly compared. A potential problem with the safety-first criterion is that the definition of the subsistence minimum is essentially arbitrary (Alderman and Paxson 1992). The same concern is also often raised regarding the use of a poverty line for general economic poverty analysis. A possible solution is the use of a moving target $x = E[u]$ (Brogan and Stidham 2005, Povell 2009). In the case of a normal distribution, LPM_0 would be 0.5 for all cases. The LPM_1 however would reflect the risk of loss relative to the respective household's living standard and not to an arbitrary poverty line. It seems reasonable to assume that the overall objective of an economic agent is to not fall below the expected or mean income, i.e. to improve or at least to maintain the habitual living standard. The assumption of a poverty line may do injustice to households that are relatively better off, but still face a high risk of losses due to some stochastic events. Nonetheless, for the purpose of this chapter a fixed income poverty line is assumed, which is defined as 50% of the average portfolio income of the sample. This assumption still permits to derive risk measures for all households irrespective of their classification as poor or non-poor applying the FGT measure.

7.3 Results

Overall, the results show similar behavior of the poverty (FGT) and vulnerability (LPM) measures, which is in line with the majority of research findings. Vulnerability is nonetheless found to be higher than poverty over the whole range of indicators. This is largely due to the fact that downside risk is considered in the analysis on dynamic poverty. To test for the sensibility of results to the definition of the poverty line, a sensitivity analysis has been conducted (Table 12). Taking the average portfolio income of 354USD, the poverty line is shifted upwards by ten percentage points from ten to 90 percent of the mean income. To account for the fact that the expected shortfall is computed for all households, while the poverty gap only holds for the poor household, both indicators are presented for the group of poor households, which increases from almost zero to over 54 percent of the sampled households. The results show that the

expected shortfall (LPM_1) is in all cases greater than the average poverty gap (FGT_1). Hence, the definition of the poverty line is not supposed to alter the ordering of households by applying poverty and vulnerability measures. Therefore, a relative poverty line of 50 percent of the mean income is applied in the following sections for comparison purposes.

Table 12: Sensitivity analysis of FGT and LPM indicators to an increase of the poverty line

Threshold of mean income	Poverty line [PPP USD]	Poverty head count ratio	Average poverty gap [PPP USD] (poor only)	Shortfall probability	Expected Shortfall [PPP USD] (poor only)
0.1	35.4	0.00	14.87	0.03	14.87
0.2	70.8	0.06	11.76	0.09	21.94
0.3	106.2	0.14	32.25	0.17	37.54
0.4	141.6	0.20	46.05	0.24	56.06
0.5	**177**	**0.28**	**67.48**	**0.31**	**70.99**
0.6	212.4	0.36	76.05	0.38	89.14
0.7	247.8	0.40	94.77	0.44	114.04
0.8	283.2	0.47	107.45	0.50	131.22
0.9	318.6	0.54	122.58	0.55	148.51

Source: Own data from risk assessment interview

Households have been categorized into four livelihood groups, i.e. sorghum, millet and rice farmers, or fishermen, if the major part of household labor is allocated to the respective activity. Table 13 presents the moments of the income distribution, i.e. the average annual portfolio income per capita and the standard deviation of income, as well as the FGT poverty indicators and LPM vulnerability indicators for each group.

It is found that 28 percent of the sampled households are poor[16] with an average poverty gap of 64.5USD. Poverty however is unequally distributed among the livelihood groups. While only about ten percent of sorghum growers and fishermen have a (time-mean) income below the poverty line, poverty incidence among millet and rice growers is 37 and 50 percent, respectively. The same pattern is observed in terms of the average poverty gap, where rice growers have the largest poverty gap with 60.44USD per capita among the poor and 37.71USD per capita for the whole sample.

[16] Since the time-mean household income is used here, the poverty measures can be interpreted in the sense of Jalan and Ravallion's (2000) chronic poverty measure.

In terms of vulnerability, the average shortfall probability is 31 percent with an expected shortfall of about 71USD. However, vulnerability comparison between the poor and the non-poor reveals that poor fishermen are second in terms of the expected shortfall with 71USD, while the loss risk for poor sorghum and millet growers is much lower with about 54USD. This indicates that poor households growing millet and sorghum as their primary crop are less liable to production risk than fishermen.

Table 13: FGT and LPM measures for order 0 to 2, by poverty and livelihood group

Poor							
			Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N			9	10	45	3	67
Mean portfolio income			129.99	126.31	101.60	111.37	109.54
Standard deviation of portfolio income			41.05	32.34	30.54	40.12	32.65
FGT poverty indicators	α=0	Poverty head count ratio	1.00	1.00	1.00	1.00	1.00
	α=1	Average poverty gap	30.03	50.69	60.44	35.63	67.48
	α=2	Squared poverty gap	3,675.36	4,016.23	7,311.49	6,288.17	6,285.40
Lower partial moments	l=0	Shortfall probability	0.80	0.85	0.91	0.84	0.88
	l=1	Expected Shortfall	53.42	54.29	78.21	71.01	70.99
	l=2	Target Semi-Variance	5,305.84	5,084.39	8,425.94	7,619.93	7,471.99

Non-Poor							
			Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N			82	17	45	27	171
Mean portfolio income			438.59	364.09	393.77	631.38	449.83
Standard deviation of portfolio income			163.52	91.61	77.97	191.20	138.23
Lower partial moments	l=0	Shortfall probability	0.11	0.11	0.07	0.06	0.09
	l=1	Expected Shortfall	10.28	4.22	3.24	4.68	6.94
	l=2	Target Semi-Variance	2,526.48	422.47	301.52	669.11	1,438.53

Poor and Non-poor							
			Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N			91	27	90	30	238
Mean portfolio income			408.07	276.02	247.69	579.38	354.04
Standard deviation of portfolio income			151.41	69.66	54.26	176.10	108.51
FGT poverty indicators	α=0	Poverty head count ratio	0.10	0.37	0.50	0.10	0.28
	α=1	Average poverty gap	4.65	18.78	37.71	6.56	19.00
	α=2	Squared poverty gap	363.50	1,487.49	3,655.74	628.82	1,769.42
Lower partial moments	l=0	Shortfall probability	0.18	0.38	0.49	0.14	0.31
	l=1	Expected Shortfall	14.54	22.76	40.73	11.31	24.97
	l=2	Target Semi-Variance	2,801.36	2,149.11	4,363.73	1,364.19	3,137.02

Source: Own data from risk assessment interview

For the group of non-poor households, the results become substantially different. In this group sorghum growers are the most vulnerable (with eleven percent average shortfall probability and 10.3USD expected shortfall), and rice growers are the least vulnerable in terms of expected shortfall. While non-poor fishermen generate the highest income (631.4USD), the variability of income is comparatively high and makes these households more vulnerable to risk (see also Figure 19). To the contrary, non-poor rice growers have a relatively low income, but the low standard deviation of income results in low vulnerability levels. Nevertheless, due to the high proportion of poor within the group of rice growers, average poverty and vulnerability incidence is highest for this livelihood group.

Interpreting the FGT measure as chronic poverty, it can be concluded that rice and millet growers are suffering from chronic poverty, while transient poverty is more prevalent among the group of sorghum growers and fishermen. This confirms the results presented in chapter 5. Overall, the per capita values of the LPMs (i.e. including poor and non-poor households) show that fishermen are clearly dominating other livelihood strategies by second as well as third order stochastic dominance. Rice growers are dominated by all other groups, while there is a change in ordering for sorghum and millet growers, by LPM_1 and LPM_2, which implies that, although the average expected shortfall is higher for millet growers, the LPM_2 values indicate that the inequality of income distribution is expected to be higher for sorghum growers and the relatively high variation makes these households more vulnerable to poverty even if their time-mean portfolio income lies above the poverty line.

The vulnerability results for the group on non-poor (or transiently poor) households already show that downside risk is an issue for all households irrespective of their position around the poverty line. As has been argued before, a reasonable assumption for the analysis of downside risk could be that households seek to maintain the habitual living standard, i.e. the expected shortfall could also be analyzed with respect to the mean portfolio income instead of a fixed poverty line. Thus, comparing LPMs with fixed and moving target it is found that the expected negative deviation from the poverty line is

decreasing in income, while with a moving target, the expected loss is increasing in income, i.e. households with a higher portfolio income face on average a larger income risk (Figure 20).

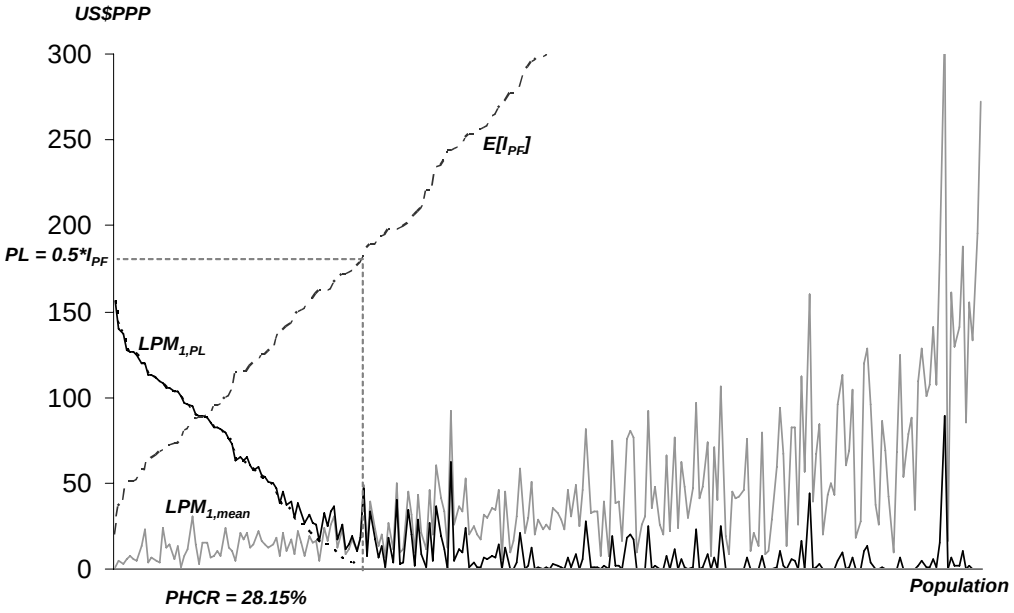

Figure 20: Distribution of first order LPM (expected shortfall) with fixed and moving target

Source: Own data from risk assessment interview

For the proportion of households below the poverty line, expected shortfall ($LPM_{1,PL}$) and poverty gap are moving very closely together. For the moving target ($LPM_{1,mean}$), results show that the risk-income ratio (where risk is represented by expected shortfall) is on average constant (about 0.122) over the whole range of the income distribution.

Splitting the expected shortfall ($LPM_{1,PL}$ and $LPM_{1,mean}$) by livelihood group, remarkable differences in risk are found, depending on the definition of the target (Table 14).

In general, for the poor households, expected shortfall is significantly lower if the target x is defined as $E[u]$, the time mean income, as compared to the poverty line target. This result is consistent with expectations, because mean income for the poor lies below the poverty line per definition. To the contrary, $LPM_{1,mean}$ is significantly higher than $LPM_{1,PL}$ for the non-poor, as indicated by Figure 20.

