Floodplain dynamics and traditional livelihoods in the upper Amazon: A study along the central Ucayali River, Peru

by

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ABSTRACT

Floodplain dynamics and traditional livelihoods in the upper Amazon: A study along the central Ucayali River, Peru

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Supervisor: Oliver T. Coomes

Poor people in rural areas of developing countries are considered to be particularly vulnerable. Research shows that the rural poor tend to live in risky environments and face greater difficulties coping because they are excluded from formal safety nets and have few assets. Today, there is much concern that risk, especially environmental risk, contributes to perpetuate poverty and threatens livelihood security, yet our understanding of the implications of environmental risk for rural livelihood remains incipient. This dissertation explores peasant livelihood within the context of environmental change through a study of peasant responses to rapid river changes along the Central Ucayali River, a highly active meandering river and a major Amazon tributary in Peru.

Livelihood responses to floodplain dynamics were examined using the case of a recent meander cut-off near the city of Pucallpa as a "natural experiment." Participant observation and a household survey with 68 *ribereño* households, in three different villages upstream and downstream from the cut-off, served to investigate: 1) livelihood before and after the cut-off; 2) the role of humans in facilitating the cut-off; 3) land tenure; and 4) the links between shocks and asset evolution.

Descriptive analysis indicates that *ribereños* modified their livelihoods in response to the biophysical changes attributed to the cut-off and derived important economic opportunities. Results suggest that *ribereños* actually intervened to facilitate the cut-off to reduce travel time and make boat travel safer. Despite the potential for unclear rights and overlapping claims, due to land instability and the coexistence of formal and customary tenure rules, land disputes did not result in physical violence. Examples from two villages were used to illustrate how tenure rules are renegotiated as the resource base expands or contracts. Descriptive and statistical analyses show that riverbank slumps were the main form of risk along the Ucayali and, despite their direct effect on land holdings, environmental shocks did not necessarily constrain land accumulation or increase inequality. This study argues that environmental risk can increase vulnerability and reduce welfare but, under certain circumstances it creates new opportunities for rural people in developing countries. The implications of these findings for vulnerability reduction, human adaptation to environmental change, and Amazonian cultural ecology are discussed.

RÉSUMÉ

Dynamiques des plaines inondables et modes de vie traditionnels en huate Amazonie : Une étude des rives du moyen Ucayali, Pérou.

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Direction: Oliver T. Coomes

Les populations pauvres des regions rurales des pays en développement sont considérées comme étant particulièrement vulnérables. Les recherches passées ont démontré que les membres de ces populations tendent à vivre dans des environnements à risques et font face à de plus grands défis parce qu'exclus du filet de sécurité sociale formel et parce que possédant comparativement moins de biens mobiliers et immobiliers. Aujourd'hui, de beaucoup s'inquiètent de la contribution de ces risques, en particulier des riques environnementaux, à perpétuer la pauvreté et du danger qu'ils posent pour le maintient des modes de vie. Malgré ces inquiétudes, notre compéhension des implications des risques environnementaux pour les modes de vie ruraux demeure faible. Cette dissertation explore le mode de vie paysan en période de changements environnementaux. Il s'agit d'une étude de la réponse des paysans du moyen Ucayali aux rapides changements dans la dynamique du fleuve. L'Ucayali est un affluent majeur du fleuve Amazone, au Pérou.

La création récente d'un méandre abandonné (bras mort) près de la ville de Pucallpa a servi de « laboratoire naturel » pour l'étude des réponses paysannes aux changements de dynamique des plaines inondables. De l'observation participative et un sondage auprès de 68 ménages *ribereños* de trois différents villages situés en amont et en aval du méandre abandonné ont permis d'investiguer: 1) le mode de vie avant et après la création du bras mort; 2) le rôle des humains dans sa création; 3) le mode de tenure des terres; ainsi que 4) les liens existants entre le choc subit par le changement et la variation des possessions terriennes des paysans.

L'analyse descriptive indique que les *ribereños* ont modifié leur mode de vie en réponse aux changements biophysiques découlant de la création du bras mort. L'analyse indique également que le changement dans la dynamique de la rivière a apporté d'importantes opportunités économiques pour les paysans. Les résultats suggèrent que les *ribereños* sont intervenus pour faciliter l'isolement du méandre afin de réduire la durée des voyages en bateau et pour rendre ces voyages plus sécuritaires. Malgré que les droits de tenure émergents de la nouvelle configuration environnementale ne soient pas clairement définis et malgré la coéxistence de règles coutumières et formelles de tenure, les multiples revendications n'ont pas abouti à la violence physique. Des exemples provenant de deux villages ont été utilisés pour illustrer comment les règles de tenure sont renégociées cependant que les ressources terriennes augmentent ou diminuent. Les analyses descriptives et statistiques démontrent que les glissements de terrain en bordure de l'Ucayali représentent la principale forme de risque pour les paysans et que, malgré leurs effets directs sur la propriété, les chocs environnementaux ne contraignent pas nécessairement l'accumulation de terres et n'accroissent pas les inégalités. Cette étude démontre que le risque environnemental peut accroître la vulnérabilité et réduire le bien-être des populations rurales des pays en développement, mais aussi qu'en certaines circonstances, les changements environnementaux créent de nouvelles opportunités pour les populations affectées. La dissertation se conclue par une discussion de ce que ces résultats impliquent pour la réduction de la vulnérabilité, pour l'adaptation des humain aux changements environnementaux et pour l'écologie culturelle de l'Amazonie.

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When I was a child, growing up in Mexico, I dreamt about going to the Amazon one day. What I did not know then is that I would have to come to Canada to do so and that I would end up devoting several years studying the livelihoods of Amazonian peoples. I feel very fortunate to have taken such a path, which has shaped my life both professionally and at a personal level.

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

Page

LIST OF APPENDICES

Page

CHAPTER 1. INTRODUCTION

1.1 Statement of the problem

The main issue addressed in this dissertation is how poor rural populations in developing countries go about making a living within the context of rapid environmental change. What kinds of environmental transformations occur and what are their implications for peasant livelihood? How do people deal with environmental risk and respond to rapid environmental change? What factors explain differential responses? And to what extent do rapid alterations in the environment reshape the long-term prospects for livelihood and well-being? These questions are particularly relevant at this time given the growing concern about the fate of the poor, especially in the developing world. The poor are said to be more exposed to risk and to face greater difficulties coping because they have fewer resources to do so. Current initiatives aim at helping the poor by creating and reinforcing safety nets, and building assets. These initiatives hope to bring people out of poverty and to increase their adaptive capacities in an increasingly changing environment; the danger being that these initiatives may be ineffective, unless they are grounded in a better understanding of these adaptive capacities.

The purpose of this study is to contribute to the literature and inform policy about the challenges and opportunities for livelihood in extremely dynamic environments. In this dissertation I argue that environmental risk can increase vulnerability and reduce well-being but, under certain circumstances it creates new opportunities for rural people in developing countries. By examining the implications of rapid environmental change upon peasant households, household responses to them, and how people actually "manage" change to derive certain benefits, I also argue that the poor may not always be as vulnerable as we think. Yes, poor people are constantly faced with risk and have limited resources to protect themselves from it, but they also show a remarkable capacity to recover from shocks and to seize economic opportunities from them. Shocks sometimes contribute to trap people in poverty, but in some instances they provide a window of opportunity that helps some to escape from it. A better grasp of this issue is much needed if policy makers are to be successful in efforts to enhance the resilience for the most vulnerable populations in the developing world.

1.2 Literature review

1.2.1 Vulnerability

Over the last two decades, "vulnerability" has become a central concept in the literature. Our understanding of what vulnerability is has evolved over time, shifting from the natural to the social spheres, and more recently towards the interface between the two spheres. Whereas early notions of vulnerability, rooted in the hazards literature, tended to emphasize exposure to hazard events and societal responses to them (White 1945; Kates 1971; Burton *et al.* 1978), today a consensus is emerging on the notion that vulnerability must be understood in terms of both exposure and the various factors that affect the capacity to anticipate, cope with and recover from shocks or contingencies (Watts and Bohle 1993; Blaikie *et al.* 1994; Adger 1999; White *et al.* 2001; Turner *et al.* 2003). People are vulnerable when they are unable to weather the effects of a disturbance; they are resilient when they can absorb and recover from it, as has been described for natural systems (Holling and Gunderson 2002). Guided by Sen's work on famine and entitlements (1981) and the concern that disasters have become more common in recent times, authors within political ecology have stressed the need to understand the social underpinnings of hazards (e.g., political economy, class structure) (Hewitt 1983a; Watts 1983; Watts and Bohle 1993; Blaikie *et al.* 1994). These approaches, however, have been unable to adequately address the sustainability of human-environment systems at interlocking scales (Turner *et al.* 2003).

Various definitions of vulnerability have been applied to specific groups of society, social systems, and human-environmental systems. A common definition used is that vulnerability is the combination of exposure to contingencies or shocks and having difficulties coping (Chambers 1989, 1; Ellis

2000, 62). This definition has two components: an external one (i.e., the shock or contingency) and an internal one (i.e., determined by the lack of assets and social networks). The World Bank (2000) also uses "exposure" and "capabilities" when it defines vulnerability as "the likelihood that a shock will result in a decline in well-being" (p. 139), typically reflected in variations in income and consumption. Vulnerability has been defined by others in terms of the characteristics of individuals and groups that contribute to put their lives and livelihoods at risk; these include class, caste, ethnicity, gender, disability, and age (Blaikie *et al.* 1994, 9). More recently, Turner and colleagues (2003, 8074) saw vulnerability as the degree to which a system or its components are likely to experience harm as a result of exposure to a shock.

Poverty and vulnerability are believed to go hand-in-hand. Poor people are often more vulnerable than those that are better-off simply because they have fewer means to weather the effects of negative shocks. There are instances, however, in which other groups are as vulnerable as the poor, or in which shocks do not affect all poor people equally. Although highly correlated, poverty and vulnerability should not be used synonymously. The term poverty is used in reference to a condition or state of well-being; vulnerability, in turn, is a dynamic concept aimed at tracking the process whereby people move in and out of poverty, or experience changes in their well-being (World Bank 2000).

Despite significant advances on the theoretical landscape, the concept of vulnerability has been difficult to apply in practical terms. In particular, the development of suitable indicators and measures of vulnerability that can be used to identify groups at risk beforehand has proven most challenging (World Bank 2000; White *et al.* 2001; Luers 2005). Such difficulties are related to the dynamic and multi-dimensional nature of vulnerability. Tracking the evolution of vulnerability calls for the use of panel data on income and consumption, but also on other factors to which vulnerability is closely related, such as, assets, entitlements (i.e., rights that enable access to and control of resources), human capital and safety nets (Blaikie *et al.* 1994; Moser 1998; World Bank 2000; Turner *et al.* 2003). Our understanding of vulnerability is also limited by the lack of recognition of the benefits associated with the use of risky or hazard prone environments (White *et al.* 2001).

This study responds to the need for closer examination of how social and economic relations actually translate to make people more (or less) vulnerable when exposed to hazards. It aims to contribute to the literature by adding a case study on vulnerability and resilience among Amazonian peasants in a markedly dynamic environment. It examines exposure, as well as responses, but rather than emphasizing income and consumption, my focus is on the evolution of assets and institutions over time.

1.2.2 Coping with risk: mitigation and coping

Risk is a determining factor on the livelihoods of rural people throughout the developing world. Rural people are often exposed to political strife, economic crises, floods, droughts, and other environmental risks, while remaining marginalized from formal credit and insurance systems. Individuals and groups, however, have devised different mechanisms in order to make a living under such conditions. Whenever possible, households will respond in ways that allow them to maintain the assets that they need in order to resume their livelihoods afterwards. For instance, households may respond to shocks first by diversifying their income, then they might draw on their social networks for insurance and on temporary migration to reduce the size of the household and its consumption needs. Following those responses, households may selectively dispose of certain productive assets and only as a last resort will they abandon land, their house and other major assets (Ellis 2000, 44).

Risk strategies can be grouped into two broad categories that more or less reflect the general sequence above: actions taken in anticipation to a shock (*ex ante*) and actions taken afterwards (*ex post*) (Fafchamps 1999; Ellis 2000; World Bank 2000; Dercon 2005). The former are aimed at reducing or mitigating the potential impacts of shocks, e.g., “income smoothing.” The purpose of the latter is to smooth consumption following a disrupting event (Morduch 1995; Ellis 2000).

Ex ante strategies include income and asset diversification, specialization, and insurance, among others (Fafchamps 1999; Ellis 2000; World Bank 2000; Dercon 2005). Perhaps the most common methods by which households mitigate risk are by augmenting the types of crops planted, cultivating different plots and engaging in non-farm activities with the aim of having a fall-back in case one fails (Bromley and Chavas 1989; Rosenzweig and Wolpin 1993; Ellis 2000) – in other words, diversification of their income and asset portfolios. Examples of diversification include how riverine peasants in the Peruvian Amazon use nearby upland areas to grow crops during the flood season (Hiraoka 1985b; 1986), or the growing dependence on urban sources of income among rural peoples throughout the developing world (Ellis 2000; World Bank 2000). Another important mitigation strategy is to set up some form of insurance in case of need. In the absence of formal insurance, households can insure themselves by accumulating savings and assets, or by nurturing social networks (within and beyond a community) that can be drawn upon in times of need (Narayan *et al.* 2000; World Bank 2000). Cash, food stocks, jewelry and livestock are often maintained, among other reasons, for self-insurance (e.g., Bromley and Chavas 1989; Rosenzweig and Wolpin 1993; Takasaki *et al.* 2004). Gifts, exchanges of produce and labor, transfers and other social arrangements based on reciprocity also help households to insure one another (i.e., informal insurance) (Fafchamps 1992; 1999).

Ex post coping involves drawing upon insurance mechanisms set up *ex ante* to deal with a crisis. Savings are used and liquid assets are disposed of in order to secure minimal levels of consumption. Similarly, kin and friends, regardless of their location, may provide assistance by sharing food, labor, remittances, and loans, or by offering alternative sources of income to keep afloat those in need (Binswanger and Sillers 1983; Udry 1990; Grimard 1997). Informal insurance systems, however, often fail when the "social network" as a whole is affected by the same shock (i.e., covariant risk). An emerging literature on tropical forest people has shown that natural resources provide another form of *ex* *post* insurance and that shocks can also lead to changes in resource use (Hecht *et al.* 1988; Pattanayak and Sills 2001; Takasaki *et al.* 2004; McSweeney 2005).

Rural people sometimes cope with adversity by drawing more heavily upon their own labor or by adjusting the size of the household. Children may be pulled out of school, and along with women, they may be expected to contribute more actively with their labor. In times of need, household members living elsewhere may be called upon to increase the labor pool within the household; an alternative option is to send some household members away to reduce consumption needs.

One of the main conclusions arrived at from this literature is that risk mitigation and risk coping strategies, although helpful in smoothing income and consumption, are unable to fully insure against shocks, leaving certain individuals and groups at risk (Bromley and Chavas 1989; Fafchamps 1992; 1999; World Bank 2000; Dercon 2005). Another concern raised is that in order to cope with adversity, poor people will make desperate decisions that may compromise their livelihood and well-being in the future (Morduch 1995; World Bank 2000; Dercon 2005). Some explanations suggest that effective diversification is difficult to achieve, that poor people do not have the necessary assets for self-insurance, that mutual support groups collapse in times of crisis and that formal safety nets for the rural poor are lacking (Bromley and Chavas 1989; Fafchamps 1992; 1999; World Bank 2000; Dercon 2005). While highlighting the challenges that poor people face when dealing with risk has been extremely valuable, this literature has contributed, perhaps unintentionally, to overshadow the strengths and capabilities of poor people to face adversity.

This study examines mitigation and coping strategies to health and environmental shocks related to river channel dynamics in the Upper Amazon. In doing so, it pays attention to the limitations of mitigation and coping strategies while arguing that, in some instances, shocks might actually create a window of opportunity to improve well-being. My focus on shocks associated with floodplain dynamics is warranted for at least two main reasons. First, although river channel changes constitute the main source of risk in the upper basin, no studies to date have addressed how people respond to them. Furthermore, these kinds of risks are present in all unstable fluvial systems. Second, the effects of floodplain dynamics can be quite distinct over limited geographical areas; the same shock may have negative implications at a particular location and at the same time have positive effects nearby.

1.2.3 Risk, risk aversion and the poverty trap

One last theme that has received much attention in the development literature is the linkage between risk and uncertainty, peasant behavior, and its effects on poverty. This literature is built on the premise that risk is ever-present in the daily lives of rural people and that it can have long-lasting effects on livelihood. In other words, shocks are not only temporary disruptions that affect income and consumption, but are also a major cause of poverty and its persistence (i.e., the poverty trap).

Risk is said to play a key role in perpetuating poverty in two distinct ways (Dercon 2005). First, shocks may have important effects on household assets, especially among the poor, and diminish the prospects for asset accumulation and improved well-being. Some effects may be directly linked to the shock itself (e.g., crop failure, destruction of property, injury of household members); others result from the strategies used to cope with it (e.g., disposition of productive assets, dispersion of social networks). In this vein, there is much concern that the inability to fully insure against shocks, *ex ante,* forces poor people to cope with shocks in ways that compromise their ability to escape poverty, or even to secure a living in the long term (Morduch 1995; Carter 1997). Key productive assets, such as, livestock, farming tools and equipment, and land, sometimes disposed of during crises are difficult to recover. In some instances, it may take several years for the poor to regain those assets; in others, they may never be able to fully recover.

Second, faced with a combination of high levels of uncertainty and the absence of effective safety nets, the rural poor tend to be risk-averse (Binswanger and Sillers 1983; Rosenzweig and Binswanger 1993). Aversion to risk is reflected in production and investment decisions geared towards insuring survival in the worst-possible scenario (i.e., the "safety first" principle) (Ellis 1993), typically through specialization in low-risk and low-return activities. In doing so, however, the poor miss out on the opportunity of engaging in other riskier activities that promise higher returns that could help them to move out of poverty (World Bank 2000; Dercon 2005). Since richer households are less risk-averse (Rosenzweig and Binswanger 1993) and have fewer problems rebuilding their assets following a disturbance, risk is said to translate into greater social and economic inequalities.

1.3 Conceptual approach

A framework that links economic livelihood, natural resource use and household assets among peasants in tropical forests serves as the main conceptual guide for this study on floodplain dynamics and traditional livelihood in the Upper Amazon floodplain (Coomes *et al.* 2004) (Figure 1.1). Inspired by perspectives on economic decision making and livelihood diversification from agricultural economics and economic anthropology, the forest peasant literature recognises the varied nature of peasant livelihood (Reardon and Vosti 1995; Ellis 1998; 2000). Indeed, forest peasants engage in a complex and dynamic mix of activities that may include farming, fishing, forest-product extraction, off-farm labour, gold panning, and other activities (Hecht *et al.* 1988; Barham *et al.* 1999; McSweeney 2000; Takasaki *et al.* 2000a; 2001). According to this framework, within a given institutional, economic and price context, resource use is heavily dependent upon three sets of factors: 1) environmental endowments; 2) household assets; and 3) household demographics.

Environmental endowments (i.e., land, forests, water, and animal life) generate potential economic opportunities for households (Takasaki *et al.* 2001) and play an important role in defining household asset holdings. For instance, the availability of land that does not regularly flood allows for the production of perennial crops; the presence of an ox-bow lake permits the exploitation of certain fish species, and so on.

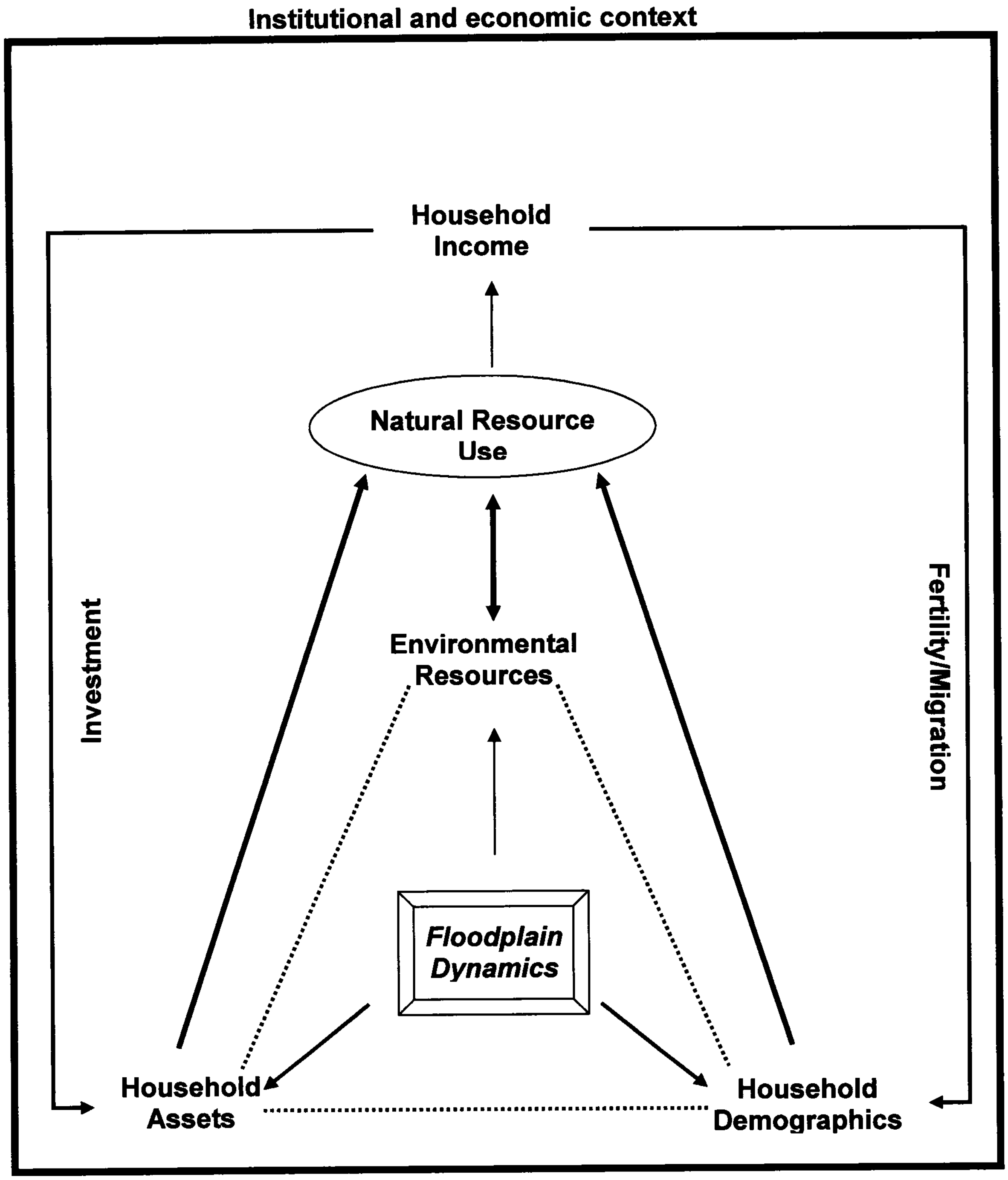

Figure 1.1. Conceptual framework for the study of floodplain dynamics and peasant livelihood. (Adapted from Coomes *et al.*, 2004).

Household assets (i.e., physical, human, and social) provide a basis for participation in specific economic activities (Coomes *et al.* 2004). Household participation or the degree of involvement in farming is contingent on the amount and types of land held. Nets and other fishing capital may also influence whether a household engages in fishing or not. Similarly, some extractive activities depend on access to a shotgun or previous experience. Finally, household demographics (i.e., age, size and composition) determine access to labour, consumption needs, and attitudes towards risk and investments (*à la Chayanov*).

The interplay between these factors is continually changing over time. Natural endowments may vary due to depletion or the emergence of new resources. Likewise, income derived from a specific economic activity may be converted into assets through investment. Lastly, a household's demographic structure evolves as a result of changes in fertility and migration, or as the household advances through its lifecycle. Floods, floodplain dynamics, illness, theft and other "shocks" may also be factors that reshape natural endowments, household demographics, and household asset holdings, thereby affecting local livelihoods and resource use. For instance, local residents may lose their farm to riverbank erosion or gain access to newly created areas of mudflat, which provide important cash earning opportunities. The formation or destruction of lakes may alter fish populations locally and affect the prospects for fishing accordingly.

This framework is used here to examine the links between floodplain dynamics (i.e., environmental shocks), peasant livelihood, and resource use along the Central Ucayali River, a major meandering river in the Peruvian Amazon. In this setting, river channel changes affect resource availability (e.g., destroy and create land, transform rivers and lakes, raze or make forest resources more readily available, and change flooding patterns locally), household assets (e.g., farm losses, dispersion of social networks), and lead to shifts in household demographics (e.g., resettlement). It is of particular interest to assess how river channel changes reshape local resource endowments and household asset holdings, in order to identify shifts in livelihood strategies and in the capacity to cope with subsequent shocks. As such, this framework is also used as an analytical tool which provides quantitative measures of the evolution of vulnerability and resilience over time, in terms of access to resources and exposure to shocks (Blaikie *et al.* 1994, 13).

The conceptual focus of the case study presented in this dissertation is primarily on the microeconomic elements of livelihood within the context of rapid environmental change; other potentially important factors (e.g., health, religious, political and cultural), however, fall beyond the scope of this study. The household, understood as the basic social unit of production and consumption (Ellis 1998, 19), is the main focus of analysis in this study. Gender and intergenerational dynamics within the household, although relevant, are not considered. For practical reasons, this study refers to the household as the group of individuals who eat from the same pot or live under the same roof (Ellis 1998). Peasant households are considered to be rational decision-makers attempting to improve their well-being; they rely primarily on internal labor, income pooling, and the allocation of resources, based on their needs, attitudes and aspirations (Ellis 1993). Peasant decisions are influenced by different constraints and opportunities at different times. A major advantage of using a microeconomic approach is that it permits one to capture variations in livelihood strategies and coping responses within and across villages, as well as over time.

This dissertation fits within the human-environment tradition in modern geography (Pattison 1964; Turner 1989).[1] Research in this tradition has been guided by the central question of "what is and ought to be our relationship to the natural world" (Kates 1987, 532) and is done primarily through empirical studies and "natural experiments" (Turner 1989, 91). Within the human-environment tradition, this study identifies with the "Berkeley School" (Turner 1989, 92) and other subfields that have emerged from it.

This dissertation is, perhaps, best situated within the subfield of cultural ecology. I adopt Denevan's (2001) definition of cultural ecology as a subfield that

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[1] Human-environment relations have been of interest to scholars from other disciplines, including anthropologists, archaeologists, and ecologists (Turner II 1989, 91). See Grossman (1977) for a review of the differences and similarities between cultural geography and anthropology.

is concerned with understanding "how human beings interact with the physical environment they find themselves in by utilizing what is useful to them (resources) and in the process change the environment in ways that are positive or negative for them" (p. 11). This study shares the interest on "how people live, doing what, how well, for how long, and with what social and environmental constraints", which has characterized the work of cultural ecologists (Butzer 1989, 192). This research is field-based and, like much of the work in cultural ecology, is rooted in the analysis of traditional practices and subsistence among societies in developing countries at micro or regional levels (Butzer 1989; 1990; Turner 1989; Zimmerer 1996). The main focus is on cultural-ecological behaviour at the level of individual strategies, from which cultural adaptations may later develop (Denevan 1983, 400). Following Denevan (1983), adaptation is understood here as the process of change in response to changes in the physical environment or internal stimuli (e.g., demography, economics, etc.), involving variation, selection and resilience (p. 401).

This study joins a new generation of cultural ecologists who combine insights and methods from anthropology (e.g., ethnographic research, economic anthropology, and decision making), with those of disciplines such as economics (e.g., agricultural economics, peasant economics, and livelihood analysis) (e.g., Browder and Pedlowski 2000; Walker *et al.* 2002; Coomes *et al.* 2004; McSweeney 2005; Roy Chowdhury and Turner 2006). I use a similar combination of approaches here to analyse peasant livelihood responses to floodplain dynamics in the Upper Amazon as a "natural experiment" or a real-life experience to shed light on the prospects of human adaptability to rapid environmental change.

In addition to having strong ties to cultural ecology, this study is also inspired by other perspectives within the human-environment tradition. For example, my interest on floodplain dynamics and peasant livelihood would also be in line with human ecology and hazards geography, a subfield concerned about human adjustments to the natural environment (Zimmerer 1996). This study, however, identifies more closely with more recent perspectives on hazards (i.e., vulnerability) and political ecology that attribute a greater role to social and economic factors in putting people at risk and creating disasters (Hewitt 1983a; Watts 1983; Blaikie *et al.* 1994; Quarantelli 1998; Wisner 2000; White *et al.* 2001). At the same time, this study seeks to draw greater attention to the capacities of "vulnerable" people, which have been recognized in the hazards/vulnerability literature, but have rarely been addressed to date. To do so, this study acknowledges but does not emphasize the linkages between the political economy, environmental change, and resource use decisions that characterize structuralist approaches in political ecology (Blaikie and Brookfield 1987; Blaikie 1999; Zimmerer and Bassett 2003; Schubert 2005; Walker 2005).

1.4 A study on floodplain dynamics and traditional livelihoods along the Central Ucayali River

I use a case study of floodplain dynamics and *ribereño* livelihood along the Central Ucayali River as a window into the potential for human adaptation to rapid environmental change. The Central Ucayali Region is located in the eastern lowlands of Peru, near the city of Pucallpa (8°20' South 74°34' West) (see Figure 1.2). The Ucayali River, which runs northward, roughly parallel to the Andes, is the dominant feature of the regional landscape. Considered the main headwater of the Amazon, the Ucayali adopts a meandering course as it reaches the lowlands and is known to be among the most unstable rivers in the Upper Amazon. The Central Ucayali River swings back and forth within its floodplain, at average rates higher than 100m/yr (Kalliola *et al.* 1992; Velásquez de la Cruz 2002); within the last 25 years or so, at least six meander cut-offs have modified the course of the Central Ucayali, between the mouths of the Pachitea and the Aguaytía rivers. The Ucayali is governed by an annual flood cycle, with a mean difference between low stage and flood stage of about 9.3 meters, at Pucallpa. There are few roads and the river serves as the main highway that connects Pucallpa with surrounding rural villages along the floodplain. Rural people living in the region, the Shipibo and the mestizo *ribereños* – descendants of Iberian and Amerindian people – are poor by all standards and receive little attention from the state.

Figure 1.2 Study area in the Eastern Lowlands of Peru. *Source*: Central Intelligence Agency (CIA). (Reproduced courtesy of the University of Texas Library, The University of Texas at Austin).

The main questions guiding this work are:

1. What are the implications of river channel migrations and associated processes (e.g., erosion, sedimentation and the cut-off of meanders) for peasant livelihood?;
2. How do peasants respond to floodplain variability and change and what factors explain differential household responses?;
3. And, to what extent do floodplain dynamics affect the prospects for peasant livelihood over time?

There are three reasons that make the Central Ucayali an interesting setting for the study on risk and human adaptation to environmental change. First, influenced by river dynamics and Andean tectonics, the Ucayali is one of the most dynamic river systems in the world and a major Amazon tributary (Neller *et al.* 1992; Pärssinen *et al.* 1996). Comparable with the delta of the Ganges-Bramahputra-Meghna Rivers in Bangladesh in terms of its dynamism, the Ucayali floodplain is not only marked by high risk due to seasonal and inter-annual variations in terms of rainfall and the annual flood cycle, but is also subjected to abrupt changes related to the lateral migration of the river, resulting in sedimentation and riverbank erosion, and isolation (i.e., when the river cuts a new channel through the neck of a meander). Such variations and changes are likely to have profound implications for people live within the floodplain. Second, a major concern is that floodplain dynamics may contribute to reduce asset holdings among the poor, both through use as a buffer and through direct destruction. Indeed, people that live along the Ucayali face the risk of losing their crops, but also of losing their land within a single year.

Third, despite such challenging conditions, the Ucayali and other dynamic rivers of the Upper Amazon have been occupied by indigenous peoples since prehistory and continue to be filled with rural settlements today. The Shipibo and the *ribereño*, make a living primarily from traditional farming within the floodplain, fishing and forest extraction, both for subsistence and cash income in a mixed economy. They have participated in the market economy and dealt with floodplain dynamics at least since the rubber boom (1860-1920). Rural residents along the Ucayali are poor by global monetary standards; their income is typically low and their assets few, and have limited or no access to formal credit and insurance. As such, a study of vulnerability and resilience among the rural poor in a setting where rapid environmental change is and has been the norm might help to improve our understanding of the links between, risk, poverty and the environment and on the potential of human adaptation to change among traditional societies.

Fieldwork and methods

In the summer of 2000 I had the opportunity to visit the Amazon for the first time. The purpose of my visit was to attend two methodological workshops, for a Pan-Amazonian project on cattle ranching and deforestation, that took place in Belém do Pará and Acre, in Brazil. The workshops and the two trips I made to the Amazon that year came at an opportune time and defined the path I have followed since. I had just completed my M.A. thesis on land use and fallowing practices in the dry tropical forests of the Yucatán in Mexico and had been accepted to pursue a doctoral degree at McGill. At the time, I knew that I was interested in peasant livelihoods and land use practices; I was also determined to conduct fieldwork in Latin America (most likely in Mexico), but was still looking for a specific research topic. I attended these workshops to explore the possibility to develop a topic within the umbrella of the cattle ranching project, ideally in the Peruvian Amazon. I participated in fieldwork in Acre following the workshop and then visited Tingo María and the surrounding valleys of Monzón and Huallaga, where fieldwork was envisioned for the project within Peru. From Tingo María, I descended to the lowlands to Pucallpa, a booming city and a major Amazonian economic center at the margin of the Ucayali River. Pucallpa offers a unique context due to its position as a major port in the Peruvian Amazon, connected by road to Lima on the Pacific coast. In the Pucallpa region one finds both the riverine context of Iquitos and other large cities located in the floodplain and the dynamics of colonist settlement and land use that have followed road construction in the Brazilian Amazon. Following advice from researchers working at the regional office of CIAT (*Centro Internacional de Agricultura Tropical*), I spent a few days in the area exploring the two parallel contexts.

After roughly a month in South America, I returned to Montreal with serious concerns about conducting fieldwork around Tingo María through the cattle ranching project; the main issue being personal safety. Upon reflection, I also realized that it was the floodplain that really captured my interest and from my conversations with riverine peasants I learned that the Ucayali River was extremely dynamic. At that point, I embarked on wide search for literature on livelihoods and resource use along the Amazon floodplains, and in general about the Ucayali River. The literature seemed consistent with local reports about the dynamism of this and other rivers in the Upper Amazon, but I was surprised to discover that there were no studies that addressed the implications of such dynamics on the livelihoods of riverine peoples, given that they seemed to be of key importance.

Fieldwork for this study was conducted over a total of 12 months, spread over three different visits in 2002 and 2003. The first trip (i.e., June through the beginning of August 2002) entailed mainly reconnaissance of the area. Activities during this phase centered on establishing contacts with government officials, researchers and NGOs (Non-Government Organizations), collection of secondary data, identification of prospective study sites, and exploring the main issues related to floodplain dynamics. Data obtained from government agencies and local libraries included books, reports, air photos, maps, and hydrographic data for the Ucayali River, at Pucallpa. In addition to spending time searching for information and making contacts in Pucallpa, I visited nine riverine villages along reaches that had undergone recent changes in the Pucallpa region, to gauge their suitability for further study and to gain initial insights that would inform subsequent fieldwork; villages included the two main ethnic groups found along the Central Ucayali (i.e., Shipibo-Conibo and the *ribereño*).

Reconnaissance work was key to single-out a recent meander cut-off near Pucallpa as a unique real-world case or "natural experiment" for this study. Informal conversations, semi-structured interviews and focus-group discussions conducted during this phase suggested a good potential to analyze conditions before and after the cut-off, and across villages situated along different reaches (i.e., upstream, downstream, former channel).[2] Furthermore, given its impacts on flooding and other floodplain dynamics, the cut-off also seemed extremely suitable to study floodplain dynamics livelihood more broadly.

A second field season was undertaken from the end of October through to December 2002, which marked the beginning of primary data collection. Work during this phase centered in one of three villages selected for this study near Bahuanisho, the site where the Ucayali River cut a new course in 1997. Specific activities at this first site included participant observation, initial pre-testing of the questionnaire, and survey work with 23 households.

The third and final fieldwork season was conducted between May and December 2003 – the bulk of the data that this dissertation is based on was gathered during this season. Participant observation, again, was used throughout this period, this time at the three study sites. Furthermore, I decided to revise my survey instrument to capture specific aspects that were not included in the 2002 questionnaire. The "new" survey was then pre-tested and, after some final revisions, it was administered to 73 households, including nineteen of the 23 households surveyed in 2002.[3]

Informed consent was sought prior to the beginning of any research activities (see Appendix I - Certificate of Ethical Acceptability of Research

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2 Due to time and logistical constraints, I was unable to include a case along the abandoned channel. As such, this study only captures conditions upstream and downstream from the cut-off.

3 The objective was to revisit each household interviewed in the first round to obtain comparable responses for all households in the sample. Of them, 21 maintained residence in the village in 2003, two households had moved to Pucallpa, and two others had migrated to another riverine village nearby or along the roadside. Nevertheless, it was possible to locate and conduct the second run with some migrant households with strong connections in the village. Typically, I spoke with them about my interest in asking them further questions, and if they agreed, we made arrangements for a visit at a subsequent date; some were visited in a neighboring village, some in the city and one in the original village, during one of their visits. Households that I was unable to track down were removed from the sample.

Involving Humans). In each village, permission to work in the community was sought from local authorities and the general assembly. Upon arrival at each of the study sites, I looked for the village leaders (i.e., Lt. Governor, Municipal Agent) and arranged a meeting to introduce myself, to explain the purpose of the study and describe the type of work proposed to be undertaken in the village, and to request their approval for the study. Typically, leaders called for a general assembly meeting to discuss the proposal and decide by consensus whether permission should be granted for work to take place. In addition to communal permission, individual verbal consent was also sought from households selected for the study. Below I describe my approach for village selection and sampling, the nature of the survey and other methods I used for data collection.

Village selection and sampling methods

Village selection was intended to capture the effects/implications of the Bahuanisho meander cut-off for peasant livelihood, and thus was not random. One of the three sites chosen for this study is located downstream from the cut-off; the other two are found within a short distance upstream, thus allowing me to contrast upstream and downstream effects. In addition to their location relative to the cut-off, the sites selected also reflect the differences between upland and lowland communities, as well as the heterogeneity found within the floodplain. Finally, other criteria for village selection included the role of residents of one village in the facilitation of the cut-off and differences between older villages and those of more recent formation.

Slight variations in sampling methods were deemed appropriate due to the particularities of each of the study sites. RRA (Rapid Rural Assessment) methods were used to rank households according to wealth in two of the study villages (Takasaki *et al.* 2000b). In Exito, such ranking served as a base for drawing a stratified random sample. Households in this village were grouped within three strata (i.e., poor, medium, and rich) based on their land and asset holdings. All households within the "richer" stratum (i.e., 19 households) plus six and eight households in the medium and the poor strata (i.e., 32 and 47 %, respectively) were randomly selected for interviewing to contrast wealthier and poorer households. In Puerto Angel[4] — the village with access to upland and floodplain areas — the strata were constructed based on key differences in land portfolio composition (i.e., lowland only, upland and lowland, and upland only). An equal number of households with access to lowland only (i.e., 15 households), and upland and lowland (i.e., 15 households) was randomly selected along with one of two households with access to land in the uplands only. In both of these villages, households that declined participation were replaced by other randomly selected households from the same stratum. Finally, all available and willing households living in Monte de los Olivos were sampled due to the small size of the village (14 households). Considering that the sample comprises more than 52 %, 33 % and 92 % of the target population in Exito, Puerto Angel and Monte de los Olivos, respectively, and captures meaningful differences within each of the study sites, I feel confident that the sample is fairly representative of the population in the three villages.[5]

Survey description

The 2003 survey was conducted by the author and a local field assistant among peasant households (n=73) to gather data on various aspects of peasant livelihoods and floodplain dynamics over time (Appendix II). Interviews were conducted in Spanish, the main language spoken by respondents, with at least one of the household heads at their homestead or while visiting their farm. Typically, interviews lasted on average between one and 1.5 hours, but in some cases were as long as 2.5 hours. Surveys focused on: household demography, family and resource use history, land use, income and wealth, social networks, experience

[4] Puerto Angel is a pseudonym. To maintain the respondents' anonymity the real name of this village is not disclosed.

[5] Relying primarily on households present at each of the study sites is a potential source of bias. In Exito, on the one hand, out-migrant households were excluded form the sample; the sample in Los Olivos does not include households that remained in Ega or that migrated to other locations. Unfortunately, the identification of and conduct visits to numerous households scattered across Pucallpa and different villages along the floodplain was deemed unfeasible. Research in this field promises important insights on the conditions that drive certain households to migrate or remain in one site under seemingly adverse conditions.

with shocks (e.g., illness, death, floods, river bank erosion), and mitigation-coping strategies. Respondents were also asked about their aspirations for the future and about the changes brought on by the meander cut-off and its effects on local livelihoods. In addition, the survey included questions about folk knowledge on fluvial geomorphology, floodplain changes foreseen for the future, and on human modification of fluvial systems. A slightly modified version of the survey was employed with the recently-settled households in Los Olivos, a village that formed as a result of the cut-off, to learn more about the circumstances that led people to resettle there and on the conditions prior to leaving and upon arrival in the new village. I also made an effort to survey migrant households in order to explore the links between floodplain dynamics and migration. This strategy soon proved to be too daunting, yet I was able to include a handful of such cases. These included households from Exito, who left since 2002 (i.e., they were part of original sample), and households that had returned to the village within the previous months.[6] The main objective was to gain insights on the reasons and circumstances for leaving/returning to the village. Although I was unable to perform any statistical analyses with these data, they provided some valuable information that helped me to gain initial insights on the factors that drive people to resettle. After discarding cases with incomplete information, the final sample size was 67 households for livelihood in 2003; 68 households for shock history and asset evolution over time.

Focus groups discussions

During the early stages of fieldwork, focus group discussions were used as a tool to learn about each of the prospective villages and to explore the links between floodplain dynamics and peasant livelihoods. Some specific topics covered at this stage included village histories, the cut-off and local livelihoods. Discussions were oriented to explore preliminary hypotheses and revise key issues for further investigation. Many of the issues raised in these discussions

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6 Out-migrants were located with the help of relatives or friends still living in the villages (Smith and McCarty 1996), or during visits they paid to the village (see sampling section above).

helped to inform the process of village selection and in the design of the survey instrument. During subsequent stages of the project, focus groups were used as a forum to discuss land tenure issues and the activities that triggered the Bahuanisho cut-off. I also used group-type interviews at an additional village suffering from riverbank erosion as a way to understand what may have occurred earlier in one of my study sites.

Participant observation

Participant observation methods served several purposes. From the beginning I tried to immerse myself, to the best of my ability, in order to understand the local context. During my stay in the field, I lived, ate, and traveled in much the same way that my informants do. I learned much about local livelihoods by accompanying *ribereños* to farm, fish, and hunt, and by traveling with them on *colectivos* to and from Pucallpa. My participation in agricultural tasks (i.e., weeding, harvesting, drying, roasting manioc, etc.) local activities, and community celebrations taught me valuable information about the local culture and helped me to gain trust and build rapport among local residents. On several occasions people openly expressed their appreciation for this and took it as an honest sign of interest in them and their lifeways. Although I did my best to make my presence and participation as unobtrusive as possible, I am aware that inevitably it had some impact on people's behavior. During later stages of the work, participant observation methods were used to validate information and to help situate findings from the survey within the local context.

Semi-structured interviews

In addition to survey work and participant observation, data was also gathered through semi-structured interviews with key informants, at the study sites as well as in Pucallpa. Depending on the topic, key informants included government officials, *colectivo* operators, middlemen, elders in the community, village authorities, and others that seemed knowledgeable. Such interviews helped to validate and complement information on a wide range of issues such as agricultural production, floodplain dynamics, land tenure issues, river travel, and product sales to name a few.

Riverbank height measurements

Differences in local flooding patterns were consistently reported in different villages near the Bahuanisho cut-off: households living upstream reported less frequent flooding since the cut-off; those living downstream reported more frequent flooding. River level data for Pucallpa were consistent with such claims for downstream reaches, but there was no data to corroborate the effect of decreased flooding upstream. To further investigate the issue of changes in flooding patterns, in relation to adjustments of the river bed itself (i.e., aggradation upstream; degradation downstream), I worked together with Dr. Michel Lapointe, a fluvial geomorphologist in the Department of Geography at McGill, measuring riverbank heights with a level along the Ucayali River between the mouths of the Pachitea and the Aguaytía rivers.[7] A total of 50 measurements were made in August 2003 with the aim of testing whether the relative height of riverbanks (in relation to water levels) varied between upstream and downstream reaches. Heights were later standardized based on Pucallpa records for August 21, 2003 and grouped into twelve aggregate points, based on their general location.

Using retrospective data

Although it would be ideal to work with longitudinal data gathered through repeated visits, this approach was not feasible because the cut-off had already taken place before I ever set a foot in the field. I therefore, had to collect retrospective data about the conditions that prevailed prior to the cut-off. Peters (1988) and Beckett *et al.* (2001) examined the advantages and limitations of using

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7 This stretch comprises roughly the area expected to be under the influence of a meander cut-off of this magnitude (Lapointe, pers. comm. 2003).

retrospective data. Ultimately, the adequacy of the retrospective approach depends on the capacity of people to accurately recall past events and conditions (Peters 1988; Beckett *et al.* 2001). Retrospective data, however, has been successfully used elsewhere to study land use practices among peasant farmers (Coomes *et al.* 2000; Abizaid and Coomes 2004). In this case, it gives the opportunity to focus on floodplain dynamics associated with a dramatic meander cut-off that occurred recently (i.e., within the last five years), and thus more likely to be easily recalled by local respondents. As part of the survey, respondents were asked to recall the timing of and how they coped with any health and environmental shocks experienced since household formation. In addition, local residents were asked to single-out shocks that were particularly difficult to cope with for further questioning. Placing emphasis on major shocks had two significant advantages: 1) it served as a concrete point of reference that aided respondents in the recollection of information about the past and thus helped to reduce problems of respondent accuracy (see Peters 1988; Beckett *et al.* 2001); and 2) accounted for those moments with the greatest potential to reshape wealth holdings and asset evolution. In the end, this information was grouped into a retrospective dataset that captures both the complete shock history of 68 households[8] between 1952 (i.e., since household inception) and 2003, and the conditions that prevailed before and after the cut-off. Data collected in the field were compiled in Excel format upon my return to Montreal, and transferred subsequently to SPSS and STATA for statistical analysis.

1.5 Structure of dissertation

The dissertation contains four substantive and independent chapters written in research article format. Each chapter addresses different questions and is tied to a specific literature, shedding light on key elements of peasant livelihood along the Central Ucayali floodplain. Chapter 2 sets the context for the rest of the

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8 Five households were excluded from the analysis. One of them was a former village resident who had migrated to Pucallpa before forming a household. Two others were households that arrived to the site(s) within the six months prior to the interview. Finally, two additional households that had been temporarily absent from their respective villages and whose land holdings had been shaped primarily by gift were also excluded.

study and delves into the study of the links between floodplain dynamics and traditional livelihoods. The first part of the chapter describes the cultural ecology of the Central Ucayali and uses income and land holding data from the *ribereño* communities to provide an overview of peasant livelihood in the region around the time of study (i.e., 2003). The second part of Chapter 2 examines the case of a major meander cut-off that occurred at Bahuanisho in 1997 as a "natural experiment" to gain insight on how peasants respond to abrupt environmental change; it focuses on the nature of the biophysical changes introduced by the cut-off and on the ways in which *ribereños* in nearby communities responded to it. To do so, the chapter compares land holding portfolios and non-land asset holdings before and after the cut-off, among all households for whom data could be reconstructed within a reasonable window of time prior to the cut-off (i.e., n= 23, 6 years), both along upstream and downstream reaches. Finally, Chapter 2 then contrasts responses to the cut-off between "richer" and "poorer" households across the three study sites and discusses the main implications in terms of vulnerability and resilience.

The large meander cut-off at Bahuanisho is also the focal point in Chapter 3. Whereas the previous chapter examined the effects of the cut-off, Chapter 3 seeks to explain how the cut-off actually occurred. In particular, this chapter examines the role that humans played in triggering a major change in the course of the river using limited technology and modest labor investments; this change in course may have taken decades or centuries to come about and had significant implications for people living nearby. This chapter concludes with a discussion on the Amazon as "pristine" and on human interventions on fluvial systems, both in the present and in prehistory.

Chapters 4 and 5 shift the focus away from the cut-off to concentrate more broadly on floodplain dynamics. Chapter 4 seeks to advance our understanding of the institutional arrangements that regulate land tenure in (dynamic) floodplains, a field of study that has been largely ignored to date. More specifically, the chapter focuses on both customary and formal tenure rules pertaining to floodplains in the Peruvian Amazon and discusses the implications of their coexistence in terms of claims and rights in a context in which land, itself, is unstable. The chapter begins with a historical analysis of the interplay between formal and customary land tenure rules since the collapse of the rubber boom, followed by a description of the existing formal and customary tenure regimes in the region. Chapter 4 ends with two recent cases, encountered while conducting fieldwork, which help to illustrate the nature of disputes and the ways in which tenure rules over dynamic floodplains might evolve as the land base contracts or expands due to riverbank erosion and sedimentation. In doing so, these cases promise to shed light on the evolution of land tenure systems.

Chapter 5 assesses the impact of major shocks on land holdings among peasant households in the Central Ucayali. Given the importance of land as the main asset among the *ribereños*, the chapter considers major health shocks and floods, but pays particular attention to major riverbank slumps, which can sharply reduce household land holdings within a single year. The chapter includes shock history data obtained from a household survey in order to investigate the level of exposure to different shocks through the household life cycle. It then appraises the effects of major shocks on land holding and identifies the main strategies used to cope with different types of shocks. Descriptive and regression analyses are used to gauge whether *ribereños* are able to recover from land losses related to major shocks, and to identify main factors that affect recovery and subsequent accumulation of land, both in the short term and over the household life cycle.

Chapter 6, the concluding chapter, summarizes the main findings of the four substantive chapter chapters of the dissertation, drawing attention to common themes that emerge. The chapter closes with a discussion of the implications of the main findings of this study in relation to the questions that guided this work.

CHAPTER 2. PEASANT LIVELIHOOD RESPONSES TO A MEANDER CUT-OFF ALONG THE CENTRAL UCAYALI

Introduction

The Amazon floodplain has always been attractive for human settlement. The combination of fertile soils, abundant wildlife resources and ease of transportation, have been used to explain the historical orientation of occupation towards the floodplain (Denevan 1996) and to stimulate a renewed interest on the floodplain as an axis for development policy in the region (Petrick 1978; Denevan 1984; Barrow 1985; Fearnside 1985; Junk 1989; Padoch *et al.* 1999; Smith 1999; WinklerPrins 1999). Flooding is considered to be the main environmental constraint for people living along the floodplain. The annual flood cycle determines the rhythm of life in the floodplain (Bergman 1980). Floods are responsible for the addition of fresh sediment (i.e., more than 1m every flood, see de Jong 1995, 4), and determine the area and type of land available for farming each year, and the type of crops that can be planted. Higher floods occur every few years (i.e., 5-7 years, depending on local elevation), which destroy crops and inundate villages for several months. To cope with high floods, floodplain residents rely on upland fields (if available) or build food reserves. Still, there are many instances in which they go through periods of food scarcity and illness, or are driven to migrate temporarily to higher areas. The risk of flooding, according to some authors, may be enough to offset the relatively high fertility of the soils and the abundance of wildlife found in the floodplain (see Denevan 1996).

Floodplain variability is no less important for riverine livelihood, especially along the dynamic rivers of the Upper Amazon. It has been suggested that aboriginal settlement along the Ucayali River was largely dependant on access to the river (Lathrap 1968). Specific sites would become more or less favorable for settlement as the river changed course over time. According to Lathrap (1968), an average meander along the Central Ucayali takes ~500 years to get cut-off, from the time of inception (p. 72), although some meander cut-offs occur within the span of decades. It is not uncommon to find settlements that are threatened by the lateral movement of the river (Hoempler T. 1962; Lathrap 1968; Kalliola *et al.* 1999). And when neck cut-offs occur, entire communities may abruptly find themselves kilometres away from the main river, and potentially dealing with much different environmental conditions.

Land is continually "created" and "destroyed" as rivers move back and forth across their floodplains (see Sternberg 1975, 17-18 ; Denevan 1984, 320) making agriculture risky and difficult (Denevan 1984, 322-323). Indeed, floodplain residents may lose not only their crops, but also their farms, to riverbank erosion, sometimes within a single year. Conversely, sizable islands and channel bars with new deposits may also form then potentially disappear with the next flood. Despite such challenges, dynamic floodplains have and continue to be used since prehistory (see Denevan 1984, 324).

The implications of floodplain dynamics for local peoples are recognized in the literature, especially in relation to towns and commercial ports. Hoempler (1962) wrote about the problem of riverbank caving in Iquitos from the 1920s to the 1960s. Higbee (1945) described how the succession of sandbars that formed in front of Nauta at the end of the 19th century, marked the fate of that town by making it impossible for large steamers to reach this town and thus reduced its economic importance *vis-à-vis* Iquitos (p. 410). Over the least couple of decades Pucallpa has struggled with maintaining an adequate port infrastructure due to the lateral migration of the Ucayali River (see Peruvian Navy 2003).

In terms of rural livelihood and resource use, several authors have pointed to some of the implications of fluvial geomorphological processes for traditional resource use (Bergman 1980; Denevan 1984; Hiraoka 1985b; Raffles and WinklerPrins 2003). Others have suggested that the widely acclaimed diversity in traditional resource use is largely related to the constant reshaping of the floodplain (see Padoch and de Jong 1992; de Jong 1995). Despite such claims, there are few studies available that specifically examine the links between floodplain variability and peasant livelihood in Peru (see Pinedo-Vasquez *et al.* 2002 for an exception). In particular, there is a pressing need to understand village and household level responses to river dynamics. This paper examines how *ribereños* — one of the main cultural groups in the region — responded to a recent meander cut-off at Bahuanisho, near Pucallpa. This cut-off offers a unique opportunity to study the links between floodplain dynamics and peasant livelihood for several reasons. First, because the change is recent (i.e., within 5-6 years from the time of study), its effects were likely still being felt by local residents, and thus were easier to recall. Second, the magnitude of the cut-off made it an extraordinary case in terms of the area and number of villages affected along the new and the abandoned channel, but also in areas several kilometers upstream and downstream. Third, it constitutes one of the most dramatic biophysical changes in the floodplain and is also representative of floodplain dynamics in the region (i.e., riverbank erosion, sedimentation, changes in local flooding patterns).

The issue is of major significance within Amazonia, where thousands of people live along the floodplain and are subjected to periodic flooding and river channel dynamics; it is also important given the renewed interest on using the floodplain for agricultural development. Moreover, it is relevant in light of the growing concern about vulnerability and the prospects for human adaptation to environmental change (Adger 1999; Turner *et al.* 2003).

The focus of this chapter is primarily on the economic nature of peasant livelihood and adaptive responses. More specific objectives are to:

1) Examine the ways in which the Bahuanisho cut-off has reshaped local environmental endowments and resource availability in different nearby areas (i.e., upstream and downstream) and identify the main implications of such changes for local livelihoods.
2) Understand the nature of peasant livelihood responses to the cut-off at the village and household levels.
3) Explore the implications of the cut off in terms of vulnerability and resilience.

In so doing, this chapter contributes to the literature in at least three areas. First, it is among the first studies that explicitly examine the links between floodplain dynamics, peasant livelihood, and resource use in Amazonia. Indeed, scholars have suggested a strong relationship between environmental heterogeneity and variability with resource use (Bergman 1980; Denevan 1984; Hiraoka 1985b; de Jong and Padoch 1990; de Jong 1995; Padoch *et al.* 1999; Pinedo-Vasquez *et al.* 2002; Coomes *et al.* 2004), yet empirical evidence, especially on floodplain dynamics, is anecdotal and tangential. This study is the first to examine livelihood responses to a meander cut-off — a common form of rapid environmental change in the Upper Amazon. As such, it provides insights on the complexity of peasant livelihood along dynamic river floodplains in the Amazon.

Second, by focusing on the challenges and opportunities derived from the cut-off, this chapter contributes to the understanding of the vulnerability and the capacities of the poor. Indeed, a number of works have highlighted the vulnerability, or the inability, of poor people to mitigate or cope with (economic, political and environmental) change (Chambers 1983; Narayan *et al.* 2000; World Bank 2000). Although the poor are often the most affected by change, the poor are anything but passive victims; they are active in adapting to change and are sometimes quite resilient. By examining livelihood responses to the cut-off, this study seeks to provide an alternative view of the poor; one that recognizes the difficulties they face, but that also highlights their capacities.

Third, this study promises insights on vulnerability and human adaptive potential to global change. The recognition of the increasing role of humans in shaping and transforming the face of the earth has prompted much interest in understanding the potential implications of global environmental change and human adaptive capacity. By focusing on peasant livelihood responses to an abrupt form of environmental change (i.e., a meander cut-off) in a setting that is extremely dynamic (i.e., an active meandering river), this study complements other works that have focused on gradual changes in more stable areas (See Adger 1999).

The chapter is structured as follows. The remainder of this section provides an introduction to the study area. The empirical approach is explained in Section 2. Section 3 contains the main results. It begins with a description of peasant livelihoods at the time of study, then examines the main changes introduced by the cut-off and discusses their potential implications for economic livelihood in nearby villages. Village and household-level responses to the cut-off are explored after that (Section 4), and are discussed in light of the problem/issue of vulnerability and resilience among the poor. The chapter concludes with a summary of the main findings and discusses their implications for policy making.

Study setting

Biophysical environment

The study region is located along the Central Ucayali River, a few kilometers upstream from Pucallpa — Peru's fastest growing city in the Amazon and the main road-link with Lima on the Pacific coast (Figure 2.1). The climate of this region is hot and humid. Mean annual temperature at Pucallpa is 26 °C (Bergman 1980, 41; Lamotte 1990), but monthly averages of maximum temperatures range between 30-32 °C (Bergman 1980, 40). Annual rainfall at Pucallpa averages 1650 mm (Gentry and López-Parodi 1980, 1355), unevenly distributed during the course of a year (Bergman 1980, 42).

The Ucayali is one of the largest rivers in the Amazon basin and, together with the Marañón, forms the Amazon River proper. This whitewater (i.e., sediment laden) river flows northwest, roughly parallel to the Andes, and is controlled by eastern outliers (Bergman 1980; Pärssinen *et al.* 1996). It drains a basin of 337 500 km^2 (Goulding *et al.* 2003, 183), an area roughly the size of Germany. Near Pucallpa, the Ucayali is 0.7 to 1 km wide (Bergman 1980, 47; Kalliola *et al.* 1992, 77) but can reach up to two kilometers in width at flood stage (Peruvian Navy 2003). Like other tributaries in the Upper Amazon, the Ucayali presents a yearly flood cycle, typically reaching its peak by March at Pucallpa.[2]

[2] The peak of the flood occurs later as the "flood wave" travels downstream (Sternberg 1975, 20-22).

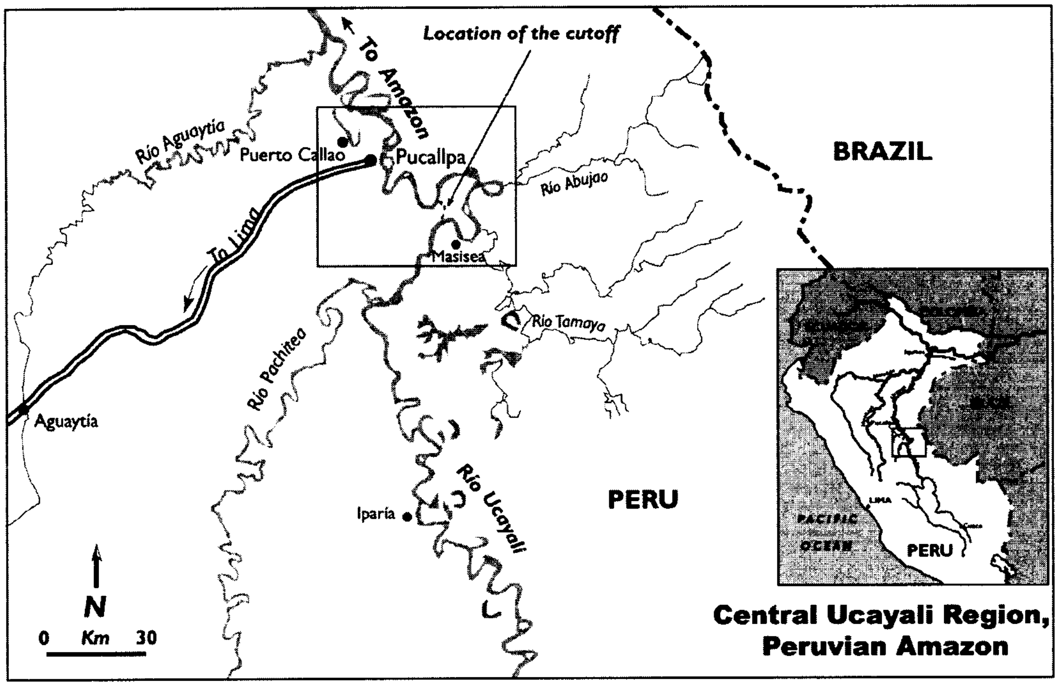

Figure 2.1 The Central Ucayali Region of the Peruvian Amazon. *Sources*: Adapted from IGN (1989, 283); Goulding *et al.* (2003, 72).

At low stage, discharge is 2,000 m^3/s, but may rise up to 22,000 m^3/s during the flood season (Peruvian Navy 2003). The difference between low and high water of about 9.3 m at Pucallpa, which is sufficient to submerge much of the floodplain for several weeks, or even months (Sternberg 1975; Bergman 1980; Denevan 1984). Every 5-7 years, however, even the tops of high levees – which remain dry on most years – are drowned for several days by higher floods (Bergman 1980).

The floodplain of the central Ucayali reaches over 24 km in width (Lathrap 1968, 64), and unlike those of the mid section of the Amazon,[3] it is consistently being reshaped by fluvial dynamics and Andean tectonics (Lathrap 1968; 1970; Lamotte 1990; Neller *et al.* 1992; Pärssinen *et al.* 1996; Velasquez de la Cruz 2002). Indeed, the Ucayali is among the most dynamic rivers in the Upper Amazon (Pärssinen *et al.* 1996) and one of the largest active meandering rivers in the world. Studies suggest annual rates of lateral migration of 100-160 m for the lower Ucayali (Kalliola *et al.* 1992, 77), though average rates of up to 285 m/yr have been reported for certain meanders near Pucallpa (Velasquez de la Cruz 2002, 53).

Resulting from such migration is a dynamic mosaic of meander scrolls, swales, and narrow and oxbow lakes that characterize much of the Upper Amazon floodplain.[4] Bergman (1980, 49-51) identified five different landforms in relation to the annual flood cycle and fluvial geomorphology along the Central Ucayali floodplain, near Panaillo, that are common the Amazon floodplain (Figure 2.2):[5] 1) **natural levees** built as sediment-rich waters overflow the main channel and deposit most of their sediment load within a few meters from the river (due to horizontal accretion), becoming higher as new silts are deposited on the same area with each flood; 2) **backswamps** formed when the river migrates laterally at inconsistent rates, leaving the bed only partially filled; 3) meander scar lakes are similar to backswamps, except that less sediment is deposited and ox-bows are

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[3] Radiocarbon dating of archaeological findings on an island in the central Amazon of Brazil suggests permanence for up to 2,000 years (Sternberg 1960; 1975).

[4] Studies suggest that as much as 18% of the lowland rainforest in the Upper Amazon may have been modified by river channel dynamics (Salo *et al.* 1986).

[5] For more detailed classifications see Hiraoka (1985c), who finds 12 different biotopes in San Jorge, a village along the Amazon, near Iquitos.

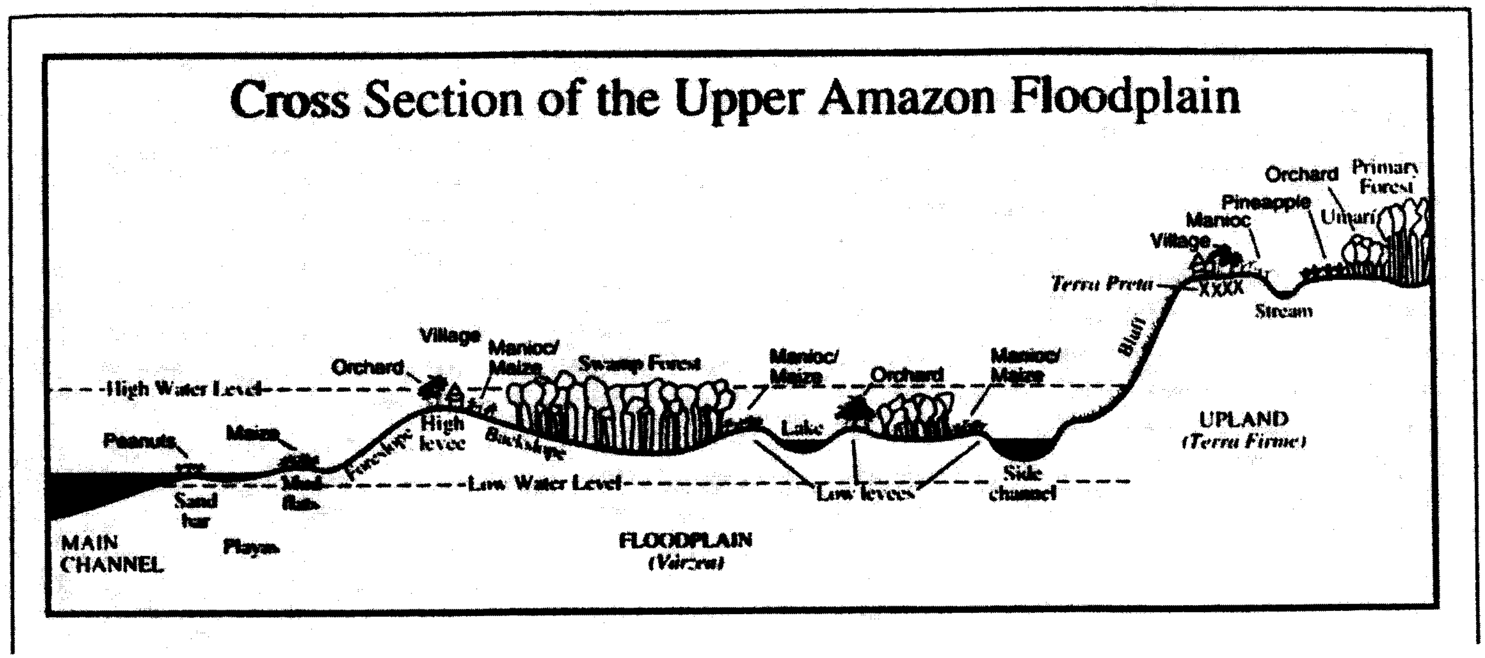

Figure 2.2 Cross section of the Upper Amazon floodplain. *Source*: Coomes (1992).

formed with the cut-off of a meander; 4) **channel and point bars** formed by sediment deposition on the inner side of a meander; they are very extensive, but highly unstable, and; 5) **tributary streams** with their respective levees and backswamps.

The high prevalence of ox-bow lakes along the Central Ucayali is indicative of earlier courses of the river and of the periodic occurrence of meander cut-offs. Remote sensing data show that at least six meander cut-offs (including the one reported here) have occurred along the Central Ucayali since 1981, near Pucallpa.

Pucallpa lies on the true left bank of the Ucayali, on the edge where the *terra firme* meets the active floodplain, approximately halfway between the mouths of the Pachitea and the Aguaytía Rivers. Being the main Amazonian port with a road connection across the Andes, Pucallpa has become a dynamic economic centre, primarily for timber extraction and oil-gas exploitation. Although such development has prompted colonist settlement along the roadside on the *terra firme* (see Fujisaka and White 1998; Smith *et al.* 1999),[6] approximately 45,000 people live within the riparian zone of the Ucayali near Pucallpa, bordering the main river, or on the edge of ox-bow lakes.

More broadly, the uplands (*terra firme*) and the floodplain (*várzea*) are the dominant features of the landscape in the region. The *terra firme* comprises Tertiary alluvial plains that rise about ten meters above the active floodplain,[7] and may be found by the river's edge in some sections as the river migrates laterally within the floodplain. These plains are generally composed of Oxisols and Ultisols, which are deep and well-drained soils that, due to long exposure to high temperature and humidity, are extremely acidic and nutrient poor (Nicholiades *et al.* 1984, 339; Sioli 1984, 676; Sombroek 1984, 525).[8] The floodplain comprises

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6 Mainly small scale migrant crop farmers and medium scale cattle ranching — similar to other small scale colonist areas in the Amazon (Brazil) under 500 m asl and 2,000 mm of precipitation. (Riesco 1995, 86).

7 The bluff at Pucallpa stands between 9-12 m above the flood level of the Ucayali River (Bergman 1980, 45). Most reports for the Peruvian Amazon refer to heights of 10-20 m above the active floodplain (Denevan 1996; Hiraoka, 1986).

8 Much variability in Amazonian soils has been recognized over the last two decades (Moran 1981; Barrow 1985; Sombroek 1984).

low-lying terraces of more recent formation (i.e., Holocene). Depending on their elevation, these alluvial terraces are susceptible to more or less flooding. Their soils are considered of high to moderate fertility (i.e., Fluvisols, Gleysols, and Entisols) with the presence of high activity minerals (i.e., illite and montmorillonite); they are chemically neutral, poorly drained (except on levees), and lack a well-developed profile (Petrick 1978; Sombroek 1984, 532-533).[9] Although encompassing a much smaller area than the *terra firme*, agricultural production in the Department of Ucayali concentrates primarily within the floodplain (Gazzo 1982).

People of the floodplain

There are two main populations living along the Central Ucayali floodplain: Shipibo Amerindians and mestizo *ribereño* (known as *caboclos*, in Brazil).[10] They use simple tools and traditional practices to make a living from agriculture, fishing, extraction and hunting, complemented by craft making, or wage labour. Like the *ribereños* and Amerindians in other parts of the Amazon, they produce most of their own food, but engage in market production to complement their diet, buy other goods, or get medical attention (Coomes 1996a). Floodplain residents typically travel by small boat to bring their produce to Pucallpa, the main economic centre in the region. Several studies have highlighted the wealth of ecological knowledge held by traditional river dwellers and have documented their responses to changing market conditions (Bergman 1980; Hiraoka 1985a; 1985b; 1985c; 1986; de Jong and Padoch 1990; Behrens 1992; Coomes 1995; Coomes and Burt 1997; Padoch *et al.* 1999; Tournon 2002).

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9 This description applies generally to the floodplains of whitewater rivers, also known as *várzea*. While these characteristics are generic, significant variations in soil conditions may be found across the floodplains of different rivers, different sections of the same river (Denevan 1984, 318; Kalliola, *et al.* 1993; Mertes *et al.* 1995), and even within small areas at the same river site (Denevan 1984, 318).

10 For more detailed descriptions of the Shipibo in the Central Ucayali see Eakin *et al.* (1986), Bergman (1980) and Tournon (2002); for the *ribereño* elsewhere in the Peruvian Amazon see Yepez (1983), Padoch (1988), Hiraoka (1985a, b, c, d), Behrens (1992), Coomes (1995; 1999) and Coomes and Burt (1997).

Local residents recognize multiple biotopes within the floodplain and use them accordingly (Bergman 1980; Denevan 1984; Hiraoka 1985b; 1986) (see Figure 2.2). The location where each crop type is planted varies according to the specific crop growth requirements, micro-variations in soil conditions and the number of months that land remains dry. Typically, low lying areas are used for growing annual crops between the floods (e.g., rice on the mudflats; melons, cowpeas and others on sandbars). Manioc and maize are planted on slightly higher areas (i.e., low levees), while plantains and perennial crops are planted on levees that stand above the average flood level (Denevan 1984; Hiraoka 1985a). On the *terra firme,* rice and manioc are planted in swiddens, which may subsequently be kept productive as agroforests (Hiraoka 1986; Coomes and Burt 1997), turned to pasture, or left in fallow.

The Shipibo and the *ribereño* have developed their own land tenure systems, and although formal rules are increasingly used to back claims (see Chapter 4), land markets remain incipient. Since government officials acknowledge preexisting customary rules and respect agreements made at the village level, tenure rights are typically defined by the interplay between formal and customary rules. Among the *ribereño* (i.e., my study group), land is typically acquired through clearing and planting. Rights carry through the fallow period and may be transferred along kin lines. Through the Ministry of Agriculture, the State grants temporary use certificates for up to ten hectares of land (see Chapter 4 for more details).

The Bahuanisho cut-off

During the 1997 flood, the course of the Central Ucayali River changed dramatically. In that year, this 0.7-1 km wide river cut through a small channel located at 8° 30' South and 74° 19' West, between Pucallpa and the town of Masisea. Before the cut-off, this channel was barely wide and deep enough to be crossed by a dugout canoe, but it allowed people to bypass a series of meanders during the flood season. This meander cut-off was, indeed, drastic as the new channel carried potentially ten times more energy than the former channel, due to similar differences in slope. By the time the waters began to recede that same year, the new channel was already 150 m wide and two to six meters deep (Peruvian Navy 2001, 14). By 1998, the new channel had captured the main flow of the river at low stage; the abandoned channel turned into a colossal ox-bow lake as its entrance silted in. With the cut-off, the course of the Ucayali in this area was effectively reduced from 71 km to about one tenth of that length (~7.5 km), and appears to be the most dramatic change in the region in the last 300 years or so (see Pärssinen *et al.* 1996).

2.2 Empirical approach

Rather than relying on a single study site, three *ribereño*[11] villages were selected to allow for a more comprehensive study. Village selection explicitly sought to capture some of the differential effects and implications in distinct areas respective to the cut-off (i.e., upstream and downstream from the new channel), as well as upland and lowland villages — the major features in the landscape — and differences between older and more recent settlements.

Basic characteristics of the study villages are summarized in Table 2.1. Villages range in size from just a few (< 15) to more than one hundred households, although one village (i.e., Exito) had a sharp population decline due to the increased rates of riverbank erosion in the years immediately after the cut-off. Two of the study sites are located upstream from the cut-off (i.e. Puerto Angel and Monte de los Olivos) and the third is located downstream (i.e., Exito). Monte de los Olivos, however, began being settled around the year 2000 (and only got a school in 2003) predominantly by migrants from Ega — a fourth

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11 As one of the last remaining Amerindian riverine groups (Denevan, 2001), the Shipibo of the Central Ucayali would seem the best candidate for a study of this nature. The decision to focus on the ribereños was based primarily on the difficulties to communicate with people, particularly the elders — younger people speak Spanish as a second language. Working with the Shipibo would have required an interpreter and several months to learn the language — something I could not afford financially, or time wise. Like the Shipibo, *ribereños* have a long history of settlement and natural resource use in the Amazon lowlands, dating back several generations into the Rubber Boom (Hiraoka 1985a; Padoch and de Jong 1990; Coomes 1995). Although *ribereños* have received much less attention than Amerindians, they are now regarded as the main traditional people living in the floodplain and as models for sustainable resource use (Hiraoka 1992).

Table 2.1 Selected characteristics of sampled villages, Central Ucayali River, Peru, 2003.

Village	*Location* [1]	*Type*	*Formation* [2]	*Size (hhlds)*
Exito	Downstream	Floodplain	Early 1900s	57
Puerto Angel	Upstream	Floodplain/upland	1930s	97
M. de los Olivos	Upstream[3]	Floodplain	2003*	13

1. Respective to the Bahuanisho cut-off.
2. Approximate time of village formation.
3. However, it is composed mainly by households who recently migrated from a floodplain village along the downstream reach.

* Year in which school was established.

village located downstream within a short distance from Pucallpa, though a few residents had been living in the area for some time prior. Exito and Puerto Angel, on the on the other hand, are relatively much older, dating back to the early 1900s and the 1930s, respectively.

The study villages also reflect differences in terms of land types. Monte de los Olivos and Exito are located within the floodplain; access to uplands is restricted to a few households with land holdings elsewhere (e.g., along the Pucallpa-Lima road or near the Pachitea River). Located on the bluff, Puerto Angel offers access to land and other resources on both the upland and the floodplain. Whereas residents of Puerto Angel and Exito have access to mudflat and sandbar areas found within their premises, no such areas are found in Monte de los Olivos.

Other factors considered for site selection included the role that residents of Puerto Angel played in triggering this particular meander cut-off (see Chapter 3) and the possibility to explore issues of riverine settlement in a village that is currently in the process of formation (i.e., Monte de los Olivos).

Slight variations in sampling methods were deemed appropriate due to the particularities of each of the study sites. RRA (Rapid Rural Assessment) methods were used to rank households according to wealth in two of the study villages (Takasaki *et al.* 2000b). In Exito, such ranking served as a base for drawing a stratified random sample. Households in this village were grouped within three strata (i.e., poor, medium, and rich) based on their land and asset holdings. All households within the "richer" stratum (i.e., 19 households) plus six and eight households in the medium and the poor strata (i.e., 32 and 47 %, respectively) were randomly selected for interviewing to contrast wealthier and poorer households. In Puerto Angel — the village with access to upland and floodplain areas — the strata were constructed based on key differences in land portfolio composition (i.e., lowland only, upland + lowland, and upland only). An equal number of households with access to lowland only (i.e., 15 households) and upland and lowland (i.e., 15 households) were randomly selected, along with one of two households with access to land in the uplands only. In both of these villages, households that declined participation were replaced by other randomly selected households from the same stratum. Finally, all available and willing households living in Monte de los Olivos were sampled due to the small size of the village (12 households).[12] Considering that the sample comprises more than 52 %, 33 % and 92 % of the target population in Exito, Puerto Angel and Monte de los Olivos, respectively, and that it captures meaningful differences within each of the study sites, I feel confident that the sample is representative of the population in the three villages.[13]

A survey was conducted by the author and a local field assistant among peasant households (n=77) in the three villages during the course of two different field seasons in 2002 (October-December) and 2003 (May-December) (Appendix II).[14] The survey instrument was designed to gather data on various aspects of peasant livelihoods and floodplain dynamics. Surveys focused on household demographics, family and resource use history, land use, income and wealth, social networks, risk attitudes, experience with shocks (e.g., illness, death, floods, riverbank erosion), and mitigation/coping strategies. Respondents were also asked about community history (e.g., stability and migration patterns) and about any observed changes associated with the meander cut-off, as well as their effects on local livelihoods. Finally, the survey included questions about folk knowledge on fluvial geomorphology, as well as on floodplain changes foreseen for the future.

Interviews were conducted with at least one of the household heads at their home or while visiting their fields. Interviews typically lasted between one and one and a half hour. A slightly modified version of the survey was employed with recently settled households in Monte de los Olivos as an attempt to capture

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12 A stratified sample in this village would have yielded an unacceptable sample size.

13 Relying primarily on households present at each of the study sites is a potential source of bias. In Exito, on the one hand, out-migrant households are effectively excluded as are households from Ega that did not migrate to Monte de los Olivos. Unfortunately, identifying and conducting visits to numerous households scattered across Pucallpa and different villages along the floodplain were deemed unfeasible. Research in this field promises important insights on the conditions that drive certain households to migrate or remain in one site under seemingly adverse conditions.

14 The sample included three migrant households from Exito as a means to gain insight on what led people to leave the village. One participant was visited at his house in the city; another was interviewed in 2003, shortly after his return to the village from the city; the last one had been living in other rural villages since the cut-off and returned to live in Exito earlier in the year.

the conditions prior to leaving their original village, the circumstances that led them to resettle, and the conditions under which they started in the new site. In cases when household participation was declined, replacements were randomly selected from the same stratum .

Survey work began with 23 households in Exito in 2002. Of these, all households remaining in the village and willing to participate were revisited in 2003 (n=19), along with other households in the sample that had not been surveyed in 2002 (n=11). The final sample, without households that left between visits or declined participation, comprises a total of 67 households. Despite having data for some households from 2002, analysis is based on data collected during the 2003 field season only. The main reason for this was to obtain data for the same flood cycle (and agricultural year) to allow for clearer comparison across villages and households. Participant observation methods were employed at different stages of the research. During reconnaissance, participant observation helped to identify critical issues about floodplain dynamics and peasant livelihood and, thus, informed survey design. At later stages, they served to validate information through triangulation.

2.3 Results

2.3.1 Sample characteristics and *ribereño* livelihood in the Central Ucayali

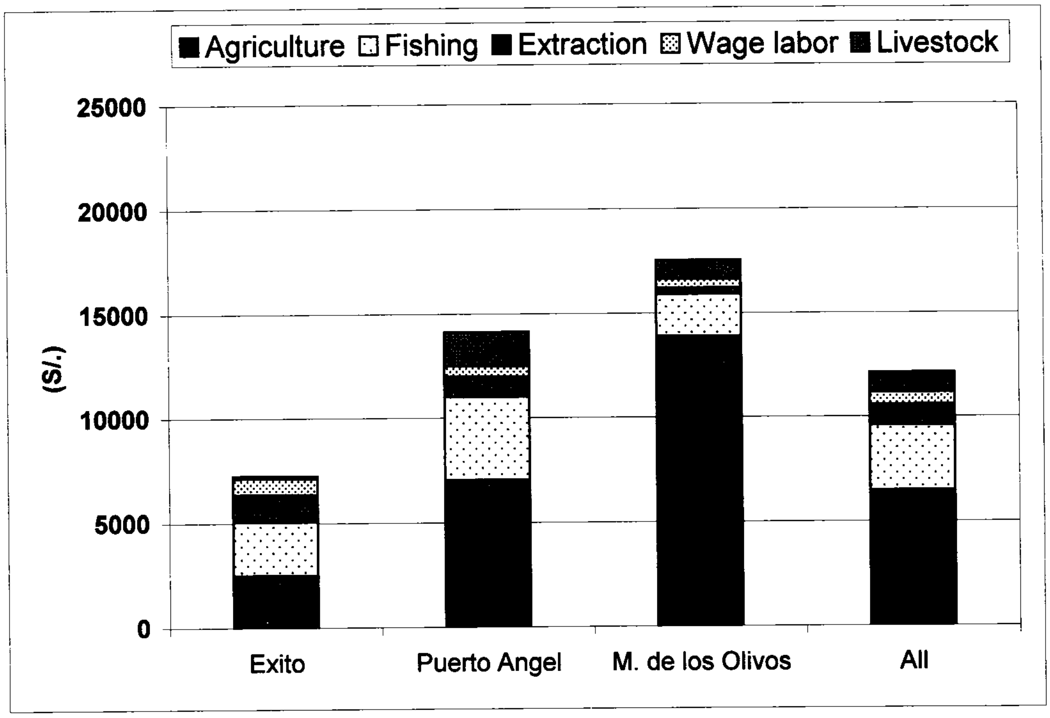
Household demographic characteristics are relatively consistent across the three study sites (Table 2.2). The average household is nuclear and is composed of a male and a female head and just over three children, of which a son is older than 15 years. The average household had been formed for 17 years at the time of study and the age of the household head was 43 years. Households in Monte de los Olivos, however, were formed more recently (mean = 13.2 yrs) and were slightly smaller (mean = 4.2 members).

Economic livelihood in the three villages is quite diverse, including farming, fishing, forest product extraction, livestock sales, and wage labor (Figure 2.3). Whereas virtually all households engage in agriculture and fishing, participation rates in other activities are more selective. Almost half of the sample

Table 2.2 Selected demographic characteristics in study villages, Central Ucayali, 2003 (n=67).

	Exito (n=25)			**Puerto Angel (n=31)**			**M. de los Olivos (n=11)**			**All (n=67)**		
	Mean	**S. D.**	**Range**	**Mean**	**S. D.**	**Range**	**Mean**	**S. D.**	**Range**	**Mean**	**S. D.**	**Range**
No. of years since household formation	18.5	11.0	(2-41)	17.0	10.8	(3-47)	13.2	14.2	(2-38)	17.0	11.5	(2-47)
Age of the household head (yrs)	44.4	12.1	(28-68)	43.6	11.2	(27-67)	40.7	13.2	(24-62)	43.4	11.7	(24-68)
No adult males (15-64 yrs.)	1.6	0.9	(1-4)	1.8	1.0	(1-4)	1.7	1.7	(1-6)	1.7	1.1	(1-6)
No. adult females (15-64 yrs.)	1.3	0.5	(0-2)	1.2	0.6	(0-3)	1.0	0.0	n.a.	1.2	0.5	(0-3)
Household size	5.4	2.1	(1-9)	5.5	1.9	(1-11)	4.3	1.9	(2-9)	5.3	2.0	(1-11)
Age of the household head at formation (yrs)	25.9	6.4	(17-38)	26.5	5.1	(18-40)	27.5	9.0	(20-51)	26.5	6.3	(17-51)

Figure 2.3 Mean household income by sector in three villages near the Bahuanisho cut-off (2002).



	Exito	Puerto Angel	M. de los Olivos	All
Income				
Total (S/.)	7241 (1264-40791)	14124 (0-21490)***	17498 (1570-47574)** ++	12109 (250-47574)
Income Gini	0.40	0.41	0.40	0.45
Agriculture (%)	34.6	49.6	79.3	53.3
Fishing (%)	35.4	28.4	11.6	26.0
Extraction (%)	17.5	6.8	1.6	7.9
Wage-labor (%)	10.8	3.7	2.5	5.0
Livestock (%)	1.7	11.6	5.1	7.9
Participation rate (% of households)				
Agriculture	100	96	91	97
Fishing	100	96	91	97
Extraction	36	61	45	49
Wage labor	76	61	27	61
Livestock	44	80	73	66
Reliance (% of households)*				
Agriculture	28	52	73	46
Fishing	44	23	9	28
Extraction	4	3	0	3
Wage labor	4	0	9	5
Livestock	0	10	0	5
No. of observations	25	31	11	67

* Reliance is defined in terms of share of total income from a given economic activity. Households deriving 50% or more of their income from a single sector are considered reliant on it.
Means statistically different with respect to Exito (**: *t*-test, P ≤ 0.05; ***: P ≤ 0.01)
Means statistically different with respect to Puerto Angel (++: *t*-test, P ≤ 0.05; +++: P ≤ 0.01)
Range in ( )
Exhange rate; 3.47 S/. = 1$US.