Table 14: First order LPM (expected shortfall) with fixed and moving target, by poverty and livelihood group

Poor						
		Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N		9	10	45	3	67
Mean portfolio income		129.99	126.31	101.60	111.37	109.54
Standard deviation of portfolio income		41.05	32.34	30.54	40.12	32.65
Expected Shortfall	PL	53.42	54.29	78.21	71.01	70.99
	E[u]	16.38**	12.90***	12.18***	16.01	13.03

Non-Poor						
		Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N		82	17	45	27	171
Mean portfolio income		438.59	364.09	393.77	631.38	449.83
Standard deviation of portfolio income		163.52	91.61	77.97	191.20	138.23
Expected Shortfall	PL	10.28	4.22	3.24	4.68	6.94
	E[u]	65.23***	36.55***	31.11***	76.28***	55.14

Poor and Non-poor						
		Sorghum growers	Millet growers	Rice growers	Fishermen	Total
N		91	27	90	30	238
Mean portfolio income		408.07	276.02	247.69	579.38	354.04
Standard deviation of portfolio income		151.41	69.66	54.26	176.10	108.51
Expected Shortfall	PL	14.54	22.76	40.73	11.31	24.97
	E[u]	60.40***	27.79	21.64***	70.25***	43.29

Source: Own data from risk assessment interviews

Note: *, **, *** indicate significance levels of difference in mean at 0.1, 0.5 and 0.01, respectively (paired T-test)

A comparison between livelihood groups shows that the ordering of distributions changes dramatically if the target is set as the time-mean income of the household. Now, rice growers are dominating other groups by second order stochastic dominance for $LPM_{1,mean}$, i.e. rice growers are less liable to adverse production conditions in terms of negative deviations from the usual living standard than other livelihood groups. While the difference for millet growers (poor and non-poor) is not significant, rice growers show even a reduction in vulnerability if the target is defined at the time-mean income. To the

contrary, it is found that sorghum growers and fishermen are now most affected by negative events and hence most likely to fall below the target.

These results show that fishermen are able to generate higher incomes, which comes at the cost of high variation in income. While these households are thus less vulnerable to poverty (if poverty is defined at a fixed threshold, below which households are considered as poor), they nonetheless face a high risk of not attaining the time-mean income. Again, this evidence supports the arguments from chapter 5, that fishers are less threatened by chronic poverty. Transient poverty however is nonetheless a non-negligible issue for fishery-dependent households. In order to counteract the high income variability, fishermen and sorghum growers may resort to livestock as a form of informal savings and credit market. However, while this may be true for sorghum growers which are mainly found in zone 3[17], fishermen are found to be least endowed with livestock The value of livestock (including small ruminants) as reported in the baseline survey is 3339, 2352, 1603 and 940USD for sorghum, millet, rice growers and fishermen, respectively. That result implies that fishermen may need different policy interventions (e.g. establishing functioning credit markets) than agriculture oriented households.

7.4 Scenario analysis

In order to test, how certain hypothetical interventions would affect income and risk, a scenario analysis has been conducted based on the assumptions outlined in chapter 6.5.2. The results are presented for both, the $LPM_{1,PL}$ and $LPM_{1,mean}$. The difference between the vulnerability indicator at $x=PL$ and $x=E[u]$ is that the former captures both, shifts in the mean of income as well as the variance, while the latter is showing the effect of changes in variance only, since shifts in the mean do not have an impact on negative deviations from $E[u]$. The results of the scenario analysis are presented in Table 15.

[17] Households in that stratum (the arid area in the western part of the floodplain) are found to have the highest livestock endowment (more than twice the value of livestock in the other zones).

Table 15: Expected shortfall (LPM_1) for two targets: PL = poverty line (50% of average income), and E[u] = time-mean household portfolio income, by livelihood group and scenario

Poor					
		Sorghum growers	Millet growers	Rice growers	Fishermen
Original scenario	PL	53.42	54.29	78.21	71.01
	E[u]	16.38	12.90	12.18	16.01
Extreme events scenario	PL	52.57	55.41	77.94	69.20
	E[u]	21.54***	16.34***	14.21***	19.97**
Sorghum increases scenario	PL	39.39***	53.80	78.06	67.07
	E[u]	12.89***	12.77	12.15	14.75
Aquaculture project scenario	PL	53.20	54.05	77.83***	70.27
	E[u]	15.88	12.37*	11.50***	13.90**

Non-poor					
		Sorghum growers	Millet growers	Rice growers	Fishermen
Original scenario	PL	10.28	4.22	3.24	4.68
	E[u]	65.23	36.55	31.11	76.28
Extreme events scenario	PL	14.23***	5.98**	5.69***	7.37***
	E[u]	80.25***	42.40***	37.75***	92.84***
Sorghum increases scenario	PL	6.86***	4.22	3.01*	4.43**
	E[u]	57.19***	36.55	30.66**	74.95**
Aquaculture project scenario	PL	10.04*	3.57***	2.80***	3.40***
	E[u]	64.68**	33.52***	28.87***	67.44***

Poor and Non-poor					
		Sorghum growers	Millet growers	Rice growers	Fishermen
Original scenario	PL	14.54	22.76	40.73	11.31
	E[u]	60.40	27.79	21.64	70.25
Extreme events scenario	PL	18.02***	24.29**	41.81	13.55***
	E[u]	74.44***	32.75***	25.98***	85.56***
Sorghum increases scenario	PL	10.07***	22.58	40.54**	10.69
	E[u]	52.81***	27.74	21.41**	68.93***
Aquaculture project scenario	PL	14.30**	22.27***	40.31***	10.09***
	E[u]	59.85**	25.68***	20.18***	62.09***

Source: Own data from risk assessment interviews

Note: *, **, *** indicate significance levels of difference in mean to original scenario at 0.1, 0.5 and 0.01, respectively (paired T-test).

The simulated effects of different scenarios are overall comparable between the poor and the non-poor households. Increasing climate variability (extreme events scenario) has a

risk increasing impact on all households, except for poor households at *x=PL*. It is found that the expected shortfall from the poverty line is decreasing for this group. Hence, despite increasing variance (see also Table 10) and $LPM_{1,mean}$, weather shocks might have a slight positive effect in terms of poverty reduction (although statistically not significant). This is mainly due to the scenario specification, where an increase of both, adverse and favorable climatic conditions, is assumed. The small-scale irrigation scenario for sorghum production (sorghum increases) has a vulnerability-decreasing effect across the board, but naturally more so for sorghum growers. Particularly the poor would benefit most from such development interventions (shortfall probability is decreasing by 15 and the expected shortfall by 26 percent compared to the original scenario). The aquaculture project scenario (assuming zero correlation between fishing and crop incomes) is also working in a favorable direction, i.e. the expected shortfall is decreasing for all groups, primarily for fishermen. Figure 21 illustrates the impact of the assumed scenarios on LPM_1 for the total sample.

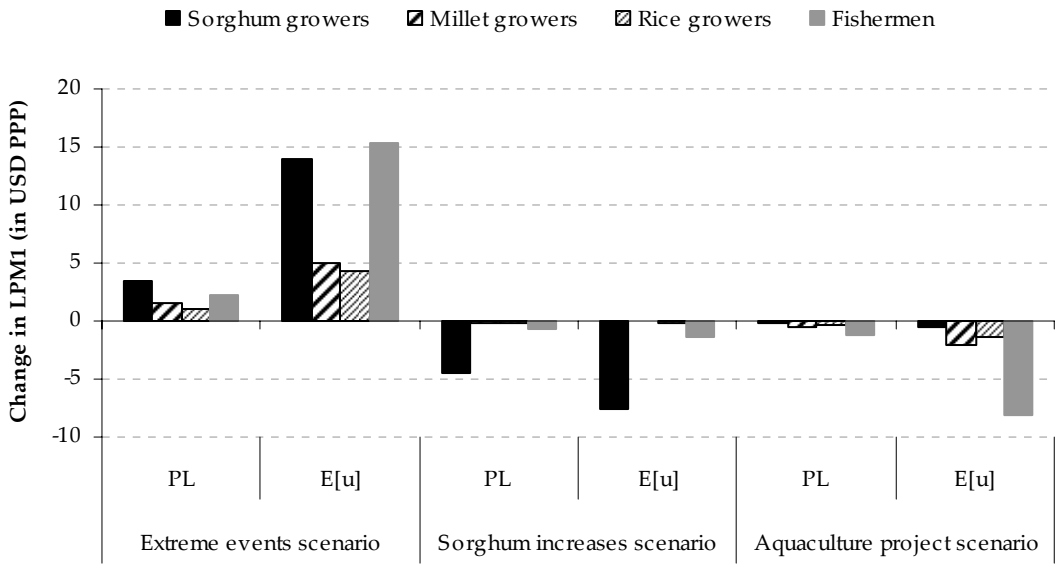

Figure 21: Changes of LPM_1 in USD, by livelihood group and scenario

Source: Own illustration based on data from risk assessment interviews

Thus, increasing climate variability would first and foremost affect sorghum growers and fishermen, and particularly increase transient poverty. This could be offset by irrigation for sorghum growers and aquaculture projects for the fishermen.

7.5 Conclusions

In this chapter the class of Lower Partial Moments (LPMs) is used for measuring vulnerability as downside risk of household income in rural Cameroon. This class of established and coherent risk measures is mainly used in the analysis of financial assets and has been shown to meet a number of desirable properties or axioms. Among others, the LPMs fulfill the focus axiom, and for order greater than zero they are in harmony with expected utility theory under the weak assumption of risk aversion. Through combining the vulnerability measure with a portfolio approach it is possible to distinguish different livelihood systems for which the poverty and vulnerability measures are the explicit result of stochastic distributions of single activities in the households' portfolio and their covariance structure. Comparing LPMs of different order also allows to make conclusions concerning the risk of income loss (expected shortfall below the poverty line) as well as the distribution of vulnerability.

The results presented here basically show the probability to be poor and the risk of income losses, given the household's production system and the variation in yield levels and prices in the past 10 years. As such, the vulnerability estimates reflect expected time-mean poverty. The results suggest that fishermen are less affected by adverse effects on income than other livelihood systems, while rice growers are the poorest and most vulnerable. Interpreting the FGT measure as chronic poverty, it can be concluded that rice and millet growers are suffering from chronic poverty, while transient poverty is more prevalent among the group of sorghum growers and fishermen. This implication is further confirmed by assuming a moving target equal to the mean portfolio income for the calculation of LPMs. The results show that fishermen face a high risk of not maintaining the time-mean welfare level, despite low vulnerability to poverty (if poverty is defined at a fixed threshold, below which households are considered as poor). This

trend is likely to become more intense, if climate variability will further increase, as suggested by climate change research. However, the results of the scenario analysis suggest that policy interventions aiming at a reduction of the covariation structure between income flows from different activities are quite promising.

CHAPTER 8

SYNTHESIS

8.1 Summary

The objective of this thesis is explore the nature, extent and causes of poverty and vulnerability to poverty among households living in fishery depending communities in the *yaéres* floodplain in North Cameroon, a major floodplain in the Lake Chad Basin. The specific objectives of the thesis are as follows:

1. To explore the extent to which households in fishing communities are exposed to adverse external events such as natural hazards (climate risk) as well as to other covariate and idiosyncratic shocks that may affect production output and hence the expected welfare position of households.
2. To analyze portfolio compositions of households and to describe the income-risk relationship of specific types of portfolios.
3. To conduct a dynamic poverty analysis, i.e. (1) to estimate vulnerability as expected poverty on household level, (2) to identify the role of fisheries in mitigating risk (low vulnerability) and (3) to explore the cause-effect relationships of different possible development interventions and vulnerability.

Methodologically, this work is adding to current research on vulnerability by advancing the vulnerability to poverty approach in two ways: First, by incorporating assets into the general vulnerability framework, based on Carter and Barrett's (2006) asset-based poverty approach; and second, by proposing and applying the class of lower partial moments (LPM) as a coherent risk measure. Drawing on the portfolio theory, stochastic income

distributions are derived for each household and vulnerability is estimated in terms of the probability and the extent of expected poverty. Hence, household vulnerability has been estimated and analyzed from different angles, which can yield multifaceted and diverse information on the relationship between SSF and vulnerability.

The results presented in this thesis provide crucial information on the value of SSF in mitigating risk and thus contributing to sustainable livelihoods and poverty reduction.

The analysis of adverse external events (Objective 1) shows that the households in the study area are found to be subject to heavy dependence on natural resources, to limited and erratic rainfall, pests and diseases and nutrient poor soils. In particular, the unpredictable climate is having a severe impact on the poor. Climate data from 1951 to 2008 reveal a considerable variation in annual and intra-annual rainfall, which has an adverse effect on the variation of output from agricultural production and fishing activities. Moreover, households reported to frequently suffer from other shocks, such as death of family members, loss of productive assets or crop pests. Adapting to these conditions, households have diversified their activity portfolio.