(i.e., 46%) derived 50% or more of their income from farming, and 26% of households were fishing reliant.[15] On average, households earned close to US$3,490 (12,109 S/.) in 2002 (cash and subsistence), of which roughly half (i.e., 53% or US$1,859) was derived from agriculture. Although accounting for only a small share of the total average income (roughly 20%), extraction, wage labour and livestock-raising may be important as a buffer in difficult times.

Income levels and livelihood composition do vary significantly across the study sites, in relation to natural endowments and wealth differences. For instance, whereas the average annual income in Exito was US$2,086 (7,241 S/.), income in Monte de los Olivos was more than 2.4 times that amount (US$5,042). Households in Puerto Angel and Monte de los Olivos depend primarily on agriculture, though fishing appears to be a complementary source of income in the former. In Exito, fishing and agriculture are equally important for economic livelihood and although wage labour accounts to only 10% of the mean annual income, three out of four households participate in this activity.

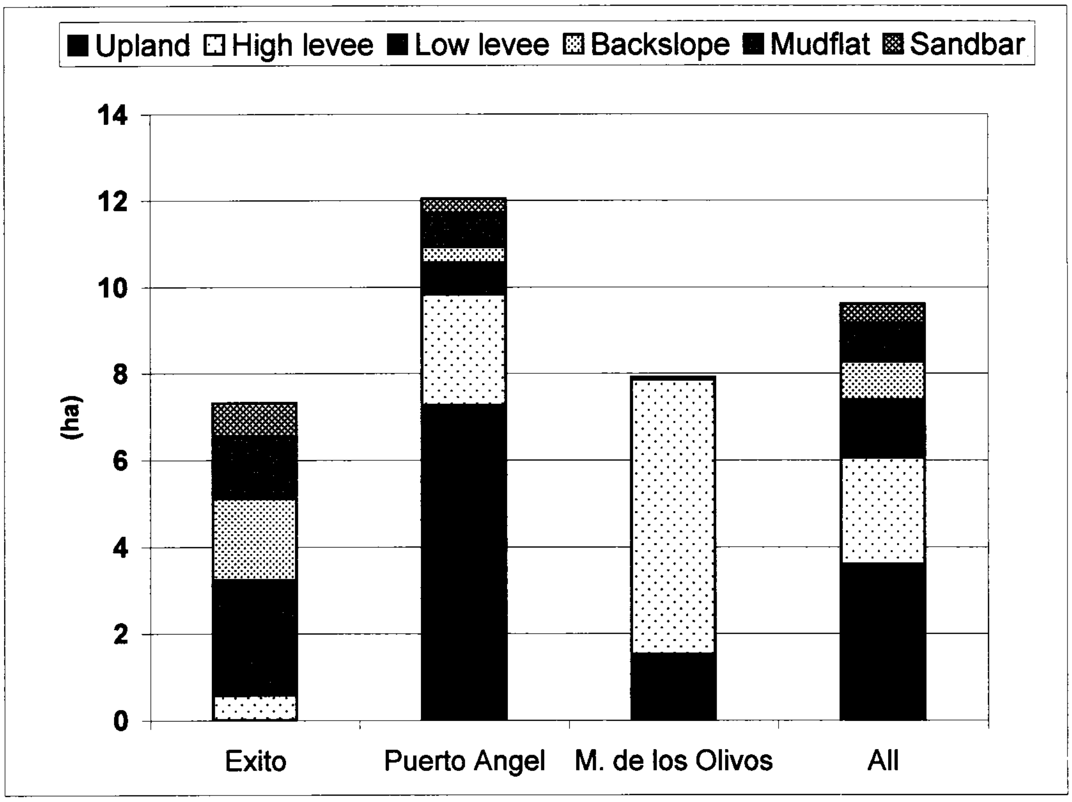
The average household in the sample holds 9.6 hectares of land in a variety of land types within the floodplain (i.e., high and low levee, backswamp, mudflat, and sandbar) and the upland (Figure 2.4). Land portfolios, however, reflect different environmental endowments in each of the study sites. For instance, in Exito (a lowland village with little high ground available) land portfolios are composed primarily of low lying biotopes (i.e., low levee, backswamp, mudflat and sandbar). Conversely, households in Monte de los Olivos hold land primarily in high levee.[16] Land portfolios are most varied in Puerto Angel, where residents have access to upland and floodplain areas.

Although land is relatively equally distributed in Exito (Gini=.368), the distribution of high levee land is highly unequal (Gini= .638). In Puerto Angel, in contrast, despite the overall land inequality, virtually all households have access

[15] Reliance refers to households earning half or more of their total income from a single sector. For example, a household with a total income of 2,500S/. of which 1,500S/. (60%) was derived from fishing would be considered fishing reliant.

[16] Some residents in Monte de los Olivos hold land in the uplands. This is, however, along the road between Pucallpa and Lima, or near the Pachitea. As such, it is not representative of local environmental endowments.

Figure 2.4 Mean household land portfolios in three villages near the Bahuanisho cut-off (2003).



	Exito	Puerto Angel	M. de los Olivos	All
Total land holding (ha)	7.3 (0.25-30.7)	12.1 (2-55.04)***	7.9 (0.35-48.5)	9.6 (0.25-55.05)
Total land Gini	0.37	0.48	0.63	0.50
Upland Gini	n.a.	0.71	0.91	0.85
High levee Gini	0.84	0.25	0.04	0.68
% in upland	0	60	19	38
% in high levee	8	21	81	25
% in low levee	36	6	1	14
% in backslope	26	3	0	9
% in mudflat	19	6	0	9
% in sandbar	11	3	0	5
No. of observations	25	31	11	67

Means statistically different with respect to Exito (**: t-test, $P \leq 0.05$; ***: $P \leq 0.01$)
Means statistically different with respect to Puerto Angel (++: t-test, $P \leq 0.05$; +++: $P \leq 0.01$)
Range in ( )

to high ground as insurance against flooding (Gini= .11). Land inequality in Monte de los Olivos (Gini=.633) is explained primarily by the contrast between recent migrant households without previous link to the area and those having deeper roots there. Such households had preferential access to land in the region and were thereby able to gain access to more land.

Households in the sample hold, on average, the equivalent of roughly US$1,000 in non-land assets (e.g., fishing equipment, other productive capital, consumer goods, and livestock) (Figure 2.5). Investment in fishing capital is fairly consistent across the study sites. The main differences in asset holdings are found in Puerto Angel and Exito, where livestock and other productive assets (e.g., tricycles, stores, shotguns, etc.), respectively are also important.

2.3.2 Changes introduced by the cut-off

Contrary to earlier studies, which suggested that changes within the floodplain occurred slowly (Lathrap, 1968)[17] and had limited effects on local livelihoods (Bergman, 1980: 49), this study suggests that the floodplain may be dramatically reshaped within short periods of time, having profound implications for local livelihood and human health.[18] This chapter focuses on three types of changes in terms of their influence on economic livelihood in areas upstream and downstream from the cut-off: transportation, flooding patterns, and natural resource endowments. Each theme is discussed below.

Transportation

The Bahuanisho cut-off had important effects on river transportation. With virtually no roads, the river network serves as a "natural highway system." Through it, people access fish and extractive resources and take produce to the market. Typically, *ribereño*s move about in dugout canoes to get to their fields or

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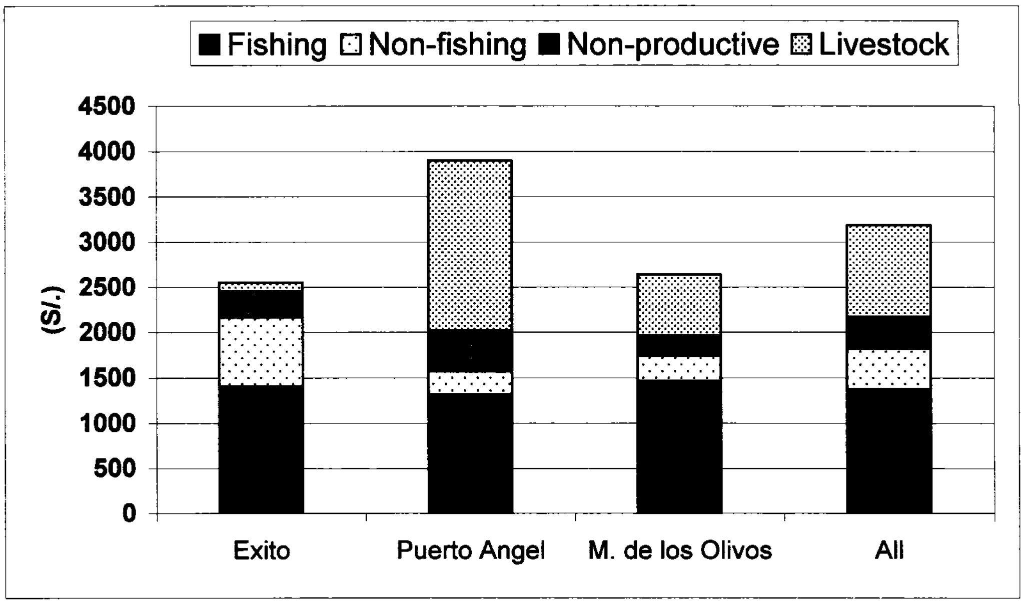
[17] Lathrap (1968) estimated that a meander takes approximately 500 years to cut-off from its inception.

[18] Access to adequate sources of water for drinking and cooking is an issue for villages removed from the main river, especially during the low water season. Implications for health, however, lie beyond the scope of this paper.

Figure 2.5. Mean household non-land asset portfolios in three villages near the Bahuanisho cut-off (2003).



	Exito	Puerto Angel	M. de los Olivos	All
Total Assets (S/.)	2548.8 (35-20956)	3938.7 (0-18700)	2638.8 (222-7795)	3206.7 (0-20956)
Asset Gini	0.70	0.52	0.47	0.60
Fishing capital Gini	0.73	0.65	0.55	0.43
% in fishing Capital	55	33	55	43
% in non-fishing Capital	30	6	11	14
% in non-productive Capital	11	11	8	11
% in livestock	4	48	26	32
No. of observations	25	31	11	67

Note: Percentages may not add exactly to 100.
Means statistically different with respect to Exito (**: *t*-test, P ≤ 0.05; ***: P ≤ 0.01)
Means statistically different with respect to Puerto Angel (++: *t*-test, P ≤ 0.05; +++: P ≤ 0.01)
Range in ( )
Exhange rate; 3.47 S/. = 1$US.

to go on fishing expeditions. Travel over greater distances (i.e., to other villages or Pucallpa) is done in small motorboats, primarily in *colectivos*.

The creation of a new (and much shorter) navigable channel, due to the cut-off, significantly reduced travel distance and transportation costs for *ribereños* living upstream (see Figure 2.6a-b and Table 2.3). According to respondents in Puerto Angel, it took a full day of travel to get to Pucallpa and the cost of shipping or embarking on a boat were considerably higher. Since the cut-off, Pucallpa may be reached within less than four hours and a return trip is possible in the same day. Estimates on transportation costs, based on travel time, suggest that the cut-off may have reduced costs by 20-67 percent for the people of Puerto Angel and nearby villages, depending on the product (Table 2.4). Other travel-related expenses have also been reduced (e.g., meals, lodging). Furthermore, the shorter route allows *ribereños* upstream to travel more frequently to Pucallpa, while reducing their time away from productive activities in the village. Indeed, easing transportation (for upstream residents) was one of the primary driving forces behind the works that ultimately triggered the cut-off (see Chapter 3).

An advantage of this sort is less obvious for downstream residents (see Figure 2.6 and Table 2.3).[19] Nevertheless, the cut-off made upstream areas more desirable in terms of their relative location to the city and opened up the opportunity for people to fish and farm in areas that would have been otherwise prohibitive in terms of distance. For instance, small-scale traditional fishermen, without access to ice or motorboats, are now able to bring fresh fish to Pucallpa from areas that would have been too distant prior to the cut-off. As such, the cut-off provided access to new resources and economic opportunities for peasants living downstream as well.

Clearly, travel distance to markets and access to resources matter, but so does accessibility to waterways. Indeed, floodplain settlement is largely contingent on access to the river and other navigable bodies of water (Lathrap, 1968). For those living along the abandoned channel, isolation seems to be the likeliest outcome, though not necessarily along the entire length of the

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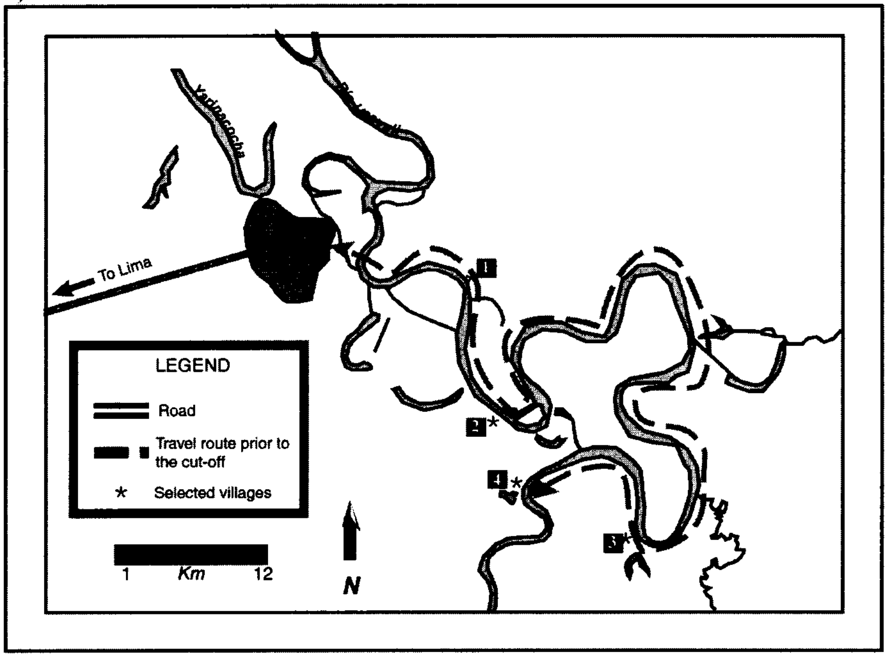
[19] The cut-off did not reduce travel distance between these settlements and Pucallpa.

Figure 2.6 Transportation routes between Pucallpa and upstream villages before and after the Bahuanisho cut-off. Maps created by the Author. Base map: Landsat 5 TM scene, June 12th, 1996.

a) Pre-cutoff



b) Post-cutoff

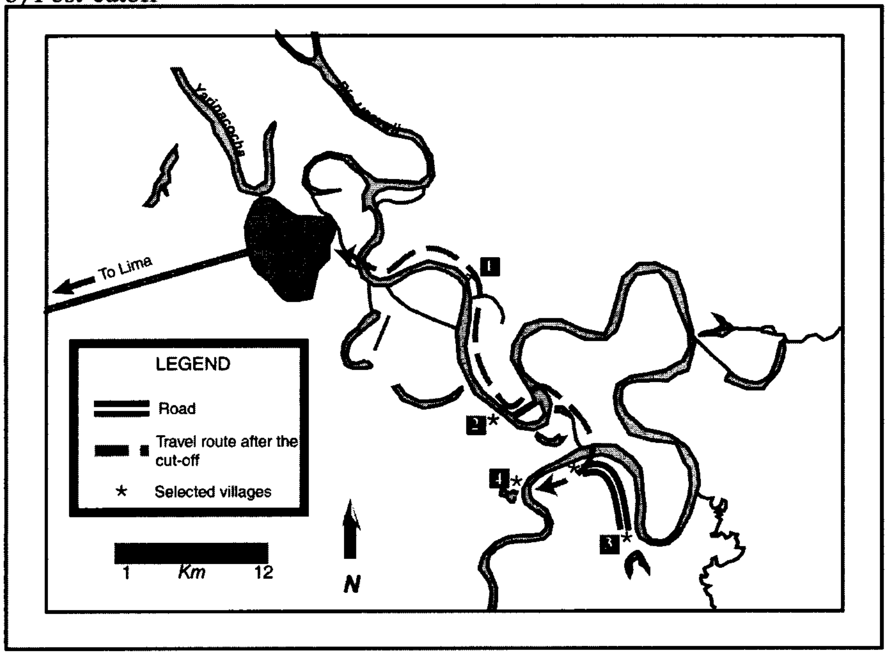


Table 2.3 vel distance between Pucallpa and selected sites upstream (low river stages), before and after the Bahuanisho cut-off.

No. on map	*Village*	*Location*	*Distance from Pucallpa (km)*	
			1996	***2001***
1	Exito	Downstream	15.7	16.5
2	San Juan	Downstream	26.9	30
3	Masisea	Former channel	90.7	43.5*
4	Puerto Angel	Upstream	107.2	60

Note: Distances were estimated from Landsat scenes for 1996 and 2001; distances are approximate.
* This distance is to Masisea's new port. An additional eight kilometers must be travelled by land, along a road built in 2000.

Table 2.4 Transportation costs to Pucallpa (by river boat) for selected crops based on travel time before and after the Bahuanisho cut-off.

	Transportation cost (S/.)[a]		
	Cut-off		
	Prior to	After	Share of original cost[c]
Rice (sack)	2.5-3.0	1	33-40%
Maize (sack)	2.5-3.0	1.5-2.0[b]	50-80%
Plantain (raceme)	1	0.5	50%

a. The exchange rate in 2003 was approximately 3.47 S/. = 1$ US.
b. The diference in cost of transporting maize and rice is only present in this zone.
c. Estimates derived from data from Labarta *et al.* (2004)

abandoned channel. Boat traffic along an ox-bow lake may be reduced, however, as *colectivos* tend to follow the shortest travel in order to minimize costs (i.e., fuel) and reduce travel time.[20] Whereas all boats traveling upstream from Pucallpa necessarily passed through the former channel prior to the cut-off, traffic today is reduced only to those boats specifically serving villages on the abandoned channel and the Tamaya and Abujao Rivers.[21] Despite the sharp reduction in through-traffic, at least one or two boats travel that route on a daily basis.

Settlements along the silted-in portion of the channel, though, face greater challenges for transportation, at least during part of the year. Residents in this area must transport their goods by land further and further as the channel dries out, when the river recedes, in order to be able to ship them by boat to Pucallpa (see Figure 2.7). Those living along the true right bank do so by motorized vehicles (i.e. truck, bus, motokar) that run service on a dirt road between the town of Masisea and its new port on the Ucayali.[22] Conversely, to get to port, those along the true left bank typically walk and carry their products on their backs or use a tricycle.

During the flood season the silted portion of the channel carries some of the flow of the Ucayali and becomes navigable, relieving local residents of this burden for part of the year. Depending on stage level, they are able to benefit from the shorter route offered by the cut-off channel for part of the year.

Despite the shorter distance to Pucallpa, the Bahuanisho cut-off has made access to the river more difficult in Puerto Angel, among other sites. Once located

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20 Reports from boatmen serving villages upstream from the cut-off (including Puerto Angel) show significant savings in fuel as a result of the cut off. According to them, a return trip from Puerto Angel to Pucallpa, during the low water season, required 15 gallons of fuel (gasoline), costing approximately 120 S/. (~US$34.50). During the flood season, once travel was possible through a side channel, the required cost was 64 S/. (~US$18.45) (8 gallons at 8 S/. per gallon; price used is for 2004). Since the cut-off, fuel consumption dropped to 9-10 gallons (58-64 S/., or US$16.60-18.44) at low water and 7-8 gallons during the flood season (45-51 S/., or US$12.90-14.80) (price is based on 6.40 S/. per gallon of diesel). The shift from gasoline to diesel represents an additional 20% in savings, ultimately decreasing fuel costs to about half during the dry season; and by about 25% during the flood season.

21 The Tamaya and Abujao Rivers are two important tributaries that flowed into the Ucayali at what has become the abandoned channel. Due to their size and low suspended sediment load, these tributaries have played a role in defining the size of the ox-bow lake (i.e., it starts at the mouth of the Tamaya River) and in delaying the siltation of the tail end of the abandoned channel.

22 This road was only built in 2000, after failed attempts to divert the river back to its former course (see Chapter 3).

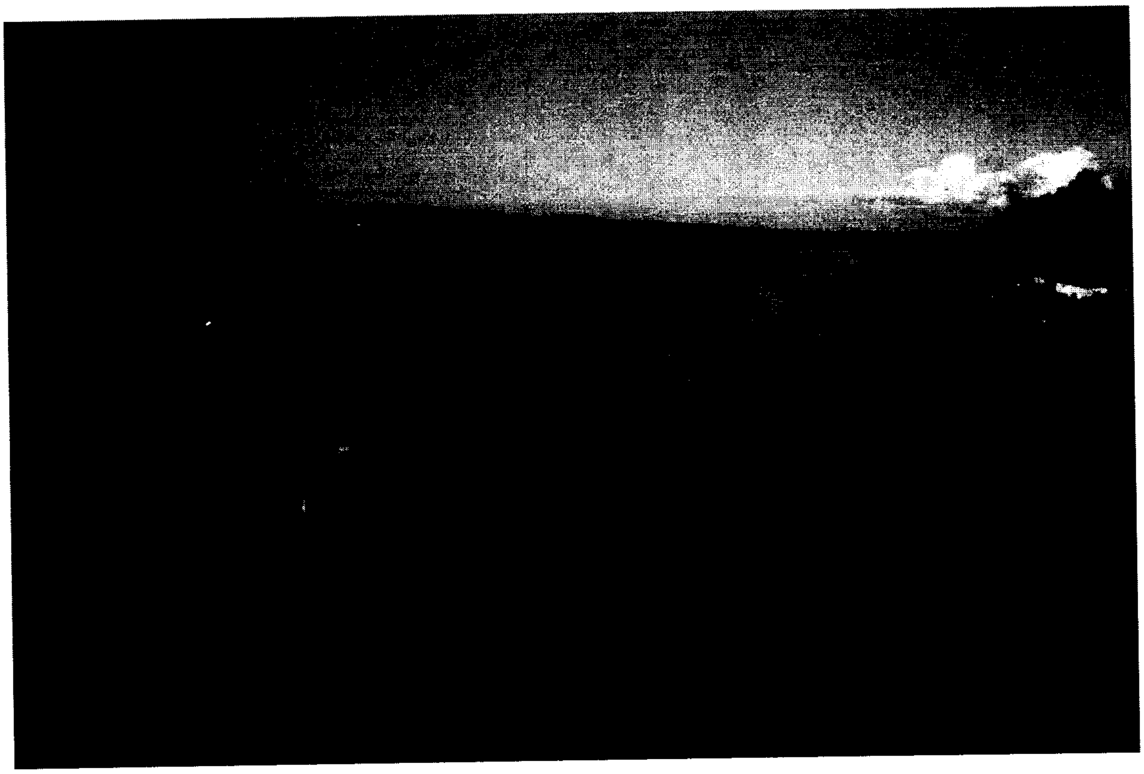

Figure 2.7 Boats at Tercera Union's port along the abandoned channel. Note how the channel is practically dry and non-navigable further into the channel (top right). Photo taken by the Author, July, 2002.

along the banks of the Ucayali, this village had direct and immediate access to the river. Residents could embark on a boat just a few steps from their homes. Puerto Angel is now some distance inland — at least during the low water season — due to the formation of a vast mudflat right in front of the village (see Figure 2.8). As a result, in the summer of 2003, local residents had to walk about half an hour with their produce to get to the nearest port.

Flooding

Perhaps the most surprising modification introduced by the Bahuanisho cut-off is that of changes in local flooding patterns. Flooding is the main environmental constraint within the Amazon floodplain (Bergman 1980; Denevan 1996; Harris 1998) and is sufficient to offset the higher fertility of its soils (Meggers 1994; Denevan 1996). The role of flooding for local livelihoods is particularly evident for agriculture, though it is also important for fishing, hunting, and forest extraction. Which crops are grown where is largely dependent on the flood level and its duration (Sternberg 1975; Bergman 1980; Denevan 1984; 2001). As described earlier, *ribereños* plant short cycle crops in low-lying areas of the floodplain, between the floods. On higher ground that floods less frequently, they grow crops that have longer growth cycles, or that cannot withstand flooding (i.e., manioc, plantains, citrus, and other perennials).

Differences in flooding determine the area of forest that is inundated during the flood season and regulate the distribution of fish species within the floodplain. *Ribereños* often fish within the forest when the river rises over its banks into the floodplain, dispersing fish stocks over larger areas. Furthermore, flood levels affect fish availability in ox-bow lakes, side channels and runlets, and change the suitability of these bodies of water for spawning, feeding, or as migration routes. Species composition in floodplain forests and the presence of fauna available for hunting are also determined by the level and the duration of the floods. Higher or lower floods also have an impact on the accessibility of

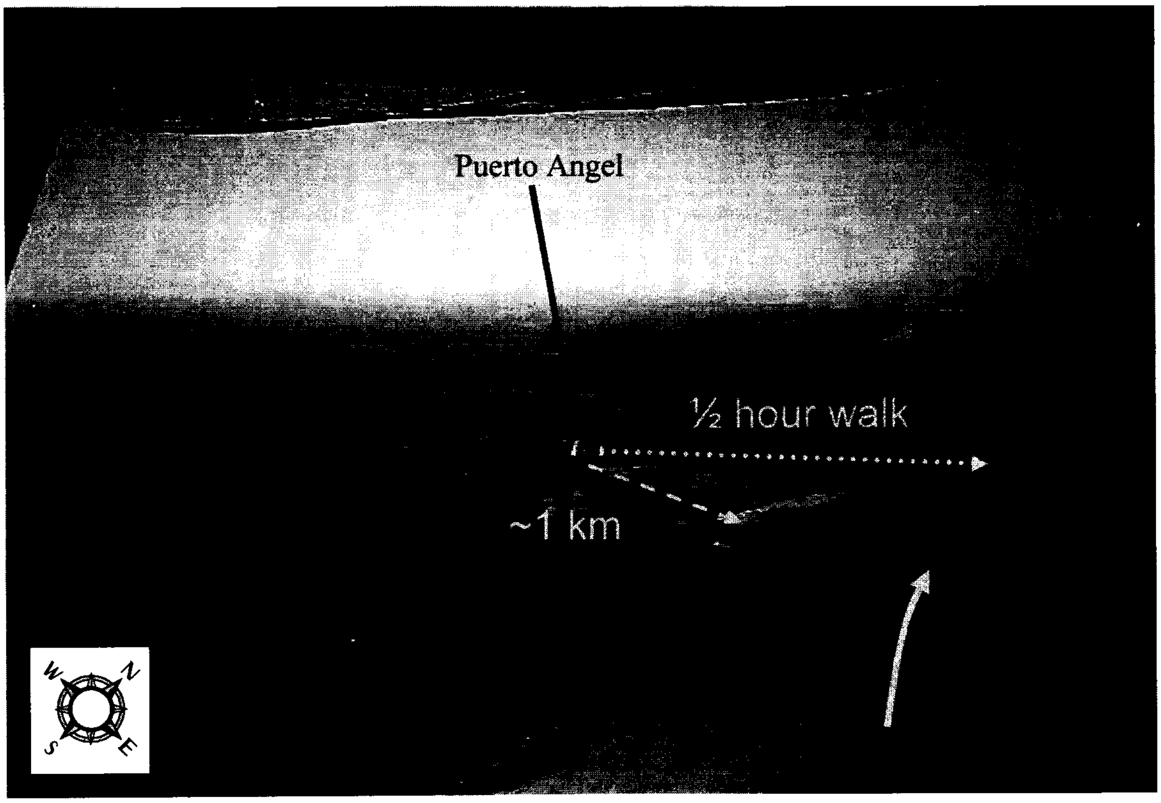

Figure 2.8 Air view of Puerto Angel showing its location in relation to the Ucayali. Photo taken by the author (July 2002).

wood and other forest products, which are hauled out of the forest during the flood season.

I obtained consistent reports from residents of more frequent flooding downstream from the cut-off, and less frequent upstream. According to *ribereños*, areas downstream, which flooded every 7-10 years, severely inundated on four consecutive years after the cut-off.[23] Conversely, levees that used to flood almost every year upstream now remain 1.5-2 m above post cut-off flood levels.[24]

Whereas reports on higher flood levels (downstream) are consistent with the literature (see Gentry and López-Parodi 1980; 1982; Sternberg 1987; WinklerPrins 1999), lower flood levels, such as those reported for upstream reaches, have not been reported. These seemingly contradicting reports, however, may be explained in terms of changes in erosion and deposition in areas adjacent to the cut-off, similar to those occurring after channel straightening (see Talbot and Lapointe 2002a).[25] Indeed, fluvial geomorphologists have found changes in a river's profile through degradation and aggradation of the riverbed, at the head (i.e., upstream) and the tail (i.e., downstream) of the channel, respectively, due to channel straightening[26] (Talbot and Lapointe 2002a). Available daily river level data at Pucallpa for the period of 1981-2003 seem to corroborate local reports of changes in flooding patterns, at least for the downstream reach, showing that floods tend to be higher and longer since the cut-off (i.e., after 1997) (Figure 2.9 and Table 2.5); at low stages, the Ucayali River has also reached unprecedented high levels.[27]

Riverbank heights were surveyed in August 2003 to test whether changes in flooding patterns could be related to the modification of the riverbed. The

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23 Levees flooded again for two more years after that, though not severely.

24 The average difference between the low and high water is about 9.3 meters. Also, note that discharge should be similar at both locations.

25 These authors refer to the artificial straightening of a river channel. The effects of a meander cut-off are essentially the same.

26 Degradation and aggradation of the riverbed are related to the balance between erosion and deposition at a given reach. When erosion is greater than deposition the river is said to be degrading. Conversely, it is said to be aggrading when the amount of sediment deposited is greater than that of carried out of it.

27 No records could be found for upstream gauging stations to corroborate the effect reported for the upstream reach.

survey included all accessible cutbanks along the Ucayali River, between the mouths of the Pachitea and the Aguaytía Rivers, an area that would be representative of the potential effects upstream and downstream from the Bahuanisho cut-off.[28] Although not conclusive, the data do suggest that banks tend to be higher upstream and lower downstream from the cut-off, which is consistent with the "aggradation-degradation" hypothesis and local reports on flooding (i.e., higher floods downstream; lower floods upstream).[29]

Local residents provided additional explanations on the observed changes in flooding patterns. *Ribereños* considered that the sinuosity of the channel prior to the cut-off slowed the flow of the river, effectively creating a "damming" effect. According to some residents, the straightening of the channel, due to the cut-off, allows water to travel through more rapidly. Others consider that, as a result of the bifurcation of the river flow between the cut-off and the abandoned channel at flood stage, areas upstream from the bifurcation are drained much faster, and those downstream from where the two channels meet again are subjected to a "damming" effect.

One would expect agricultural risk and the prospects for crop production to change according to the new patterns of flooding derived from the cut-off in each of these areas. With greater flooding downstream after 1997, it would be more difficult to grow plantains and perennial crops and even annual crops could be lost more easily to flooding. Conversely, in areas upstream, which are experiencing lower floods, *ribereños* could potentially plant crops with longer growth cycles (i.e., perennials), or short cycle crops (i.e., annuals), without much concern about flooding.[30]

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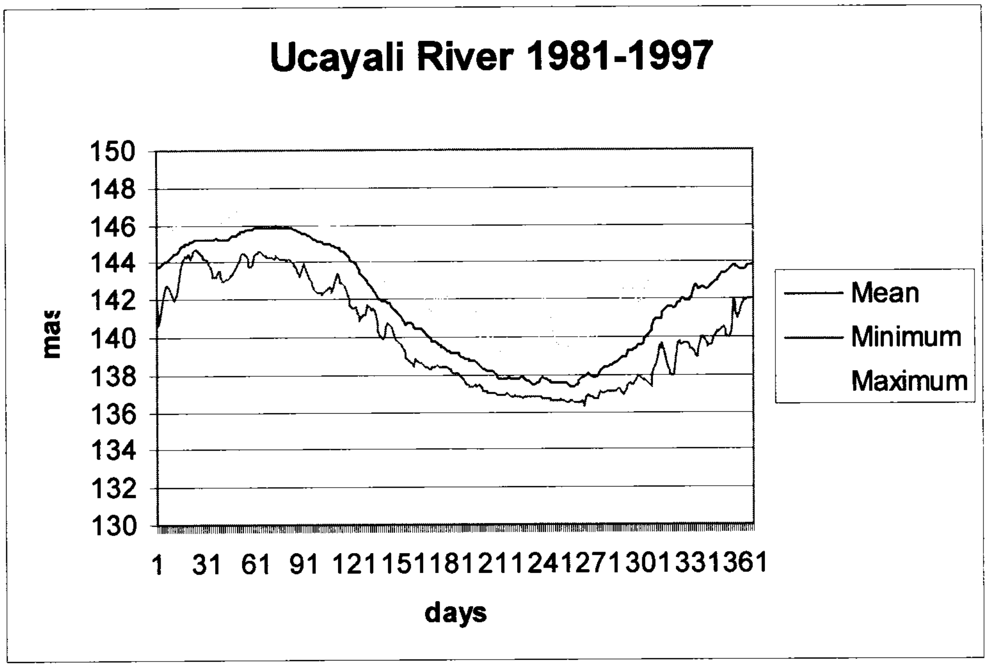
28 Banks were measured with respect to the water level in the Ucayali River at low stage accounting for a total of 50 data points. Heights were later standardized based on Pucallpa records for August 21, 2003 and grouped into twelve aggregate points, based on their general location.

29 Appropriate sampling of banks is faced with serious difficulties. Due to the lateral migration of the river, cutbanks located beside the current channel may be more representative of flood levels dating back to earlier courses of the river than to more recent flood levels. Important differences in bank height may also be present due to the irregular rate at which river channels migrate laterally (Bergman, 1980). Higher levees tend to form over time when the river maintains a relatively stable course for some time, allowing for the periodic deposition of sediment at the same spot with every flood.

30 This was evident in the reactions of informants living upstream, who almost laughed when they were asked about the possibility of experiencing a big flood in the next few years. In

Figure 2.9 Daily river levels for the Ucayali at Pucallpa. Source of data: DGTA-MTC, Regional Office at Pucallpa.

a) Pre-cut-off



b) Post-cut-off

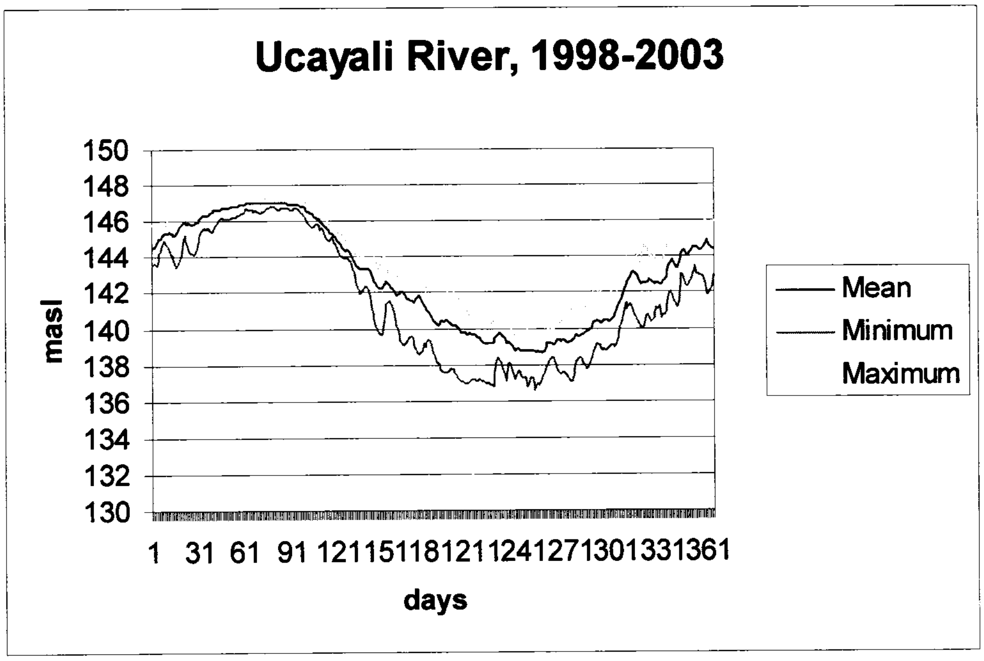


Table 2.5 Ucayali River maximum and minimum stages at Pucallpa (1980-2003).

Year	River Stage at Pucallpa (masl)			
	High	**Date**	**Low**	**Date**
1980	145.52	4/8	136.25	9/19
1981	146.47	3/2	136.57	9/14
1982	**147.08**	3/14	**137.37**	9/17
1983	145.69	2/2	137.23	9/1
1984	**146.83**	2/21	137.16	9/22
1985	145.67	3/18	137.21	9/13
1986	**147.28**	3/15	**137.25**	8/8
1987	146.49	2/6	136.57	9/1
1988	146.44	2/19	136.50	9/15
1989	146.22	3/15	137.08	8/30
1990	145.44	2/16	136.88	8/19
1991	146.49	3/28	136.48	9/9
1992	145.14	3/29	**137.30**	8/15
1993	146.19	3/24	137.02	9/16
1994	**147.48**	2/27	137.09	8/22
1995	146.25	3/25	137.02	10/12
1996	**146.63**	3/11	136.67	9/27
Cut-off → **1997**	**147.05**	3/14	136.52	9/15
1998	**146.82**	3/19	136.61	9/6
1999	**147.34**	3/12	**137.83**	8/29
2000	**147.32**	3/20	**138.93**	8/28
2001	**147.34**	3/9	**138.68**	9/5
2002	**147.23**	2/19	**139.43**	8/19
2003	**147.02**	3/25	**138.12**	9/9
Average1980-2003	146.56		137.24	
Average 1980-1997	146.35		136.90	
Average 1998-2003	147.18		138.27	
No. of years above mean max. (80-03)	12			
Prob. of above mean flood (80-03)	0.55			
No. of years above mean max. (80-97)	6			
Prob. of above mean flood (80-97)	0.33			
No. of years above mean max. (98-03)	6			
Prob. of above mean flood (97-03)	1.00			

Shaded cells represent values greater than the mean for the 1980-2003 period
Source: DGTA-MTC, Regional Office Pucallpa.

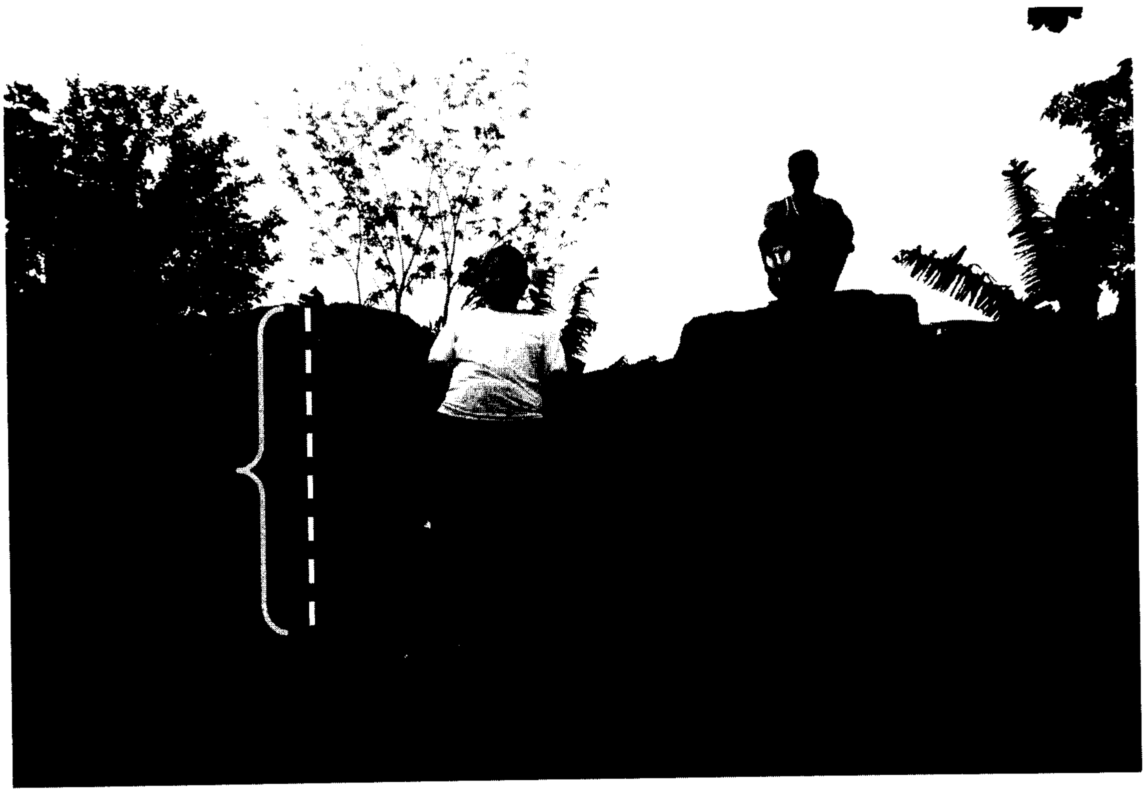


Figure 2.10 Maximum flood level in an upstream community since the Bahuanisho cut-off. The woman in the picture is standing at the approximate height the water at flood stage since the cut-off. Prior to that, the water spilled over the bank at the same location.

Likewise, different flooding patterns are likely to have affected the prospects for fishing, hunting and extraction of certain forest products. Local residents reported variations in relation to fishing, hunting and extraction. In Puerto Angel (located upstream), certain fish species have apparently become scarce in a nearby lake, but at the same time their shores have turned into prime sites to catch catfish during their migration. On the other hand, in the downstream village (Exito) residents have reported fishing more in the forest during the flood season. With few areas for animals to remain dry during the flood season, the availability of game for hunting in downstream areas is limited primarily to aquatic birds. Conversely, game may be more abundant where there is less flooding, though dispersed over larger areas. Since certain tree species can withstand flooding better than others, it is likely that with time, the cut-off could affect forest species composition in nearby areas, especially in areas that flood more frequently (Puhakka *et al.* 1992), thus affecting the prospects for timber and firewood extraction.

Natural endowments and resource availability

Natural endowments and resource availability also have been altered since the cut-off, due primarily to the modification in local flooding patterns, changes in river channel geometry, and the formation of an extensive ox-bow lake. Changes in flooding levels mentioned earlier, in some sense, have transformed qualitatively and quantitatively the availability certain land types. In Puerto Angel, for instance, the cut-off increased the availability of high levee lands, whereas in Exito there is virtually no levee high enough to remain dry during the flood season.

The Bahuanisho cut-off induced dramatic transformations in the geometry of the Ucayali, affecting the patterns of riverbank erosion and deposition in nearby areas. [31] Riverbank erosion advanced much faster in some areas (e.g., near Exito) and in others sedimentation is now occurring along former cutbanks (e.g., near Puerto Angel) (see Figure 2.11). Two of my study sites are illustrative of

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[31] Riverbank erosion is a major source of risk in the Central Ucayali.