Five livelihood activities exist in the study area: agriculture, livestock rearing, fishing, fish trade and off-farm work (commerce, carpentry, herdsmen, etc.). Agriculture is the main activity of the majority of households in the floodplain, and is dominated by three major crops in terms of input allocation (labor and land) and income: sorghum, millet and rice. Off-farm work possibilities are very limited, contributing only about 1.5 percent to aggregate household income. For most households in the Logone floodplain, livestock is used as an income buffer. Farmers accumulate livestock in favorable years where income from agriculture and fishing is high, and sell it in bad years in order to smooth income. This does not affect farming production decisions in the first place, i.e. income through livestock sales is treated here as an *ex post* coping action, not as production output. The analysis of activity diversification reveals that fishing-related activities make a significant contribution to the livelihoods of the peoples in the Logone floodplain, including fishing, fish processing and fish trade. Fishing is a major activity for many households in terms of nutrient supply and income generation. Over 60 percent of households are engaged in

SSF. On average, fishing accounts for over 28 percent of total gross income, and constitutes the major income source for 23 percent of the sample ($income\,share\ from\ fishing \geq 50\%$). Fishers tend to sell their catches at the landing sites to local traders who transport it to local markets, where it may also be bought by local or other traders that market further afield.

The diversification effect through the combination of different activities in a household specific portfolio has been analyzed by applying portfolio theory (Objective 2). The stochastic distributions of crop yields over time show that rice is dominating sorghum and millet by first-order stochastic dominance with an average yield level of 1712kgy^{-1}. However, the variation in yields is also highest for rice with a standard deviation from the time-mean of 650kgy^{-1}. Considering price fluctuations, production analysis reveals that the total value of production is highest for rice, followed by sorghum, millet and fishing. In general, portfolio analysis suggests that the allocation of labor between possible activities is depending on efficiency considerations and hence follow a rational behavior. Results show that rice growers are less diversified, while fishermen display a relatively high activity diversification ($SID_{fishermen} = 0.82 > SID_{rice\ growers} = 0.62$). Despite high correlation coefficients between the different activities, the resulting portfolio incomes show the following order by second-degree stochastic dominance: Fishermen $\succ$ Sorghum growers $\succ$ Millet growers $\succ$ Rice growers.

With regard to poverty and vulnerability among the sampled households (Objectives 3.1 and 3.2), both, the asset-based as well as the LPM approach to V^{EP} yield consistent findings. In general, fishing households are able to generate higher incomes, albeit at the cost of higher variation in income. As a result, fishermen are the least affected by poverty and vulnerability, whether measured at absolute levels (US$1.25 per capita per day) or applying a relative poverty line (50% of time-mean average household income). Further, results show that fishermen suffer rather from transient poverty (foremost stochastic poverty). To the contrary, households for whom agricultural activities have a higher priority are suffering to a larger extent from chronic poverty, in particular rice and millet growers. Hence, the probability to be poor as well as the extent of poverty (measured as

the expected shortfall) is significantly lower for fishers, compared to other livelihood groups. Considering risk as the expected negative deviation from the time-mean income confirms these results.

To estimate the effect of possible development interventions, a scenario analysis has been conducted, based on research findings and policy propositions (Objective 3.3). Thus an increase in climate fluctuations is found to have a considerable negative impact on income risk. The standard deviation would for example increase by up to 23%, resulting in significant increases in vulnerability to poverty for all livelihood groups. However, it is also shown that such trend could be counteracted by interventions that particularly aim at a reduction in the covariation structure of income flows from different activities. For example, small-scale irrigation projects or the introduction of aquacultural enterprises could be able to disconnect specific income flows from the general dependency on climatic variation.

8.2 Conclusions and recommendations

Scientific research on SSF often comes to the conclusion that rural populations in tropical fisheries zones are marginalized and threatened by poverty and vulnerability. Tropical small-scale fisheries are said to be characterized by their marginality, i.e. their geographic, socioeconomic, and political remoteness from democratic decision-making structures, at the same time carrying fishery-specific risks, which stem for example from the fugitive nature of the resource and the perishability of the product (Pauly 1997, Vichitlekarn 2008). These risks are assumed to result in potentially very high vulnerability (Allison *et al.* 2006), even if chronic poverty is not necessarily an issue for fishing households.

Such statements imply that higher dependence on fisheries makes households more economically vulnerable (Béné 2009). Following the hypotheses of economic theory on diversification, the assumption is often made, that profitability is negatively correlated with risk, which means that a high degree of specialization always comprises a higher volatility of income and hence higher risk. However, the empirical relationship between

activity diversification and risk has mostly been intuitively derived, and exact quantitative estimations are still lacking.

The results presented in this thesis show that risk reduction through diversification is hardly an effective strategy in the study area. External conditions mostly affect all production activities that depend on natural resources in the same direction, whether it is agricultural production or fisheries. Hence, external impacts on resources are found to be very significant, since "fishery-specific risks", such as the high variation in fish stocks, are highly correlated with general covariant risks (see also Cochrane 2008). As a result, climate conditions (mainly rainfall) affect both cropping and fishing outputs in the same direction, i.e. in times where crop yields are low, fish yields are also low. Hence, fisheries cannot adequately solve the intra-annual income variability problem because it is covariant with farming outputs. There is also increasing pressure on natural resources, leading to risks of deforestation and overfishing and increasing conflict among users. This has direct implications on both, future research on SSF as well as rural development programs for poverty reduction. Although the question concerning the value of SSF in reducing vulnerability can be answered to the affirmative in this study, that does not mean that turning to fishing would be a panacea to the prevailing poverty in the study area. If access is de facto limited or resources over-stretched there is limited opportunity in these areas for fisheries to improve the lot of non-fishing households. This results in temporary or permanent migration of many people out of the floodplain in search of fishing opportunities elsewhere. Hence, for further research and particularly for policy interventions, it is recommended to look at the ensemble of socio-economic production systems in the rural areas. Rather than focusing on certain sub-sectors or activities, it is more useful to apply a holistic household approach in poverty research. Also, meaningful poverty and vulnerability reduction can only be realized with a multi-sectoral approach. There is therefore a greater need for fisheries departments to engage in effective coordination with other sectors.

Another issue that is important in view of intertemporal management of financial and physical capital is an often high cross-price elasticity of crops and livestock. In the

Sudano-Sahelian zone households have to rely on liquidable assets such as livestock to counterbalance the inter-annual variation in crop production and fishing (FAO 2001). However, according to FAO (2001), the main cause of poverty in Sub Saharan Africa, apart from successive droughts and food shortages, are sharp increases in grain prices and collapse of livestock prices. "Crop failure is exacerbated by the seasonal price 'scissors effect' between grain and livestock. In the hungry season it takes three times as many animals to buy a bag of grain than in the harvest season; while grain prices soar and livestock prices collapse when crops fail" (FAO 2001, p.68). Hence, primary policy interventions should aim to reduce the likelihood of crop failure in drought years through, for example, improved soil and water management, small-scale irrigation projects, or through the adoption or drought-resistant, early-maturing millet and sorghum varieties. As shown by Carsky *et al.* (1995) and Macaretti (2001) millet and sorghum yields can be increased significantly through simple but effective soil management practices. Policies should also aim to offset or reduce the tendency for decreased prices of livestock during famine periods. This can be attained by improving the capacity of the poor members of the communities through the formation of functional cooperative societies. The cooperative societies will assist the poor to have a strong voice in decisions making process related to asset ownership and disposal.

Further, the results of this study suggest that in small-scale fishing communities in the Logone floodplain most households are poor because they possess few productive assets, which limits their ability to diversify their livelihoods and/or to generate enough income to escape transient or chronic poverty. Although livelihoods are already relatively diverse, the lack of assets limits productivity. It is therefore recommended that rural development policies should aim at facilitating asset accumulation by households. Policy measures could include, for example, increased access to credit, such as micro-lending systems.

In areas where fresh fish fetches higher prices than dried or smoked fish, such as in the Logone floodplain, fishers in remote communities cannot realize the full potential value of their catches. To add value to the fisheries in such areas, and thus to improve the

wellbeing of the population, there is need to raise the ability of fishers to market fresh fish. This could be achieved by:

- Improving the infrastructure (thus significantly decrease travel costs and time), or
- Introducing more effective refrigeration techniques (e.g. supplying of ice boxes by traders).

In the vast majority of floodplains in Africa (including the Logone floodplain), access to electricity however is still limited. In those areas fish sun-drying and smoking are the only alternatives to conserve this highly perishable product. Processing facilities and techniques are however frequently inadequate or ineffective and often involve the application of pesticides (against insect attacks). Interventions aiming at improving these processing techniques and reducing pesticide use are required and would not only increase the value added of the fish commodity (and thus the income of the fishers/traders), but also help tackling food safety and health issues in these areas.

In addition, alternative activities should be promoted to complement the seasonal and/or inter-annual income patterns of farming and fishing, in order to reduce the pressure on the resource, smooth income variation and increase income. These could include:

- Non-agricultural employment. Theoretical as well as empirical evidence suggests that non-farm employment is mostly negatively correlated with biophysical production outputs, which depend on natural resources (Ito and Kurosaki 2009, Barlett 1991, Kimhi and Bollmann 1999). Income from the non-agricultural (and non-fisheries) sector would therefore not only decrease the pressure on natural resources but also stabilize household income over time.
- Introduction of aquaculture initiatives. Such investments may significantly improve the food security situation and reduce the inter-temporal variation in income through constant supply of fish, independent of the inter-annual variation in precipitation and hence the water level in the water bodies.

To sum up, in order to achieve the objective of reducing poverty and vulnerability among fishery dependent communities, it is of paramount importance to take a holistic, multi-sectoral approach to poverty alleviation and resource management. On the one hand, accumulation of productive as well as convertible assets would be an effective strategy for the structurally poor. On the other hand, reducing the high covariation of income flows across time and different activities would result in intertemporal yield stabilization and risk reduction for the stochastically poor. In view of the expected increases in climate extremes in space, time, and intensity (e.g. Scott *et al.* 2004, Milly *et al.* 2002, IPCC 2001), such interventions are necessary to avoid increasing poverty (chronic and transient) and vulnerability. It is also advisable to combine different interventions in a broader portfolio, complementing each other not only in terms of the desired impact but also in terms of the target population. Since rural populations are often found to be very diverse and to adopt multi-activity livelihood strategies, well-targeted local approaches and interventions need to be given higher priority than large universal approaches.

Although this study has contributed to an improved understanding of the socio-ecological value of small scale fisheries, some gaps in information and understanding remain. These gaps include understanding of long term patterns and linkages between socio-economic systems, ecosystem functioning and management systems. A great deal of research is still necessary to reach a full understanding about the sustainability (and resilience) of these socio-ecological systems. Efforts should be made to monitor people's livelihoods and wellbeing as well as the resource dynamics and its use. This should be done as a collaborative effort between fisheries and agricultural departments and statistical and planning offices that deal with welfare.

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APPENDICES

APPENDIX A: BASELINE QUESTIONNAIRE (MAY 2007)

Ministère de l'Elevage, des Pêches et des Industries Animales (MINEPIA)

Projet sécurité alimentaire et réduction de la pauvreté à travers l'amélioration de la gouvernance et de l'évaluation des pêches continentales en Afrique

Project food security and poverty alleviation through improved valuation and governance of river fisheries in Africa

Etude sur l'Evaluation Economique de la Pêche dans la plaine d'inondation du Logone, Province de l'Extrême Nord, Cameroun

Questionnaire de base sur les ménages
Avril 2007

STRICTEMENT CONFIDENTIEL

Village	
Numéro d'identification du ménage	
Numéro d'identification de l'agent enquêteur	
Date	

Résumé

Section 1 : Liste des membres du ménage
Section 2 : Production
Section 3 : Biens
Section 4 : Dépenses

1

Numéro d'identification du ménage :

Chère personne interrogée!