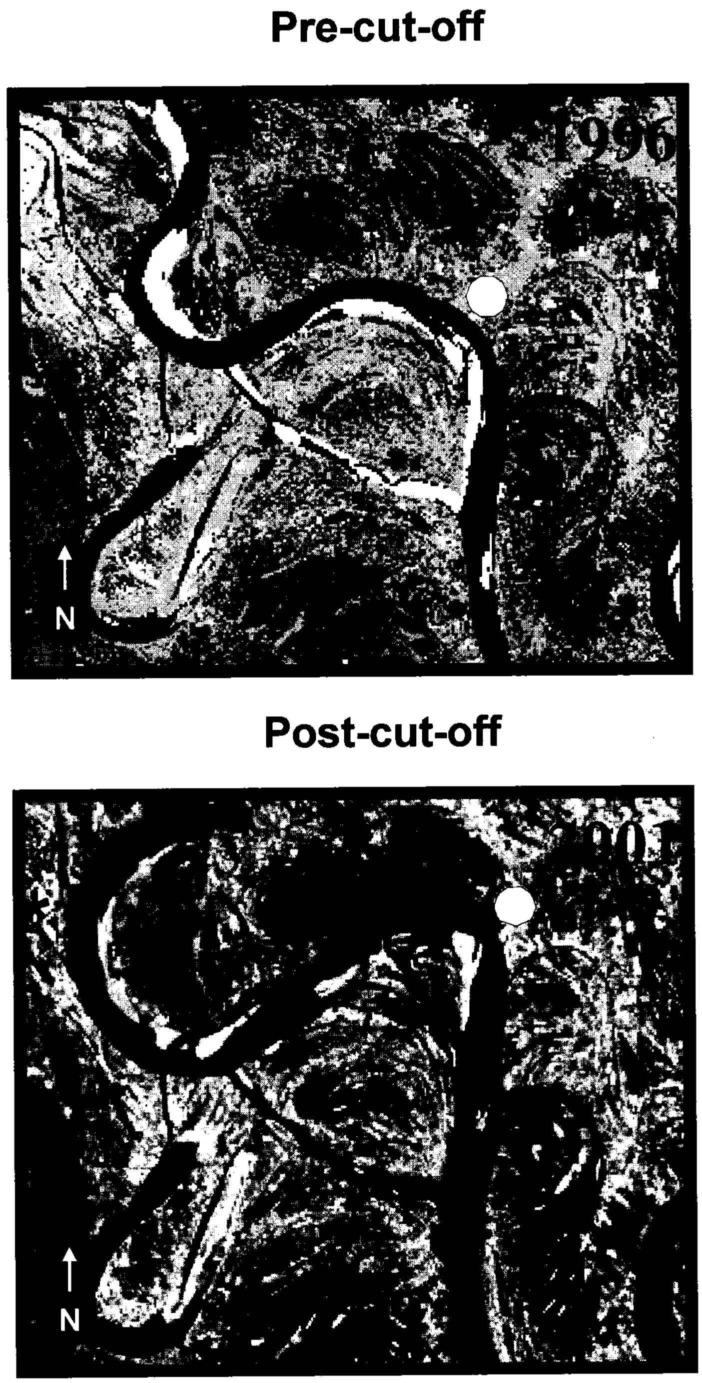

Figure 2.11 Increased riverbank erosion in Exito as a result of the cut-off, Central Ucayali. Sources: LANDSAT 5 data © NOAA 1996 and LANDSAT 7 ETM+ data © NOAA 2001; received and processed by USGS/EROS Data Center: processed and redistributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University)

this. Located on an outer bank of the Ucayali, Exito had a long history of riverbank erosion and had to retreat gradually further back as the river eroded the bank where the village was located. According to local residents, the actual site I visited in 2002-03 was in fact the third Exito, and was roughly about two hours (by foot) from the village's location in the 1950s, near the bank of the Ucayali. However, the village experienced unprecedented rates of riverbank erosion between 1998 and 2000, (i.e., since the Bahuanisho cut-off), which destroyed much of the agricultural land in the village. It appears that the straightening of the channel, due to the cut-off, allowed water velocity to increase dramatically, which pounded directly onto village lands. Local residents were forced to disassemble their homes and to retreat further inland, and to find new areas to plant their crops.[32] Many households moved to Pucallpa or to new areas that opened upstream from the cut-off, so the village I visited was significantly smaller than what it was prior to the cut-off.

Puerto Angel had also been subjected to riverbank erosion and, like Exito, it retreated as the river slowly carved through the bluff on which the village rests. However, contrary to what occurred in Exito, erosion is now occurring on the opposite bank, where some Puerto Angelinos have their agricultural plots. At present, the village is separated from the current course of the Ucayali by a mudflat that has been deposited in front of the former riverbank. The effects of sediment deposition are discussed more extensively later in this section.

Other effects of riverbank erosion on natural resource use include the destruction of valuable forest resources (e.g., trees, fruit palms, emergency foods), either by the river itself or through rapacious harvests driven by the threat of erosion, and by improved access to forest resources that were previously too far removed from the river's edge. Indeed, old growth forests, which are rarely found near the main channel of the Ucayali, are now strategically placed along the banks of the new channel. Although *ribereños* have been unable to benefit much from

[32] During the summer of 2002, the river deposited a mudflat just in front of the bank that it had been previously eroding. This change was probably associated with the development of a chute channel that began to take most of the flow by that year, even at low stages.

this, loggers from Pucallpa stripped the area of all valuable trees within the first year or two.

The river has formed vast mudflats and sandbars near at least two of my study sites (i.e., Exito and Puerto Angel), as well as on the entrance of the abandoned channel. Although fairly unstable (Denevan 1984, 320), these newly formed land areas are attractive to local residents for planting rice, cowpeas, melons, and other crops.[33] Although some *ribereños* had access to land on mudflats and sandbars in the past, these recently emerged lands constitute a new resource for many residents, one that has gained much importance since the cut-off.

The Bahuanisho cut-off created a large ox-bow lake that measures between 33 and 47 km^2 in area (during the low water season), potentially altering conditions for fish populations.[34] Water chemistry in ox-bow lakes is different from that of the main river (i.e., clearer, more acidic, warmer vs. turbid, basic, cooler) and as such, offers a niche for different fish and plant species. Fish are believed to be more abundant in ox-bow lakes and black water tributaries, and are highly valued by local populations (Coomes 1999). As such, the ox-bow could potentially become a prime site for fishing for people throughout the Central Ucayali. *Ribereños* reported local changes in the availability of fish in the river itself; apparently fish migrations (locally know as *mijanos*) concentrate on the channel carrying the main flow and catfish are more abundant in the area immediately upstream from the cut-off, where the current is stronger.

33 In the past only mudflats were particularly desired as they offered important cash earning opportunities through rice production. In recent years, however, sandbars have gained greater attention for cowpea production due to more attractive prices.

34 Estimates are based on an average width of 0.7 to one kilometer, and a length of 47 km.

2.3.3 Livelihood responses to the cut-off

My analysis of peasant livelihood responses to the cut-off is driven by two general questions:

1) How did the cut–off and related changes reshape household land holding portfolios and non-land asset holdings?; and,
2) What changes in livelihood and resource use can be attributed to the cut off?

Analysis is based on a comparison of pre- and post-cut-off conditions for all households for whom data could be reconstructed within six years prior to the cut-off (n=23). Although relatively small, the sample does provide a good sense about economic livelihood before and after the cut-off in the three study sites.

My focus is primarily on agriculture, which is the primary livelihood activity. Other activities, such as fishing and extraction, are omitted due to difficulties in gathering retrospective data for statistical analyses. Land holding portfolios, asset holdings, land use, and crop composition before the cut-off were contrasted with those of 2003 (i.e., after the cut-off) across and within each of the study sites. An additional "transitional" moment was included to account for losses to riverbank erosion prior to the cut-off.[35] Pre- and post-cut-off comparisons were done first at the village level and then at the household level (i.e., within-village differences). Although, data on income levels prior to the cut-off were not readily available, cropping portfolios provide a fairly good sense of economic livelihood prior to the cut-off.

Village level responses

Analysis of data for the periods pre- and post-cut-off suggests considerable changes in asset holdings and livelihoods across villages (see Figures 2.12-2.15). The trends for each of the study sites are presented below.

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[35] Riverbank erosion sometimes destroys important shares of household land holdings. A similar adjustment period could not be reconstructed for the post cut-off period for the entire sub-sample due to data constraints.

***Exito* (downstream)**

Despite losses to riverbank erosion in 2003, households in Exito held, on average, more than six hectares of land (i.e., roughly 50% more land after the cut-off) than they did prior to the cut-off (Figure 2.12). The smaller land portfolios they held prior, however, included areas that remained above the flood in most years (i.e., 2 ha or so), which allowed them to grow plantains — a major staple and an important source of cash income — and thus were key to livelihood. Lower levees were used to grow maize and some manioc between the floods (Figure 2.13). Local residents referred to the pre-cut-off period as "good times" when plantains and fish were abundant and flooding was not a major problem, even for annual crops (e.g., maize). Subsistence needs were easily met, and due to its high alluvial soils and close proximity to Pucallpa (i.e., within an hour ride by boat), local residents could grow plantains and sell them in Pucallpa every two to three weeks throughout the year.[36] Local boatmen reported much larger volumes of goods being shipped out of the village prior to the cut-off, and apparently there was more money available to hire labor to tend for, harvest, or transport plantains.

Larger land portfolios since the cut-off are not necessarily a sign of improved conditions for local residents. With virtually no higher ground, plantain production is now rare (only half of the households in the sub-sample held land in plantain at the time of study, total area=1.85 ha, mean area=0.14 ha) and is restricted to flood-resistant varieties that are not commercially valuable or very palatable (e.g., *sapucho, campeón*)[37] (Figure 2.13). Those who can afford to do so buy plantains in Pucallpa, but many others obtain them through exchanges of fish or labor with kin and friends in other villages. Annual crops have become predominant (in terms of land area and agricultural income), especially maize (mean area= 1.25 ha). Yet, even the production of annuals is being increasingly threatened by flooding. Small areas on the levee tops are planted with manioc,

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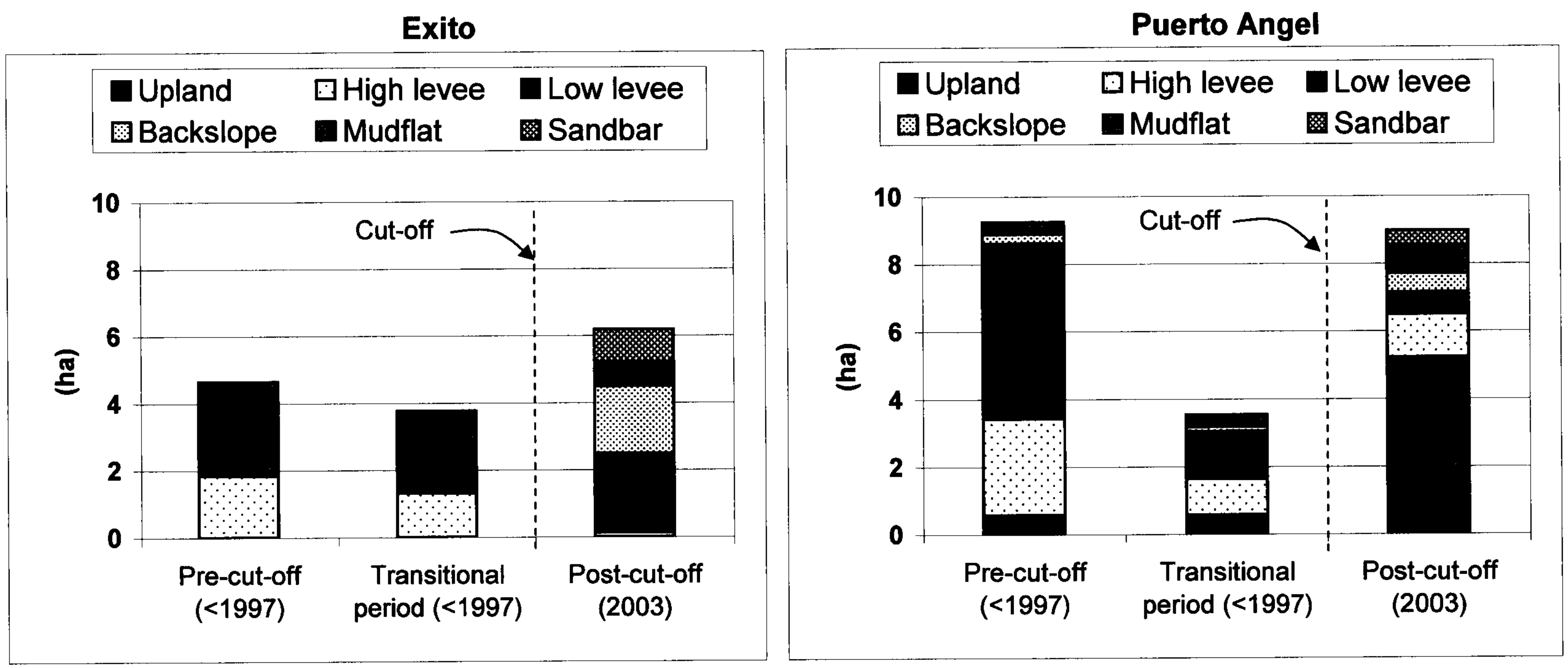
[36] Puerto Angel was one of the main plantain producing areas for Pucallpa during this period.

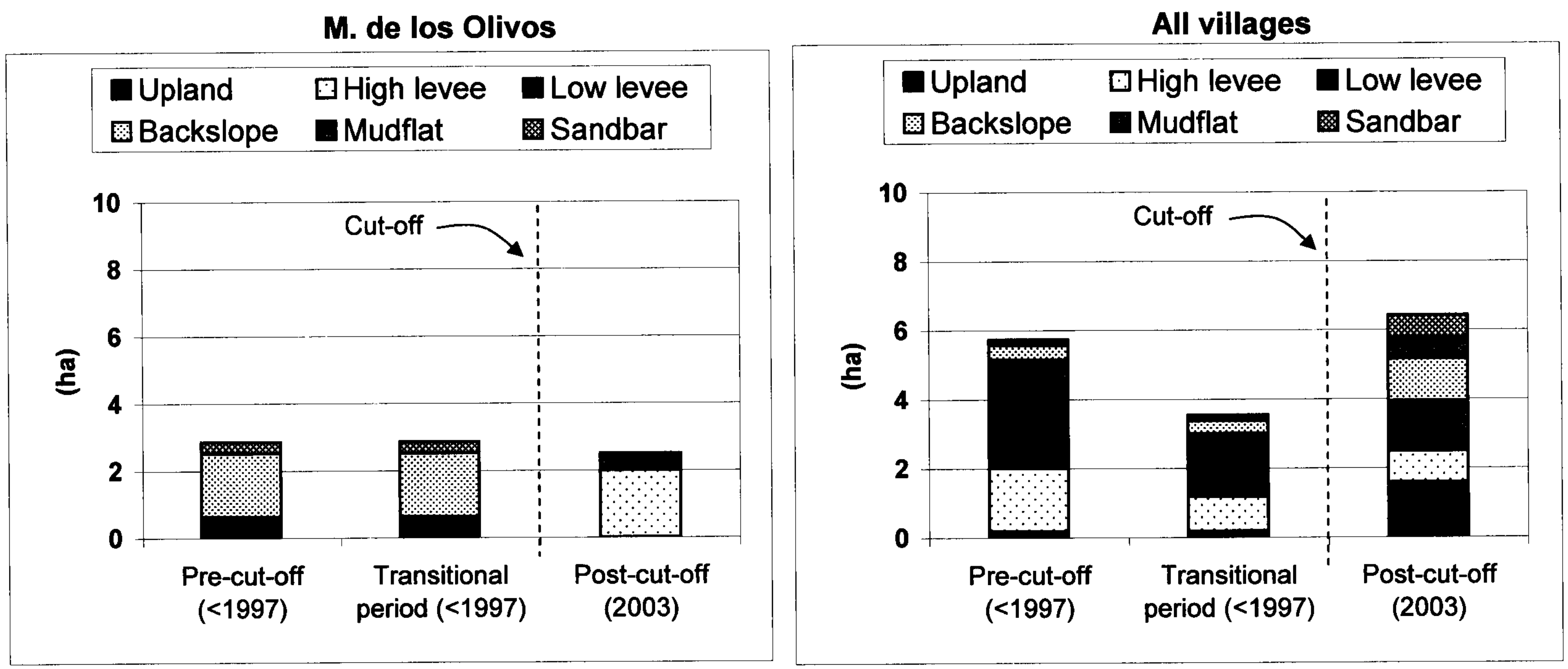
[37] Local residents began to establish small plantain plots again in hopes that flooding will no longer occur in the near future due to a new chute cut-off.

Figure 2.12 Mean land holding portfolios in selected villages near the Bahuanisho cut-off.



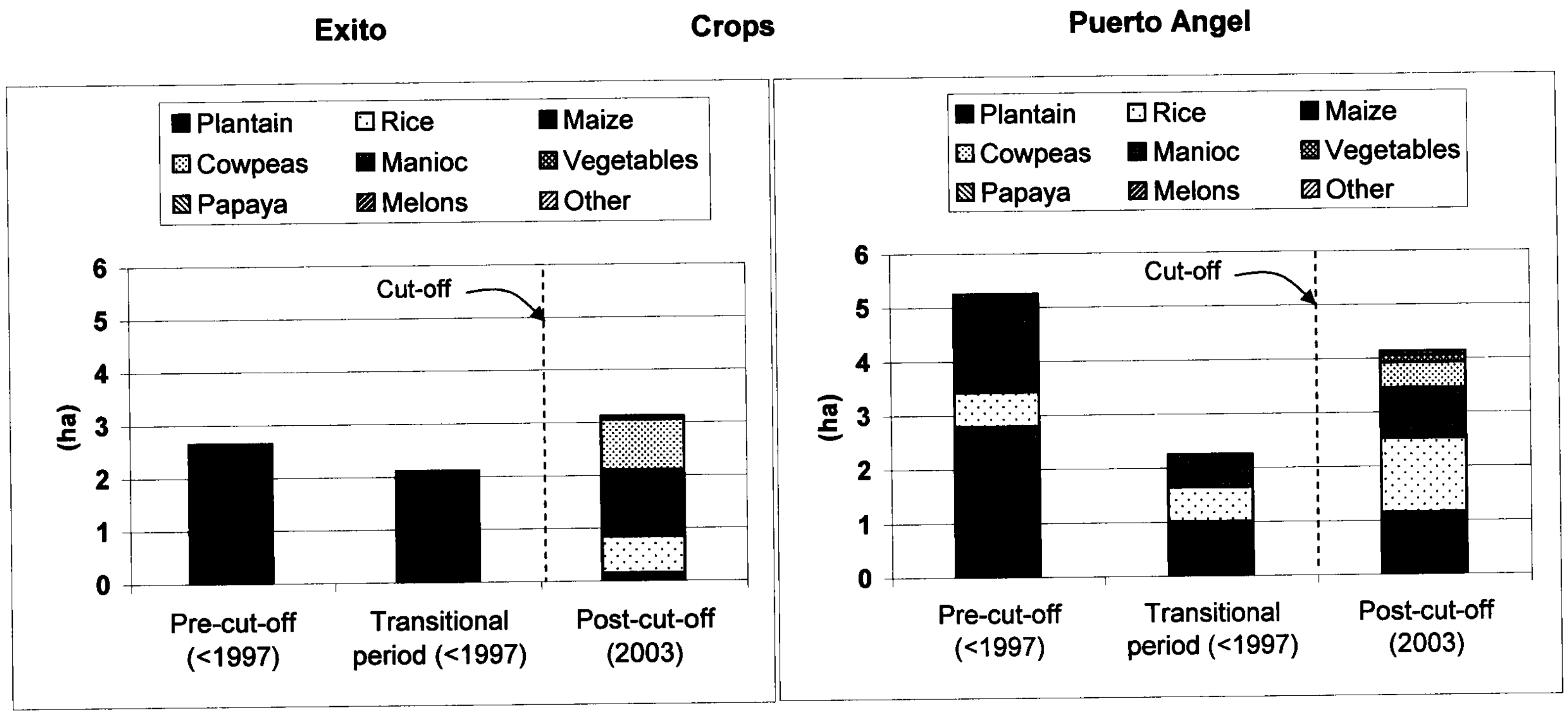
	Exito: Pre-cut-off (<1997)	Exito: Transitional period (<1997)	Exito: Post-cut-off (2003)	Puerto Angel: Pre-cut-off (<1997)	Puerto Angel: Transitional period (<1997)	Puerto Angel: Post-cut-off (2003)
Total land Gini	0.528	0.616	0.305	0.44	0.635	0.472
High levee Gini	0.574	0.765	0.808	0.407	0.699	0.444
Upland Gini	n.a.	n.a.	n.a.	0.857	0.857	0.755

Figure 2.12 Mean land holding portfolios in selected villages near the Bahuanisho cut-off (continued).



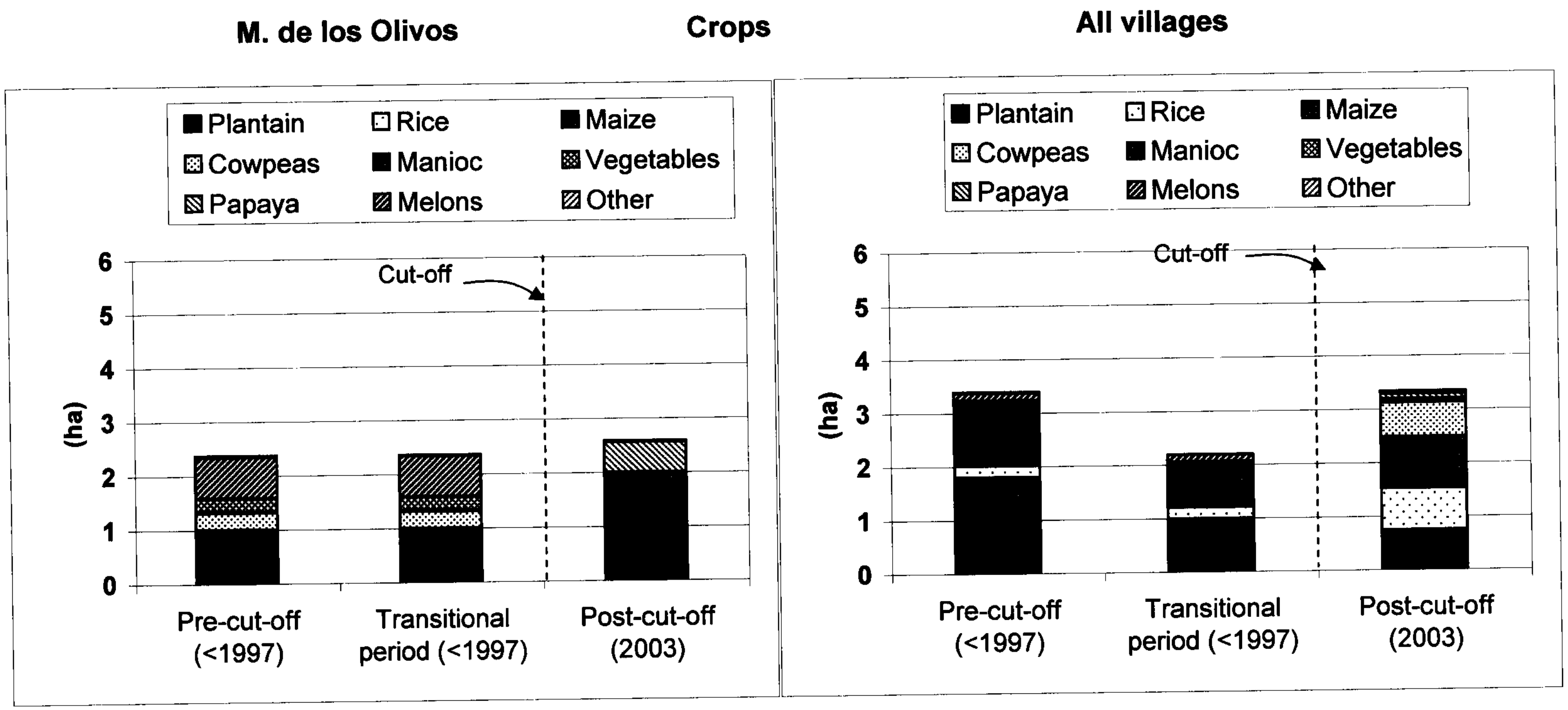
	M. de los Olivos: Pre-cut-off	M. de los Olivos: Transitional	M. de los Olivos: Post-cut-off	All villages: Pre-cut-off	All villages: Transitional	All villages: Post-cut-off
Total land Gini	0.44	0.44	0.14	0.537	0.628	0.407
High levee Gini	n.a.	n.a.	0.147	0.611	0.786	0.639
Upland Gini	n.a.	n.a.	n.a.	0.957	0.957	0.926

Figure 2.13 Mean crop portfolios in three villages near the Bahuanisho cut-off.



Vegetables include coriander, sweet and hot peppers, cucumber, and others.
Other crops include beans, peanuts, pineapple, sugar cane, taperiba, avocado, citrus and timber species.

Figure 2.13 Mean crop portfolios in three villages near the Bahuanisho cut-off (continued).



Vegetables include coriander, sweet and hot peppers, cucumber, and others.
Other crops include beans, peanuts, pineapple, sugar cane, taperiba, avocado, citrus and timber species.

which is processed into *fariña* (or manioc flour)[38] — a food reserve during the flood season — or *masato*. Rice is grown on the mudflats, and since 2002 cowpeas have started to be produced in larger areas on nearby sandbars. Exito is still located fairly close to Pucallpa, however, its advantage in terms of distance to the market relative to other villages has been substantially reduced. As a result of these shifts, residents in this village are using more land than in the pre cut-off period (Figure 2.14)

Faced by greater uncertainty in crop production, households in Exito appear to be turning to other forms of capital, especially other productive assets such as a store, tricycle, shotguns, etc. (Figure 2.15). This could be a diversification strategy to buffer against more frequent flooding and lower income levels from agriculture.

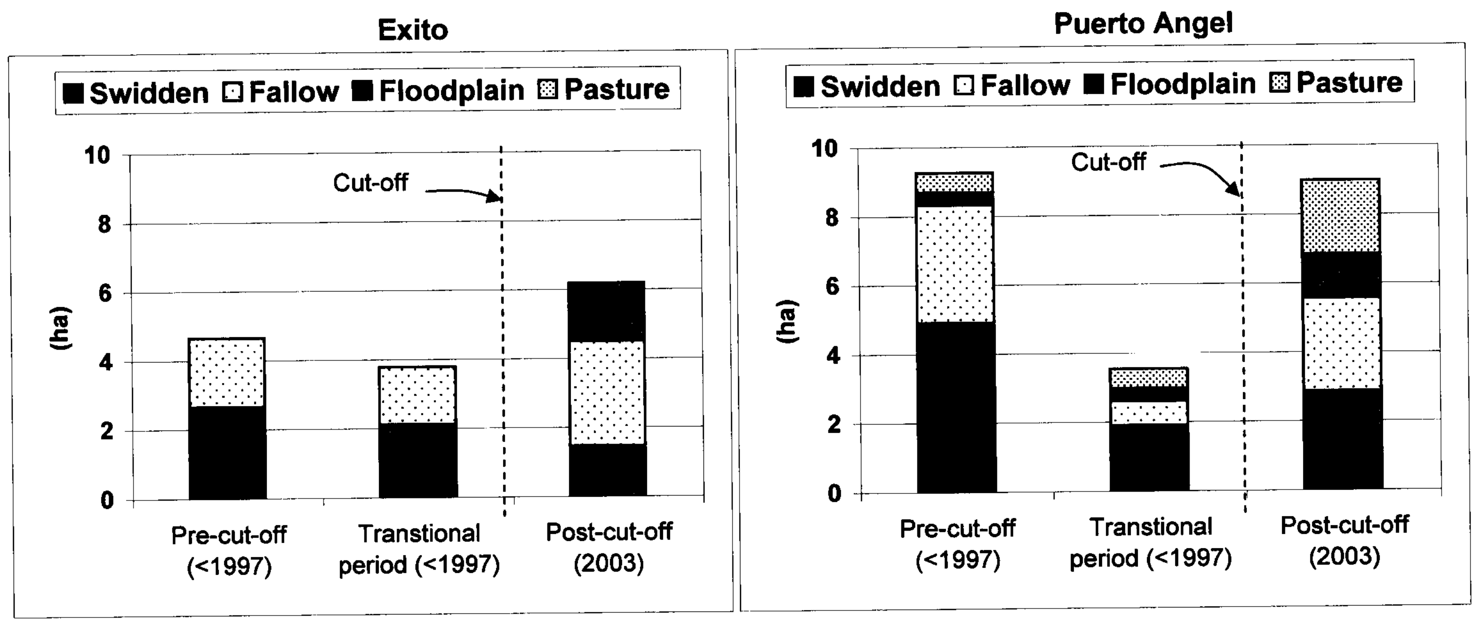
***Puerto Angel* (upstream)**

In 2003, Puerto Angel residents held roughly the same amount of land as they did in the pre-cut-off period, and despite losses to riverbank erosion they continue to hold the largest average holdings in the sample. In terms of land area, their orientation appears to be turning increasingly towards upland areas (~60% of average portfolio in 2003), while benefiting from the use of diverse land types within the floodplain (including mudflat and sandbar) (Figure 2.12).

Annual crops (e.g., maize, rice) planted on low levees were equally important as plantains prior to the cut-off (Figure 2.13). Plantains were grown primarily for subsistence and were often destroyed by frequent flooding. Every flood brought important losses, and following it, farmers had to replant their fields and wait for several months before new produce could be harvested. Access to upland areas (even if small) probably served as insurance against floods, allowing local residents to grow manioc year-round and to raise livestock. Some residents exchanged other products for manioc or *fariña* with people living in nearby

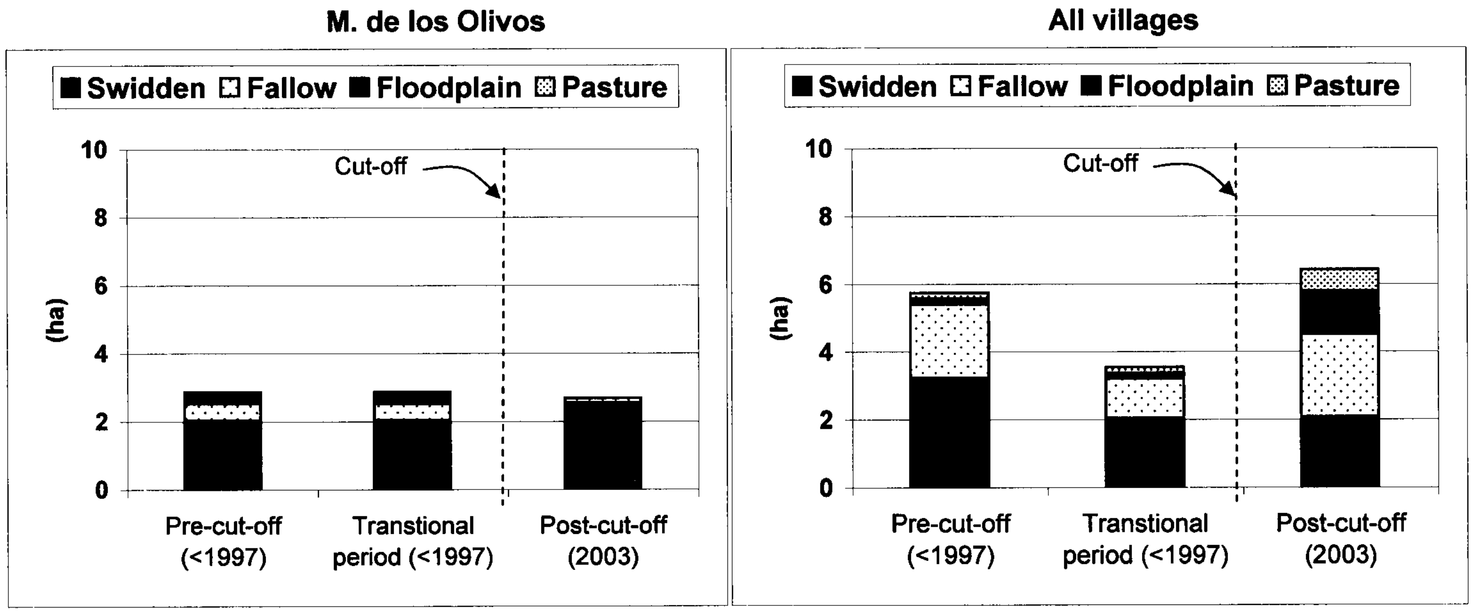
[38] Although flooded every year, the top of low levees remains dry for a sufficiently long period of time to allow for early-maturing varieties of manioc to produce tubers (~6 months). *Fariña* is a key staple particularly during the flood season, when other foods are scarce; *masato* is fermented drink served at celebrations and working parties (Chibnik and de Jong 1989).

Figure 2.14 Mean household land use portfolios in three villages near Bahuanisho cut-off.



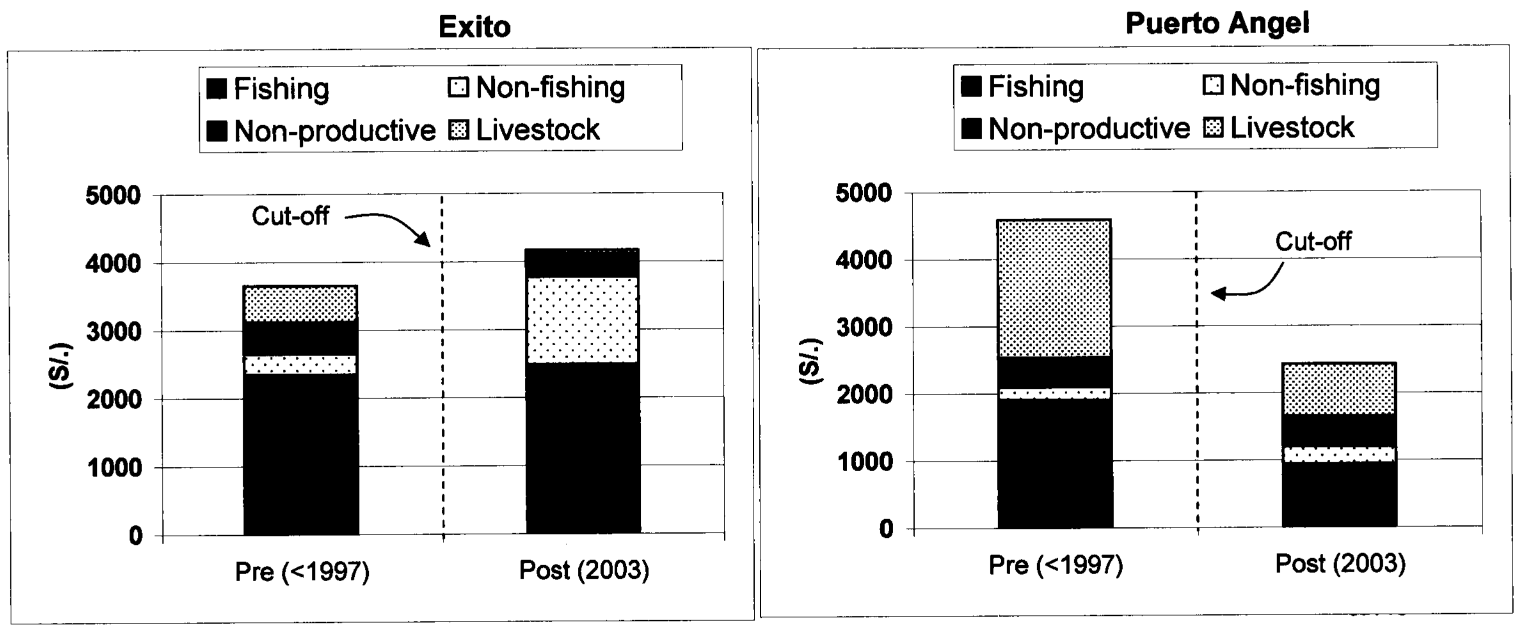
	Exito: Pre-cut-off (<1997)	Exito: Transtional period (<1997)	Exito: Post-cut-off (2003)	Puerto Angel: Pre-cut-off (<1997)	Puerto Angel: Transtional period (<1997)	Puerto Angel: Post-cut-off (2003)
Total land holding (ha)	4.6	3.8	6.2	9.3	3.5	9.0
Area swidden (ha)	2.6	2.1	1.4	4.9	1.9	2.9
Area falllow (ha)	2.0	1.7	3.0	3.4	0.7	2.7
Area floodplain farming (ha)	0	0	1.7	0.4	0.4	1.3
Area pasture (ha)	0	0	0	0.6	0.6	2.1
Swidden/fallow ratio[1]	1.30	1.24	0.47	1.44	2.71	1.07
No. of observations	12	12	12	7	7	7

Figure 2.14 Mean household land use portfolios in three villages near Bahuanisho cut-off (continued).



	M. de los Olivos: Pre-cut-off (<1997)	M. de los Olivos: Transtional period (<1997)	M. de los Olivos: Post-cut-off (2003)	All villages: Pre-cut-off (<1997)	All villages: Transtional period (<1997)	All villages: Post-cut-off (2003)
Total land holding (ha)	2.9	2.9	2.7	5.7	3.5	6.4
Area swidden (ha)	2.0	2.0	2.5	3.2	2.0	2.1
Area falllow (ha)	0.5	0.5	0.1	2.2	1.2	2.4
Area floodplain farming (ha)	0.3	0.3	0	0.2	0.2	1.3
Area pasture (ha)	0	0	0	0.2	0.2	0.7
Swidden/fallow ratio[1]	4.0	4.0	25.0	1.45	1.67	0.87
No. of observations	4	4	4	23	23	23

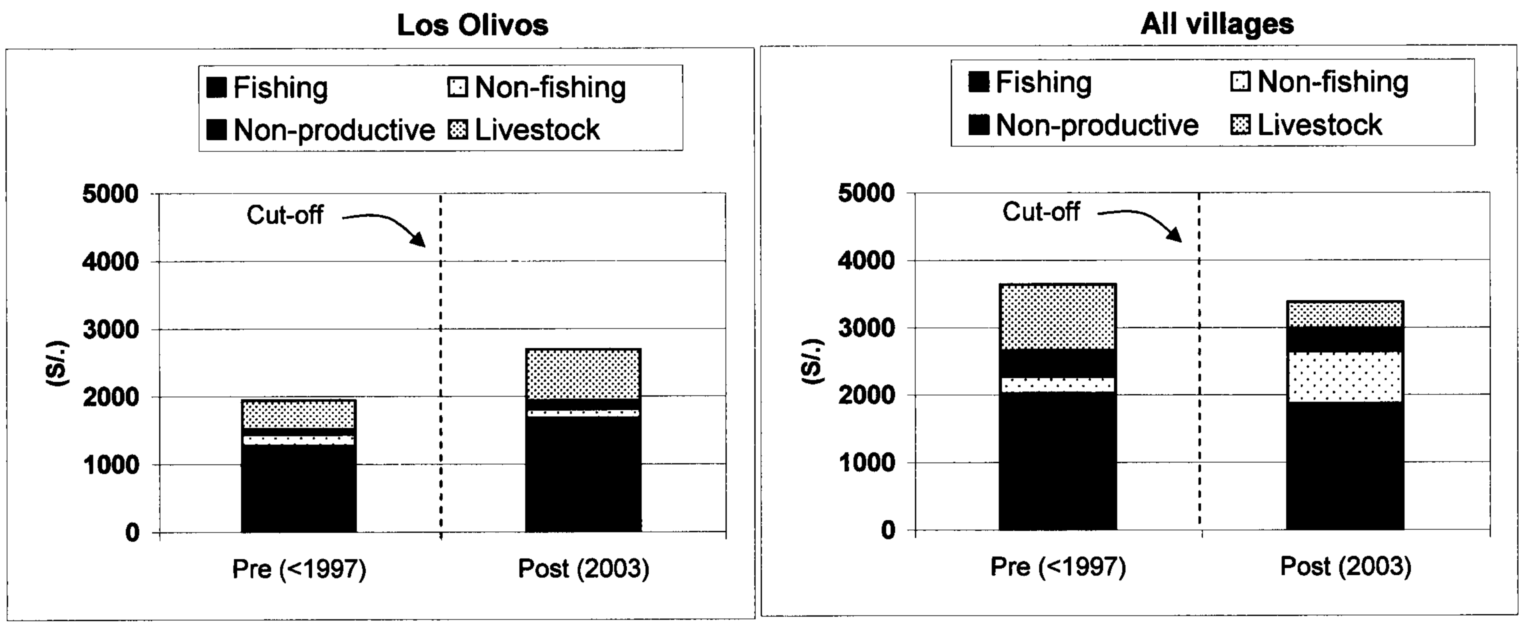
Figure 2.15 Mean non-land asset portfolios in three villages near of the Bahuanisho cut-off.



Asset Gini	0.659	0.678	0.2	0.163
Fishing asset Gini	0.742	0.705	0.527	0.446

Exchange rate: 3.47 S/. to $1 US (Based on average interbank rate on the first day of the month from June-December 2003).

Figure 2.15 Mean non-land asset portfolios in three villages near of the Bahuanisho cut-off (continued).



Asset Gini	0.605	0.137	0.556	0.597
Fishing asset Gini	0.708	0.459	0.71	0.672

Exchange rate: 3.47 S/. to $1 US (Based on average interbank rate on the first day of the month from June-December 2003).

upland areas. Breadfruit stands within village lands were another important source of emergency food.

Puerto Angelinos reported significant benefits from the cut-off. Whereas plantains used to be relatively scarce prior to the cut-off, since then they have become one of the most important crops grown in this and other villages situated upstream (Figure 2.13). Although covering a smaller area than before, plantain production in Puerto Angel is sufficient to cover subsistence needs, feed domestic animals, and generate regular income spread throughout the year. By reducing the risk of flooding, the cut-off appears to have been critical in this shift. As soon as it became evident that the levees would no longer flood, Puerto Angelinos sought to secure land for risk-free plantain production. Annual crops continue to play an important role in Puerto Angel and, as in Exito, crop portfolios appear to be more diverse now than in the past. Since the cut-off, maize — which was previously affected by early floods — is now grown with little concern about flooding.

Diversification in Puerto Angel seems also partly related to the mudflat-sandbar that formed in front of the village after the cut-off, as well as the increasingly attractive prices for cowpeas. In 2003, households held on average 1.4 ha and 0.5 ha in rice[39] and cowpeas, respectively. Furthermore, taking advantage of the shorter distance to Pucallpa and higher prices during the off-season, households planted vegetables in small areas. Despite the increase in the average area in pasture, the data suggest that land use practices were more intensive in 2003 (Figure 2.14). Households held less land in swidden and fallow and more land in floodplain farming.