Je suis _____. Je suis ici dans le cadre de l'étude sur l'évaluation économique de la Pêche dans la plaine d'inondation du Logone, qui est menée par le MINEPIA, le Ministère Allemand de la Coopération Economique et du Développement, le WorldFish Center des Nations Unies et l'Université de Hanovre en Allemagne.

Vous savez que les populations rurales de la plaine d'inondation du Logone rencontrent beaucoup de difficultés. Pour avoir une meilleure idée de ce qui se passe réellement, il est indispensable d'étudier les conditions de vie de centaines de personnes dans diverses familles. C'est seulement après avoir fait la synthèse de leurs réponses que nous pouvons avoir une idée réelle des conditions de vie desdites populations.
A cet effet, plus de 300 ménages ont été choisis au hasard. Le vôtre en fait partie. L'authenticité des résultats de toute l'étude dépendra de votre sincérité et de l'exactitude de vos réponses aux questions figurant sur le présent questionnaire. Nos questions porteront sur plusieurs sujets relatifs à votre personne, aux membres de votre famille et à vos activités quotidiennes (vos activités, les dépenses pour ces activités, votre ration alimentaire, vos épargnes, autres biens, etc.). Cette entrevue sera répétée 3 fois dans l'année afin de savoir quelles opportunités vous avez et à quelles difficultés vous faites face au cours de l'année. Elle ne durera plus de deux heures.
Vous pouvez librement poser des questions à tout moment. Nous vous donnons l'assurance que les informations recueillies dans le cadre de cette étude sont confidentielles et ne seront exploitées que pour les besoins de cette étude. Vos réponses ne seront pas révélées à vos voisins ni à l'Etat. Après le traitement de ce questionnaire par ordinateur ni votre nom ni celui de votre famille ne seront utilisées à d'autre fin.

D'avance, je vous exprime ma gratitude pour votre participation à l'étude.

Personne interrogée: ☐ Accepte ☐ Refuse

Ma signature ci-dessous atteste que je suis agent enquêteur dans le cadre du projet sus-mentionné. J'ai lu la fiche de consentement au participant qui a marqué sa volonté de prendre part à l'étude en cochant la case ci-dessus

Signature de l'agent enquêteur: Date: ___/___/_____

2

SECTION 1. LISTE DES MEMBRES DU MENAGE

PARTIE 1A. MEMBRES DU MENAGE (FAMILLE) RESIDANT DANS LE VILLAGE

Code ID	1 Nom *Dresser la liste de toutes les personnes vivant dans ce ménage avant de passer aux questions suivantes* *(Pour les enfants de moins de 10 ans donner seulement le nombre)*	2 Présents à l'entrevue *Indiquer à l'aide d'une croix si [le Nom] figure*	3 Sexe *Masculin – 1 Féminin – 2*	4 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	5 Âge *Indiquer le nombre d'années*	6 Statut matrimonial *Marié(e) – 1 Divorcé(e) – 2 Veuf / Veuve) – 3 Célibataire – 4*	7 Groupe ethnique *Kotoko – 1 Mouyegum – 2 Fulbé – 3 Arabes – 4 Mana – 5 Autres - préciser*	8 Niveau d'études	9 Occupation principale au cours de l'année passée *Agriculture – 1 Pêche – 2 Elevage – 3 Commerçant de poisson – 4 Autre commerce – 5 Travailleur occasionnel – 6 Titulaire d'un emploi – 7 Ménagère – 8 Elève / Etudiant – 9 Autres –spécifier!*	10 Occupation secondaire au cours de l'année passée *Agriculture – 1 Pêche – 2 Elevage – 3 Commerçant de poisson – 4 Autre commerce – 5 Travailleur occasionnel – 6 Titulaire d'un emploi – 7 Ménagère – 8 Elève / Etudiant – 9 Autres –spécifier*
A-1										
A-2										
A-3										
A-4										
A-5										
A-6										
A-7										
A-8										
A-9										
A-10										
A-11										
A-12										
A-13										
A-14										
A-15										

Nombre d'enfants de moins de 10 ans: _____

PARTIE 1B. INFORMATION SUR LES PARENTS RESIDANT AILLEURS

Un membre de votre ménage ne résidant pas actuellement dans le village, vit-il quelque part au Cameroun ou à l'étranger ?

Code ID	1 Nom	2 Sexe *Masculin – 1 Féminin – 2*	3 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	4 Âge *Indiquer le nombre d'années*	5 Où réside-t-il? *Préciser le nom du village, de la ville du Cameroun ou du pays étranger*	6 [Nom] est-il (elle) absent(e) en permanence ou pour une courte durée ? *saisonnier (moins de 6 mois) – 1 [-> Q.7] permanent – 2 [-> Q.8]*	7 (6=1) Durée de l'absence saisonnière *Indiquer les mois. Exemple : Janvier-Avril 2007*	8 (6=2) Depuis quand est-il (elle) absent(e) ? *Donner une date e.g. : Juillet 2004*	9 Quelle est la cause de l'absence?
B-1									
B-2									
B-3									
B-4									
B-5									
B-6									
B-7									
B-8									
B-9									
B-10									
B-11									
B-12									
B-13									
B-14									
B-15									

PARTIE 1C. RÉSEAU SOCIAL

Etes-vous membre d'un groupe ou d'une association?

Oui ☐
Non ☐

Si oui, lequel / laquelle?

	Nom de l'association ou du groupe	Objectif de l'association ou du groupe
1		
2		
3		
4		
5		

5

PARTIE 1D. CHOCS, INCIDENTS AFFECTANT LE MENAGE

1 Un des incidents sur la liste au-dessus est-il survenu au cours des dix dernières années? (Code A) (lister 3 chocs les plus graves) *Oui – **Préciser quelle année**? Non – 0* **Code A** / **Année**	2 Bien vouloir donner une estimation de perte à cause de ce choc (en FCFA)	3 Avez-vous entrepris une des activités énumérées au-dessous pour vous en sortir? (Code B) *Préciser le numéro d'activités palliatives pour chaque incident*	4 Bien vouloir donner une estimation financière (e.g. du bétail vendu ou de l'argent emprunté) en *FCFA*	5 Votre ménage continue-t-il à réduire la consommation à cause de l'incident et malgré les solutions de crise? *Oui – 1 Non – 0*	6 Quel est selon vous le temps nécessaire pour surmonter ce choc? *Préciser la durée en mois ou en années*

Code A : Incidents :

1 - Maladie grave d'un adulte
2 - Décès d'un adulte
3 - Maladie grave d'un enfant
4 - Décès d'un enfant
5 - Absence permanente du membre de la famille
6 - Incendie
7 - Crime
8 - Perte d'argent
9 - Perte de biens productifs
10 - Perte d'emploi
11 - Sécheresse
12 - Surabondance des pluies ou inondation
13 - Animaux nuisibles ou maladies affectant les plantes
14 - Animaux nuisibles ou maladies affectant le poisson
15 - Animaux nuisibles ou maladies affectant le bétail
16 - Hausse du prix des intrants
17 - Baisse du prix des commodités produites
18 - Absence de la demande ou incapacité à vendre les produits agricoles, le poisson ou le bétail

Code B : Activités palliatives :

1 - Travailler plus dur
2 - Recourir à une occupation supplémentaire
3 - Migrer à la recherche d'un emploi
4 - Retirer les enfants de l'école
5 - Faire usage des épargnes
6 - Vendre ses biens
7 - Vendre le bétail
8 - Vendre les terres
9 - Emprunter de l'argent
10 - Recevoir des dons des parents
11 - Assistance des parents ou des habitants du village
12 - Assistance de la mosquée / église
13 - Assistance de l'Etat
14 - Réduire les dépenses de subsistance

6

PARTIE 1E. MALADIES AFFECTANT LE MENAGE

ID	1 Les membres de votre ménage, ont-ils eu une maladie depuis Janvier 2007? *Oui – 1* *Non - 0*	2 Si oui, laquelle?			3 Qu'est-ce que vous avez fait pour faire face à cette situation? *Rien fait – 1* *Prix les médicaments à la pharmacie – 2* *Allé à l'hôpital – 3* *Consulté un médecin traditionnel – 4* *Autres – spécifier*		4 Combien est-ce que vous avez dépensé?	5 Ce membre de votre ménage a-t-il arrêté ses activités habituelles (travailler/fréquenter etc)? *Oui – 1* *Non – 0*	6 Si oui, pendant combien de temps (jours, semaines, mois)?
		Maladie 1	Maladie 2	**Codes pour question 2** *1--Paludisme* *2—Diarrhée* *3—Mal de ventre* *4—Problèmes respiratoires* *5—MST* *6—Asthme* *7—Maux de tête* *8—problèmes mentaux* *9—maladie de peau* *10—problèmes dentaires* *11—problèmes des yeux* *12—mal au dos* *13—problèmes de coeur* *14—autres (spécifier)*	Maladie 1	Maladie 2			
A-1									
A-2									
A-3									
A-4									
A-5									
A-6									
A-7									
A-8									
A-9									
A-10									
A-11									
A-12									
A-13									
A-14									
A-15									

SECTION 2: PRODUCTION

PARTIE 2A. AGRICULTURE

Je voudrais vous poser quelques questions sur la terre que les membres de votre ménage utilisent

Numéro de parcelle	1 Quelle est la superficie des terres dont dispose votre famille? *m^2– 1* *ha – 2* *are – 3* *pas – 4* *quart – 5* Superficie	Code	2 Ces terres sont: *Une propriété privée – 1* *Louées pour longtemps – 2* *A usage temporaire – 3* *Autres – spécifier!*	3 (2=1) Si ces terres vous appartiennent, comment les avez-vous acquises? *Achat – 1* *Héritage – 2* *Attributions par des tiers (chefs locaux) – 3* *Autres – spécifier!*	4 (2=2,3) Si vous louez ces terres, quel est le montant du bail?	5 Votre ménage utilise-t-il les terres pour pratiquer les cultures suivantes?: *Maz – 1* *Mi blanc – 2* *Mil rouge - 3* *Sorgho – 4* *Haricot – 5* *Pois – 6* *Arachides – 7* *Vouanzou – 8* *Riz – 10* *Elevage – 11* *Verger – 12* *Autres – préciser*	6 Quelle quantité de produits avez-vous récolté l'année passée?	7 Combien de kg par unité de mesure?	7 Quelle quantité de cette récolte avez-vous vendu?	8 Combien avez-vous reçu de cette vente?	9 Combien avez-vous consommé?	10 Combien avez-vous réservé pour la semence ou utilisé pour autres besoins?
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

11. Bien vouloir estimer globalement en FCFA les dépenses totales pour votre production agricole au cours de l'année dernière:_____FCFA (main d'œuvre, intrants, etc.)
12. Quels sont les membres de votre ménage (maison) qui ont contribué à la production agricole l'année dernière? **Codes ID** _____

PARTIE 2B. PÊCHE

I. Votre ménage pratique-t-il la pêche?

Oui ☐-> continuer
Non ☐-> passer au II)

Plans d'eau	1 Où avez-vous pratiqué la pêche l'année passée? *Indiquer la période (par ex. Oct-Juillet)*	2 L'accès à ces zones de pêche est-il libre ou limité? *libre – 1 limité – 2*	3 (2=2) En cas de limitation d'accès qui en est l'auteur?	4 (2=2) Comment?	5 Depuis quand y péchez-vous?
Lac Maga					
Dans le Logone					
Dans les défluents					
Mares saisonnières					
Mares permanentes					
Plaine d'inondation					
Canaux de pêche					
Autres :					

9

PARTIE 2B. PÊCHE

6. Quelle est la quantité de vos prises au cours de l'année dernière?

Quantité	Code A

7. Combien de poissons frais avez-vous vendu?

Quantité	Code A

8. Combien de poissons frais avez-vous séché?

Quantité	Code A

9. Combien de poissons frais avez-vous fumé?

Quantité	Code A

Code A:
kg – 1
paniers – 2 1 panier =_____kg
sac – 3 1 sac =_____kg
carton – 4 1 carton =_____kg
pirogue – 5 1 pirogue =_____kg

10. Quel était le revenu total de vente de poisson frais l'année dernière?

Revenu_____

11. Quel était le revenu total de vente de poisson séché l'année dernière?

Revenu_____

12. Quel était le revenu total de vente de poisson fumé l'année dernière?

Revenu_____

10

PARTIE 2B. PÊCHE

13. Le poisson destiné à la vente est-il de meilleure qualité que celui que vous consommez vous-même?
    Oui ☐
    Non ☐

14. Essayez de donner une estimation des autres dépenses faites dans le cadre de la pêche au cours de l'année passée. (main d'œuvre, réparation de l'embarcation, du matériel de pêche, carburant, etc.)

    Dépenses _____ FCFA

II) Commerce du poisson

1. Achetez-vous du poisson chez des tiers (pêcheurs, transformateurs, commerçants) pour le revendre directement?
   Oui ☐ -> continuer
   Non ☐ -> passer à la partie 2C.

2 Poisson acheté	3 Quantité (Code A)	4 Prix d'achat	5 Prix de vente	6 Quantité (Code A)	7 Prix d'achat	8 Prix de vente
Frais						
Séché						
Fumé						

Code A: *kg – 1*
paniers – 2 1 panier = _____kg
sac – 3 1 sac = _____kg
carton – 4 1 carton = _____kg

9. SVP, essayez d'estimer les dépenses que vous avez effectuées cette dernière année pour la commerce de poisson (par exemple: carburant, réparation véhicule, frais de transport, etc.) Dépenses: _____FCFA

PARTIE 2B. PÊCHE

10. Quelles sont les personnes faisant partie de votre ménage qui ont pratiqué **la pêche** l'année passée? Codes ID : _____, _____, _____

11. Quelles sont les personnes faisant partie de votre ménage qui ont pratiqué **la transformation du poisson** l'année passée? Codes ID : _____, _____, _____

12. Quelles sont les personnes faisant partie de votre ménage qui ont pratiqué le **commerce du poisson** l'année passée? Codes ID : _____, _____, _____

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

	Animal	1 Votre ménage pratique-t-il l'élevage de [Animal]? *Oui = 1 Non = 0*	2 Combien d'animaux avez-vous actuellement ?	3 Combien des animaux avez-vous vendu l'année passée?	4 A quel prix? (prix total) *FCFA*	5 Combien de jeunes vos femelles ont-elles mis bas au cours de l'année passée?	6 Combien des animaux avez-vous abattu l'année passée?	7 Combien des animaux avez-vous acheté l'année passée?	8 A quel prix? (prix total) *FCFA*	9 Combien avez-vous dépensé pour la main-d'œuvre l'année passée? *FCFA*
1	Bovins									
2	Moutons									
3	Chèvres									
4	Chevaux									
5	Ânes, mulets									
6	Poulets, coqs									
7	Oies, canards, autre volaille									
8	Abeilles									
9	Lapins									
10	Pigeons									
11	Porc									
12	Autres animaux									
13										

13

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

	10 Combien des produits suivants avez-vous récolté au cours de l'année passée?	11 Combien avez-vous gagné en vendant ces produits l'année passée?
Lait et produits laitiers		
Œufs		

11. SVP, essayez d'estimer les dépenses totales effectuées pour l'élevage des animaux l'année dernière :

    Dépenses: _____ FCFA

12. Quelles sont les personnes faisant partie de votre ménage qui ont pratiqué l'élevage l'année passée?

    Codes ID : _____, _____, _____

13. Existe-t-il un membre du ménage exerçant un emploi?
    Oui ☐ -> continuer
    Non ☐ -> passer à la SECTION 3.

14. Qu'est-ce que ces membres font ?

Code ID du membre	Description du travail	Salaire/Revenu mensuel (en FCFA)

14

SECTION 3: BIENS

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET AUTRES

Avoirs immobiliers

Question	Indiquer le Code	Code
1 Certaines personnes possèdent intégralement leur maison. D'autres en sont partiellement propriétaires mais continuent de les payer ou de les louer ou habitent simplement des maisons dont ils ne sont pas propriétaires sans payer le loyer. Qu'est-ce qui correspond le mieux à votre situation?		*Propriétaire – 1* *Propriétaire à crédit – 2* *Loyer – 3* *Habite avec des amis, des parents ou est logé par des amis et parents gratuitement – 4* *Autres – préciser!*
2 Comment avez-vous pu obtenir cette maison?		*Achetée – 1* *Héritée – 2* *Construit – 3* *Autres - préciser*
3 Si on devait construire la même maison actuellement, combien ça coûtera?		*FCFA*
4 Combien de cases l'habitation compte-t-elle? (*Agent:Inclure les chambres isolées existant dans la même concession si elles appartiennent au même ménage*)		*Nombre des cases*
6 En quel matériau est faite la toiture?		*Paille – 1* *Bois – 2* *Tôles ondulées (métal) – 3*
7 De quel type est le mur?		*Paille et Argile - 1* *Paille - 2* *Brique – 3* *Brique ou pierre avec du ciment – 4*
8 Quel type de plancher la maison a-t-elle?		*Terre – 1* *Ciment – 2* *Ciment plus matériau supplémentaires – 3*

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Avoirs productifs

	Outil	1 Combien des outils vous appartiennent-ils ?	2 Quelle valeur ont vos outils agricoles aujourd'hui? (Donner le total) *FCFA*	3 Votre ménage, combien d'articles a-t-il acheté au cours de l'année passée?	4 A quel prix? FCFA	5 Votre ménage, combien d'articles a-t-il vendu au cours de l'année passée?	6 A quel prix? FCFA
1	Charrue						
2	Charrette						
3	Pulvérisateur d'insecticide						
4	Motopompe						
5	Bêches, pelles, etc..						
6	Houe						
7	Pousse-pousse						
8	Brouette						
9	Autre équipement agricole :						
10							
11	Pirogue						
12	Embarcation à voile						
13	Hors-bord						
14	Filet de pêche						
15	Canne à pêche						
16	Autre matériel de pêche						
17	Matériel de séchage du poisson						
18	Matériel de fumage du poisson						
19	Matériel de réfrigération						
20	Autres accessoires de la pêche						
21							

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Autres avoirs
Parmi les articles suivants, quels sont ceux dont dispose votre ménage?

	Article	1 Votre ménage dispose-t-il de [article]? Quel nombre ?	2 Combien pourriez-vous obtenir si vous vendiez tous ces articles aujour'hui? (Montant total) *FCFA*	3 Combien des articles avez-vous acheté l'année passée ?	4 A quel prix ? *FCFA*	5 Combien des articles avez-vous vendu l'année passée ?	6 A quel prix ? *FCFA*
1	Tables en plastic / en bois						
2	Chaises en plastic / en bois						
3	Lit en fer / en bois						
4	Armoire / Garde-robe						
5	Matelas						
6	Lingeries						
7	Téléphone portable						
8	Téléviseur						
9	Radio						
10	Vélo						
11	Voiture						
12	Motocyclette						
13	Electricité						
14	Tapis						
15	Assiettes						
16	Autres						
17							

17

PARTIE 3B. EPARGNE ET REMBOURCEMENT

1. Combien disposez-vous actuellement de somme d'argent pour vos besoins quotidiens?

   _____FCFA

2. Votre ménage doit-il de l'argent à un tiers ou à un organisme?
   Oui ☐
   Non ☐

   Si oui, combien ?

		FCFA	Remboursez-vous avec intérêt? A quel pourcentage ?
1	Parents vivant au village		
2	Parents vivant ailleurs		
3	Voisins / habitants du village		
4	Associations locales d'épargne		
5	Organisme de micro-crédits		
6	Banques		

3. Votre ménage a-t-il une dette à recouvrer?
   Oui ☐
   Non ☐

   Si oui, combien ?

		FCFA	Bénéficiez-vous de paiement d'intérêts? Combien ?
1	Parents vivant au village		
2	Parents vivant ailleurs		
3	Voisins / habitants du village		
4	Associations locales d'épargne		
5	Organisme de micro-crédits		

4. Votre ménage a-t-il bénéficié d'un envoi d'argent de la part d'un membre de la famille vivant ailleurs ou d'une autre source au cours de l'année passée?

   _____FCFA, De qui? _____ *(Donner le numéro d'identification si possible)*

5. Quelle est la somme d'argent épargnée par les membres de votre ménage l'année dernière? _____FCFA

6. Combien a dépensé votre ménage l'année dernière en remboursement d'emprunts antérieurs? _____FCFA

7. Avez-vous fait des envois d'argent à des membres de votre famille vivant ailleurs? _____FCFA

18

SECTION 4: DEPENSES

PARTIE 4A. ARTICLES CONSOMMABLES

1. SVP, évaluez la somme dépensée par votre ménage sur les articles suivants l'année dernière (Agent : noter ce que le répondant dit. Par an, par mois, par jour…)

	Article	FCFA (Montant total)	Code *Par jour – 1* *Par semaine – 2* *Par mois – 3* *Par an – 4*
1	Produits pour l'hygiène corporelle (savon, shampoing, pâte dentifrice, l'huile etc.)		
2	Produits à usage domestique (allumettes, bougies, ampoules, détergent, plats, etc.)		
3	Essence, gasoil, pétrole		
4	Bois de chauffe, charbon de bois pour cuisiner		
5	Religion (dons aux mosquées, chefs religieux)		
6	Loisirs		
7	Vêtements pour adultes		
8	Vêtements pour enfants		
9	Draps, couvertures, serviettes		
10	Construction et réparation de la maison		
11	Impôts, taxes		
12	Voyages		
13	Mariages et autres manifestations (impliquant des cadeaux à offrir)		
14	Dépenses funérailles		

PARTIE 4B. DÉPENSES ALIMENTAIRES

I) Dépenses relatives aux denrées alimentaires

1. Quel a été votre principal aliment de base l'année passée?

   _____

2. Combien de repas entiers votre famille prenait-elle par jour l'année dernière?

   _____ repas

3. Quel est le nombre de jours, au cours de l'année dernière, où vous n'avez pas eu assez à manger?

   _____ jours

Denrées alimentaires	4 Au cours de l'année dernière, votre ménage a-t-il consommé cette denrée alimentaire? *Oui – 1* *Non – 0*	5 A quelle fréquence consommez-vous cette denrée alimentaire au cours de cette période? *Par jour – 1* *Par semaine – 2* *Par mois - 3*		6 Combien dépensez-vous par mois pour cette denrée?
		Fois par :	Code	FCFA
Mil rouge				
Mil blanc				
Sorgho				
Riz				
Beignets				
Farine de mais				
Légumes				
Viande				
Poisson frais				
Poisson fumé / séché				
Jus/Boissons				
Haricots				
Œufs				
Thé				
Autres				

PART 4C. DÉPENSES ALIMENTAIRES

8. Si les denrées (par ex. riz, mil…) que vous avez produites vous-même, sont finies, qu'est-ce que vous faites pour nourrir votre famille?

   Code: ____, ____, ____, ____, ____

   1 – Acheter
   2 – Réduire la consommation
   3 – Dons par des parents, amis, autres membres de village
   4 – Autre – spécifier

9. Si vous achetez, quelle est la source d'argent?

   Code: ____, ____, ____, ____, ____

   1 – Epargnes
   2 – Vente de bétail
   3 – Vente d'autres biens
   4 – Pêche
   5 – Crédit
   6 – Autre - spécifier

II) Dépenses scolaires

1. L'année dernière, combien votre ménage a-t-il dépensé (en FCFA) pour la scolarisation des enfants ?

   Frais de scolarité _____
   Livres et fournitures scolaires _____
   Tenue / Vêtements _____
   Transport _____
   Repas à l'école _____
   Autres _____

MERCI !!

Merci beaucoup pour votre participation et coopération!

Avez-vous encore quelque chose à ajouter?