Asset holdings among Puerto Angelinos have changed dramatically during the period of study, dropping by almost 50% from roughly 4,500 S/. (US$1,296) (Figure 2.15). The causes of asset reductions in this village are less clear and perhaps are not necessarily related to the cut-off. One possible explanation, however, is that with the lower risk of flooding, greater access to the uplands (also

[39] Rice is also grown in new clearings in upland areas, often in the off-season. Total area in rice accounts for upland and mudflat rice.

as a buffer) and a consistent income year-round, households have a lower need for a buffer.

Monte de los Olivos

Monte de los Olivos did not formally exist prior to the cut-off. The site had been claimed by a few residents from Puerto Angel, but was considered relatively marginal because of flooding and it was far from the village. Most of its residents at the time of study had arrived from Ega — a village located by an ox-bow just upstream from Pucallpa — after the cut-off. Back in Ega, they grew annual crops (e.g., maize, cowpeas, and melons) in low lying areas of the floodplain and fishing helped to smooth income through the flood season. Ega, however, was known in the region for its melons and vegetables, grown between the floods for urban consumption (Figure 2.13). Since the cut-off, households in Monte de los Olivos substituted annual crops for perennials. Interestingly, this change is related to new conditions both downstream and upstream from the cut-off. Shortly after the Bahuanisho cut-off, flooding became more pronounced in Ega, causing many households to resort to fishing during the flood season as a coping strategy. Not long after, however, a group of them began to plant crops at the site of Monte de los Olivos — an area where they had observed no flooding while they were out on a fishing expedition.

By migrating to this new site, these households derived enviable opportunities. They gained access to higher areas of alluvial soils within the floodplain and were able to accumulate almost as much land as they held in their former village, despite the cost and investments required to get started at a new location (Figure 2.12).

Agricultural production in Monte de los Olivos is fairly specialized, with two thirds of their crop portfolios devoted to plantain and about 85% to perennials in general (Figure 2.13). Perennial crops are harvested and sold every two to three weeks, providing residents with regular income that resembles a pay cheque. Although not significant in terms of land area, vegetables constitute an additional advantage for residents of Monte de los Olivos, who market then in the off season (i.e., when these crops are scarce and prices are more attractive).

Overall, land use practices are more intensive at Monte de los Olivos than at their former site (Figure 2.14). Indeed, local residents hold a larger area in swidden and virtually no land in fallow or floodplain farming (see also swidden fallow ratios). Although intensive land use practices are not surprising in recently formed settlements, they may also be the product of the greater emphasis on perennial crops, which remain productive for several years without a fallow period.

In summary, prospects for economic livelihood in the three study sites were significantly modified as a result of the cut-off. Data on land use and farming portfolios prior to and after the cut-off suggest that economic livelihood in these villages changed accordingly. Such variations may be seen as responses to the conditions that have emerged after the cut-off, but likely to other factors as well.

Richer vs. poorer household responses

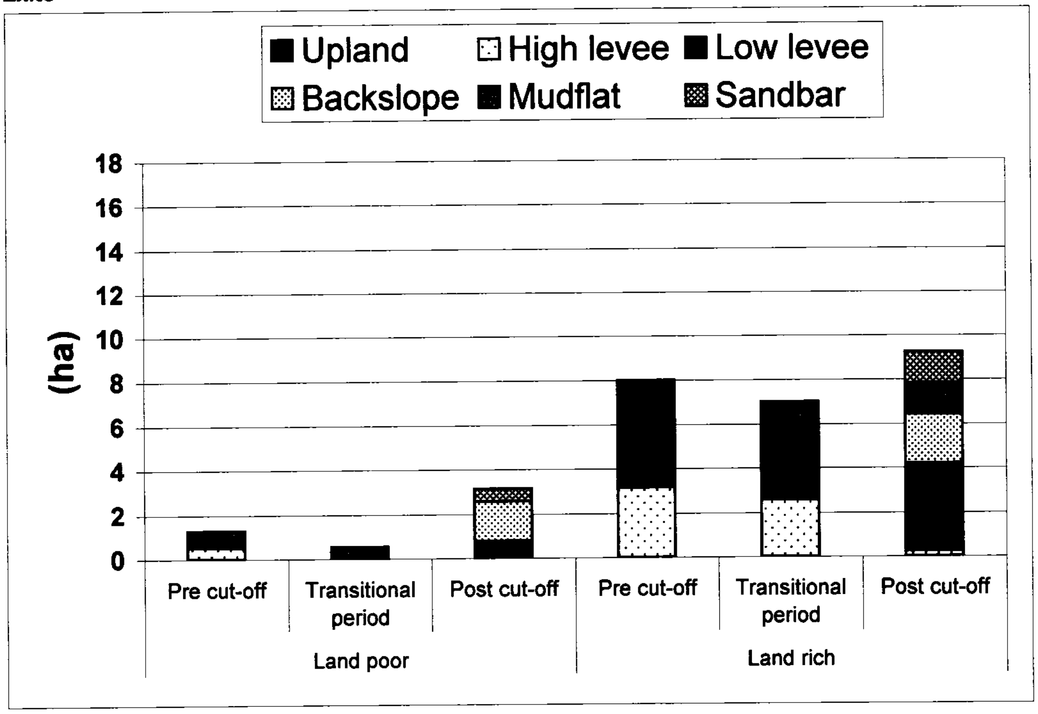
Village-level analysis, although providing useful information about livelihood responses to the cut-off in diverse settings, does not consider variations in livelihood responses within different villages. Based on recent works that highlight heterogeneity in economic livelihood and resource use within peasant villages, I turn to explore household level responses in each of the study sites. To do so, households were divided (at the median) into two categories ("land rich" and "land poor" households) to capture wealth differences within the study sites (Figures 2.16-2.19).

Land portfolios and asset holdings

In terms of land holding size, the poor appear to have gained ground since the cut-off in at least two of the study sites (Exito and Monte de los Olivos) (see Figure 2.16 a-d). Indeed, households in the "land poor" category in these villages

Figure 2.16 Mean household land portfolios by land wealth categories in three villages near the Bahuanisho cut-off.

Exito



Puerto Angel

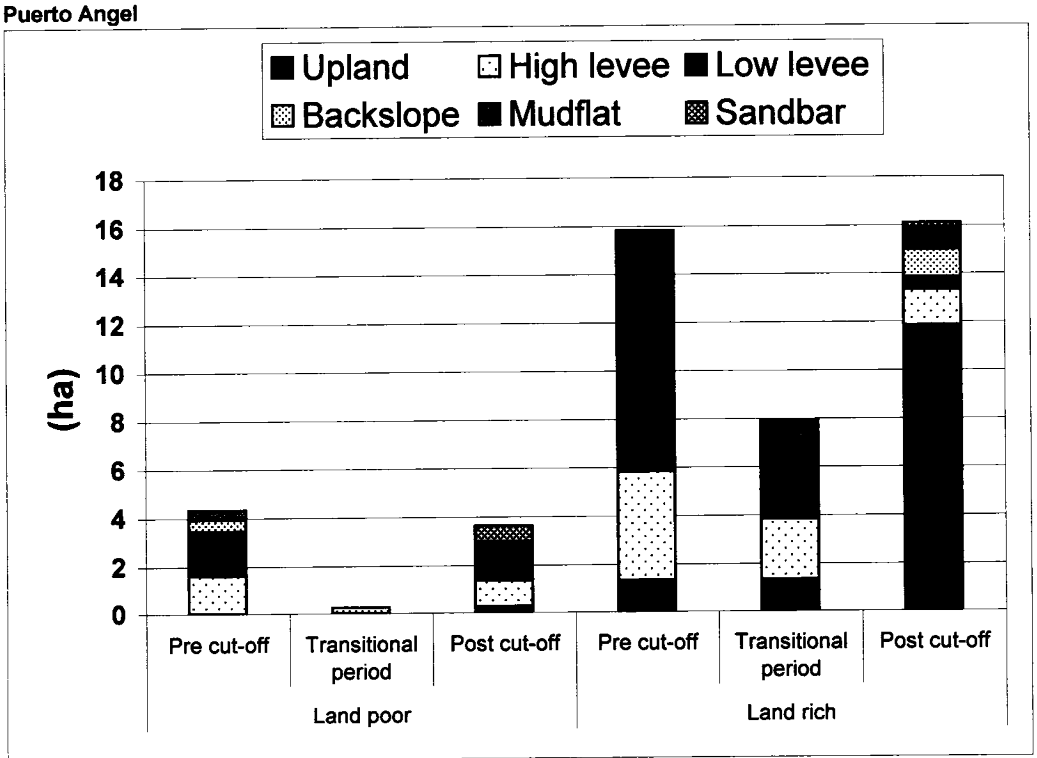
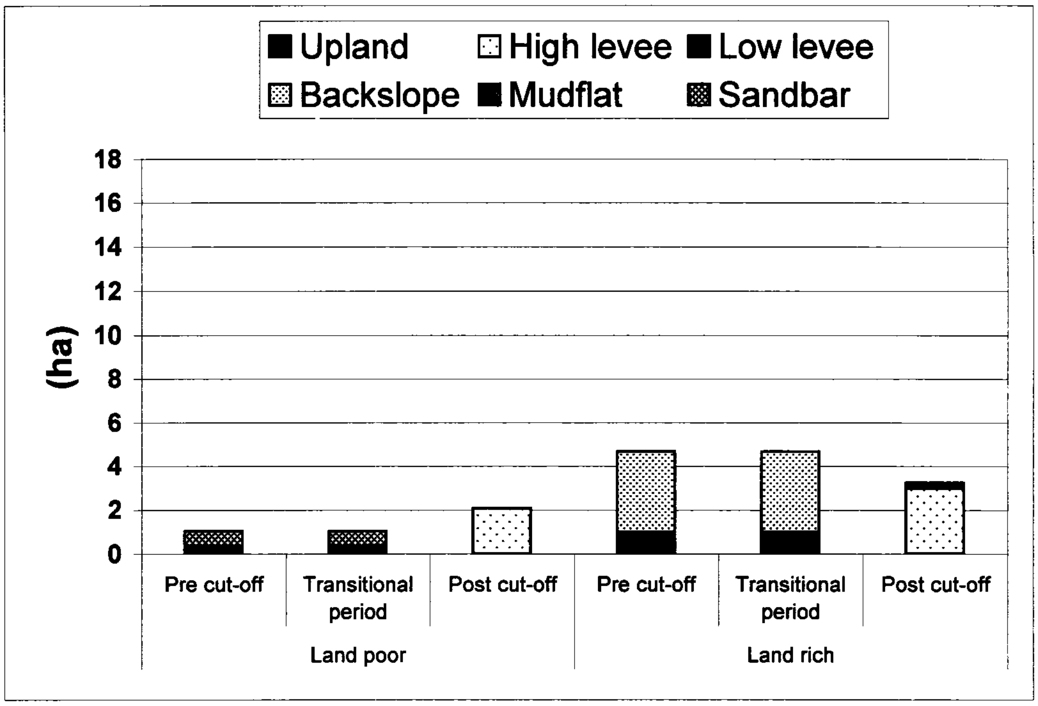
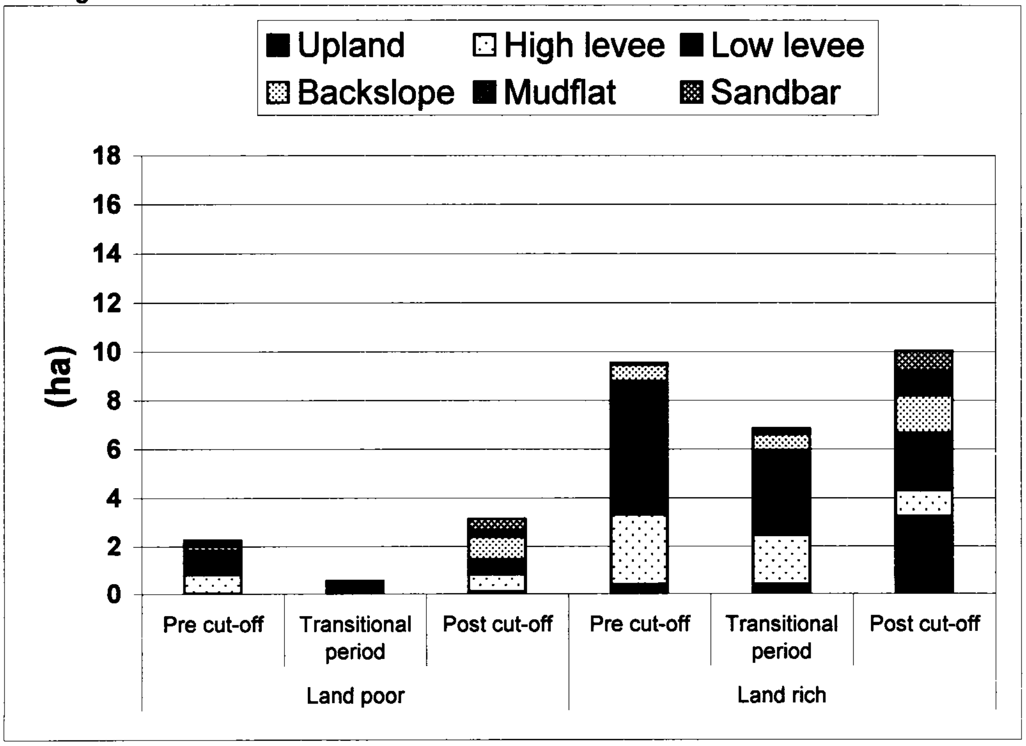


Figure 2.16 Mean household land portfolios by land wealth categories in three villages near the Bahuanisho cut-off (continued).

M. de los Olivos



All villages



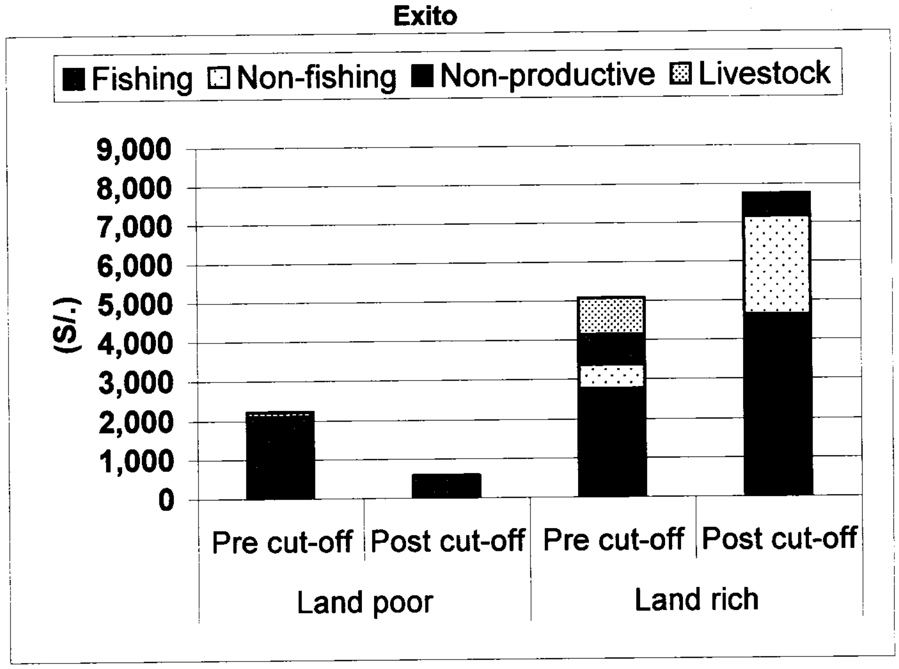
have practically doubled their pre cut-off holdings, whereas the land holdings of the "land rich" have barely increased or reached similar levels similar to the pre-cut-off period. Slower growth among the land-rich in Exito is due, at least in part, to the great loss of land to riverbank erosion after the cut-off; land contraction in Monte de los Olivos appears to be related to other factors (e.g., land scarcity, cost of setting up new plantations, etc.). Poorer households in Puerto Angel, on the other hand, show only a minimal decrease in the total land area held.

Distinct patterns also arise in terms of land portfolio composition (Figure 2.16a-d). Originally, all households (i.e., poor and rich) in Exito and Puerto Angel held some land on high levee. As shown in this figure (Figure 2.16), riverbank erosion destroyed some of the high levees in these villages and left the poor without access to higher ground. Since then, "land rich" households in Exito have also lost their land on high levees and by 2003 there was virtually no high levees left in the village. In contrast, "land poor" households in Puerto Angel have been able to regain land on high levees, which now flood less frequently, and hold as much high levee land as the "land rich". These results are consistent with local reports on how households rapidly sought to secure access to land in areas that used to flood more frequently prior to the cut-off. With their move to Monte de los Olivos, both "land poor" and "land rich" households gained access to high levee land. In fact, according to local respondents, the lack of high ground in Ega (i.e., their former village) was a major reason to search for a more favorable site.

In Exito, households in both wealth categories hold land primarily in low-lying areas, which are susceptible to flooding. In 2003, however, the "land rich" held exclusive access to the mudflats and three times as much land on sandbars than the "land poor", who in turn, expanded their holdings on more marginal land types (e.g., low levee and backslope).

The gap between "land rich" and "land poor" households in Exito, in terms of physical assets, also increased dramatically by 2003 (Figure 2.17). "Land rich" households increased their asset holdings by 50% or so, while assets among the "land poor" households sharply declined (by 70%). With more fishing capital and investment in other types of productive assets (e.g., store, bar, tricycle, etc),

Figure 2.17 Mean household asset portfolios by land wealth categories in three villages near the Bahuanisho cut-off.



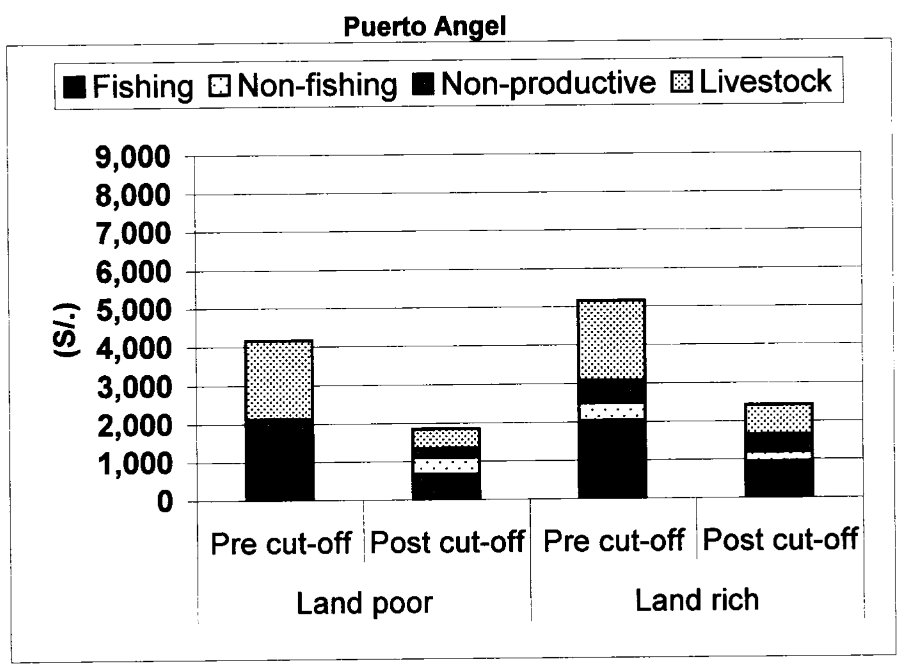
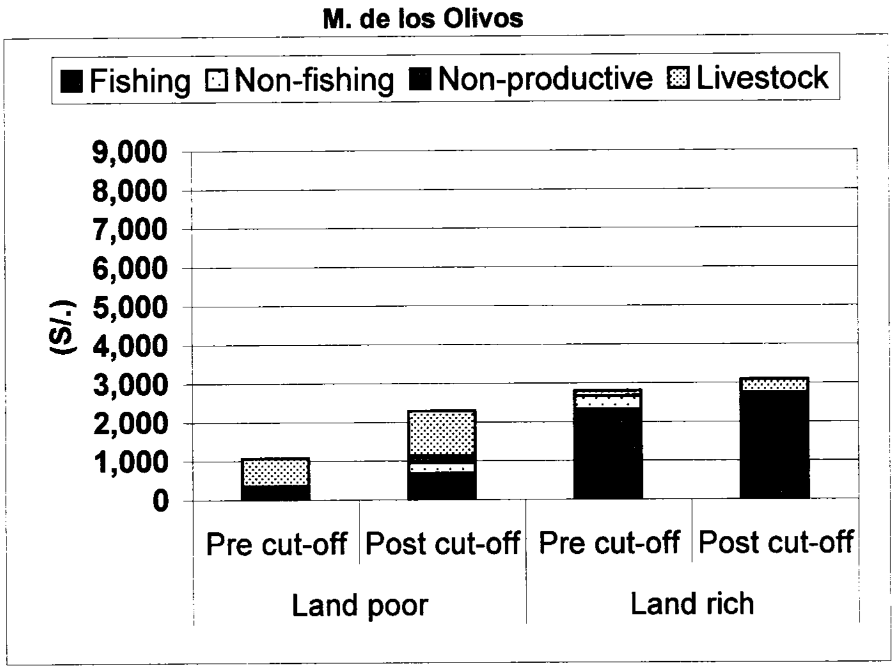
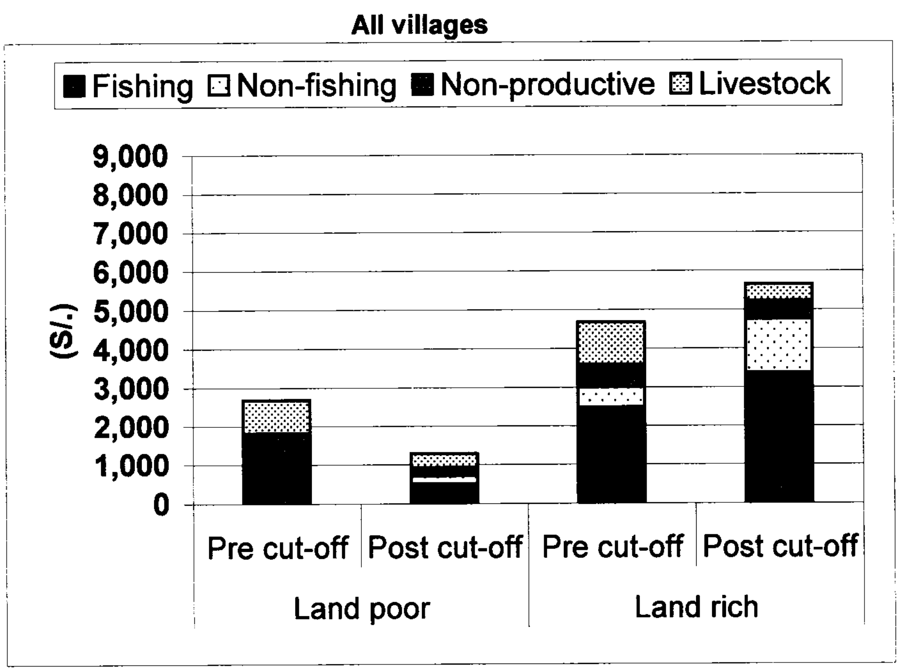


Figure 2.17 Mean household asset portfolios by land wealth categories in three villages near the Bahuanisho cut-off (continued).





the "land rich" account for the net effect on assets observed at the village level and by far the largest asset holdings in the sample.

In Puerto Angel, "land rich" and "land poor" households seem to be following distinct trajectories. Whereas the former show an increasing focus on the uplands, the latter predominantly use land within the floodplain. This pattern existed, to some degree, prior to the cut-off, but appears to have become more prominent since. In 2003, upland areas accounted for more than 70% of all the land held by "land rich" households in Puerto Angel. Overall, land holdings in Puerto Angel have become more diverse than in the pre-cut-off period due to the formation (and later expansion) of a mudflat/sandbar in front of the village. Although not explicit in my analysis here, the parcelization of these lands among all interested parties within the village favored a more egalitarian distribution of these areas than is found in Exito.[40]

Despite considerable reductions in physical assets, wealth in Puerto Angel continues to be more equally distributed. Both groups have reduced the amount of capital held in fishing assets and livestock. The "land poor" appear to be shifting to other types of assets, whereas livestock continues to be the main type of non-land capital held among the "land rich." In Monte de los Olivos, the "land poor" appear to be investing in fishing equipment and livestock.

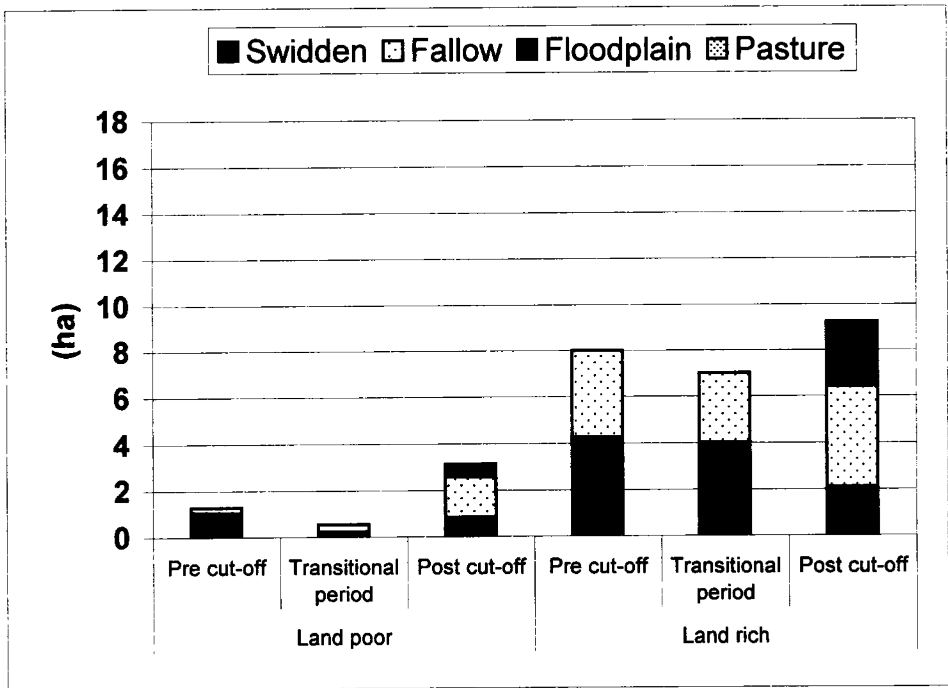
Activity choices

Since the cut-off, households in Exito rely more heavily on floodplain farming (i.e., on mudflat and sandbar) (see Figure 2.18 a-d). Among the "land poor", floodplain farming has been coupled with an expansion of fallow land; among the "land rich" the area in swidden has contracted. This shift towards floodplain farming is not surprising considering the cash earning prospects from rice cultivation on mudflats and the relatively lower labor investments of using newly formed land, *vis-à-vis* clearing a piece of forest for cultivation.

40 This is not reflected in the descriptive analyses shown here due to the way in which the sample was split. For the pre cut-off period one household (land poor) held 1 ha of mudflat and another (land rich) held 1.5 ha. In 2003, however, practically every household in the sample held a 30 meter-wide parcel of riverfront.

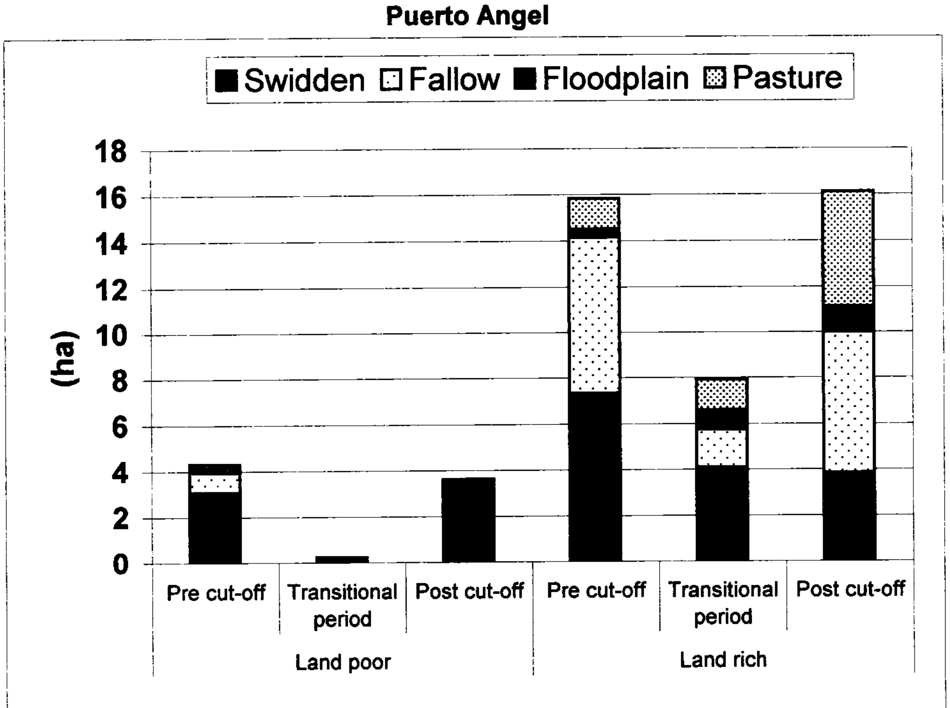
Figure 2.18 Mean household land use portfolios by land wealth categories in three villages near the Bahuanisho cut-off.

Exito



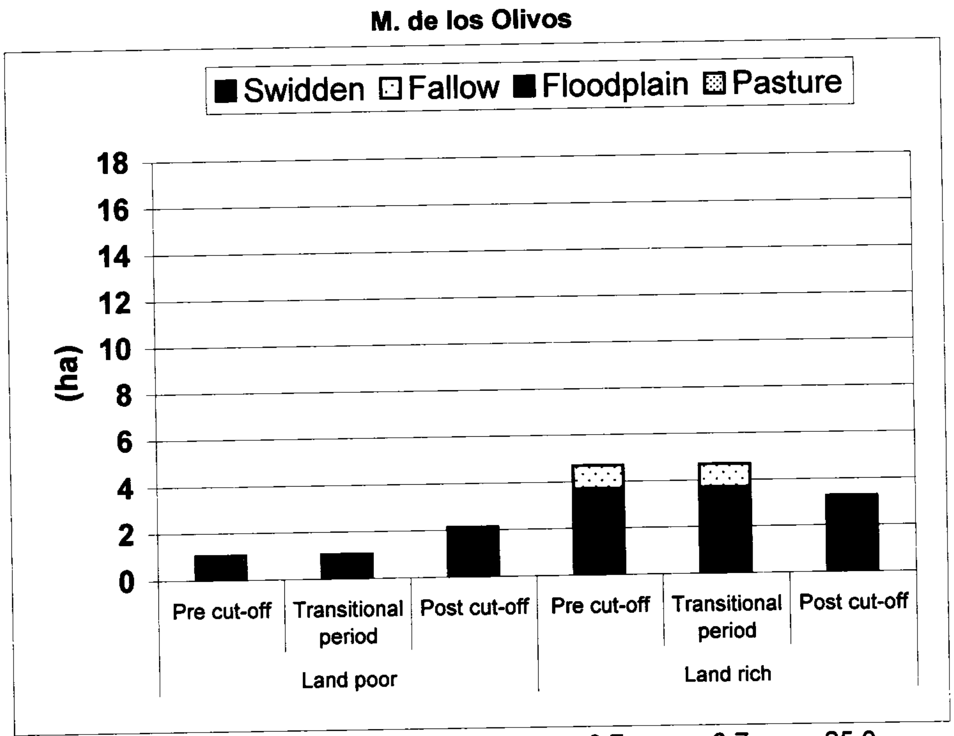
Swidden/fallow ratio	4.1	0.6	0.5	1.1	1.3	0.5

Puerto Angel

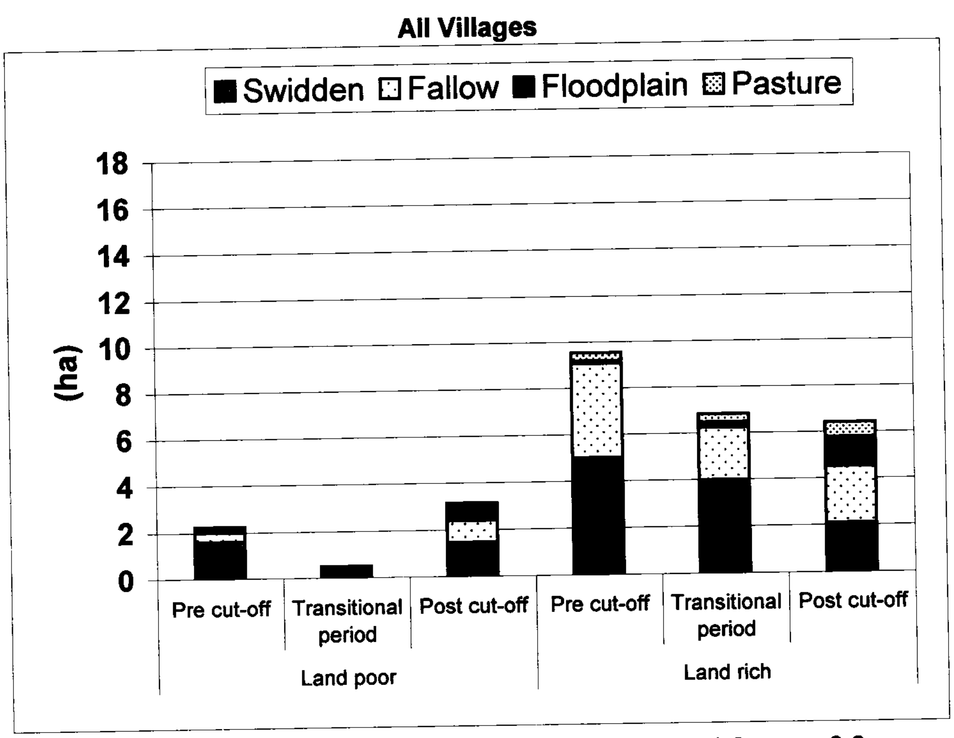


Swidden/fallow ratio	3.5	n.a.*	17.0	1.7	2.7	0.6

Figure 2.18 Mean household land use portfolios by land wealth categories in three villages near the Bahuanisho cut-off (continued).



Swidden/fallow ratio n.a.* n.a.* 13.3 3.7 3.7 25.0



Swidden/fallow ratio 7.8 1.5 1.5 1.2 1.8 0.8

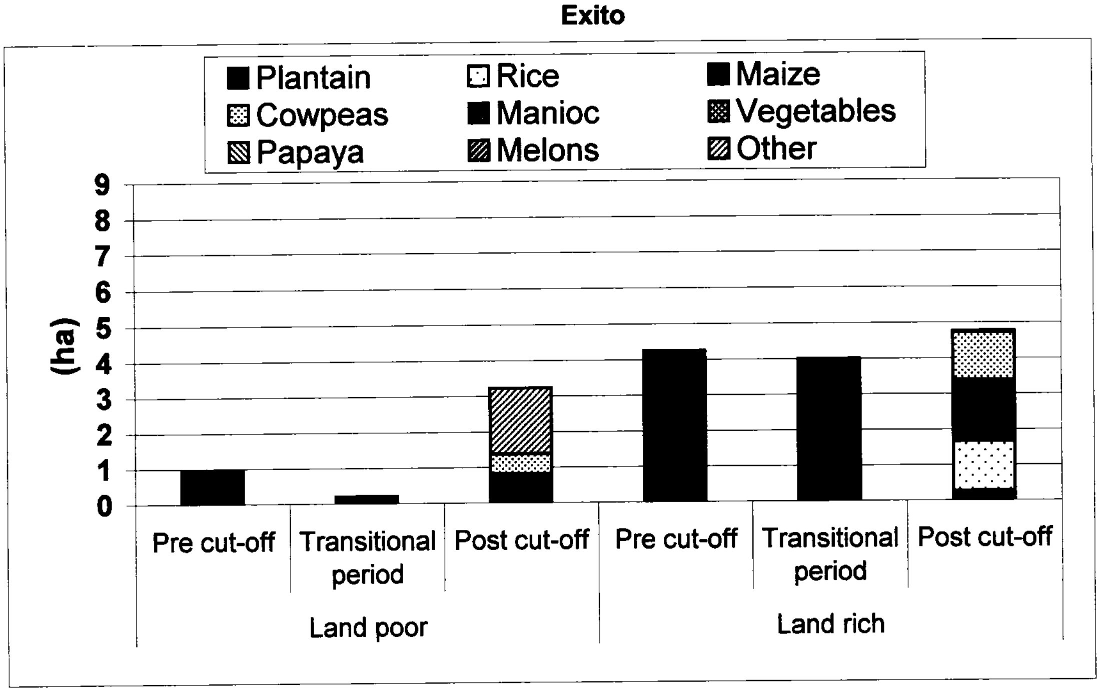
Prior to the cut-off, all households in Exito held land in plantain (Figure 2.19). The "land poor" held enough land in plantain for subsistence (~0.5 ha), though their most important crop in terms of area was maize. The "land rich" held substantial areas of plantain (>3 ha) that provided them with food and a consistent flow of cash income. With no land in plantain after the cut-off, the poor saw their subsistence threatened. The destruction of most of the plantain stands among the "land rich" has meant the demise of an important source of a stable income.

As a response, both groups have turned to planting more annual crops; the "land poor", maize and cowpeas; the "land rich" are producing rice in addition to the former. As such, the "land poor" seem to be moving from a slightly more subsistence-oriented agriculture (i.e., plantain) to rely more on cash crops (i.e., maize, cowpeas). The "land rich", on the other hand, have maintained their orientation towards commercial agriculture by altering and diversifying their crop mix, which helps them (to some degree) make up for the loss of a regular income and as a buffer during hard times in the future.

In Puerto Angel, land use practices have changed according to the different focus among "land poor" (floodplain only) and "land rich" households (upland/floodplain), towards more intensive uses. Lower risk of flooding and the formation of the mudflat have allowed "land poor" households to derive greater benefits from their floodplain holdings, while drastically reducing the amount of land in fallow. Maize and other annual crops are now rarely threatened by early floods. Local crop portfolios have become more diverse (e.g., plantain, rice, maize, cowpeas) and constitute an important source of cash income. In addition, lower flood levels are allowing them to plant vegetables (e.g., cilantro, peppers) during the flood season, when most other floodplain areas near Pucallpa are flooded and prices tend to be higher. Diversification seems reasonable, considering the heterogeneity of land types now found within the village.

The main land use changes among the "land rich" include a reduction in the area in swidden and an increase in mudflat, sandbar, and pasture holdings. Richer residents in Puerto Angel diversified into pasture, while still using a considerable amount of land in the floodplain, comparable to that of the "land

Figure 2.19 Mean household crop portfolios by land wealth categories in three villages near the Bahuanisho cut-off.



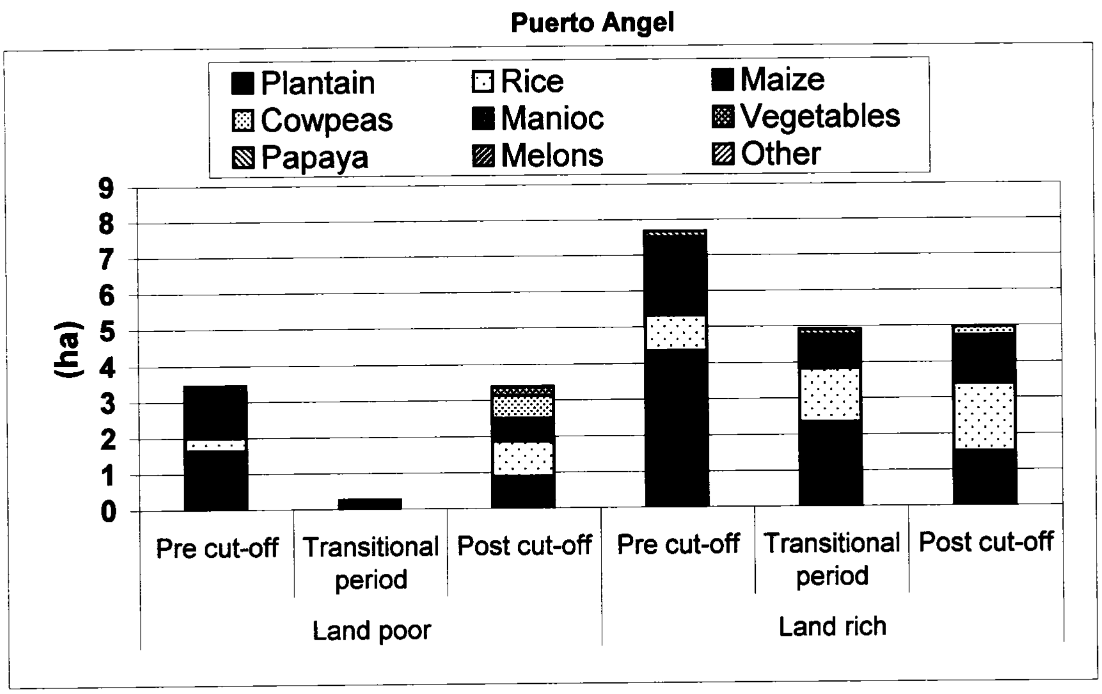
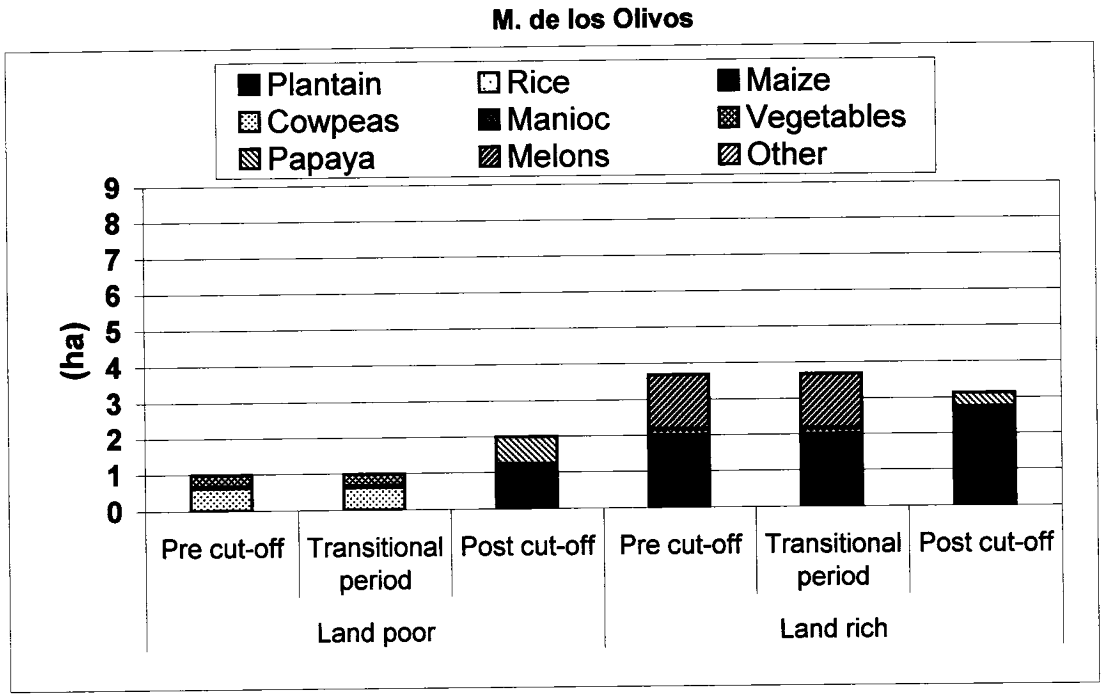
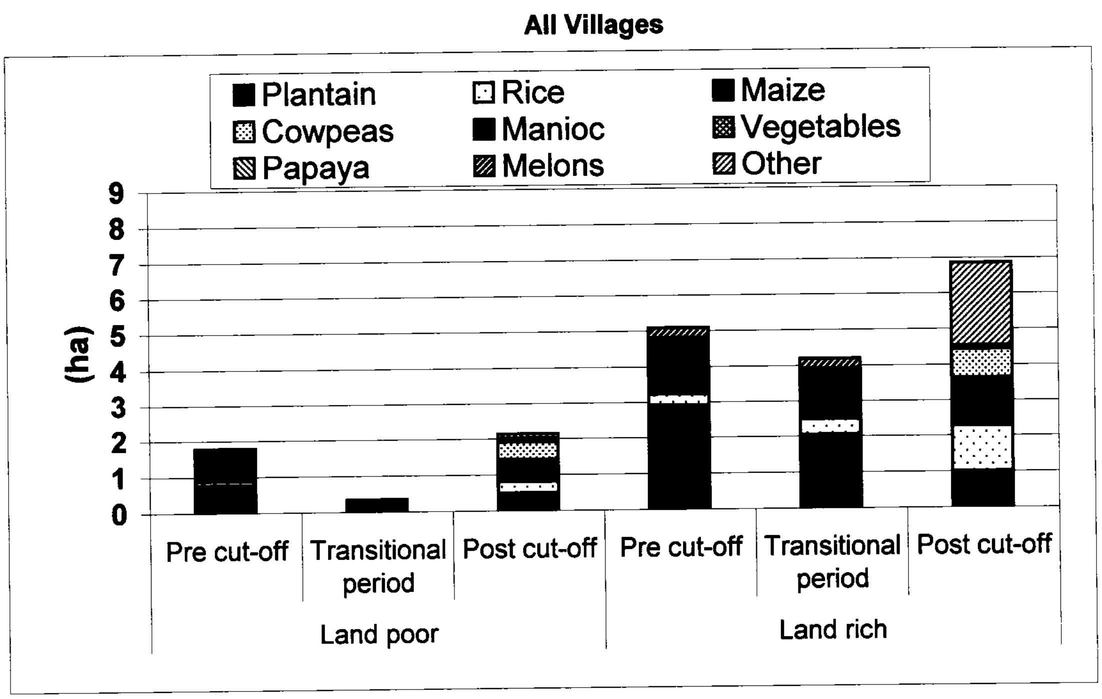


Figure 2.19 Mean household crop portfolios by land wealth categories in three villages near the Bahuanisho cut-off (continued).





poor" (they actually hold a larger area in crop). It is possible that some "land rich" households are investing profits gained from the floodplain in the upland, more specifically in pasture.