_____

_____

_____

_____

Observations générales et commentaires de l'enquêteur:

_____

_____

_____

_____

_____

APPENDIX B: 1ST FOLLOW-UP QUESTIONNAIRE (NOVEMBER 2007)

Ministère de l'Elevage, des Pêches et des Industries Animales (MINEPIA)

Projet sécurité alimentaire et réduction de la pauvreté à travers l'amélioration de la gouvernance et de l'évaluation des pêches continentales en Afrique

Project food security and poverty alleviation through improved valuation and governance of river fisheries in Africa

Etude sur l'Evaluation Economique de la Pêche dans la plaine d'inondation du Logone, Province de l'Extrême Nord, Cameroun

« Follow-up » questionnaire

Novembre 2007

STRICTEMENT CONFIDENTIEL

Village	
Numéro d'identification du ménage	
Numéro d'identification de l'agent enquêteur	
Date	

Résumé

Section 1 : Liste des membres du ménage
Section 2 : Production
Section 3 : Biens
Section 4 : Dépenses

1

PARTIE 1A. MEMBRES DU MENAGE (FAMILLE)

1 Depuis notre dernier passage, est-ce que un membre a rejoint le ménage? *Oui – 1 Non – 0*	2 Si oui, quels sont les noms de ces membres?	Code ID	3 Sexe *Masculin – 1 Féminin – 2*	4 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	5 Âge *Indiquer le nombre d'années*	6 Raison pour joindre le ménage? *naissance - 1 mariage - 2 retour d'un voyage - 3 chercheur de travail - 4 autre) - 5*
		C1				
		C2				
		C3				
		C4				

7 Depuis notre dernier passage, est-ce que un membre a quitté le ménage? *Oui – 1 Non – 0*	8 Si oui, quels sont les noms de ces membres, qui ont quitté le ménage?	Code ID	9 Sexe *Masculin – 1 Féminin – 2*	10 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	11 Âge *Indiquer le nombre d'années*	12 Raison pour quitter le ménage? *Mariage - 1 travail - 2 études - 3 pêche – 4 garder le bétail - 5 mort - 6 **autre - 7***

2

PARTIE 1B. CHOCS, INCIDENTS AFFECTANT LE MENAGE

1 Un des incidents sur la liste au-dessus est-il survenu depuis Mai 2007? (Code A) (lister 3 chocs les plus graves) *Oui – **Préciser quel mois**? Non – 0* **Code A** / **Mois**	2 Bien vouloir donner une estimation de perte pour chaque choc (en FCFA)	3 Avez-vous entrepris une des activités énumérées au-dessous pour vous en sortir? (Code B) *Préciser le numéro d'activités palliatives pour chaque incident*	4 Bien vouloir donner une estimation financière (e.g. du bétail vendu ou de l'argent emprunté) en *FCFA*	5 Votre ménage continue-t-il à réduire la consommation à cause de l'incident et malgré les solutions de crise? *Oui – 1 Non – 0*	6 Quel est selon vous le temps nécessaire pour surmonter ce choc? *Préciser la durée en mois ou en années*

Code A : Incidents :

1 - Maladie grave d'un adulte
2 - Décès d'un adulte
3 - Maladie grave d'un enfant
4 - Décès d'un enfant
5 - Absence permanente du membre de la famille
6 - Incendie
7 - Crime
8 - Perte d'argent
9 - Perte de biens productifs
10 - Perte d'emploi
11 - Sécheresse
12 - Surabondance des pluies ou inondation
13 - Animaux nuisibles ou maladies affectant les plantes
14 - Animaux nuisibles ou maladies affectant le poisson
15 - Animaux nuisibles ou maladies affectant le bétail
16 - Hausse du prix des intrants
17 - Baisse du prix des commodités produites
18 - Absence de la demande ou incapacité à vendre les produits agricoles, le poisson ou le bétail

Code B : Activités palliatives :

1 - Travailler plus dur
2 - Recourir à une occupation supplémentaire
3 - Migrer à la recherche d'un emploi
4 - Retirer les enfants de l'école
5 - Faire usage des épargnes
6 - Vendre ses biens
7 - Vendre le bétail
8 - Vendre les terres
9 - Emprunter de l'argent
10 - Recevoir des dons des parents
11 - Assistance des parents ou des habitants du village
12 - Assistance de la mosquée / église
13 - Assistance de l'Etat
14 - Réduire les dépenses de subsistance

PARTIE 2B. PÊCHE

1 Les membres de votre ménage, ont-ils eu une maladie depuis Mai 2007? *Oui – 1 Non - 0*	2 Si oui, laquelle?			3 Qu'est-ce que vous avez fait pour faire face à cette situation? *Rien fait – 1 Prix les médicaments à la pharmacie – 2 Allé à l'hôpital – 3 Consulté un médecin traditionnel – 4 Autres – spécifier*		4 Combien est-ce que vous avez dépensé?	5 Ce membre de votre ménage a-t-il arrêté ses activités habituelles (travailler/fréquenter etc)? *Oui – 1 Non – 0*	6 Si oui, pendant combien de temps (jours, semaines, mois)?	**Codes pour question 2** *1—Paludisme 2—Diarrhée 3—Mal de ventre 4—Problèmes respiratoires 5—MST 6—Asthme 7—Maux de tête 8—problèmes mentaux 9—maladie de peau 10—problèmes dentaires 11—problèmes des yeux 12—mal au dos 13—problèmes de coeur 14—autres (spécifier)*
	Code ID	Maladie 1	Maladie 2	Maladie 1		Maladie 2			

Je voudrais vous poser quelques questions sur vos activités en agriculture depuis Mai 2007

Numéro de parcelle	1 Votre ménage utilise-t-il les terres pour pratiquer les cultures suivantes?: *Maïs – 1 Mi blanc – 2 Mil rouge - 3 Riz – 4 Autres – préciser*	2 Superficie de parcelle?	3 Quelle quantité de produits avez-vous récolté depuis Mai 2007?	4 Combien de kg par unité de mesure?	5 Quelle quantité de cette récolte avez-vous vendu?	6 Combien avez-vous reçu de cette vente? FCFA	7 Combien avez-vous consommé?	8 Combien avez-vous réservé pour la semence ou utilisé pour autres besoins?	9 Combien avez vous dépensé pour le mains d'œuvre depuis Mai 2007?
1									
2									
3									

10. Bien vouloir estimer globalement en FCFA les dépenses totales pour votre production agricole depuis 2007 (sauf pour le main d'œuvre):_____FCFA

PARTIE 2B. PÊCHE

1. Combien de temps les membres de votre ménage qui font l'agriculture ont-ils investi pour le travaux sur le champs depuis Mai 2007?

Code ID	Mai 2007		Juin 2007		Juillet 2007		Août 2007		Septembre 2007		Octobre 2007		Novembre 2007		Décembre 2007	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

5

PARTIE 2B. PÊCHE

I. Votre ménage a-t-il pêché depuis Mai 2007 ?

Oui ☐ -> continuer
Non ☐ -> passer au II)

Si oui, **où** avez-vous pratiqué la pêche? Code: _____

1 - Lac Maga
2 - Dans le Logone
3 - Dans les défluents
4 - Mares saisonnières
5 - Mares permanentes
6 - Plaine d'inondation
7 - Canaux de pêche
8 - Autres :

1. Combien de poisson frais avez-vous vendu?

Quantité	unité	kg par unité

2. Combien de poisson séché avez-vous vendu?

Quantité	unité	kg par unité

3. Combien de poisson fumé avez-vous vendu?

Quantité	unité	kg par unité

4. Quel était le revenu total de vente de poisson frais depuis Mai 2007? Revenu_____FCFA
5. Quel était le revenu total de vente de poisson séché depuis Mai 2007? Revenu_____FCFA
6. Quel était le revenu total de vente de poisson fumé depuis Mai 2007? Revenu_____FCFA

Unités: kg – 1 paniers – 2 sac – 3 carton – 4 pirogue – 5

7. Combien de poisson, que vous avez pris, avez-vous consommé depuis Mai 2007?

Quantité frais	unité	Quantité fumé	unité	Quantité seché	unité

6

PARTIE 2B. PÊCHE

8. Combien avez-vous dépensé pour le main d'œuvre? _____FCFA

9. Essayez de donner une estimation des autres dépenses faites dans le cadre de la pêche depuis Mai 2007 (sauf pour le main d'œuvre).

10. Dépenses _____FCFA

11. Combien de temps les membres de votre ménage qui font la pêche ont-ils investi pour la pêche depuis Mais 2007?

Code ID	Mai 2007		Juin 2007		Juillet 2007		Août 2007		Septembre 2007		Octobre 2007		Novembre 2007		Décembre 2007	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

II) Commerce du poisson

1. Achetez-vous du poisson chez des tiers (pêcheurs, transformateurs, commerçants) pour le revendre directement?
   Oui ☐ -> continuer
   Non ☐ -> passer à la partie 2C.

2 Poisson acheté depuis Mai 2007:	3 Combien de voyages faites vous par mois ?	4 Combien de mois avez vous fait le commerce du poisson depuis Mai 2007?	5 Quantité moyenne **par voyage**	6 Unité	7 kg par unité	8 Prix d'achat moyen (par voyage)	9 Prix de vente moyen (par voyage)
Frais							
Séché							
Fumé							

Unité : kg – 1 paniers – 2 sac – 3 carton – 4 pirogue – 5

9. SVP, essayez d'estimer les dépenses que vous avez effectuées depuis Mai 2007 pour le commerce de poisson (par exemple: frais de transport, taxe, etc.)
   Dépenses: _____FCFA

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

	Animal	1 Combien des animaux avez-vous vendu depuis Mai 2007?	2 A quel prix? (prix total) *FCFA*	3 Combien de jeunes vos femelles ont-elles mis bas depuis Mai 2007?	4 Combien des animaux avez-vous abattu depuis Mai 2007?	5 Combien des animaux avez-vous acheté depuis Mai 2007?	6 A quel prix? (prix total) *FCFA*
1	Bovins						
2	Moutons						
3	Chèvres						
4	Chevaux						
5	Ânes, mulets						
6	Poulets, coqs						
7	Oies, canards, autre volaille						
8	Abeilles						
9	Lapins						
10	Pigeons						
11	Porc						
12	Autres animaux						
13							

	7 Combien des produits suivants avez-vous récolté depuis Mai 2007?	8 Combien avez-vous gagné en vendant ces produits depuis Mai 2007?
Lait et produits laitiers		
Œufs		

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

9. SVP, essayez d'estimer les dépenses totales effectuées pour l'élevage des animaux depuis Mai 2007 (main d'œuvre, vaccination, traitement, etc.):

   Dépenses: _____ FCFA

10. Combien de temps les membres de votre ménage qui font l'élevage ont-ils investi pour le travaux avec les animaux depuis Mai 2007?

Code ID	Mai 2007		Juin 2007		Juillet 2007		Août 2007		Septembre 2007		Octobre 2007		Novembre 2007		Décembre 2007	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

11. Existe-t-il un membre du ménage qui a fait une autre activité en dehors de l'agriculture, la pêche et l'élevage depuis Mai 2007 (p.ex. commerce, berger, travail occasionnel, emploi)?

    Oui ☐ -> continuer
    Non ☐ -> passer à la SECTION 3.

12. Qu'est-ce que ces membres font ?

Code ID du membre	Description du travail	Salaire/Revenu mensuel (en FCFA)

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Avoirs productifs

	Outil	1 Votre ménage, combien d'articles a-t-il acheté depuis Mai 2007?	2 A quel prix? *FCFA*	3 Votre ménage, combien d'articles a-t-il vendu depuis Mai 2007?	4 A quel prix? *FCFA*
1	Charrue				
2	Charrette				
3	Pulvérisateur d'insecticide				
4	Motopompe				
5	Bêches, pelles, etc..				
6	Houe				
7	Pousse-pousse				
8	Brouette				
9	Hache				
10	Machette				
11	Pirogue				
12	Embarcation à voile				
13	Hors-bord				
14	Filet de pêche				
15	Canne à pêche				
16	Autre matériel de pêche				
17	Matériel de séchage du poisson				
18	Matériel de fumage du poisson				
19	Matériel de réfrigération				
20	Autres accessoires de la pêche				
21					

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Autres avoirs

	Article	1 Combien des articles avez-vous acheté depuis Mai 2007?	2 A quel prix ? *FCFA*	3 Combien des articles avez-vous vendu depuis Mai 2007?	4 A quel prix ? *FCFA*
1	Tables en plastic / en bois				
2	Chaises en plastic / en bois				
3	Lit en fer / en bois				
4	Armoire / Garde-robe				
5	Matelas				
6	Lingeries				
7	Téléphone portable				
8	Téléviseur				
9	Radio				
10	Vélo				
11	Voiture				
12	Motocyclette				
13	Electricité				
14	Tapis				
15	Assiettes				
16	Nattes				
17	Autres:				

11

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

1. Votre ménage a-il remboursé des dettes à un tiers ou à un organisme depuis Mai 2007? Oui ☐ Non ☐

Si oui, combien ?