In Monte de los Olivos, "land rich" households seem to have begun using land more intensively than at their previous site (Ega). This may be, in part, due to their smaller land holdings, but also to the greater productivity and lower risk provided by the high levee land found in Monte de los Olivos. Plantains accounted for about 80% of the average household crop portfolio of the "land rich", substituting melons and maize. The "land poor" have replaced cowpeas with plantains and papaya.

2.3.4 Vulnerability and resilience: the fate of the poor

Different responses to the cut-off should not necessarily be taken as signs of resilience and adaptability. Responses may be desperate attempts to survive under deteriorating circumstances, which may ultimately fail to help peasant households secure a living in the long run. As such, it is important to examine the degree to which the cut-off has made *ribereños* in these sites more or less vulnerable. To be consistent with the literature, the main focus is placed on the poor (i.e., "land poor" households), who are often the most vulnerable to environmental and other forms of change. Contrary to most other works, which consider change as synonymous to deterioration, the approach taken here is that new conditions brought in by the cut-off created unique sets of challenges and opportunities at each site, some of which are more constraining than others. Indeed, my results suggest that the poor have become more or less vulnerable, depending on the site.

Exito (downstream)

In Exito, where flooding became more frequent and riverbank erosion hit with greater intensity after the cut-off, the poor appear to be finding it more difficult to make a living. Results for an additional moment after the cut off (n=5) suggest that the land poor have experienced important land losses as the river began to erode more intensively onto village lands, destroying much of the highest ground available within the village. Although they have been able to accumulate enough land to surpass the amount of land they held prior, their holdings are more prone to flooding (and remain inundated longer). As a result, the poor are no longer able to grow plantains for subsistence (or market) and rely on annual crops that are marketable, but provide a low and seasonal income. The sudden increase in cowpea production on sandbars in 2003, if continued, may contribute to ease their situation.[41] Nevertheless, the rich have excluded poorer households from having access to the mudflats for rice production.

The observed decrease in asset holdings among the poor in this village is concerning. My findings suggest that households have been liquidating assets and thereby have reduced their capacity to use them as a buffer in the future. Poor households appear to have kept only the minimal fishing equipment to allow them to catch for subsistence, to sell, or to barter for plantain in other villages. Another sign for concern is their relatively low income in 2002 (US$1,156, by far the lowest in the sample). Despite their greater reliance on fishing, the poor in this village derived only about 2,500S/. (US$719) from this activity. High levels of participation in wage labor suggest other strategies used by the poor to make ends meet, even if the prospects for earning a wage locally are limited.

***Puerto Angel* (upstream)**

Despite their smaller land holdings, "land poor" households in Puerto Angel appear to be in a position of greater resilience. They seized emergent opportunities by moving into alluvial lands that stopped flooding after the cut-off and as a result, they are able to produce plantain for subsistence and as a regular source of cash income. In addition, the poor in this village have been able to benefit from the internal parcelization of the mudflat and sandbar to plant rice and cowpeas, and are benefiting from the lower flood levels and shorter distance to Pucallpa to grow vegetables in the off-season. Through intensification and

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[41] Without the need for clearing to claim land on sandbars, labor investments are much lower on sandbar and mudflat areas, than in other floodplain biotopes.

diversification in their crop mix, they have improved their prospects to meet subsistence needs, generate cash, and buffer against potential future losses. Lower risk of flooding may help to explain the reduction in physical asset holdings.

Income among poor households in Puerto Angel is considerably higher than in Exito and more diversified — albeit the overall greater reliance on farming. Moreover, plantain production year-round has allowed the poor in Puerto Angel to generate the equivalent of 475 S/./month (US$137), which is greater than the minimum wage paid in Pucallpa.

"Land poor" households in Puerto Angel, however, are still subjected to riverbank erosion, especially those with holdings on the true right bank of the Ucayali (opposite from the village site), where the river is currently eroding. With fewer assets at their disposal to use as a buffer, they are likely to face greater difficulties if riverbank erosion intensifies and land becomes scarcer.

***Monte de los Olivos* (upstream)**

In contrast with the poor in Exito, those in Monte de los Olivos appear to have benefited considerably by migrating upstream to take advantage of new opportunities created by the cut-off. The year the cut-off occurred, households in Ega experienced severe flooding, to which they responded by relying increasingly on fishing during the flood season and planting short-cycle crops during the low water season. It was through fishing that they discovered an attractive site to set up new agricultural fields and eventually moved for permanent residence.

This new site, although not very extensive, is comprised predominantly of alluvial lands that remained well above the flood, even at times in which Ega remained virtually entirely inundated. As a result of the cut-off, the new site had also been strategically repositioned within a four hour boat ride from Pucallpa. Migrant households swiftly started to plant crops (initially annual crops, followed by plantains) in this area; some migrated to the site a few months later, once crops were well established and could provide sustenance. Other households opted for using resources at both sites to try to maximize their opportunities; during the low water season they would plant annual crops in Ega both for subsistence and cash and spent the flood season in Monte de los Olivos, where they had already established perennial crops (i.e., plantain and papaya) and could plant vegetables in the off-season to provide a smoothed income throughout the year. In 2003 or so, riverbank erosion destroyed much of the land in Ega. This loss and the formal inauguration of a school are prompting some of these households to make a permanent move to Monte de los Olivos.[42] As such, this gradual move seems to have been key in minimizing the effects of riverbank erosion in Ega and maximizing opportunities derived from the cut-off.

Despite the initial costs of moving, "land poor" households have increased their land holdings and have more assets at their disposal to use as a buffer in case of need. "Land poor" households in this village have the highest mean annual income in this sub-sample (four times greater than that of "land poor" households in Exito) and fairly equally distributed through out the year. Although the risk of flooding appears to be negligible at Monte de los Olivos, residents there are still exposed to riverbank erosion.

2.4 Discussion and conclusion

In summary, the results presented herein offer sufficient evidence to question prevailing views about vulnerability among the rural riverine poor in the Upper Amazon. This case shows that peasant households swiftly responded to three major changes introduced by the cut-off (i.e., changes in transportation, flooding patterns, and natural endowments) in nearby upstream and downstream areas by changing the number (e.g., crop diversification and specialization) and combination of crops that they grow (e.g., switching from annuals to perennials, from perennials to annuals), and by gradually shifting resource use to other geographical areas. Clearly, though, other factors affected livelihood during the period of study. Data suggest that the poor in one village (Exito) are facing greater difficulties to secure a living. But in contrast to earlier findings, this study suggests that environmental change may not necessarily lead to increased

42 Households in Monte de los Olivos reported no losses to riverbank erosion, largely because they had already moved to the site by the time their land in Ega was eroded by the river; some even sold land before their departure.

vulnerability and destitution, and that there may be instances in which the poor actually become better off, as shown in Puerto Angel and Monte de los Olivos. Such benefits are, to a great extent, related to the new sets of conditions created by the cut-off, but also to the responsive capacity of individuals. These findings underline the fact the poor are not passive victims of change but active agents that quickly respond to, and at times, act in anticipation of environmental change in order to minimize potential negative effects or to seize emerging opportunities. Future research will be needed to further corroborate these results and to examine long-term livelihood responses to rapid environmental change. Below is a summary of more specific insights from this study and a discussion of their potential implications for poverty alleviation and economic development in the Amazon.

Livelihood responses to abrupt river channel changes

First, this study highlights the idea that the Amazon floodplain is not only heterogeneous, but may also be extremely dynamic over time, especially in the Upper Amazon. Change is probably gradual in most cases, but there are instances in which change may be sharp and occur over short periods, as shown by this case of a meander cut-off. This study also shows how the same event (i.e., a meander cut-off) may have radically different effects in locales that are not too distant from one another, changing the prospects for economic livelihood differently. More or less flooding (down and upstream), increased riverbank erosion and sedimentation locally, and a dramatic reduction in travel distance (for those upstream), did exactly that for *ribereño* households in my study sites, creating new challenges and opportunities for them. Some of these newly emerged conditions will remain for a long period of time, yet others are likely to change as the river continues to reshape its floodplain in the next few years. The dramatic implications that the cut-off had for peasant livelihood underline the importance of developing a more thorough understanding of the interaction between floodplain dynamics, poverty, and resource use, especially now when development efforts in the Amazon are once again turning to the floodplain. For instance, as shown in this case, the prospects for growing specific crops, as well as relative distance and resource availability, are dynamic over space and time.

Second, the patterns we see in the evolution of land holding portfolios (the main asset), land use, and crop production are indicative of important changes in economic livelihood in the three study villages. In each of the study villages, households appear to be responding to a new suite of possibilities for economic activity derived from the biopyisical and economic changes introduced cut-off – a rapid form of environmental change. Ultimately, such responses may alter the prospects for subsistence security, cash income, and risk insurance. This study suggests that peasant responses are swift and, at times, even anticipatory, largely due to a well-developed traditional ecological knowledge of the floodplain. Peasant responses may be prompt, even to unanticipated effects, such as local flooding patterns. Overall, this study highlights the importance of local environmental knowledge in helping the poor to respond to rapid environmental change and complements a number of works that examine variation and change in economic livelihood among forest peasants (see Padoch and de Jong 1990; 1992; Coomes 1995; 1999; Padoch and Pinedo-Vasquez 1999; Pinedo-Vasquez *et al.* 2002). Traditional knowledge on fluvial geomorphology is a field that needs to be recognized in the future.

Third, the fact that the poor seem to be doing better in some cases, but not in others, raises other questions that may help to inform the design of poverty alleviation and vulnerability reduction policies among the poor. For instance, answers to questions such as when do the poor actually benefit and why, will be useful in understanding some of the ways that may help to generate more resilience among those least-favored. Furthermore, my findings suggest that the poor are not passive to environmental change; instead, they highlight the role of agency and responsiveness that may, in some cases, allow them to take advantage of emerging economic opportunities. Such recognition should serve as a more solid base for the design and implementation (when necessary) of policies that actually contribute to enhance resilience among those that are most vulnerable.

Fourth, at a regional level, my findings also contribute to the identification of vulnerable regions and vulnerable groups within them needing assistance. For instance, although the floodplains of active rivers may be quite dynamic, there is some degree of predictability, especially along meandering rivers, which would be instrumental for mitigation or early response systems. Typically there are signs as to where a cut-off might occur or on where river bank erosion will destroy land. Furthermore, policymakers should consider that local flooding patterns and river transportation may also be altered by cut-offs elsewhere. Had more frequent flooding and increased riverbank erosion been anticipated prior to the cut-off, households in Exito could have been better prepared when the cut-off occurred. Some specific policies that may contribute to enhance resilience among the poor at a low cost include: the creation of opportunities for wage labor, assisting poorer households in the acquisition of basic fishing equipment (e.g., canoe, net), sponsoring social events (e.g., sports tournaments, cultural events, festivities) that help to enhance social capital across villages in the region which may serve as insurance (see Tournon, 1988; 2000), especially if local flooding patterns are dynamic over time, and disseminating information about legal procedures for land tenure to foster more egalitarian access to land types that remain above the floods or offer significant cash earning opportunities.

Fifth, despite creating potential economic opportunities, dynamic environments also impose serious constraints for vulnerability reduction and development. In cases such as these, in which the river destroys and creates land, incentives for long term investment in land are few. Furthermore, factors that appear to be crucial for livelihood security at one moment in time may disappear from one year to the next (or vice versa) due to the ephemeral nature of the floodplain; in other words, it is possible that households that are more resilient now may become more vulnerable in the future. As such, policies aimed at reducing vulnerability may not necessarily lead to investment and economic growth, and in turn, those directed to generate investment and growth may not do their part to enhance resilience.

In summary, this study suggests that even those people that we have typically considered to be more seriously affected by change may, in some cases, be able to derive important benefits from change in an environment that to us would be overwhelming. Learning to live with change, as they do, is probably one of the factors that allows them enough flexibility to mitigate, cope with, and derive opportunities from change.

CHAPTER 3. AN ANTHROPOGENIC MEANDER CUT-OFF ALONG THE UCAYALI RIVER, PERUVIAN AMAZON[1]

> *"When the river is rising fast, some scoundrel whose plantation is back in the country, and therefore of inferior value, has only to watch his chance, cut a little gutter across the narrow neck of land some dark night, and turn the water into it, and in a wonderfully short time a miracle has happened: to wit, the whole Mississippi has taken possession of that little ditch..."*
>
> **—Mark Twain [1874] 1923**

Introduction

In recent years, a number of authors have advanced the discussion on human-environment interactions in the Amazon basin by presenting evidence — both contemporary and archaeological — of anthropogenic management of an environment previously regarded as "pristine" (Balée 1989, 74-76; Denevan 1992; Erickson 2000a). It is estimated that humans have intervened in Amazonia since about 11,000 B.P. (Cleary 2001). So far, attention has been given particularly to the management of (agro)forests (see Denevan and Padoch 1988; Balée 1989; Anderson *et al.* 1995; Coomes 1995), and the widespread presence of anthropogenic black earths on both the floodplain and the *terra firme* (Smith 1980; Woods and McCann 1999; Hecht 2003; Lehmann *et al.* 2003; Glaser and Woods 2004). These works lend support to the active role of humans in shaping the forest landscapes and soils of the Amazon Basin.

Less attention has been devoted to the study of river-management practices among riverine populations (see Chernela 1989; Raffles 2002; Raffles and WinklerPrins 2003). William Denevan (1966, 76) reported that meander necks were intentionally cut off to create shortcuts on the Río Negro, a small tributary of the Baures River in the Mojos of Bolivia. More recently, Hugh

[1] This Chapter was published in *The Geographical Review* 95 (1): 122-135, January 2005 (actually appeared in January 2006) (See Appendix III).

Raffles and Antoinette WinklerPrins (2003) made the case for more extensive human intervention on Amazonian fluvial systems in a review of available evidence, including their own research, published materials and previously unavailable reports. They, too, wrote of artificial cut-offs on a tributary of the Juruá River in the state of Acre, in the Western Amazon of Brazil, and in the Arapiuns Basin, near Santarém, and the Guariba River in Amapá, in the eastern Amazon (Raffles and WinklerPrins 2003, 175).This chapter seeks to complement this literature by reporting on a case in which Amazonian people have played a key role in facilitating a meander neck cut-off that changed the course of one of the largest rivers in the Amazon Basin, the Ucayali River of Peru.

During 2002 and 2003, I conducted twelve months of fieldwork for my doctoral dissertation research along the Central Ucayali River, near the city of Pucallpa — Peru's fastest growing city in the Amazon and the main road link with Lima on the Pacific coast (Figure 3.1). The main purpose of the study is to examine how *ribereños* —descendants of Iberian and Amerindian people who use traditional techniques of agriculture, fishing, and forest extraction to make a living — adapt their economic livelihoods in an extremely dynamic fluvial environment such as the Ucayali, and to understand how floodplain dynamics reshape the challenges and opportunities for agriculture and natural-resource use.

Together with the Marañón River, the Ucayali forms the Amazon River proper. This turbid river drains a basin of 337 500 km^2 (Goulding *et al.* 2003, 183), an area roughly the size of Germany. Near Pucallpa the Ucayali is 0.7-1 km wide (Bergman 1980, 47; Kalliola *et al.* 1992, 77), but it can reach up to two kilometers in width at flood stage (Peruvian Navy 2003). The difference between low water and high water is approximately 9.3 m at Pucallpa. At the low-water stage the discharge is 2,000 m^3/s; during the flood season, up to 22,000 m^3/s (Peruvian Navy 2003). Influenced by Andean tectonics and fluvial dynamics, the Ucayali is among the most dynamic rivers in the Upper Amazon Basin (Pärssinen *et al.* 1996) and one of the largest active meandering rivers in the world. Studies suggest annual rates of lateral migration of 100-160 m for the Lower Ucayali (Kalliola *et al.* 1992, 77), although average rates of up to 285 m/yr have been

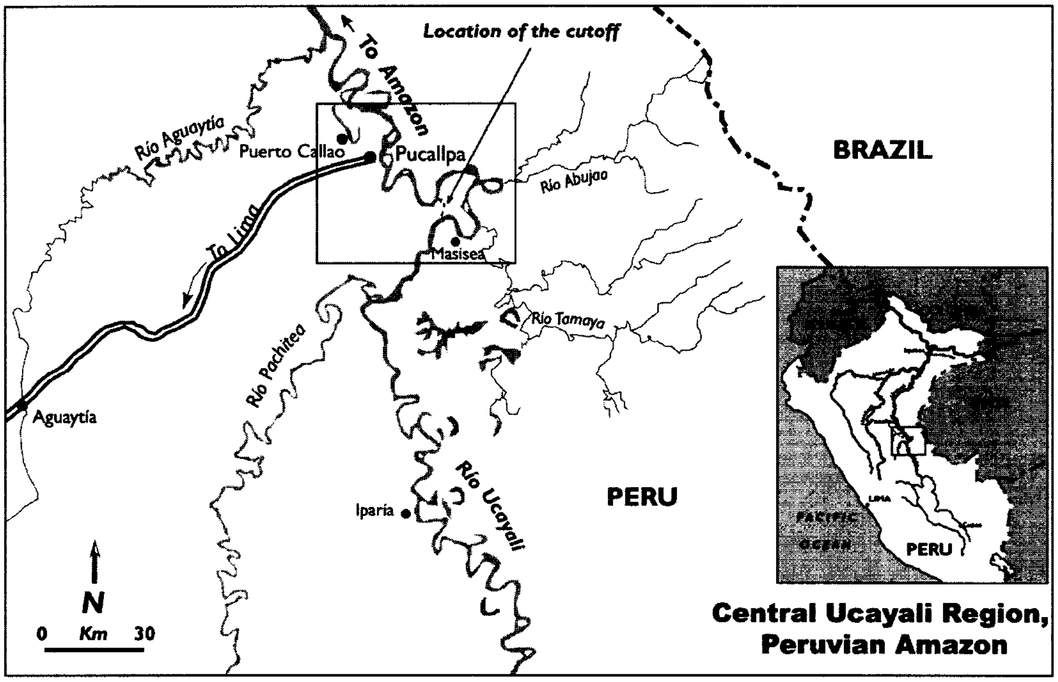

Figure 3.1 The Central Ucayali Region of the Peruvian Amazon. The rectangular box on the main map surrounds the area shown in Figures 3.2 and 3.3; the heavy black lines on the inset show the major Peruvian and Ecuadorian rivers that join to form the Amazon River. *Sources*: Adapted from IGN (1989, 283); Goulding *et al.*(2003, 72)

reported for certain meanders near Pucallpa (Velásquez de la Cruz 2002, 53). The result of such change is a mosaic of meander scrolls and swales, along with narrow and oxbow lakes, not unlike those described for the Upper Solimões-Amazon in Brazil (Mertes *et al.* 1996). Located more than 4,500 km from the mouth of the Amazon in the Atlantic Ocean, Pucallpa is only 154 m asl (IGN 1989, 283) and the Ucayali River has a very low gradient (approximately 5 cm/km; see Peruvian Navy 2003). At least six meander cut-offs, including the one reported in this chapter, have occurred along the Ucayali since 1981, between the mouths of the Pachitea and the mouth of the Aguaytía Rivers (Figure 3.1). Donald Lathrap (1968; 1970) recognized such dynamism and indicated its implications for archaeology and Upper Amazonian prehistory.

Human modification of the course of a major Amazonian river was not something I expected to find when I began fieldwork. The issue was initially raised during a conversation with local farmers while we were traveling on a local public riverboat (*colectivo*). We were going from Pucallpa to one of my prospective study sites, located near a large meander cut-off that occurred in 1997, a few kilometers upstream (Figures 3.2 and 3.3). According to my travel companions, the large cut-off of interest had been facilitated in a manner not very different from the one described by Mark Twain in his *Life in the Mississippi* ([1874] 1923, see the epigraph). A small channel connecting the Ucayali with an oxbow lake existed there for years and served for travel during the flood season — a common practice in other parts of Amazonia. At first, it was barely wide and deep enough to be crossed by a dugout canoe at flood stage; today it has become the main course of the Ucayali, year-round (Figures 3.4 and 3.5). The cut-off effectively reduced the length of the channel from about 71 km to roughly one-tenth of its former distance on the same reach in 1981; in so doing it wiped out one village and left at least a dozen more, as well as Masisea — a district capital — along the abandoned channel. This can be seen in Landsat scenes for precut-off and postcut-off periods (Figures 3.2 and 3.3). Figure 3.2 shows the sinuosity of the channel prior to the cut-off. The small channel that eventually became the main course of the Ucayali is marked with a dashed line in the box course of the

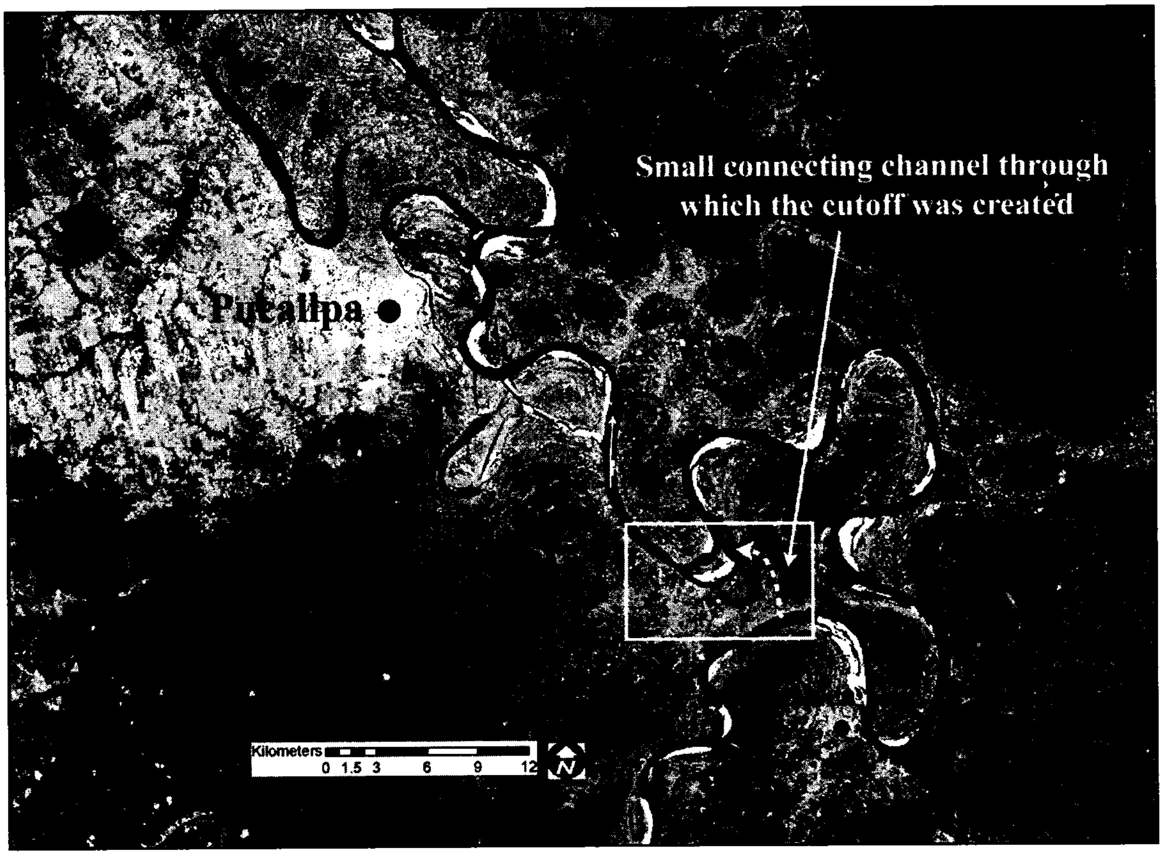

Figure 3.2 The Central Ucayali River in the Peruvian Amazon prior to the meander cut-off through the oxbow lake of Bahuanisho *cocha,* from a Landsat 5 TM image taken on 12 June 1996 (low-water-stage). *Source*: LANDSAT 5 data © NOAA 1996; received and processed by USGS/EROS Data Center: processed and redistributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University)

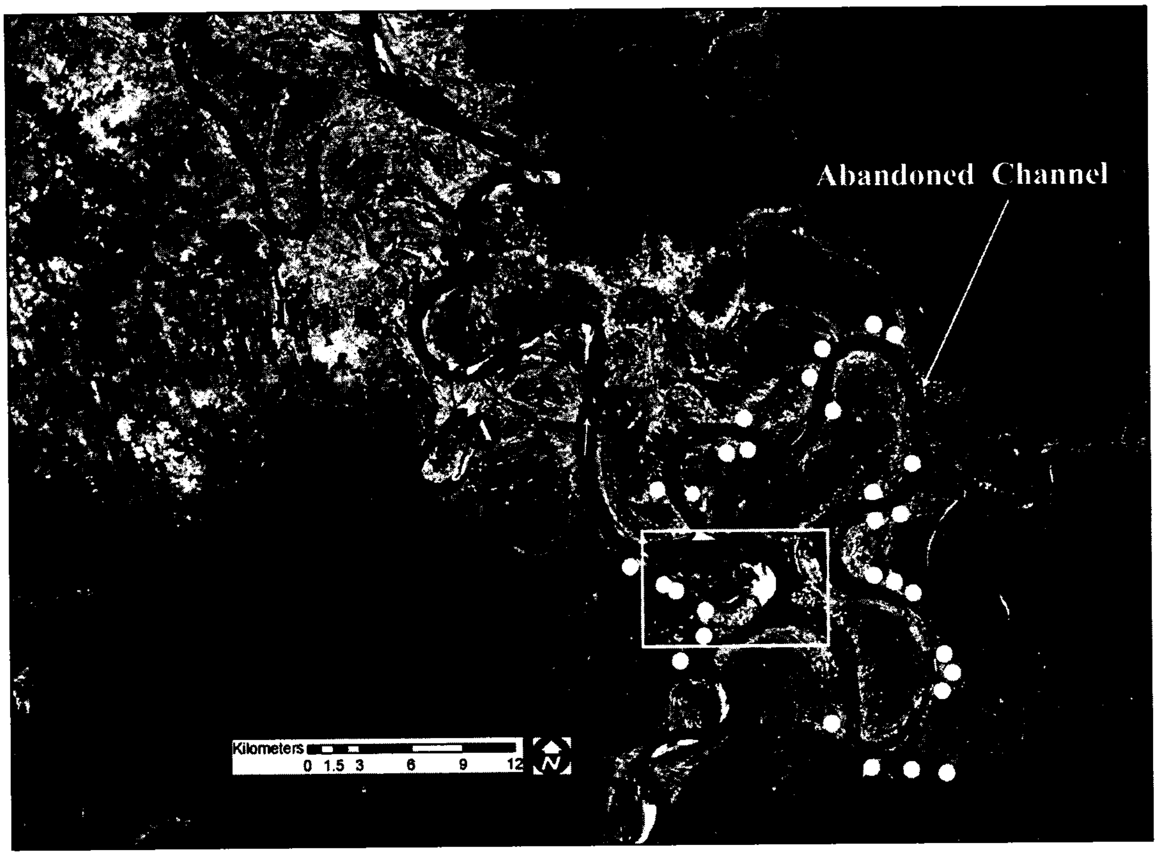

Figure 3.3 The Central Ucayali River in the Peruvian Amazon after the meander cut-off, from a Landsat 7 TM+ image taken on 3 August 2001 (low-water-stage). The white dots represent my study sites and other villages negatively or positively impacted by the cut-off. "A" marks the site of another suggested anthropogenic meander cut-off. *Source*: LANDSAT 7 ETM+ data © NOAA 2001; received and processed by USGS/EROS Data Center: distributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University)

Figure 3.4 A small channel in the Peruvian Amazon near the village of Santa Rosa de Capsinay, similar to the one described in this chapter. (Photograph by the author, October 2003)

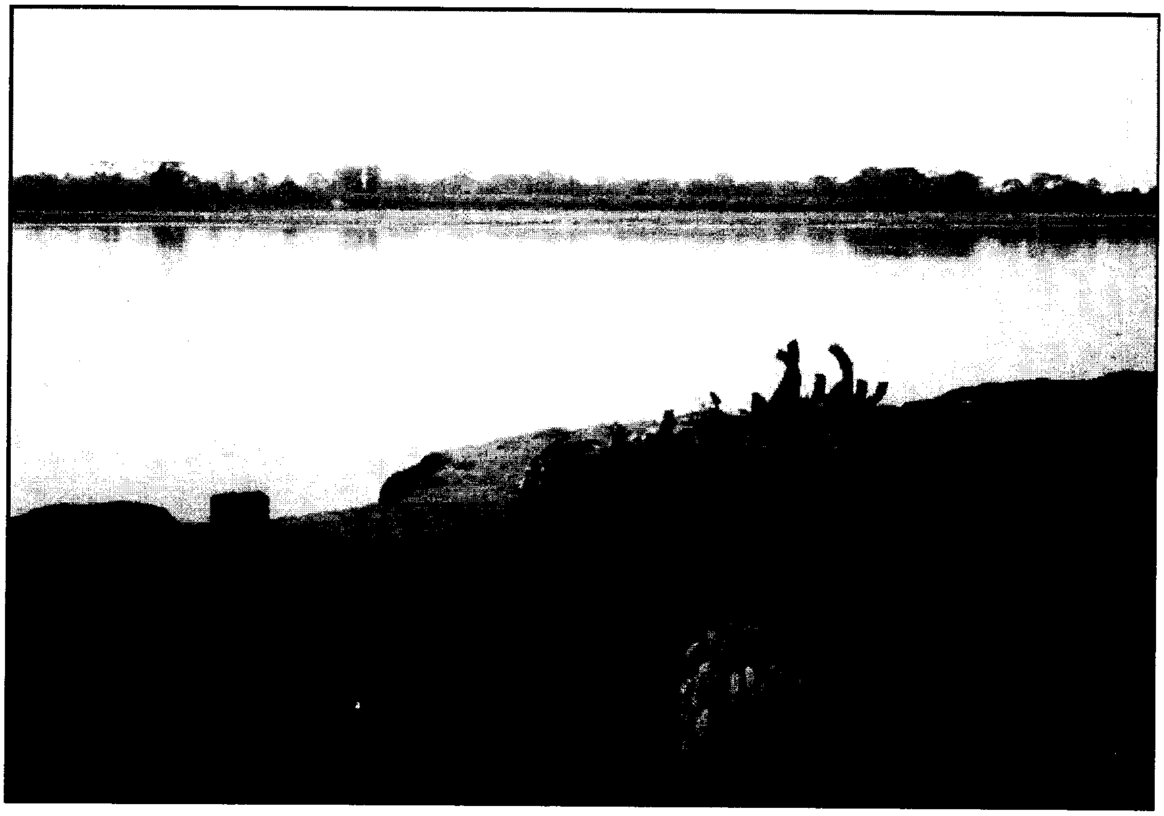

Figure 3.5 The Ucayali River in the Peruvian Amazon. (Photograph by the author, July 2003)

Ucayali is marked with a dashed line in the box. Figure 3.3 shows the course of the Ucayali after the cut-off. Note how the former channel has infilled northeast of Masisea (bottom right).The potential for this cut-off was documented in the literature as early as the 1940s by Augusto Cabrera la Rosa (1943, 44), who suggested it could occur within a short period due to the progressive narrowing of the neck in the previous years.

Drawing from insights gained during fieldwork, I suggest that local people possess both a strong spatial sense, despite the lack of major differences in relief in the region, and sufficient knowledge of fluvial geomorphology to understand the potential for a cut-off. Such an understanding is not surprising, given that the river plays a central role in their lifeways and livelihoods. They were also aware of the potential benefits of broadening the small extant channel; that is, locals had an explicit purpose for investing labor on such activities. Finally, I argue that these actions did, in fact, trigger the meander cut-off.

3.1 Riverine livelihood and local knowledge on fluvial geomorphology

Ribereños use the lower-lying areas on the floodplain (i.e., sandbars and mudflats) to grow annual crops between the floods; perennials are grown on higher levee areas, which typically flood every seven to ten years. Even before the waters recede, knowledge of fluvial dynamics helps farmers to claim new land areas created by sediment deposition for agriculture. It also helps them anticipate and mitigate the effects of riverbank erosion and the risk of flooding. Local residents fish along the main river, side channels and backswamps, and in nearby lakes. Their understanding of fluvial dynamics allows them to identify the best areas for fishing at different times of the year.

Without any major roads, the river and other channels provide the main "highway" network for travel, by boat or canoe. Travel distance between two locations depends more on the number and size of meanders than on the actual areal distance that separates them. Local people typically measure distances in terms of the number of meanders rather than travel time or kilometers.

The spatial sense held by local people is also reflected in their search for the shortest fluvial route during the flood season (see Bergman 1980, 48). As soon as a channel that offers more direct route is filled with water when the river begins to rise, people use it as an alternative to the meandering course offered by the river during the low-water season.

Ribereños have developed a strong intuition about fluvial geomorphology based on observation and a long history of occupation along the river. During my interviews, respondents were able to identify on a sketch map where erosion and deposition occur, and relate them to channel geometry and water velocity. Using the same understanding, they also accurately explained the process of how meanders are cut off when the neck becomes too narrow and erosion continues at both ends of the neck, or where a small connecting channel serves as a shortcut to another segment of the river.

3.2 Why facilitate the cut-off?

For local people to invest labor in removing vegetation and in widening and maintaining the channel, the benefits of their efforts must be clear. The main reasons reported are related to improving river transportation — namely, to reduce travel distance from upriver to Pucallpa, the main regional market — and to make river travel safer for goods and people.

Interviews conducted in Puerto Angel,[2] a village located just upstream from the cut-off, reveal that, prior to the cut-off, local residents had to travel up to sixteen hours by boat to take their produce to the markets in Pucallpa. The cost of shipping produce or embarking on a boat reflected the distance traveled. Farmers often used the port of a neighboring village immediately downstream from the cut-off and traveled one hour by foot to and from Puerto Angel, thereby saving twelve hours or so of boat travel along the meandering course of the Ucayali. It was not uncommon for produce to be shipped by boat at night; the owner would wait for the load at the port in the next village early the following morning to take it to Pucallpa. Loads were sometimes carried by tricycle or by foot to this

2 As discussed in the first chapter Puerto Angel is a pseudonym used to protect repondents' anonymity.

advantageous port. During the flood season, boats used the small connecting channel,[3] but travel was contingent on the stage of the flood. Field observations suggest that this often occurs along the Ucayali.

The small connecting channel offered a shorter seasonal route at flood stage, but was dangerous to travel. The relative steep gradient (i.e., approximately ten times greater than that of the main channel) created a strong current, which together with the debris in the channel, made it difficult for boatmen to maneuver their boats effectively. Respondents reported several accidents in which people had drowned and boats had been wrecked while traveling through the channel.

Another motive for maintaining the channel was the *ribereños*' intention to collect a toll from all transiting boats in order to bolster village finances. A collection booth was indeed set up, and loggers and boatmen apparently welcomed the initiative for a more navigable channel because it allowed them to save much time and fuel by taking the shorter route. The booth was abandoned, however, after its crew was robbed during the flood season.[4]

It is unclear whether the people involved explicitly sought to divert the main channel of the Ucayali or simply wished to create a larger and deeper chute channel that served as a much shorter route to the market. Based on their knowledge of fluvial geomorphology, one would expect local residents to have foreseen that the cut could change the course of the Ucayali and lead to the abandonment of a large segment of the river, the whole Masisea meander complex, approximately 71 kilometers long. If that were the case, it seems that their intent was to alter the course of the Ucayali completely and have access to a shorter and safer route year-round. It is possible, however, that their intentions were more limited and their expectations more modest. Respondents reported that

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3 Such channels, called "*sacaritas*," are small natural depressions that carry water during the flood season. They may be crossed by canoes and facilitate communication across the neck of a meander or between one point near the mouth of an affluent and another point on the main river. They may be called "*canoe paths*" and are known in Brazil as "*furos*" (Cabrera la Rosa, 1943).

4 According to one respondent, the village collected up to US$1,400 (or 5,000 nuevos soles [new sols] in Peruvian currency) during the months in which the booth was in operation — a significant amount in a region where the daily wage is only ten nuevos soles.

they sought to facilitate river transportation through an already existing channel during the flood season.

In either case, the ultimate outcome has been the complete alteration of the course of the Ucayali and the stranding of about a dozen villages as well as the town of Masisea (with a population of about 3,500 as estimated by my field sources; no up-to-date official numbers have been available since 1993), which is now eight kilometers away from the new course of the river. Some informants reported that, in response to the cut-off, the mayor of Masisea hired people to dig a short channel to the Ucayali in an attempt to force the river to flow back close to the town. Their channel swiftly filled in, however, and a dirt road had to be built instead. At least one village disappeared as a result of the cut-off. Its residents either formed new settlements upstream or migrated to Pucallpa. The people of Puerto Angel are aware of such implications and they feel both uneasy and culpable. Whereas most residents consistently mentioned the activities documented below, some denied that any work actually took place. But local populations had the necessary understanding to conceive of the cut-off and a purpose that would, indirectly or directly, facilitate it.

3.3 The anthropogenic role in the cut-off

Local reports suggest that several activities were undertaken over less than a decade. For the most part, they were carried out with simple tools and did not require a high degree of social organization often assumed for this scale of landscape modification (see Doolittle 1984). The original channel connecting the Ucayali with the oxbow lake of Bahuanisho (Bahuanisho *cocha*) was barely wide or deep enough to fit a canoe during the flood season. Residents of Puerto Angel, on the Ucayali just upstream from the channel entrance, grew crops along both sides of the small channel until about 1990, a period when credit was available from the Agrarian Bank. According to respondents the channel was only about two meters wide and one meter deep, and access was impossible when the river was low. Nevertheless, canoe and, later, motorboat traffic at high-flood stages gradually led to the widening and deepening of the channel through erosion by boat wash. The first concerted attempt to manage the channel was carried out by about a dozen residents of Puerto Angel in the late 1980s, who spent four to eight days in one year clearing the channel before the flood season, using machetes, axes, shovels and a chain saw. They removed all debris and buried logs (or *palizadas*) that blocked the flow and made travel dangerous. They also cleared the banks of all vegetation within five to 15 m of the channel, up to the entrance of Bahuanisho cocha, in order to facilitate bank erosion by the stronger currents during the annual flood. My respondents claimed that they essentially failed, although the channel did become somewhat wider. Two or three years later, some of the participants, acting then as village authorities, convinced the community of the benefits of the chute channel and of maintenance work. Subsequent clearing of the channel was done as communal work once a year by some 40-50 men from the village,[5] working for a day before the onset of the flood. A few years before the actual cut-off occurred, Puerto Angelinos dug a series of circular holes, measuring one to two meters in diameter and one meter in depth in the bed of the channel and continued to clear the banks. The purpose of such holes, I was told, was to create a circular current that would further enhance the erosional power of the floodwater. The current did help widen the channel and create deep and wide pools from the scour holes dug earlier. The final touch was applied before the 1997 flood, when the entrance of the channel was enlarged by a logger using a tractor. During the 1996/1997 flood season, after four or five years of modest communal works by the people of Puerto Angel, the Ucayali cut its main course through that channel.

Small-scale incremental activities leading to significant transformations on the landscape have been reported elsewhere. Early canal systems in Peru were probably constructed and expanded gradually (Denevan 2001, 148), as was the

5 Respondents were unable to recall the exact number of participants in these works and village records from those years are missing. The estimate provided here is based on current membership in the village assembly (approximately 110 members) minus possible absentees. Typically, unless otherwise specified, 50 percent of the membership must be present for the work to be done.

largely anthropogenic landscape found around Lake Titicaca (including terraces, raised fields, sunken gardens and irrigated pastures) (Erickson 2000b). The Safford Valley grids in the U.S. Southwest, which functioned as a horizontal water-control system for agriculture, were likely constructed in a similar fashion (Doolittle and Neely 2004). It is now believed that this may have also been the case for early irrigation systems in prehistoric Mexico (Doolittle 1990), Mesopotamia and Persia (Downing and Gibson 1974). Likewise, Raffles and WinklerPrins have reported small-scale incremental activities leading to large-scale transformations in the Amazon estuary (Raffles and WinklerPrins 2003). Thus, modest amounts of labor invested incrementally but regularly by small social groups over long periods of time, or at critical moments, can make a significant impact on the landscape.

It is difficult to discern whether the cut-off would have occurred in the near future without human intervention. The Ucayali is, after all, under the influence of active Andean tectonics and fluvial dynamics. The cut-off is consistent in direction with an avulsion related to tectonic activity in the late 1700s, which rapidly shifted the course of the Ucayali River in this general area up to 45 kilometers west from its original location (Neller *et al.* 1992; Pärssinen *et al.* 1996). My visual examination of Landsat imagery prior to the cut-off (1987, 1988, 1993, and 1996) suggests that if would have taken decades or more for the cut-off to occur, due to low rates of lateral erosion at the neck.

What is now the course of the Ucayali is a much more energy-efficient route than the meandering sequence prior to the cut-off. The fact that a channel, though small, had been there at least since the 1960s suggests that the river could have taken that course at some earlier time. Rapid changes in the course of a river are typically associated with intermittent phenomena such as extreme peak discharges, and in other regions of the world, ice jams, or beaver dams, and side channels left by the river in the past (Törnqvist and Bridge 2002). I found no significant earthquake activity, either in the official records of the Peruvian Geophysical Institute, or in local reports close to the date of the cut-off (cf.

Lathrap *et al.* 1985, 63).[6] I examined daily river-level records for Pucallpa in order to determine whether the cut-off may have been related to extreme discharge. The 1997 flood — when the cut-off occurred — was indeed above the 1981-2003 average, but Pucallpa records show higher floods for three flood years prior to 1997, the highest flood being almost 0.5 meter higher than the 1997 peak level. If triggered by extreme discharge, the cut-off would have occurred with that (higher) flood (Lapointe 2004). None of those higher floods, however, was sufficient to trigger the cut-off. Flood-stage records therefore lend further support to the thesis of human facilitation of the cut-off.

The cumulative effect of less dramatic floods could have also led to the change in the river course (Leopold *et al.* 1995, 80-94). In this case, however, the strong correlation between human action and the occurrence of the cut-off suggests otherwise. The cumulative effect of normal floods played a role in the creation of the setting (i.e., the sequence of meanders) in which humans intervened, but I conclude that human action ultimately the triggered the change. Clearly, people intervened in what was a highly attractive alternate route, one that by-passed a reach of tortuous meandering. The greater difference in gradient at that reach increased the likelihood that their actions would trigger the cut-off.

3.4 Discussion: anthropogenesis of large fluvial systems

The observations reported in this chapter suggest human intervention on riverine environments at a much larger scale than previously acknowledged: Amazonians may be able to accelerate changes in the course of large rivers that otherwise would take decades or centuries to occur, even if, in this case their ultimate goal was only to improve transportation to the main regional market in order to sell their products. Such interventions entail primarily the use of rudimentary tools, manual labor, and the force of the water in motion. Four insights are derived from this study.

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6 The earthquakes reported during the 1996/1997 flood season were similar to those experienced in other years at flood stage.

First, local environmental knowledge held by traditional peoples is complex and extends beyond areas currently identified within ethnoecological research (see Minnis 2000; Geoderma 2003). This study suggests that traditional peoples understand fluvial systems and processes just as they understand plants, animals, soils, and weather. Widespread evidence of human management of wetlands and fluvial systems for irrigation, sedimentation and flood control implicitly points to such complex understanding (see Downing and Gibson 1974; Rubin 1991; Doolittle 2000). However, local knowledge of fluvial processes is a field that has not been formally recognized and deserves much attention. In a setting such as the Ucayali, where change is part of the riverine way of life and the river is a dominant element in the *ribereño* environment, such knowledge is not surprising. Understanding that the river may erode one's farmland, form a new mudflat where rice can be grown, or change its course completely may be a matter of survival. Yet, local understanding is neither complete nor perfect; it is continually evolving. People living in the area reported more frequent flooding downstream from the cut-off and less frequent flooding upstream since the change in the river course, which is consistent with the literature on fluvial geomorphology. A steepening gradient due to channel shortening increases flow velocity and results in the degradation and aggradation of the river bed upstream and downstream, respectively (see Brookes 1988; Talbot and Lapointe 2002b).[7] According to local informants, no one anticipated local changes in flooding prior to the cut-off. Nevertheless, they rapidly perceived the change and adjusted their livelihoods accordingly.

Second, if contemporary traditional people were able to facilitate a meander cut-off along a major river such as the Ucayali, similar anthropogenic works may also exist along other meandering rivers — large and small — in the recent past or in prehistory. During fieldwork I obtained consistent reports from residents in another one of my study sites suggesting another anthropogenic cut-off along the Ucayali a few kilometers upstream from Pucallpa (see the spot in

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7 In fact, until the 1970s one of the main reasons for straightening river channels was to reduce flood levels upstream (Brookes 1988, 3-24).

Figure 3.3 marked "A"). Respondents at the site reported that males from villages in the vicinity, participating in communal work parties, had dug a one-and-a-half meter wide channel alongside a path that crossed the neck of the meander to facilitate transportation to Pucallpa. According to them, it took a few flood seasons before the actual cut-off occurred.[8] An American pilot commented on meander cut-off canals near the mouth of the Aguaytía River, and villagers reported a 150 meter-long ditch (*cavado*) near the mouth of the Tamaya River that substantially shortens the distance before the confluence of the Tamaya with the Ucayali.

Although no archaeological evidence of prehistoric anthropogenic meander cut-offs have been reported to date in Amazonia, the utility of improved water routes in the past is obvious, particularly as people traveled by canoe. Evidence of ancient artificial canals to improve communication by water in Bolivia's Llanos de Mojos Region attests to this (Nordenskiöld 1916; Denevan 1966, 74-76). The idea of building such canals, according to Nordenskiöld (1916, 417), had derived from the seeing how rivers cut through meander bends. The investigation of prehistoric anthropogenic meander cut-offs, however, is challenged by the difficulty of identifying material evidence of human intervention and by the constant reworking of the floodplain.

The third lesson is that the activities that ultimately triggered the cut-off, although they generated important benefits to some people, harmed people living in nearby areas. Villages were wiped out or left stranded kilometers away from the river; people drowned; and livelihoods were dramatically affected. These negative effects help to explain the sense of unease I perceived among some respondents.

The fourth lesson is that human intervention ultimately appears to have triggered the cut-off, although the cut-off would have occurred eventually even if local people had not taken part in the process. *Ribereños* understood enough about

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8 One night during the flood season, a loud noise was heard in the middle of the night, announcing that the river had made its main course through that channel. The next morning, the river upstream of the cut-off had dropped by about one-and-a-half meters, leaving canoes and boats beached at the port.

the river and its dynamics to envisage the possibility of altering the river's course, and the benefits of a cut-off were evident to those involved in its facilitation. The type of activities reported here are consistent with the literature (see Raffles 2002; Raffles and WinklerPrins 2003) and make sense in terms of enhancing the erosional force of the water along a channel that offered a more energy-efficient route. Change was induced with minimal investments of labor over a short period and in combination with natural fluvial processes. Raffles (2002) and Raffles and WinklerPrins (2003) have documented other instances in which humans have used and manipulated fluvial processes for a specific purpose. For instance, they report on channels that were dug to facilitate access to natural resources, such as forest products, game, fish, or agricultural land, or to shorten travel distances (Raffles 2002, 12-43; Raffles and WinklerPrins 2003, 169-170). Artificial crevasses cut through levees to create new land for agriculture have been documented in other parts of Amazonia (Raffles and WinklerPrins 2003, 172-174). Artificial crevasses have been also documented by Sternberg (Sternberg 1995, 143; Raffles and WinklerPrins 2003, 172-174).[9] A crevasse forms when a levee breaks during a flood event allowing silt-laden waters to spread over low lying areas behind where sediment is deposited and eventually land gets filled in (Boyer *et al.* 1997, 85). As such, by managing the small channel the residents of Puerto Angel effectively altered the process of fluvial geomorphological change along the Ucayali River, the main headwater tributary of the Amazon.

[9] A crevasse or levee breach occurs when a levee breaks during a flood event and allows silt-laden waters to spread over low-lying areas behind it, where sediment is deposited and the elevation of the land increases gradually (Boyer *et al.* 1997, 85).

CHAPTER 4. LAND TENURE ON DYNAMIC FLOODPLAINS: LESSONS FROM AN ACTIVE MEANDERING RIVER IN THE PERUVIAN AMAZON

> *"The Mississippi is a just and equitable river; it never tumbles one man's farm overboard without building a new farm just like it for that man's neighbour"*
>
> **—Mark Twain [1874] 1923**

Introduction

Land tenure issues have been at the forefront of the discussion on Amazonian development. Reports on deforestation and land conflicts involving colonists, rubber tappers, cattle ranchers, and Amerindian groups in Brazil have circulated around the world for more than twenty years (Hecht and Cockburn 1990; Alston *et al.* 1999; Simmons 2004; 2005). So far, the debate around land tenure in the Amazon has centered primarily on upland areas, the main development frontier, particularly in Brazil. Despite such interest on land tenure issues in Amazonia our understanding of tenure regimes in the region remain incipient; in particular, information concerning traditional tenure rules and land tenure in the floodplain is scant. Traditionally, development efforts have centered primarily on the uplands, and although receiving renewed attention in recent decades (Katzman 1976; Petrick 1978; Barrow 1985; Junk 1989; Padoch *et al.* 1999; PRA 2001; Soto and Romero 2001; Hidalgo Ríos *et al.* 2003), floodplains are still largely seen as areas that are "underutilized" and in the public domain.

The purpose of this chapter is to draw attention towards land tenure issues in the Upper Amazon and thereby stimulate a discussion of land tenure on the Amazon floodplain. An aspect that makes the study of land tenure in the Upper Amazon floodplain particularly interesting is the dynamism of its rivers and floodplains, setting it apart from the central and lower reaches, which are fairly stable (Sternberg 1960; 1975; Denevan 1984).[1] The quote by Mark Twain (see epigraph of this chapter) captures quite nicely the essence of the problem: land in the floodplain is unstable due to the lateral migration of the major rivers. The implications of land instability in the Upper Amazon floodplain for land tenure were recognized by Denevan (1984) two decades ago. "[A] farm or a village may disappear overnight as the banks cave in" and "a large playa [mudflat/sandbar] fronting a village may not reappear a year later (Denevan 1984, 320)." Yet since then, there is only one study that devotes considerable (though not exclusive) attention to land tenure issues in the Peruvian Amazon floodplain (Chibnik 1990; 1994).

This chapter focuses on three critical aspects related to land tenure in the floodplain. The first is that the instability of land itself within the floodplain makes land tenure in these areas complex and challenging for conventional notions of property, which are based on more stable areas. Land creation and destruction changes the relative value of land by affecting its availability and its distance from the river and markets; land may become locally scarcer or more abundant; more or less accessible. Second, formal and customary tenure regimes tend to coexist within floodplain areas. These regimes sometimes coincide, but often differ, creating potential for unclear rights and overlapping claims, especially because floodplain areas are seen as unclaimed fertile lands that are well communicated via the river network (Katzman 1976; Petrick 1978; Barrow 1985). And third, for thousands of people living along dynamic floodplains, land tenure is particularly important for livelihood security and well-being. In a context in which land is created and destroyed consistently, the institutions that define access to newly created or shrinking resources affect people's ability to cope with flood risk and riverbank erosion, and define the context for economic opportunities. Formal tenure rights are said to be more secure and are typically critical to gain access to credit.

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[1] The Central and Lower Amazon regions are, to some degree, dynamic as well (Raffles 2002), but are much more stable relative to the Upper Amazon.

Relevance

Understanding land tenure in floodplain environments is important on at least three fronts. First, millions of people live along floodplains in the developed and the developing world alike, and particularly in the latter, rural livelihood are closely linked to having access to land, fish, water, and other resources found in the floodplain. Floodplains are considered to be a risky or dangerous, yet fertile and attractive environment for human settlement. It is, thus, surprising that there has been relatively little attention to date in understanding land tenure rules and other institutions governing access to natural resources in floodplains in general. Although a few studies do describe land tenure on floodplain and wetlands in Africa (Park 1992; Haller 2002; 2004) and in Asia (Zaman 1989; Wescoat 1990; Adger and Luttrell 2000), no studies describe land tenure issues on floodplains in the Americas.

Second, it is now widely recognized that tenure rules and other institutions governing access to resources are not static over time. Although institutions serve as the "rules of the game in society" (North 1990), they continually change as a result of power struggles between different actors and other causes (Ensminger 1992). The outcome of such struggles may be further inequality or more egalitarian access to resources, increased vulnerability or resilience.

Third, understanding land tenure in the Upper Amazon floodplain is crucial at this moment in which national and regional governments, NGOs, and private interests turn increasingly to the Amazon floodplain as an important arena for development in the region (Padoch *et al.* 1999; PRA 2001; Soto and Romero 2001; Hidalgo Ríos *et al.* 2003). A better understanding of the dynamic nature of the floodplain (especially in the Upper Amazon) and its implications for land tenure rules may contribute to minimize overlapping claims and the potential for conflict over land, thereby improving the chances for such initiatives to yield better results.

The present chapter is guided by three general questions:

1. How have the formal and customary regimes interplayed since the collapse of the rubber boom?;
2. What are the basic land tenure rules along dynamic floodplains in the Peruvian Amazon? (i.e., how do people claim and transfer rights over land? What kinds of disputes emerge and how are they resolved?); and
3. How do land tenure rules evolve within a context in which land is created and destroyed?

As such, this study makes several contributions. First, this chapter joins a small number of papers that refer to land tenure issues in floodplain areas and is perhaps the first one devoted exclusively to the Amazonian literature. Second, the chapter emphasizes the dynamic nature of the floodplain in the Upper Amazon and its implications for land tenure, something that has been recognized for some time, but had not yet been fully studied. Perhaps the closest attempt was done by Chibnik (1990; 1994) who provided valuable insights on some of the tenure problems that arise over newly formed mudflats (which are attractive for rice production) near Iquitos. And although he recognized that mudflats are quite unstable and often may not appear from one year to the next, he did not pay significant attention to riverbank erosion. The only other study specifically devoted to land tenure in the Amazon floodplain is centered in Brazil, where the floodplain is fairly stable (Vieira 2000). The focus here on customary rules and their interaction with formal tenure rules is the third major contribution of this chapter. Until now, customary tenure rules have been typically given a secondary role, or have been neglected completely. Some authors acknowledge them (some exceptions are Chibnik 1990; 1994; McGrath *et al.* 1993), however, they have not yet been systematically studied. Fourth, by looking at land tenure in a context in which land is created and destroyed, this study serves as a window on land tenure that will help to inform our understanding of the nature and evolution of land tenure systems.

Structure of the chapter

The remainder of the chapter is structured as follows. Section 2 describes the study area and the methods used for this study. Section 3 presents the historical evolution of land tenure rules since the demise of the rubber boom in the Peruvian lowlands, circa 1915. This discussion focuses primarily on two general points: a) the varying interaction between formal and customary tenure rules at different periods and b) the recognition of and consideration of the instability of the floodplain by applicable land tenure rules. Basic formal and customary rules governing access to land on the floodplain among traditional peoples (i.e., Amerindians and mestizos) are examined in Section 4, stressing the similarities and differences across the two systems and the ways in which they interact. The two case studies presented in Section 5 delve further into the process of interaction and evolution of land tenure rules in relation to an extremely dynamic floodplain. One case is representative of land destruction due to riverbank erosion, the other one is representative of land formation due to sedimentation. The last section (Section 6) contains a summary of the main insights from this study and discusses some of their implications for livelihood security and development in the region.

4.2 Study Area and Methods

4.2.1 Study area

Research was conducted along the Central Ucayali River near Pucallpa — Peru's main inland port and second most important city in the Peruvian Amazon, after Iquitos. The Ucayali is one of the main tributaries of the Amazon and one of the most dynamic meandering rivers in the world. There are few places in which land is created and destroyed at a large scale — the Ucayali is one of them, along with the Mississippi, the Mekong, and the Ganges-Brahmaputra. With mean annual rates of lateral migration ranging between of 100-160 m/yr (Kalliola *et al.* 1992), as much as 1,600 ha of land are created and destroyed each year over a one-hundred-kilometer stretch of the river; enough to leave 160 rural families without land.[3]

As in most of the Peruvian Amazon, the population lives primarily along the main river and nearby lakes. In 1993, roughly 70,000 people, divided into two major groups (i.e., Shipibo Amerindians and mestizo *ribereños*) lived in rural settlements along the Central Ucayali River, in the vicinity of Pucallpa (INEI 2006). These people use traditional techniques to make a living from farming, fishing, and forest extraction for which they use resources found primarily within the floodplain. Both groups identify multiple biotopes within the floodplain and use them to grow different crops according to the amount of time that they remain inundated (i.e., elevation) and soil properties. For instance, annual crops are grown on low lying areas between the floods. Rice is grown on mudflats, cowpeas and melons on sandbars, and maize on low levees and backswamps. Crops with longer growth periods, such as manioc and plantains and perennials (e.g., citrus, papaya, mangoes), are planted on higher levees that flood only every 7-10 years.

Although the Shipibo and *ribereños* produce most of what they consume, their production is closely linked to the demand for foodstuffs of the rapidly growing population of Pucallpa.[4] Each of these groups has developed their own tenure rules and although formal rules are increasingly used to back claims, land markets remain incipient. Customary rules coexist with land tenure rules defined by Peruvian law, which assign preferential rights to Amerindian groups since 1978 (Law No. 22175 1978). In recent years, there have been important initiatives to produce crops intensively on the Ucayali floodplain for regional and

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3 These migration rates correspond to lower reaches of the Ucayali. Although no average migration rates are available for upper reaches, the Central Ucayali is considered to be more active. A study near Pucallpa shows average rates of up to 285 m/yr for one meander (Velásquez de la Cruz 2002, 53). The number of families affected is based on land holdings of ~10 hectares, the average landholding size in my sample. Source: Fieldwork, 2003.

4 In 1940, before the road connecting Pucallpa with Lima on the Pacific coast, the population of Pucallpa was under 2,400 inhabitants; by 1993 it had grown to 172,286 (Santos-Granero and Barclay 2000, 194). During the same period, Iquitos grew from close to 32,000 to 274,759. By 2001 the population of Pucallpa-Yarinacocha urban area is close to 250,000 inhabitants (INEI 2002, 91)

international markets (PRA 2001; Soto and Romero 2001; INEI 2002; Hidalgo Ríos *et al.* 2003).

At a broad level this study focuses on the Peruvian Amazon lowlands, where most of the large rivers are found and riverine settlements tend to concentrate. Despite differences in channel form among the main rivers in the region, the Upper Amazon floodplain is considered to be considerably dynamic as a whole, especially when compared to the Central and Lower Amazon (Sternberg 1975; Denevan 1984).

4.2.2 Methods

Data were gathered over more than twelve months of fieldwork in the Central Ucayali during 2002-2003. Fieldwork was centered in Pucallpa and in three rural villages located a few kilometers upstream, near a recent meander cut-off, in addition to short visits to seven other villages (including two Shipibo villages). Research in the city consisted of interviews with officials from the Ministry of Agriculture (henceforth MINAG) and the Aquatic Transportation Regional Office of the Ministry of Transportation (henceforth DGTA-MTC) and a review of some internal documents.

In the rural villages, data were collected through participant observation, informal interviews, and a household survey with 73 households. The survey instrument was designed to gather data on various aspects of peasant livelihoods and floodplain dynamics over time. Surveys focused on household demographics, family and resource use history, land use, income and wealth, social networks, risk attitudes, experience with shocks (e.g., illness, death, floods, riverbank erosion), and mitigation/coping strategies. Respondents were also asked about community history (stability and migration patterns) and about any observed changes associated with the meander cut-off, as well as their effects on local livelihoods. The survey included questions about folk knowledge on fluvial geomorphology and on floodplain changes foreseen for the future. Respondents were also asked questions about different plots in their land holding portfolios (e.g., how each plot was claimed/acquired and how it is being held?) and about disputes and dispute resolution, especially over newly formed mudflats (e.g., have they been involved in any disputes? If so, how were they resolved? What was the outcome?). The final sample, without households that left inbetween visits or declined participation, comprises a total of 67 households.[5]

Two of the villages (i.e., Exito, which lost most of its village lands in recent years and Puerto Angel, where a new mudflat has been deposited) were selected to examine more closely the evolution of institutions where land is created and destroyed. Much of the information for one of the case studies (i.e., Puerto Angel) derives from attending a village meeting with a MINAG official concerning tenure issues over a recently formed mudflat and conversations with local residents leading up to and following the meeting.

4.3 History of land tenure in the Peruvian Amazon floodplain

The first formal attempts to regulate access to land in the Peruvian Amazon in the 19th century date back to the mid 1800s, as part of an effort to secure dominion over its Amazonian territory and integrate the region with the rest of the country (Basadre 1969, 259-260; Coomes 1995, 110; Santos-Granero and Barclay 2000). The law *Declarando Dueños Absolutos a los Indígenas y Otros que Cultiven Tierras de Montaña y Fijando Normas para su Adjudicación* (Declaring Indigenous People and Others that Cultivate the Land in the Amazon as Absolute Owners and Setting-up Norms for Land Allocation), passed in 1845, recognized indigenous people and colonists as legitimate owners of the land they worked. The 1845 Law was complemented in 1853 by a Supreme Decree that defined specific terms about land allocation, as a means to attract European families to colonize the Amazon (*Facultando al Gobernador de Loreto para Conceder Terrenos de Montaña Gratuitamente* [Granting Authority to the Governor of Loreto to Allocate Land in the Amazon, Free of Charge]) (MINAG 1956). Since then, there have been several attempts to define formal rules of access to land in the Peruvian Amazon (see MINAG 1956; d'Ans 1982; Coomes

5 For more information about village selection and sampling see fieldwork and methods section in Chapter 1.

1995; Legislative Decree No. 838 1996; Santos-Granero and Barclay 2000); some applied to alluvial areas, though seldom considering the particularities of the floodplain. Historically, however, formal tenure rules have not always been fully enforced. Formal rules have gained importance during some periods (e.g., after the collapse of the rubber economy and during the latter half of the 1980s), but have been less so during others (e.g., rubber boom). Customary rules, in turn, have never disappeared. In fact, as Barham and Coomes (1996) and Donayre (1999) have shown for the period of the rubber boom, customary rules have continued to exist, in one way or another, and interplayed with the formal regime in different ways through time.

This section examines this interplay for the period starting around 1915, with the collapse of the rubber boom, through to recent years. The analysis presented here is divided into three periods: 1) the end of the rubber boom and the reorganization of the regional economy based on the *fundo* system; 2) national integration and state intervention; and 3) neoliberal reforms. Each of them is explained below.

4.3.1 The end of the rubber boom and the reorganization of the regional economy based on the *fundo* system

In 1898, when Amazonia was the main source of rubber in the world, the Peruvian government passed the *Primera Ley Orgánica de Terrenos de Montaña* (First Statutory Law for Land in the Amazon), a new law that established more defined regulations governing access to land (MINAG 1956; Santos-Granero and Barclay 2000, 97). The First Statutory Law established four different forms of rights that could be acquired over state lands: 1) land grants; 2) concessions; 3) contracts and; 4) land purchases (MINAG 1956). During the rubber boom, however, rights to land for rubber extraction were allocated through concessions and land grants, although squatter rights were also recognized throughout the basin, even in areas close to main trading centers (Barham and Coomes, 1996: 55).

In practice, in the land tenure during the rubber boom period varied depending on the type of rubber extracted. Caucho, a low grade rubber found in small densities in upland areas, was typically extracted from vast state lands without a formal claim (Barham and Coomes 1996, 55). Incentives to claim land formally or for land improvements were few, given that the trees from which caucho was extracted (i.e., *Castilloa* spp.) were found in small densities and had to be felled in order to drain the latex. In contrast, land tenure arrangements associated with the extraction of hevea rubber (*Hevea* spp.) were more diverse. This higher-grade rubber, found primarily near rivers (rarely more than 10 km inland), was extracted from estates owned by patrons and commercial firms, but also by independent tappers (Barham and Coomes 1996, 55-58); agricultural estates were established in areas where hevea trees were scarce or absent (Coomes 1995, 111). Formal claims (i.e., concessions and land grants) were more common among hevea than caucho estates. As stipulated by Peruvian Law, properties were surveyed in order to obtain certificates and titles, though many estate owners continued to hold land informally (see Barham and Coomes 1996, 56-57). The fact that hevea extraction did not rely on felling the trees for sap collection as was needed for caucho collection, and tree-tapping was done regularly for years favored a greater interest on the *estradas* (rubber trails cut through the forest), and to some degree the land itself. In addition, hevea estates combined rubber extraction with agriculture, both by the patron and his tenants. Tenants typically collected *hevea* on their rubber trails (*estradas*) when the river was low and spent the off-season farming and hunting within the estate (Coomes 1995, 111). These factors may help to explain why formal rights were comparatively more prevalent for this type of rubber.

Rubber properties also differed dramatically in terms of size. Caucho estates were typically large, often extending over thousands of hectares (Barham and Coomes 1996, 55). Hevea estates, in turn, were generally smaller, especially near the main rubber trading posts (i.e., Belém, Manaus, and Iquitos) and along the main rivers, where independent tappers were most common (Barham and Coomes 1996, 58). Coomes (1995, 11) reported that most estates along the

Tahuayo River, near Iquitos, comprised 10,000-20,000 hectares, although some covered as little as eighteen hectares.

After the collapse of the first rubber boom, in 1915, the economy of the region underwent significant changes. With the decline in demand for Amazonian rubber in international markets, attention shifted to other forest products (e.g., vegetable ivory, *balata, pashaco*, barbasco, and timber) and agriculture (Coomes 1995, 112). Indeed, (subsistence and commercial) agriculture gained a higher profile after the rubber boom and accounted for almost half of Loreto's exports between 1928 and 1948 (Santos-Granero and Barclay 2000, 144).

Such changes also brought about the spatial rearrangement of production in rural areas from the hinterlands towards the floodplains of large rivers (Santos-Granero and Barclay 2000). Life became more sedentary and small hamlets formed around the huts of patrons. During this period, the estate (*fundo*), as a unit of production, became much more land-based and as a result, access to land, especially along the floodplain, gained relevance. River floodplains were attractive for their fertile soils and good accessibility through the river network. Most of the suitable land along the major rivers was claimed by estate owners, taking over areas that remained vacant during the rubber boom, but also displacing some indigenous populations (Santos-Granero and Barclay 2000). The region underwent a land rush during the 1910s, with the total number of land grants increasing more than fivefold, from 174 during the peak of the rubber boom (1898-1910), and doubled again during the 1920s (Santos-Granero and Barclay 2000, 174).[6] Properties measured up to several thousand hectares (Higbee 1945; Coomes 1995),[7] though most *fundos* were much smaller, many of them comprised less than 10 hectares (Santos-Granero and Barclay 2000, 187). Land grants during this period, again, were centered primarily within the floodplain.

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[6] This land rush may have started earlier, during the peak of the rubber boom (Coomes 1995, 111). However, it intensified thereafter as the regional economy became more land-based.

[7] Higbee (1945) describes San Regis as a "middle class" hacienda extending over 30,000 acres (~12,140 hectares) along the Marañon River. The estate was primarily in forest and had roughly 150 tenant families (p 415). During the rubber boom estates along the Tahuayo River, near Iquitos, held up to 20,000 hectares (Coomes 1995, 111).

Although many *fundo* owners held titles to agricultural lands, not all land claims were backed by the formal regime. Some *fundos* functioned without any formal rights and, in many instances, patrons used and controlled resources beyond their legal claim (especially for extractive activities). The virtual control over land by the estates became another means to secure access to labor, in addition to debt-relations through the *habilitado* system. With practically all of the higher ground claimed by the *fundos* in combination with a large dependence on manufactured goods, many indigenous peoples established themselves within the estates as tenants (Santos-Granero and Barclay 2000, 162-163, 179). Land, although relatively fertile, was most valuable in terms of its role in attracting tenants that would provide a labor force to work in the estates (Higbee 1945).

Typically, patrons granted rights to live, plant crops, and use resources within the *fundos* in exchange for exclusive access to the tenants' labor and produce (Santos-Granero and Barclay 2000, 179). Rent was demanded by patrons in some cases in the form of labor, cash, or its equivalent in produce (Coomes 1995; Santos-Granero and Barclay 2000, 179-180). Tenants were also required to seek permission to extract forest products, even for subsistence (Coomes 1995, 112). A few independent indigenous and mestizo villages existed amidst a landscape dominated by the *fundos* (Santos-Granero and Barclay 2000). These villages enjoyed more independence from the estates, yet remained linked to a patron through the *habilitado* system (p 185).

Despite the impetus to formalize access to land during this period, the state was unable to fully enforce rights and its presence overall in the region was weak – patrons claiming land without titles, or with possessing titles to only a fraction of the land they used, are a clear indication of this. Competition over land (and boundaries) among different estate owners likely occurred in suitable areas for economic production, especially near towns and cities. In this way, access to land was, to some degree, contingent on the capacity of patrons to draw labor to claim land through use. There is no information in the literature regarding disputes over land created by the river through sedimentation during this period, however, it is likely that access to these lands (which required no labor for clearing) was also contested by different patrons. Although it remains unclear whether land disputes between patrons and independent farmers were common during this period, would-be peons had little leverage against patrons and would have found it difficult to obtain credit and market their products outside of the *fundos*. Nevertheless, there may have been cases in which independent farmers could have successfully contested the claims of more powerful individuals (see Donayre 1999). Overall, land disputes among patrons and between patrons and independent farmers were not always resolved through the formal regime.

It was, perhaps, within the *fundos* that informal tenure rights were more prevalent, due to the absence of formal rules. Although informal rules for land allocation within the *fundos* used at the time remain unclear, customary rules found today might provide some insights on how they may have operated in the past. Patrons often reserved the control of the most suitable land for commercial production for the *fundo*, typically within the titled area (Santos-Granero and Barclay 2000). Sugarcane, cotton, coffee, barbasco, and pastures were grown on the high terraces (*restingas*), rice on the mudflats, and peanuts and vegetables on the sandbars and lower levees (Santo-Granero and Barclay, 2000). Tenants would have been allowed to plant their crops on similar areas further away or on more marginal areas close by. Much like today, tenants claimed land through clearing and planting, using a mix of in-household and communal labor (i.e., *mingas*). Clearings were small due to labor demands placed by the patron, though tenants would have been able to use the land in sequence with the annual flood cycle. Patrons, or their overseers, would grant authorization to establish new plots and probably acted as mediators in disputes. Rights would have carried through the fallow period and transferred along kin lines, though the patron probably reserved the right to overtake any piece of land if it became useful to the estate.[8] As such, land accumulation among tenants was probably dependant on factors such as family size and access to labor, time of residence in the *fundo*, and relations with the patron.

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[8] Rent paid to the patron, however, was probably based only on the land used for cultivation.

In sum, the reorganization of the economy after the rubber boom fueled a race to claim land within the floodplain among a segment of the rural population with contacts to merchants in the city. Many estate owners sought formal land grants to back their claims, though they often used larger areas or simply claimed land without titles altogether. The state was unable to fully enforce formal rights. Thus, land disputes between different estates and access to land among tenants within the estates were largely defined by informal tenure rules.

4.3.2 National integration and state intervention

The Upper Amazon became accessible by road in the 1940s, coinciding with an increase in demand for strategic products for the war effort during World War II. The new boom was, at least, partly related to the state's effort to integrate the Amazon with rest of the country. The road connecting Pucallpa, along the Ucayali, and Lima on the Pacific coast, made it faster and cheaper to transport commercial goods across the Andes than importing them from Brazil or from other countries via Brazil. The road also opened access to national markets for regional products (Santos-Granero and Barclay 2000, 194). Pucallpa, which was until then a small village, came to rival Iquitos in size and economic importance. Population growth in both cities, however, created an important market for foodstuffs in the region.

The state sought to increase its presence in the Amazon in the 1950s. Besides road construction, existing laws regulating access to land became more rigidly enforced and the state played a greater role in the regional economy. It offered agricultural credit, price supports, and processing infrastructure, which stimulated agricultural production for urban markets in the region and the rest of the country.

Regulating access to land in the Amazon became a priority during this period. In 1953, a Supreme Decree (*Autorizando al Ministerio de Agricultura a Otorgar Certificados de Posesión para Uso Temporal de las Playas de los Ríos* [Authorizing the Ministry of Agriculture to Grant Certificates of Possession for

Temporary Use of River Sandbars]) designated floodplain areas as state lands, which could be granted in temporary use for agriculture (MINAG 1956). During Belaúnde's first administration unused lands held by private owners were turned back to the state, as established by law since the late 1800s. Although the law failed to include special provisions for floodplain areas, it is likely that enforcement applied to all lands, including alluvial areas. This law, however, had only a limited impact in the Amazon. It was not until the military government, led by Velasco Alvarado (1968-1975), that a new and more radical legislation was passed, the *Ley de la Reforma Agraria* (Agrarian Reform Law) (Law No. 17716 1969), which was complemented nine years later by the Ley de Comunidades Nativas y de Desarrollo Agrario de las Regiones de Selva y Ceja de Selva (Law of Native Communities and Agrarian Development in the Amazon Region]) (Law No. 22175 1978). These laws were aimed at eliminating large estates in favor of small and medium properties (Velasco Alvarado 1970). In the Amazon, they formally marked the end of the *fundo* era.

Although targeted primarily at the coast and highland regions, the Agrarian Reform Law stipulated that tenants could obtain formal rights to lands they had been previously occupying for areas up to fifteen hectares free of charge (Santos-Granero and Barclay 2000, 220). Although it remains unclear whether former tenants actually obtained titles, titles to agricultural *fundos* were reverted and rights were granted to former tenants settled in *ribereño* communities and later to recognized Amerindian communities (see Hiraoka 1985b; Padoch 1990; Coomes 1995; Santos-Granero and Barclay 2000). But more importantly, it liberated the latter from any rent obligations to the patron (Coomes 1995, 120). The *Ley de Aguas* (Law on Waters) (Law No. 17752 1969), passed a month later, reaffirmed the dominion of the state over floodplain areas and the assignation of rights through temporary use certificates.

The Law for Native Communities of 1978 was specifically designed to regulate access to land in the Amazon (Law No. 22175 1978). It formally recognized the rights of indigenous peoples and established their right to full and inalienable titles to land collectively referred to as a "community". It also recognized their rights to resolve some civil matters and allocate land among its membership according to their customs. Although an important advance for indigenous peoples, the law failed to assign similar rights to other groups that fell outside the definition of "native" (*sensu sricto*).[9] As such, the law essentially created a dual rights system, for Amerindian and non-Amerindian groups.

What the agrarian reform and the native communities laws did was to cancel the rights of the *fundos* and replaced them with a new system that formalized access to land more or less as defined by customary rules. By then, most *fundos* had ceased to be economically viable. Production had declined and many owners had taken their assets and moved to Iquitos or Pucallpa, leaving the land to its tenants.[10] The laws allowed former tenants to hold formal rights to estate lands for the first time; Amerindians as communal titles and non-Amerindians as temporary usufruct rights.

State intervention in the agricultural sector reached its climax during the presidency of Alan García, in the latter half of the 1980s, as part of a macroeconomic development program for Peru. *Presa* (*Programa de Reactivacion Agropecuaria y Seguridad Alimentaria*), as the program was known, was aimed at increasing agricultural output, raising farmers' income, and securing foodstuffs for the growing urban population (Coomes 1996b, 1334). The program consisted of providing subsidized rural credit, especially in areas affected by insurgent movements (i.e., *Sendero Luminoso*, MRTA). Along with credit, the program offered to secure land tenure in favor of local agrarian organizations (Coomes 1996b).

During the 1986-89 period, the Government became the main source of agricultural credit, providing 90% of all credit in the country (Coomes 1996b, 1335). Almost half of the land worked with government credit, under PRESA, (41%) was located in Amazonia (Coomes 1996b, 1336); some of this land would have been presumably in the floodplain. As many as 87,400 hectares were

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[9] Amerindian communities derive from tribal groups from the Amazon region and are formed by groups of families linked by language, cultural, and social characteristics, and by common and permanent property rights over a territory (Law No. 22175).

[10] For details on the factors that led to the demise of the *fundo* system see Santos-Granero and Barclay (2000).

sponsored by the government through the Agrarian Bank branch in Iquitos, when credit was at its highest in 1988-89 (Coomes 1996b, 1338).

The prospects of obtaining subsidized credit led to a greater interest in securing land through formals rules — a prerequisite to be eligible for credit. This trend towards the formalization of rights was stronger near urban areas, where competition for land was more intense. In 1989, 59% of households living along the Tahuayo River — a small tributary of the Amazon near Iquitos — held certificates of use obtained from the Ministry of Agriculture (Coomes 1996b, 1339). Certificates were requested for unclaimed lands, but likely to back claims to land already held under the customary system. Customary rules prevailed in more remote areas.

Agricultural credit also reached the floodplain, especially for rice and jute (Chibnik 1990, 291), as did the demand for formal tenure over areas suitable for their production (e.g., mudflats for rice). To obtain credit for rice, farmers had to demonstrate land rights, though in many cases MINAG respected land rights granted under customary rules (Chibnik 1990, 286, 292).

By law, rights for temporary use of the floodplain could be granted to practically anybody that requested them. Yet the process of formalization of land rights and obtaining credit remained prohibitive to many, implying multiple visits to the city, visual inspections from MINAG officials, and the payment of a fee for the certificates (Chibnik 1990, 292).

In summary, the 1940s marked the integration of the Amazon with the rest of Peru, allowing regional products to reach national markets. The state played an active role in the region and its economy. It provided credit and passed new laws regulating access to land. Although these laws marked the end of the *fundo* system and, in principle, allowed former tenants to gain formal rights, it was not until the late 1980s that the formal regime actually became of considerable importance, mainly as a means to secure credit. Laws passed in the late 1960s and 1970s, in principle, allowed for the formalization of existing customary rules by granting titles to indigenous communities and certificates of use to other groups, like the *ribereño*. Customary rules, however, continued to prevail in remote areas, and to some degree, were still applicable within native communities and among the *ribereño* in areas closer to the city, where they coexisted with the formal regime.

4.3.3 Neoliberal reforms

Shortly after Alberto Fujimori was inaugurated as president in 1990, policies towards the agricultural sector changed dramatically, as part of an orthodox economic stabilization program. Price controls and government subsidies were removed and within a short period of time rural credit was eliminated altogether (Coomes 1996b, 1341). Although the laws governing access to land remained essentially the same, the formal regime was debilitated. Without credit, the need for formal rights declined and land was abandoned in many areas. Certificates of use continued to be requested only near urban centers, where competition over suitable land was highest. In fact they are still requested today by many residents near cities mainly because crops, such as rice, continue to be an important source of cash income, and no longer as way to secure subsidized credit. Overall, however, *ribereños* appear not to be requesting certificates as often as they did when credit was available (Brisson 2003, 30)

A new land titling program, launched in 1996 as part of a national initiative to support populations that had been displaced by violence and terrorism, was also implemented in the region (*Para Favorecer la Reincorporación de la Población Desplazada por la Violencia Terrorista*) (Legislative Decree No. 838 1996). In recent years the government of the Department of Ucayali has been actively seeking to attract private interests to invest in the production of maize and beans on the sandbars and levees near Pucallpa, using intensive technology. Regional NGOs are also promoting the use of sandbars for bean production among floodplain residents and are offering some incentives. Together, these initiatives could increase competition over land in the region and raise the potential for disjuncture between the formal and the customary regimes. The next section examines the evolution of tenure rules in the floodplain in a context in which land is created and destroyed.

4.4 Land tenure rules

Land tenure in the Amazon floodplain is defined by formal and informal rules. Formal rules include constitutional provisions, statutes, and judicial rulings set by the state that define access to land in the floodplain. Informal or customary rules include social norms, conventions, and customs that structure behavior among people that use the floodplain without the sanction of the state (Libecap 1989, 1). Although formal and informal tenure rules are typically regarded as mutually exclusive, both systems often coexist in space and time. In some situations the two systems reinforce one another. For example, in some cases, formal rules recognize pre-existing rules and incorporate them into the legal system. In other instances, however, there is a mismatch between the two, leading to insecure rights and overlapping claims; a common occurrence in wetlands and floodplains (Adger and Luttrell 2000). Within the Upper Amazon floodplain the coexistence of formal and customary rules is further complicated by the continuous creation and destruction of land due to river channel dynamics. Below is a general overview of both sets of rights in the Peruvian Amazon.

4.4.1 Formal rules

Since 1953, Peruvian law establishes that land within the floodplain belongs to the state and may only be used with prior authorization from the Ministry of Agriculture (Law No. 17752 1969; Santos-Granero and Barclay 2000, 261). Through regional offices of the MINAG, the state grants two types of rights over land within the floodplain: certificates and land titles (Chibnik 1994, 74-75), and defines different rights for Amerindian and non-Amerindian groups (Law No. 22175 1978). Certificates give temporary-use rights to land for agriculture and were formalized as part of the Agrarian reform program in the 1960s and 1970s, and apply primarily to non-Amerindian peoples. Certificates are valid for a single year on more unstable landforms, such as mudflats, and may be renewed. According to Hiraoka (1985b), this is advantageous as it allows farmers to change sites in the event of farm losses (p. 12). However, it may lead to other complications, such as the yearly renewal of certificates and increased competition over new mudflat areas when they form. On the levees, rights are recognized only while land remains in use (Chibnik 1994, 74).[11] Individual families may be granted up to 10 hectares of land, provided that they pay a fee, work the land pacifically, and that they are in good standing with the Agrarian Bank (CTARU-DRAU 2001; 2002). Amerindian communities are exempted from this restriction and are given preferential rights over newly created mudflats, free of charge, if the land is adjacent to their village. Hoping to promote investment in the region, the local office of the Ministry of Agriculture extended this exemption to other juridical persons (e.g., peasant or producers organizations, non-governmental organizations, financial institutions, agribusinesses) and removed the cap on the amount of land that could be granted under temporary use (CTARU-DRAU). Although certificates are technically sufficient to serve as collateral, formal credit has not been available in the region since Peru adopted an orthodox stabilization program in the early 1990s.

Titles are permanent rights to land and aboveground resources in Peru (Chibnik, 1994, 74). In the past, titles were granted individually to commercial estates and collectively to officially-recognized indigenous communities. By law, such communities could be granted collective titles to the area used for agriculture, livestock rearing, hunting and fishing, or to the amount necessary to support their population (Law No. 22175 1978, Art. 10). Similar rights, however, were not extended to other traditional peoples living along the floodplain, such as the *ribereño*. More recently, some *ribereños* obtained titles, as part of a national program to improve living conditions in areas affected by terrorism (Legislative Decree No. 838 1996). This program granted titles to state lands, free of charge, until December 1998 in the *sierra* (highlands) and *selva* (Amazon) regions, where

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[11] Although the law does not provide a specific definition of use, it is understood to refer to land under cultivation or used for livestock raising. As such, some problems arise over agroforests, which may appear to be no longer in use to outsiders (see Chibnik 1994, 75).

political violence and economic marginalization were more acute. Along with previously displaced persons, any individual without other formal land rights, who used the land directly and pacifically for more than one year, could benefit from the program.[12] Although it is unclear whether the law established a maximum area, a cadastral map of Exito shows parcels greater than 10 hectares (PETT 1997). Titles to areas under dispute would not be issued until the best right of possession was determined (CTARU-DRAU 1998). As a result of intense riverbank erosion, many residents in this village were left with titles for lands that were destroyed by the river between 1997 and 2000.