		FCFA
1	Parents vivant au village	
2	Parents vivant ailleurs	
3	Voisins / habitants du village	

2. Votre ménage a-t-il prêté de l'argent chez un tiers ou un organisme depuis Mai 2007? Oui ☐ Non ☐

Si oui, combien ?

		FCFA
1	Parents vivant au village	
2	Parents vivant ailleurs	
3	Voisins / habitants du village	

3. Votre ménage a-t-il bénéficié d'un envoi d'argent depuis Mai 2007? _____FCFA

4. Quelle est la somme d'argent épargnée par les membres de votre ménage depuis Mai 2007? _____FCFA

5. Avez-vous fait des envois d'argent à des membres de votre famille vivant ailleurs? _____FCFA

6. SVP, évaluez la somme dépensée par votre ménage sur les articles suivants depuis Mai 2007

	Article	FCFA (Montant total)	*Par jour –1 Par semaine –2 Par mois –3*
1	Produits pour l'hygiène corporelle (savon, shampoing, pâte dentifrice, l'huile etc.)		
2	Produits à usage domestique (allumettes, bougies, ampoules, détergent, plats, etc.)		
3	Essence, gasoil, pétrole		
4	Bois de chauffe, charbon de bois pour cuisiner		
5	Religion (dons aux mosquées, chefs religieux)		
6	Loisirs		
7	Vêtements pour adultes		
8	Vêtements pour enfants		
9	Draps, couvertures, serviettes		
10	Construction et réparation de la maison		
11	Impôts, taxes		
12	Voyages		
13	Mariages et autres manifestations (impliquant des cadeaux à offrir)		
14	Dépenses funérailles		

12

PARTIE 4A. DÉPENSES ALIMENTAIRES

Dépenses relatives aux denrées alimentaires

1. Combien de repas entiers votre famille prenait-elle par jour depuis Mai 2007?

   _____ repas

2. Quel est le nombre de jours, depuis Mai 2007, où vous n'avez pas eu assez à manger?

   _____ jours

No	3 Combien avez-vous dépensé pendent cette période pour cette denrée depuis Mai 2007?	*Mai, Juin, Juillet, Août* Dépenses réelles par denrée en FCFA	*Sept, Octobre, Novembre, Décembre* Dépenses réelles par denrée en FCFA
1	Mil rouge		
2	Mil blanc		
3	Riz		
4	Beignets		
5	Viande		
6	Poisson frais		
7	Poisson fumé/séché		
8	Thé		
9	Lait caillé		

MERCI !!

Dépenses scolaires

1. Depuis Mai 2007, combien votre ménage a-t-il dépensé (en FCFA) pour la scolarisation des enfants **par mois**?

   Frais de scolarité _____
   Livres et fournitures scolaires _____
   Tenue / Vêtements _____
   Autres _____

Merci beaucoup pour votre participation et coopération!

Avez-vous encore quelque chose à ajouter?

Observations générales et commentaires de l'enquêteur:

APPENDIX C: 2ND FOLLOW-UP QUESTIONNAIRE (MAY 2008)

Ministère de l'Elevage, des Pêches et des Industries Animales (MINEPIA)

Projet sécurité alimentaire et réduction de la pauvreté à travers l'amélioration de la gouvernance et de l'évaluation des pêches continentales en Afrique

Project food security and poverty alleviation through improved valuation and governance of river fisheries in Africa

Etude sur l'Evaluation Economique de la Pêche dans la plaine d'inondation du Logone, Province de l'Extrême Nord, Cameroun

« Follow-up » questionnaire

Avril 2008

STRICTEMENT CONFIDENTIEL

Village	
Numéro d'identification du ménage	
Numéro d'identification de l'agent enquêteur	
Date	

Résumé

Section 1 : Liste des membres du ménage
Section 2 : Production
Section 3 : Biens
Section 4 : Dépenses

1

PARTIE 1A. MEMBRES DU MENAGE (FAMILLE)

1 Depuis notre dernier passage, est-ce que un membre a rejoint le ménage? *Oui – 1 Non – 0*	2 Si oui, quels sont les noms de ces membres?	Code ID	3 Sexe *Masculin – 1 Féminin – 2*	4 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	5 Âge *Indiquer le nombre d'années*	6 Raison pour joindre le ménage? *naissance - 1 mariage - 2 retour d'un voyage - 3 chercheur de travail - 4 autre) - 5*
		C1				
		C2				
		C3				
		C4				

7 Depuis notre dernier passage, est-ce que un membre a quitté le ménage? *Oui – 1 Non – 0*	8 Si oui, quels sont les noms de ces membres, qui ont quitté le ménage?	Code ID	9 Sexe *Masculin – 1 Féminin – 2*	10 Lien de parenté avec le chef de famille *Chef de famille – 1 Mari / Epouse – 2 Fils / Fille – 3 Beau-fils / Belle-fille – 4 Père / Mère – 5 Frère / Sœur – 6 Petit-fils – 7 Grand parent – 8 Neveu / Nièce – 9 Autre Parent – 10 Autre personne sans lien de parenté avec la famille – 11*	11 Âge *Indiquer le nombre d'années*	12 Raison pour quitter le ménage? *Mariage - 1 travail - 2 études - 3 pêche – 4 garder le bétail - 5 mort - 6 **autre - 7***

2

PARTIE 1B. CHOCS, INCIDENTS AFFECTANT LE MENAGE

1 Un des incidents sur la liste au-dessus est-il survenu depuis Novembre 2007? (Code A) (lister 3 chocs les plus graves) *Oui – Préciser quel mois?* *Non – 0* **Code A** | **Mois**	2 Bien vouloir donner une estimation de perte pour chaque choc (en FCFA)	3 Avez-vous entrepris une des activités énumérées au-dessous pour vous en sortir? (Code B) *Préciser le numéro d'activités palliatives pour chaque incident*	4 Bien vouloir donner une estimation financière (e.g. du bétail vendu ou de l'argent emprunté) en *FCFA*	5 Votre ménage continue-t-il à réduire la consommation à cause de l'incident et malgré les solutions de crise? *Oui – 1* *Non – 0*	6 Quel est selon vous le temps nécessaire pour surmonter ce choc? *Préciser la durée en mois ou en années*

Code A : Incidents :

1 - Maladie grave d'un adulte
2 - Décès d'un adulte
3 - Maladie grave d'un enfant
4 - Décès d'un enfant
5 - Absence permanente du membre de la famille
6 - Incendie
7 - Crime
8 - Perte d'argent
9 - Perte de biens productifs -> **précisez :**_____
10 - Perte d'emploi
11 - Sécheresse
12 - Surabondance des pluies ou inondation
13 - Animaux nuisibles ou maladies affectant les plantes
14 - Animaux nuisibles ou maladies affectant le poisson
15 - Animaux nuisibles ou maladies affectant le bétail
16 - Hausse du prix des intrants
17 - Baisse du prix des commodités produites
18 - Absence de la demande ou incapacité à vendre les produits agricoles, le poisson ou le bétail

Code B : Activités palliatives :

1 - Travailler plus dur
2 - Recourir à une occupation supplémentaire
3 - Migrer à la recherche d'un emploi
4 - Retirer les enfants de l'école
5 - Faire usage des épargnes
6 - Vendre ses biens -> **précisez :**_____
7 - Vendre le bétail
8 - Vendre les terres
9 - Emprunter de l'argent
10 - Recevoir des dons des parents
11 - Assistance des parents ou des habitants du village
12 - Assistance de la mosquée / église
13 - Assistance de l'Etat
14 - Réduire les dépenses de subsistance

PARTIE 2A. AGRICULTURE

1 Les membres de votre ménage, ont-ils eu une maladie depuis Novembre 2007? *Oui – 1* *Non - 0*	2 Si oui, laquelle?			3 Qu'est-ce que vous avez fait pour faire face à cette situation? *Rien fait – 1* *Prix les médicaments à la pharmacie – 2* *Allé à l'hôpital – 3* *Consulté un médecin traditionnel – 4* *Autres – spécifier*		4 Combien est-ce que vous avez dépensé?	5 Ce membre de votre ménage a-t-il arrêté ses activités habituelles (travailler/fréquenter etc)? *Oui – 1* *Non – 0*	6 Si oui, pendant combien de temps (jours, semaines, mois)?	**Codes pour question 2** *1—Paludisme* *2—Diarrhée* *3—Mal de ventre* *4—Problèmes respiratoires* *5—MST* *6—Asthme* *7—Maux de tête* *8—problèmes mentaux* *9—maladie de peau* *10—problèmes dentaires* *11—problèmes des yeux* *12—mal au dos* *13—problèmes de coeur* *14—autres (spécifier)*
	Code ID	Maladie 1	Maladie 2	Maladie 1	Maladie 2	FCFA			

Je voudrais vous poser quelques questions sur vos activités en agriculture depuis Mai 2007

Numéro de parcelle	1 Votre ménage utilise-t-il les terres pour pratiquer les cultures suivantes?: *Maïs – 1* *Mi blanc – 2* *Mil rouge – 3* *Riz – 4* *Autres – préciser*	2 Superficie de parcelle?	3 Quelle quantité de produits avez-vous récolté depuis Novembre 2007?	4 Combien de kg par unité de mesure?	5 Quelle quantité de cette récolte avez-vous vendu?	6 Combien avez-vous reçu de cette vente? FCFA	7 Combien avez-vous consommé?	8 Combien avez-vous réservé pour la semence ou utilisé pour autres besoins?	9 Combien avez vous dépensé pour le mains d'œuvre depuis Novembre 2007?
1									
2									
3									

10. Bien vouloir estimer globalement en FCFA les dépenses totales pour votre production agricole depuis Novembre 2007 (sauf pour le main d'œuvre):_____FCFA

PARTIE 2A. AGRICULTURE

1. Combien de temps les membres de votre ménage qui font l'agriculture ont-ils investi pour les travaux sur le champ depuis Novembre 2007?

Code ID	Novembre 2007		Décembre 2007		Janvier 2008		Février 2008		Mars 2008		Avril 2008		Mai 2008	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

5

PARTIE 2B. PÊCHE

I. Votre ménage a-t-il pêché depuis Novembre 2007 ?

Oui ☐ -> continuer
Non ☐ -> passer au II)

Si oui, **où** avez-vous pratiqué la pêche? Code: _____

1 - Lac Maga
2 - Dans le Logone
3 - Dans les défluents
4 - Mares saisonnières
5 - Mares permanentes
6 - Plaine d'inondation
7 - Canaux de pêche
8 - Autres :

Un membre de ménage a-t-il voyagé ailleurs pour la pêche l'année passée?

Si oui, où ? _____, pendent combien de temps ? _____

1. Combien de poisson frais avez-vous vendu?

Quantité	unité	kg par unité

2. Combien de poisson séché avez-vous vendu?

Quantité	unité	kg par unité

3. Combien de poisson fumé avez-vous vendu?

Quantité	unité	kg par unité

4. Quel était le revenu total de vente de poisson frais depuis Novembre 2007? Revenu_____FCFA
5. Quel était le revenu total de vente de poisson séché depuis Novembre 2007? Revenu_____FCFA
6. Quel était le revenu total de vente de poisson fumé depuis Novembre 2007? Revenu_____FCFA

Unités: kg – 1 paniers – 2 sac – 3 carton – 4 pirogue – 5

7. Combien de poisson, que vous avez pris, avez-vous consommé depuis Novembre 2007?

Quantité frais	unité	Quantité fumé	unité	Quantité seché	unité

6

PARTIE 2B. PÊCHE

8. Combien avez-vous dépensé pour le main d'œuvre? _____FCFA

9. Essayez de donner une estimation des autres dépenses faites dans le cadre de la pêche depuis Novembre 2007 (sauf pour le main d'œuvre).
   Dépenses _____ FCFA

10. Combien de temps les membres de votre ménage qui font la pêche ont-ils investi pour la pêche depuis Novembre 2007?

Code ID	Novembre 2007		Décembre 2007		Janvier 2008		Février 2008		Mars 2008		Avril 2008		Mai 2008	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

II) Commerce du poisson

1. Achetez-vous du poisson chez des tiers (pêcheurs, transformateurs, commerçants) pour le revendre directement?
   Oui ☐ -> continuer
   Non ☐ -> passer à la partie 2C.

2 Poisson acheté depuis Novembre 2007:	3 Combien de voyages faites vous par mois ?	4 Combien de mois avez vous fait le commerce du poisson depuis Novembre 2007?	5 Quantité moyenne **par voyage**	6 Unité	7 kg par unité	8 Prix d'achat moyen (par voyage)	9 Prix de vente moyen (par voyage)
Frais							
Séché							
Fumé							

Unité : kg – 1 paniers – 2 sac – 3 carton – 4 pirogue – 5

7

PARTIE 2B. PÊCHE

9. SVP, essayez d'estimer les dépenses que vous avez effectuées depuis Novembre 2007 pour le commerce de poisson (par exemple: frais de transport, taxe, etc.) Dépenses: _____FCFA

8

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

	Animal	1 Combien des animaux avez-vous vendu depuis Novembre 2007?	2 A quel prix? (prix total) FCFA	3 Combien de jeunes vos femelles ont-elles mis bas depuis Novembre 2007?	4 Combien des animaux avez-vous abattu depuis Novembre 2007?	5 Combien des animaux avez-vous acheté depuis Novembre 2007?	6 A quel prix? (prix total) FCFA
1	Bovins						
2	Moutons						
3	Chèvres						
4	Chevaux						
5	Ânes, mulets						
6	Poulets, coqs						
7	Oies, canards, autre volaille						
8	Abeilles						
9	Lapins						
10	Pigeons						
11	Porc						
12	Autres animaux						
13							

	7 Combien des produits suivants avez-vous récolté depuis Novembre 2007?	8 Combien avez-vous gagné en vendant ces produits depuis Novembre 2007?
Lait et produits laitiers		
Œufs		

9

PARTIE 2C. ELEVAGE ET ACTIVITÉ NON RURALE

9. SVP, essayez d'estimer les dépenses totales effectuées pour l'élevage des animaux depuis Novembre 2007 (main d'œuvre, vaccination, traitement, etc.):

   Dépenses: _____ FCFA

10. Combien de temps les membres de votre ménage qui font l'élevage ont-ils investi pour les travaux avec les animaux depuis Novembre 2007?

Code ID	Novembre 2007		Décembre 2007		Janvier 2008		Février 2008		Mars 2008		Avril 2008		Mai 2008	
	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine	Semaines par mois	Jours par semaine

11. Existe-t-il un membre du ménage qui a fait une autre activité en dehors de l'agriculture, la pêche et l'élevage depuis Novembre 2007 (p.ex. commerce, berger, travail occasionnel, emploi)?

    Oui ☐ -> continuer
    Non ☐ -> passer à la SECTION 3.

12. Qu'est-ce que ces membres font ?

Code ID du membre	Description du travail	Salaire/Revenu mensuel (en FCFA)

10

PARTIE 2D. EVALUATION DE RISQUE

Evaluation de risque

1. Quel est votre principale activité agricole? _____

2. Pour cette principale activité, combien récoltez-vous : Dans une année moyenne? Dans une mauvaise année? Dans une bonne année?

	Mauvaise Année	Année moyenne	Bonne année
Activité principale: _____	Sacs: Ha:	Sacs: Ha:	Sacs: Ha:

3. Sur les sacs de cette culture, que vous récoltez, combien vendez-vous et combien consommez-vous dans une année mauvaise (moyenne, bonne) ?

	Mauvaise Année		Année moyenne		Bonne année	
	Vendu	Consommé	Vendu	Consommé	Vendu	Consommé
Nombre de sacs:						

4. Pendent les 10 dernières années combien de fois avez-vous fait face à une année moyenne/mauvaise/bonne par rapport à votre activité principale?

Indiquez la fréquence en placent les cailloux dans les trois cases…

	Mauvaise Année	Année moyenne	Bonne année
Fréquence:			

PARTIE 2D. EVALUATION DE RISQUE

5. Dans une année moyenne (mauvaise, bonne) pour votre activité principale, combien avez-vous récoltez pour les autres cultures (autres céréales)?

Autres cultures :	Année mauvaise pour la principale activité	Année moyenne pour la principale activité	Bonne année pour la principale activité
_____	Sacs: Ha:	Sacs: Ha:	Sacs : Ha:
_____	Sacs: Ha:	Sacs: Ha:	Sacs : Ha:

6. Dans une année mauvaise (moyenne, bonne) pour votre activité principale, combien de revenu avez-vous obtenu de la pêche ?

Année mauvaise pour la principale activité	Année moyenne pour la principale activité	Bonne année pour la principale activité
FCFA par mois: Effort fourni:	FCFA par mois: Effort fourni:	FCFA par mois: Effort fourni:

Effort fourni pour la pêche : 1 - faible, 2 - moyen, 3 - élevé

7. Sur 10 poissons, que vous capturez, combien vendez-vous et combien consommez-vous dans une année mauvaise (moyenne, bonne) ?

Indiquez la fréquence en placent les cailloux dans les cases…

	Mauvaise Année		Année moyenne		Bonne année	
Poisson	Vendu	Consommé	Vendu	Consommé	Vendu	Consommé
Nombre :						

PARTIE 2D. EVALUATION DE RISQUE

8. Dans une année mauvaise (moyenne, bonne) pour votre activité principale, combien de revenu avez-vous obtenu de la commerce du poisson ?

	Année mauvaise pour la principale activité	Année moyenne pour la principale activité	Bonne année pour la principale activité
Revenu de la commerce du poisson	FCFA:	FCFA:	FCFA:

9. Dans une année mauvaise (moyenne, bonne) pour votre activité principale, combien avez-vous dépensé pour l'achat des animaux ? Combien de revenu avez-vous obtenu de la vente des animaux?

	Année mauvaise pour la principale activité	Année moyenne pour la principale activité	Bonne année pour la principale activité
Dépenses pour achat	FCFA:	FCFA:	FCFA:
Revenu de la vente	FCFA:	FCFA:	FCFA:

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Avoirs productifs

	Outil	1 Votre ménage, combien d'articles a-t-il acheté depuis Novembre 2007?	2 A quel prix? *FCFA*	3 Votre ménage, combien d'articles a-t-il vendu depuis Novembre 2007?	4 A quel prix? *FCFA*
1	Charrue				
2	Charrette				
3	Pulvérisateur d'insecticide				
4	Motopompe				
5	Bêches, pelles, etc..				
6	Houe				
7	Pousse-pousse				
8	Brouette				
9	Hache				
10	Machette				
11	Pirogue				
12	Embarcation à voile				
13	Hors-bord				
14	Filet de pêche				
15	Canne à pêche				
16	Autre matériel de pêche				
17	Matériel de séchage du poisson				
18	Matériel de fumage du poisson				
19	Matériel de réfrigération				
20	Autres accessoires de la pêche				
21					

PARTIE 3A. AVOIRS IMMOBILIERS, PRODUCTIFS ET CONSOMMABLES

Autres avoirs

	Article	1 Combien des articles avez-vous acheté depuis Novembre 2007?	2 A quel prix ? *FCFA*	3 Combien des articles avez-vous vendu depuis Novembre 2007?	4 A quel prix ? *FCFA*
1	Tables en plastic / en bois				
2	Chaises en plastic / en bois				
3	Lit en fer / en bois				
4	Armoire / Garde-robe				
5	Matelas				
6	Lingeries				
7	Téléphone portable				
8	Téléviseur				
9	Radio				
10	Vélo				
11	Voiture				
12	Motocyclette				
13	Electricité				
14	Tapis				
15	Assiettes				
16	Nattes				
17	Autres:				

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PARTIE 4A. DÉPENSES GÉNÉRALES

1. Votre ménage a-il remboursé des dettes à un tiers ou à un organisme depuis Novembre 2007? ☐ Oui ☐ Non

   Si oui, combien ?

		FCFA
1	Parents vivant au village	
2	Parents vivant ailleurs	
3	Voisins / habitants du village	

2. Votre ménage a-t-il prêté de l'argent chez un tiers ou un organisme depuis Novembre 2007? ☐Oui ☐Non

   Si oui, combien ?

		FCFA
1	Parents vivant au village	
2	Parents vivant ailleurs	
3	Voisins / habitants du village	

3. Votre ménage a-t-il bénéficié d'un envoi d'argent depuis Novembre 2007? _____FCFA
4. Quelle est la somme d'argent épargnée par les membres de votre ménage depuis Novembre 2007? _____FCFA
5. Avez-vous fait des envois d'argent à des membres de votre famille vivant ailleurs? _____FCFA
6. SVP, évaluez la somme dépensée par votre ménage sur les articles suivants depuis Novembre 2007

	Article	FCFA (Montant total)	*Par jour –1 Par semaine –2 Par mois –3 Depuis novembre - 4*
1	Produits pour l'hygiène corporelle (savon, shampoing, pâte dentifrice, l'huile etc.)		
2	Produits à usage domestique (allumettes, bougies, ampoules, détergent, plats, etc.)		
3	Essence, gasoil, pétrole		
4	Bois de chauffe, charbon de bois pour cuisiner		
5	Religion (dons aux mosquées, chefs religieux)		
6	Loisirs		
7	Vêtements pour adultes		
8	Vêtements pour enfants		
9	Draps, couvertures, serviettes		
10	Construction et réparation de la maison		
11	Impôts, taxes		
12	Voyages		
13	Mariages et autres manifestations (impliquant des cadeaux à offrir)		
14	Dépenses funérailles		

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PARTIE 4B. DÉPENSES ALIMENTAIRES

Dépenses relatives aux denrées alimentaires

1. Combien de repas entiers votre famille prenait-elle par jour depuis Novembre 2007?

   _____ repas

2. Quel est le nombre de jours, depuis Novembre 2007, où vous n'avez pas eu assez à manger?

   _____ jours

No	3 Combien avez-vous dépensé pendent cette période pour cette denrée depuis Novembre 2007?	*Novembre, Décembre, Janvier* Dépenses réelles par denrée en FCFA	*Février, Mars, Avril, Mai* Dépenses réelles par denrée en FCFA
1	Mil rouge		
2	Mil blanc		
3	Riz		
4	Beignets		
5	Viande		
6	Poisson frais		
7	Poisson fumé/séché		
8	Thé		
9	Lait caillé		

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MERCI !!

Dépenses scolaires

1. Depuis Novembre 2007, combien votre ménage a-t-il dépensé (en FCFA) pour la scolarisation des enfants **par mois**?

   Frais de scolarité _____
   Livres et fournitures scolaires _____
   Tenue / Vêtements _____
   Autres _____

Merci beaucoup pour votre participation et coopération!

Avez-vous encore quelque chose à ajouter?

_____

_____

Observations générales et commentaires de l'enquêteur:

_____

_____

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APPENDIX D: HOUSEHOLD LIST

	No of households			
Village ID	Baseline	1st follow-up	2nd follow up	Risk assessment
1	12	12	12	10
2	43	43	41	25
3	18	14	14	15
4	12	12	12	9
5	17	17	15	13
6	27	25	24	22
7	28	25	25	22
8	17	17	16	15
9	10	10	9	7
10	24	24	24	20
11	13	13	13	11
12	25	25	25	25
13	30	30	29	29
14	23	23	18	15
Total	**299**	**290**	**277**	**238**