4.4.2 Customary rules

Under customary regimes, people acquire land primarily through clearing and planting, with prior authorization from local authorities or the village assembly. To get such authorization, an individual must be accepted as an assembly member and commit to participate in public works; residence in the village is sometimes required too. In the case of death, rights are transferred to the widow of the deceased or to an adult child living with her/him, typically a son (or sons). Daughters and their husbands may inherit the land if there are no sons or these have moved away (Coomes, unpublished data). When a daughter dies, her husband is entitled to rights to only the land he was working, except on mudflats (Coomes, unpublished data).

Households that leave a village may retain rights over land, if left with kin or friends, or by making periodic visits to the village and participating in public works. During that time, kin left in charge are allowed to use the land and sell the produce as their own (Coomes, unpublished data). If there is no further interest in the area, land may be given to kin or friends, or sold for the value of the standing crop (e.g., on high levee) (Brisson 2003, 30).

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[12] This is from the closing of the program (i.e., December 1998). The program was later extended through to December 2000 (CEPES 2005).

There are some subtle differences between customary rules between *ribereños* and the Shipibo. Among the former, rights are carried through the fallow period and are transferred mainly along kin lines. To get started, a young *ribereño* couple is typically given a plot of land by one of their parents (Brisson 2003, 29). Over time, the household will claim more land through clearing and may eventually transfer some to their children, or other kin. Land is sometimes parceled out by local authorities when villages are forming in order to attract new settlers. In contrast, individual rights among the Shipibo end when a field is left in fallow. At that point the plot goes back to the commons and any village member may subsequently request it from local authorities. The Shipibo, only exceptionally, grant rights to non-Shipibo people (Tournon 2002, 168).

Access to newly formed lands (i.e., mudflats and sandbars) depends more on local environmental knowledge than on access to labor to clear the forest. Typically, those interested in the mudflats will go out in their canoes to observe the river during the flood season to identify areas where the current is slower and clay and silt would deposit. Before the river starts to recede, they inspect depth and soil consistency in the area and set up sticks to define their claim in terms of riverfront. Planting follows as soon as the waters begin their gradual descent; rice is typically broadcasted on mudflats and cowpeas and other crops are planted with a digging stick on the sandbars. In some *ribereño* villages new mudflats are allocated by local authorities, who sometimes give preference to households without previous access to mudflats (Brisson 2003, 30).

Mudflats and sandbars, however, are fairly unstable. They may vary in size, elevation and sediment composition with every flood. "A large [mudflat/sandbar] fronting a village during low water one year may not reappear a year later" (Denevan 1984, 320). These landforms also tend to "drift" downstream, and it is not uncommon for people to follow the moving bank further downstream (Coomes, unpublished data).

4.4.3 The interaction between formal and customary rules on the floodplain

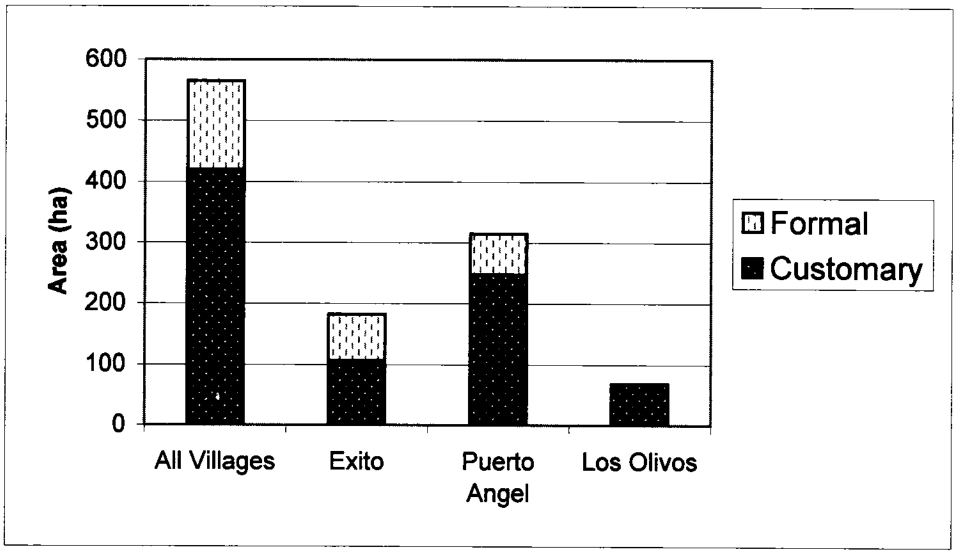
Survey data in three *ribereño* villages from 2003 (n=67) corroborates that the two tenure regimes (i.e., formal and customary) coexist simultaneously in the Central Ucayali floodplain. On average, three quarters of the land held within the sample was originally acquired through customary rules (e.g., clearing, planting, gift, or village decisions), yet roughly half of the land held in 2003 was backed formally with certificates or titles (Figures 4.1 and 4.2). This suggests that land is typically claimed through customary rules and rights are eventually formalized to secure claims. Only in one of the three villages (i.e., Exito) did I find a different pattern. Data show that almost half of the land held by residents was originally claimed through the formal regime (i.e., certificates and titles), potentially due to its proximity to Pucallpa and the greater need to secure access to land following rapid riverbank erosion that affected the village (see description of case below).

Two interesting issues stand out when we examine how different land types were acquired and are being held by households in the sample (Tables 4.1 and 4.2). The first one is that critical land types (i.e., higher areas, which serve as flood insurance, and mudflats, which provide important cash opportunities) tend to be backed by certificates or titles, except in Monte de los Olivos — where settlement is much more recent. The second issue is that in Exito some households have used the formal regime as a tool to claim land on the mudflat. I will elaborate on these points in the discussion of the case studies.

Disputes

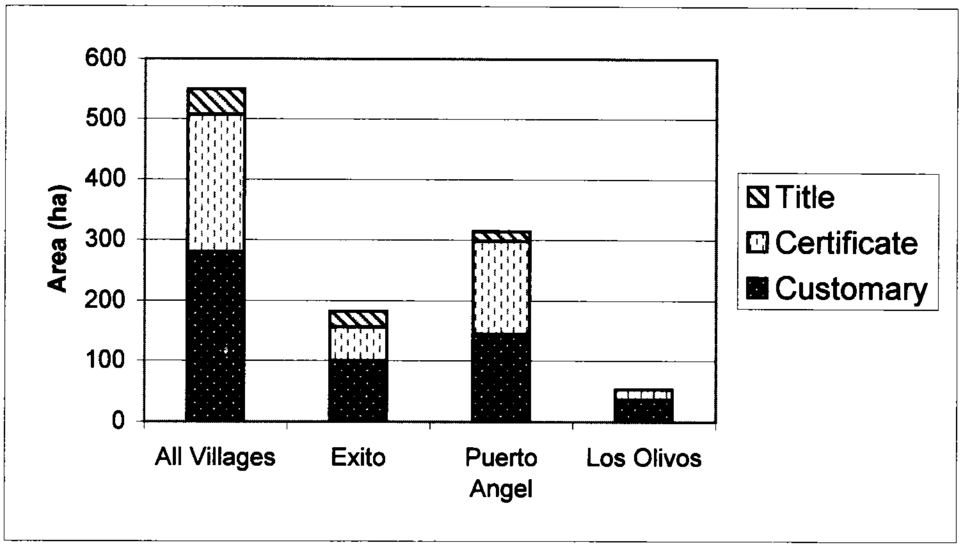
Survey data suggests that disputes and conflicts are not as common and serious as one would expect (Table 4.3). Indeed, it seems that only about 40% of a sub-sample of households (n=53) had ever been involved in a land dispute since household inception. Disputes were primarily with other members of the same village (i.e., 80% of the cases) and according to respondents they tended to be minor and typically resolved by talking and measuring the land in dispute with the other party(ies). Typically, if land is taken by another party without the owner's consent, the latter will return the seed planted to the offender and will keep the

Figure 4.1 Forms of land acquisition, Central Ucayali, 2003 (n=67).



No obs. 67 25 31 11

Figure 4.2 Forms of land tenure, Central Ucayali, 2003 (n=67).



No obs. 67 25 31 11

Table 4.1 Land acquistion by land type, Central Ucayali, 2003 (n=67).

	Acquisition							
	Customary				Formal			
	Clear/gift/plant		Parcelization[1]		Minag[2]		Buy	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Exito								
Upland	2	100	0	0	0	0	0	0
High levee	13.5	81	0	0	0	0	3.1	19
Low levee/backslope	73.9	69	0	0	2	2	30.9	29
Mudflat	0	0	0	0	35.4	100	0	0
Sandbar	14.9	77	0	0	4.5	23	0	0
Total	104.2	58	0	0	41.9	23	34.0	19
Puerto Angel								
Upland	85.5	100	0	0	0	0	0	0
High levee	107.3	94	1	1	0	0	6	5
Low levee/backslope	15.2	32	3.2	7	0	0	29.4	61
Mudflat	1.8	8	21.8	92	0	0	0	0
Sandbar	1.4	13	9.2	87	0	0	0	0
Total	211.2	75	35.2	12	0	0	35.4	13
Los Olivos								
Upland	15.5	100	0	0	0	0	0	0
High levee	49.8	96	0	0	0	0	2.2	4
Low levee/backslope	0.5	100	0	0	0	0	0	0
Mudflat	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sandbar	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total	65.8	97	0	0	0	0	2.2	3

1. An internal division of land outside of the formal regime.
2. Land acquired through the formal regime (i.e., titles, certificates).
Source: Fieldwork 2003

Table 4.2 Land tenure by land type, Central Ucayali, 2003 (n=67).

	Tenure					
	Customary		Certificate		Title	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Exito						
Upland	2	100	0	0	0	0
High levee	7.05	36	0.04	0	12.5	64
Low levee/backslope	87.79	80	8.6	8	12.75	12
Mudflat	0	0	35.4	100	0	0
Sandbar	6.99	36	12.36	64	0	0
Total	103.83	56	56.4	30	25.25	14
Puerto Angel						
Upland	40.45	26	105	66	12.5	8
High levee	60.19	66	28.75	31	2.75	3
Low levee/backslope	18.47	47	20.6	53	0	0
Mudflat	23.59	100	0	0	0	0
Sandbar	10.53	100	0	0	0	0
Total	153.23	47	154.35	48	15.25	5
Los Olivos						
Upland	0		0		0	
High levee	36.69	68	17	32	0	0
Low levee/backslope	0.5	100	0	0	0	0
Mudflat	0		0		0	
Sandbar	0		0		0	
Total	37.19	69	17	31	0	0

Source: Fieldwork 2003

Table 4.3 Reported land disputes, Central Ucayali (n=53).[1]

	Involved in disputes[2]		Dispute type			
			Internal[3]		External[4]	
	No. of hhlds	(%)	No. of hhlds	(%)	No. of hhlds	(%)
Exito	4	20	2	50	1	25
Puerto Angel	17	54.8	15	88.2	2	11.8
Monte de los Olivos	0		n.a.		n.a.	
Total	21	39.6	17	81	3	14.3

1. Data was missing for 14 households (4 in Exito and 9 in Monte de los Olivos)
2. Denotes involvement in disputes since household formation, not number of disputes
3. With residents from the same village
4. With outsiders (e.g., estate owners, residents from other villagers, or people from the city)

n.a. Not applicable
Source: fieldwork 2003

harvest. However, when the land owner is not planning to use a plot planted by an intruder, he/she may allow the latter to harvest the crop planted under the condition that no claim to the land is made thereafter. Only rarely did they rely on local authorities or government officials.

These results are surprising considering the high potential for overlapping claims and the instability of the floodplain. We must remember, however, that land tenure and disputes are difficult subjects to investigate in the field. Respondents are often reticent to provide answers that may portray social relations as conflictive and tense, especially in kin-based societies like the *ribereño*.

During fieldwork, however, I witnessed and heard reports that suggest conflict may be underestimated by the survey data and that serious problems do arise. I found a case in which a group of *ribereños* invaded an agricultural estate following a severe flood and later took over land from a neighboring village to remove limitations to their expansion behind the village. I also witnessed heated disputes over boundaries on mudflats and levee lands between residents from the same village and with outsiders. There is even a case in which an "internal" land reform took place. I will examine some of these cases more closely below.

4.5 Land tenure in the context of land being created and destroyed

This section uses two case studies to illustrate the complexity of land tenure in the floodplain: one where land has been recently destroyed and another where land has been created (Figure 4.3). These cases inform us on some of the kinds of disputes and conflicts that arise from the instability of the floodplain itself, from local power relations, and from the interaction between formal and customary rules.

4.5.1 Riverbank erosion and readjustments in Exito

The first case is Exito, a lowland village located about 45 minutes by boat upriver from Pucallpa, and a few kilometers downstream from a recent meander

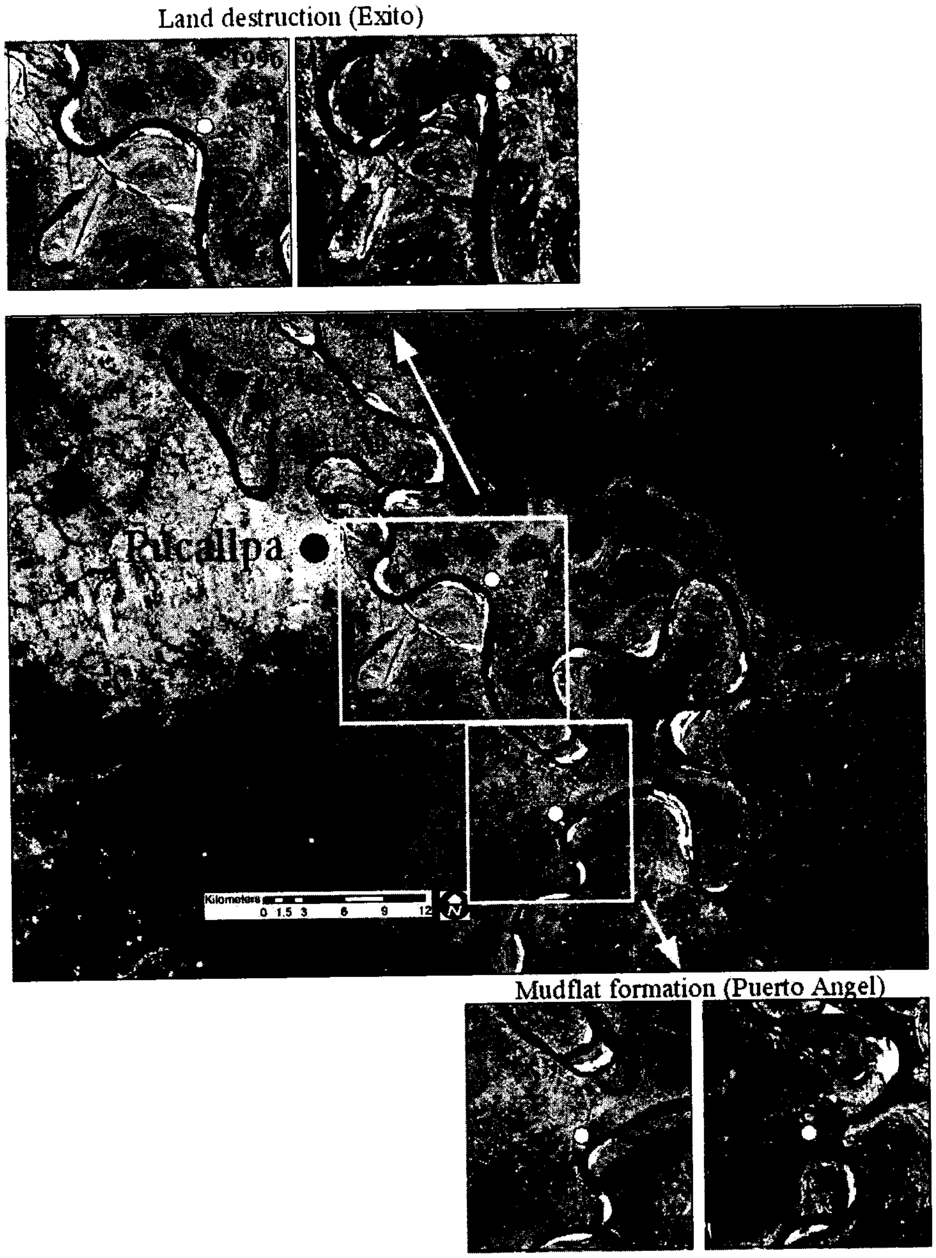


Figure 4.3 Representative cases of land destruction and formation, Central Ucayali River, Peruvian Amazon. Sources: LANDSAT 5 data © NOAA 1996 and LANDSAT 7 ETM+ data © NOAA 2001; received and processed by USGS/EROS Data Center: processed and redistributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University).

cut-off (Figure 4.3). Situated on the outer bank of a meander, Exito had a long history of periodic riverbank erosion. However, since the cut-off occurred (i.e., 1997), the river has eroded most of the village's land and flood levels have become consistently higher. Within a span of three years, residents were forced to disassemble their homes and to retreat further inland. Many moved to Pucallpa or to new areas that opened upstream from the cut-off (Figure 4.4). Confined by a wealthier neighboring village behind and due to the original settlement pattern of the village (i.e., perpendicular to the river), people rebuilt their homes on land belonging to villagers that lived further back from the river. At some point, villagers even contemplated the full relocation of Exito and made arrangements to look for a favorable site (Caserío Exito n.d.). In the end, they decided to stay put when erosion ceased. Later that same year, a mudflat began to form in front of the village.

In such crisis, the original owners in Exito tolerated the occupation of their land for housing. Disputes did arise, over time, regarding ownership of the trees that remained around the houses, which had been maintained by the original owners. For instance, the citrus trees surrounding Don Miguel's house belonged to Don Julio, who owned the land and periodically came to harvest them.[13] Although lacking rights, it was practically impossible to keep occupants like Miguel and his children from picking the fruit. Some owners girdled the trees to kill them as an attempt to stop them. In 2003, after riverbank erosion ceased, the village assembly agreed to define urban lots with full rights to the land surrounding the houses, still perpendicular to the river. During my stay, village authorities surveyed 20 m x 30 m lots, despite the dissent of the original owners, who protested and, in some instances, uprooted trees from the areas in dispute (Abizaid field notes 2003). An agreement was finally reached in which the owners acknowledged the division as long as they were paid for all standing trees on the property.

In addition to the relocation of houses, most residents saw their fields being washed away. Desperate to find a place to grow their crops, many cleared

13 Pseudonyms are used to maintain the anonymity of local residents.

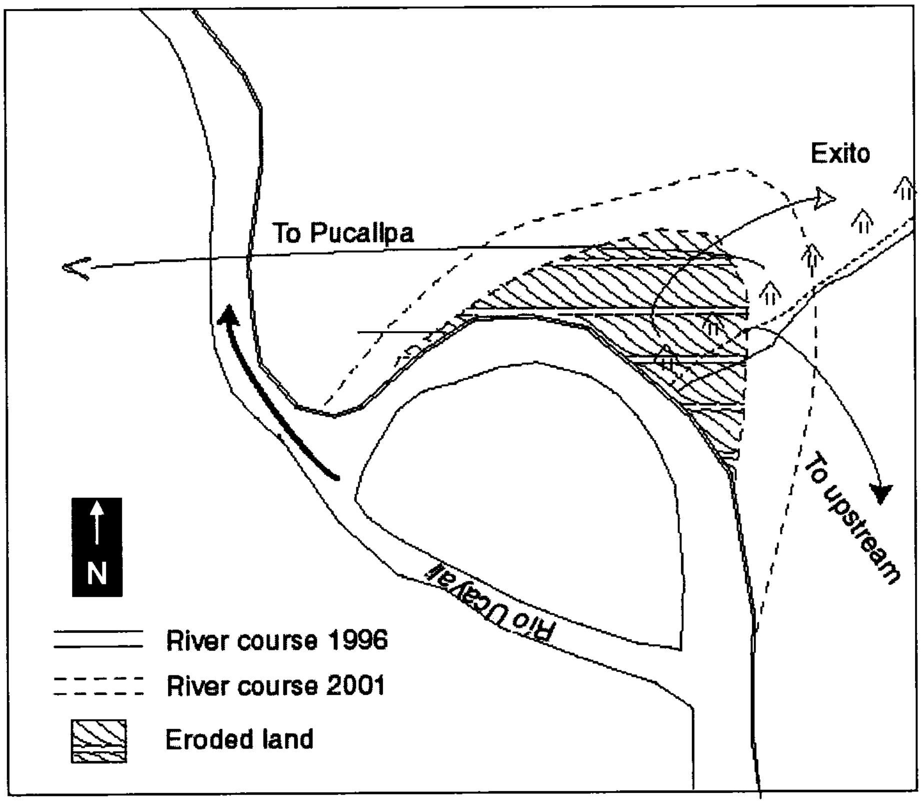


Figure 4.4 Schematic map of riverbank erosion and retreat in Exito. Sources: LANDSAT 5 data © NOAA 1996 and LANDSAT 7 ETM+ data © NOAA 2001; received and processed by USGS/EROS Data Center: processed and redistributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging.

land in lower areas (e.g., low levee and backswamp), which are more susceptible to flooding, though some bought or were given a piece of land from kin. Those fortunate enough to hold the remaining high levee areas took advantage of the official titling program in 1998 to secure their claims, as shown earlier. When the mudflat began to appear, residents who had lost land to the river felt they should get priority as compensation for their loss. Others, in turn, considered that access to the new mudflat should be open to anyone. In the end, a small number of households managed to monopolize the mudflat and did so with the aide of formal tenure rules. As the first signs that a mudflat would appear in that location, these households swiftly went to the city to request a certificate from MINAG and used the names of adult children to get access to larger areas of mudflat and keep others from using them. Considering that this was done even before the mudflat actually emerged, formal rights have served not only to legitimize land claims, but also as a tool to preemptively claim land.

4.5.2 Land formation in Puerto Angel

The second case — Puerto Angel — is located on the bluff, just upstream from the cut-off mentioned above (Figure 4.3). Residents there have access to floodplain and upland areas. Since the cut-off, flood levels have decreased locally and the river has formed a new mudflat just below the bank it used to erode. The river is now eroding the opposite bank, where some Puerto Angelinos have their agricultural plots. The actual village site is safe now and despite some land losses on the opposite bank, a considerable amount of land has become more attractive since the cut-off, due to lower flood levels and the formation of the mudflat.

As soon as it became evident that levees would no longer flood, one or two residents began claiming land (through clearing) and growing plantains — a basic staple and a source of cash; others followed soon after. Although the levee is highly prized, labor constraints limited the amount of land which could be claimed, allowing all those interested to secure a piece.

About a dozen households used customary rules to monopolize control over the mudflat when it first appeared, claiming areas of up to 500 m of riverfront.[14] After the harvest, however, a group of people who were also interested in the mudflat began a campaign to persuade other residents in the village that as "poor peasants", they all deserved a right to the mudflat. The issue was discussed and approved at a village assembly.

Concerned by this, the original claimants requested that an agent from the Ministry of Agriculture survey the mudflat in order to obtain their certificates. Upon that visit, however, the rest of the village stood up and forced the government official to survey the mudflat and set up parcels for all interested households. In the end, plots were defined, measuring 30 m of riverfront and extending back to the former bank of the Ucayali; their allocation was done randomly through a lottery. This is an interesting example of an internal land reform that has made access to the mudflat fairly egalitarian.

Clearly, the first claimants of the mudflat were unhappy with this reform and apparently issued death threats against some of its initiators. Such threats, however, never materialized and the reform is now accepted by all villagers.

In spite of the land reform, disputes are still common today and are related to the changing geometry of the channel and the orientation of the parcels on the mudflat (Figure 4.5). Some households have strategically moved the sticks that define their boundaries to follow the new mudflat as it "drifts" downstream, and by doing so, they have effectively expanded their riverfront. Their immediate neighbors have adjusted their boundaries accordingly, but eventually someone's access downstream will be cut-off. Villagers with the mudflat furthest downstream, along with estate owners who have been waiting for the mudflat to drift downstream, were heavily concerned about this. During my stay I

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14 Certificates of use are defined in terms of area in hectares. However, mudflat holdings are measured typically in terms of riverfront and extend to the former bank of the river. Although, in some instances, such areas are quite extensive, yet the actual area of mudflat that may be potentially used is much smaller and is dependant upon the rate of lateral migration of the river.

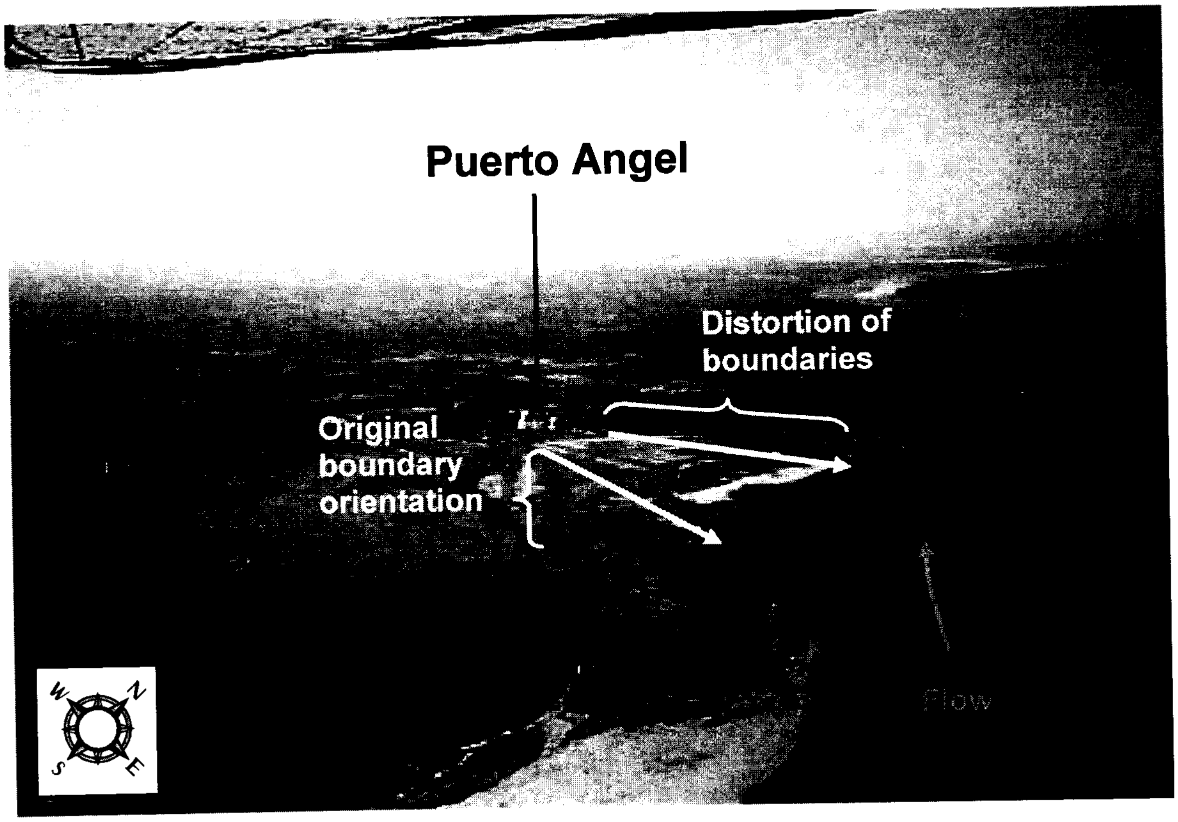

Figure 4.5 Recent mudflat fronting Puerto Angel seen from the air looking north. Photo by the Author, 2003

participated as an observer at a meeting to discuss the issue with two independent estate owners and an official from the Ministry of Agriculture. After heated debate, the official tried to convince village residents that the problem would be solved by requesting their certificates. Villagers, however, had a sense of mistrust about the official's intentions and thought that he wanted to collect the fees to pocket the money.

In the absence of a final agreement on the issue, the official from the Ministry of Agriculture was able to broker a deal to determine, at least, where the village claims ended and where those of the independent estate started. The measurements were made and a formal act was drafted and signed by the estate owner, village authorities, and the mediator.

4.6 Discussion and conclusions

These results provide a first glance on the complexity of land tenure along dynamic floodplains. The ongoing creation and destruction of land and the interaction between formal and customary regimes set the stage for disputes and conflict, due to potentially unclear rights, although disputes are seldom violent. Rules appear to be made spontaneously through contestation, negotiation, and mediation. Returning to the main points outlined in the introduction, these are the lessons learned from this study:

1. The process of creation and destruction of land (and related changes in natural resource availability), although a challenge to conventional notions of property, appears to offer a critical moment during which changes in tenure rules may be brought about. For instance, in Exito, the first case presented, I found that residents who had not been significantly affected by riverbank erosion and still held land could not refuse to let others rebuild their homes on their land — something inadmissible under normal circumstances. Such concessions were probably limited to a level that did not severely affect livelihood security. The same residents would have probably not tolerated the invasion of their agricultural plots especially in

a context in which land had become scarcer due to riverbank erosion. Allowing others to set up their houses without rights to the produce or the trees on the property was the source of disputes, which eventually led to a sounder agreement once river bank erosion seemed to have ceased.

The second case study suggests that a similar window of opportunity may also arise when new resources suddenly appear. The organization of village residents to collectively challenge the claims of a small group, and even government authorities, is remarkable. But the fact that it led to a fairly egalitarian distribution of the mudflat is even more exceptional, suggesting that rapid environmental change may also function as a mechanism that constraints inequality through institutional change.

2. As expected, land conflicts in the Upper Amazon floodplains are common, though surprisingly not outright violent. There is heated contestation, but to my knowledge, people are not physically violent with one another over land disputes, as does occur in the upland area of the Brazilian Amazon and in other regions. Although the reasons for this remain unclear, some potential explanations could be: 1) that land is still relatively abundant and therefore it is easier to claim land elsewhere and; 2) there may be something about the malleability of tenure rules that reduces the potential for violent conflict. In fact, flood risk or riverbank insurance may be two reasons why some peasants do not resort to violence in these conflicts. Farmers know that they may be the ones affected at some point and that other party(ies) may well be the one(s) they can turn to for assistance.

3. Formal and customary rules coexist simultaneously on the floodplain and interact in complex ways; they have also done so in recent history. Formal laws have existed throughout the period covered herein. And although they have been more rigorously enforced during certain periods, there has always been space for customary rules to exist and interact with the formal regime. Land is typically acquired through customary rules and later

tenure is secured through the formal system. The fact that local residents tend to formally back their claims over critical land types (i.e., those that provide important cash earning opportunities or flood insurance) suggests that perhaps they regard the formal regime as having a higher status in terms enforceability, since formal credit is no longer available in the region. Yet the case studies presented here also point to two interesting issues. The first one shows how a group of people, based on local knowledge, anticipated the formation of the mudflat and went beyond securing their claim land through the formal regime, to using the latter as a tool to claim and monopolize the mudflat. The second case, on the other hand, in which villagers confronted the government official and forced him to survey and divide the mudflat among all villagers, suggests there may be instances in which local people may contest the formal regime and customary rules actually supersede it. Peruvian law does not officially recognize customary rights (Law No. 17752 1969; CTARU-DRAU 2001). However, in practice, government officials recognize, to some degree, preexisting rules defined by custom and tend to respect agreements made at the village level. This is consistent with Chibnik's observations when credit was widely available in the region (1990; 1994).

Attention to these issues is crucial at this moment when the interest in promoting floodplain development in the Upper Amazon is on the rise. And with it, competition over land in the floodplain, at least near major urban centers, is likely to intensify. Although the implications of this for the *ribereño* and the Shipibo remain to be seen, there is a danger that their rights may be overridden to favor investment in the region.

CHAPTER 5. SHOCKS, WEALTH AND ASSET EVOLUTION AMONG PEASANT HOUSEHOLDS IN THE PERUVIAN AMAZON

5.1 Introduction

Concern about the fate of the poor has prompted much interest in the impact of shocks or adverse events, on assets and rural livelihoods. Poor people, especially in rural areas of developing countries, are considered to be more exposed to economic, political and environmental uncertainty, and unlike those that are better-off, often find it more difficult to cope with shocks (see discussion in Fafchamps 1999; World Bank 2000).

Such difficulties arise, in part, from the fact that the poor are generally excluded from formal credit and insurance systems, and thus are left to deal with shocks on their own, or through informal insurance systems. With informal insurance systems that are not always able to protect those in need and with few assets at hand, the poor are believed to be among the most vulnerable to shocks. Economic crises, political unrest and environmental shocks (e.g., floods, droughts and others), especially if recurrent, are said to perpetuate poverty and increase vulnerability among the poor.

Today, there is much concern that shocks or contingencies, and in particular environmental shocks, are a major constraint for development in many developing nations, and even threaten livelihood security among the rural poor (Chambers 1983; Blaikie *et al.* 1994; Fafchamps 1999, 53; Narayan *et al.* 2000; World Bank 2000). The fate of the poor seems to be further endangered as natural risks intensify and the ability of poor people to respond to them is reduced as a result of global environmental change (Blaikie *et al.* 1994; Adger 1999; Adger and Kelly 2001; Kasperson 2001; Kasperson and Kasperson 2001). Based on these views, scholars, governments and development organizations, including the World Bank, have called for an urgent need to reduce vulnerability among the poor, paying particular attention to natural hazards (World Bank 2000; IDS 2006).

Yet in practice, helping the poor to manage risk has been challenged by important gaps in our understanding about the nature of, and the evolution of, vulnerability over time. Consensus is now emerging around the need to pay greater attention to the links between shocks and assets, in order to better capture the essence of vulnerability (Blaikie *et al.* 1994; Narayan *et al.* 2000; World Bank 2000). Another necessary step towards building resilience is the recognition of the capabilities of poor people. To date, most of the literature on vulnerability highlights what the poor cannot do, paying little attention to what these people can do to cope with shocks. This literature, however, has made a significant contribution by underscoring the social character of natural disasters (Sen 1981; Hewitt 1983b; Blaikie *et al.* 1994; Leach *et al.* 1999; White *et al.* 2001). Unfortunately, in doing so, it has helped to reinforce images of the poor as passive and helpless people who are at the mercy of shocks and the social context in which they live. Our failure to consider capabilities and responsiveness among the poor in vulnerability reduction efforts has, in many instances, undermined local capacities and created dependency (Gupta 1995).

Shocks, assets and vulnerability

Assets are essential to livelihood and in the absence of formal insurance, they help poor people to mitigate and cope with adversities. Asset holdings (i.e., physical, social, human, and environmental) determine the range of economic activities that an individual, household, or a group of people may engage in (see Reardon and Vosti 1995; Dercon 1998; Barham *et al.* 1999; Coomes *et al.* 2004). People's ability to cope with and recover from shocks, or crises, is also closely linked with assets (Moser 1998). Asset diversification allows people to spread risk (Ellis 2000). Cash and other assets which may be easily liquidated in times of need (e.g., livestock, jewelry, food stocks) are often accumulated, among other reasons, to serve as a buffer. Livestock is used as insurance against droughts and floods in various parts of the developing world, including the Peruvian Amazon (Matlon 1990; Rosenzweig and Binswanger 1993; Takasaki *et al.* 2004). Farm tools, equipment, vehicles and farm buildings are sometimes sold as well to smoothen income (Fafchamps 1999, 13). Overall, in the absence of formal insurance, physical assets (i.e., land and non-land assets) and other forms of capital (i.e., environmental, social, human) constitute the main resources available to the poor to cope with shocks.

However, shocks or contingencies have the potential to reshape asset holdings and wealth accumulation paths, especially among the poor. Some of the effects of shocks on assets are direct (e.g., destruction of property, death of livestock, crop failure due to a flood or drought); others result indirectly from the strategies followed by the poor to respond to them, namely their role as a buffer (e.g., the liquidation of food stocks or livestock to pay for medication). Asset reductions, especially the liquidation of, or destruction of, productive assets often constrain livelihood opportunities in the future and reduce the capacity of the poor to deal with subsequent shocks (Fafchamps 1999, 13). In light of this, shocks may be key to understanding prevailing asset inequalities in developing contexts.

Shocks may affect assets in other ways that include changes in investment strategies to minimize the effects of future shocks or to seize new opportunities. For instance, a farmer may decide to shift his/her investments away from land into other forms of capital (e.g., livestock, education, a store) in response to weather variability; within the Amazon floodplain, someone affected by a flood may seek to secure access to high ground.

Surprisingly, despite much research on poverty, risk, and vulnerability, our understanding of the links between shocks, assets and vulnerability remains limited. In particular, we have much to learn about the effects of contingencies on wealth and asset accumulation patterns, as well as their implications for vulnerability over time (Blaikie *et al.* 1994; Fafchamps 1999; World Bank 2000). So far, researchers interested in persistent economic inequalities in the Third World have examined asset accumulation in terms of initial asset endowments and assets held at a given point in time (Barham *et al.* 2002), but paid relatively little attention to the role that shocks potentially play in shaping asset portfolios, and in increasing or reducing inequalities over time. Studies on risk, poverty and environment within the development literature, and on vulnerability and political ecology have highlighted the importance of shocks for rural poverty. In particular, they have made us increasingly aware of the short-term effects of contingencies and the multiple strategies that the poor use to mitigate (i.e., *ex ante*) or cope (i.e., *ex post*) with risk and uncertainty.[1] These works, however, often assume that shocks also affect assets in the long run, but have rarely explicitly examined them. This study seeks to improve our understanding of vulnerability/resilience in rural settings in the developing world by examining the links between shocks, wealth and asset evolution among forest peasants in the Peruvian Amazon. It pays particular attention to both the immediate effect of shocks on assets and their implications for asset evolution and vulnerability over time.

A better understanding of the links between shocks and assets, and more specifically, the recognition of the adaptability and responsiveness of the poor is much needed for the design and implementation of policies aimed at enhancing resilience, especially as the concern about the fate of the rural poor is rapidly increasing in light of increasing vulnerability. This study promises insights towards such an understanding and furthermore, on the prospects for human adaptation to rapid environmental change.

This chapter is guided by four related research questions:

1. How exposed are forest peasant households to health and environmental shocks in the Upper Amazon?;
2. What are the immediate effects of major health and environmental shocks on household land holdings and non-land assets and how do peasant households respond to different types of major shocks?;
3. How well are different households able to recover from a major shock and what factors allow certain households to bounce back more easily than others?; and,

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[1] See Fafchamps (1999) and World Bank (2000) for more details on the range of risk mitigation and risk coping strategies.

4. What role do major shocks play in shaping asset holding evolution over the household life cycle?

I address these questions through a case study in three riverine villages along the Central Ucayali region, where local residents are poor and continuously exposed to illnesses, accidents, floods and riverbank erosion. The focus is on the household as the basic unit of production and consumption (Ellis 1993), without attempting to capture intra-household dynamics. The specific contributions of this chapter are:

1. A shift in focus away from the differential effects of a specific shock (e.g., the 1994 flood, the 2005 drought) to the examination of the impacts and responses to shocks that people were most vulnerable to over the household life cycle;
2. Emphasis is placed simultaneously on the immediate effects of shocks on assets and household responses, and on the implications of shocks for asset accumulation over the household lifecycle. This complementary approach promises to shed deeper insights on the evolution of vulnerability/resilience over time;
3. By focusing on different shocks (i.e., illnesses, floods, riverbank slumps, and floods with riverbank slumps), this study provides insights on the poor's adaptive potential to shocks of different nature. In doing so, it departs from most studies to date, which focus exclusively on one type of shock;
4. It is among the first efforts to assess how Amazonian peasants are affected by and respond to riverbank erosion — the dynamism of the Upper Amazon floodplain is well recognized in the literature, but has rarely been studied;
5. This study shares the concern over the enormous burden that shocks may impose upon the poor, but at the same time aims to assess their responsive capacities;

6. Finally, this study among the *ribereños* of the Ucayali constitutes a "natural experiment" that serves as a lens through which we can learn about the prospects for human adaptation to environmental change (Kates 1987).

The remainder of this chapter is structured as follows. Section 2 describes the biophysical and socioeconomic setting for this study. Section 3 explains the methods used and provides a basic characterization of the sample. The main findings of this study are presented in Section 4; their implications for poverty and vulnerability reduction in the Upper Amazon and beyond are discussed in the final section (Section 5).

5.2. Study Area

This study is centered in the *selva central* of Peru, along the Central Ucayali floodplain near Pucallpa — Peru's main fluvial port in the Amazon, and one of the fastest growing cities in Peru. This city of 172,000 inhabitants in 1993 (INEI 1994)[2] is the capital of the Department of Ucayali. Although it is connected to Lima by road (i.e., ~750 km) (GOREU n.d.), the Ucayali River and its tributaries are the main "highway network" connecting Pucallpa with rural settlements within the Ucayali floodplain.

The region lies within the tropical lowlands at approximately 145m asl. Climate is hot and humid throughout the year (26°C, 1650 mm), with a distinct dry season (July to September) (Bergman 1980, 41; Gentry and López-Parodi 1980, 1355; Lamotte 1990). Along the Ucayali, the yearly flood cycle (mean difference is approximately 9.3 m) determines the seasons and influences the rhythm of life along the floodplain (Bergman 1980). Local residents identify only two seasons: the flood season, or "winter", and "summer", when the river is low.[3] Floods add a fresh layer of sediment that contributes to restore soil fertility within

[2] Results from the 2005 Census were not yet available at the time of thesis preparation.

[3] The Ucayali (at Pucallpa) begins to rise typically during the latter part of September and reaches its peak at the end of February, or early March; at that point the river starts to recede again.

the floodplain (Higbee 1945; Denevan 1984; Hiraoka 1985b). The flood season, however, is often a period of stress, marked by food shortages and a greater risk of respiratory diseases (Murray and Packham 2002, 224-225; Goy and Waltner-Toews 2005, 48-49). Furthermore, every few years (i.e., 5-7 yrs), floodplain villages are submerged and crops destroyed by a big flood, furthering health problems, post-flood hunger and temporary migrations (Follér 1995; Tournon 2002; Goy and Waltner-Toews 2005).

The Ucayali is among the most dynamic meandering rivers in the world. Like many other rivers in the Upper Amazon, the Ucayali continually migrates back and forth within its floodplain. In the process, it destroys farms and villages, sometimes overnight, and creates extensive areas suitable for cultivation (Sternberg 1975, 17-18; Denevan 1984, 320). Average rates of lateral migration for the Lower Ucayali range between 100 and 160 m/yr (Kalliola *et al.* 1992, 77), but may be as high as 285 m/yr in some bends in the Central Ucayali near Pucallpa (Velásquez de la Cruz 2002). The Central Ucayali has been particularly dynamic during the last twenty-five years or so. During this period, there have been at least six meander cut-offs between the mouths of the Pachitea and the Aguaytía rivers. In addition, within the last fifteen years Pucallpa has seen the Ucayali move away from the edge of town to as far as 4.3 km (i.e., in 1990), only to return progressively less than a decade later, beginning to destroy some of the low-lying neighborhoods of the city by the 2003-04 flood season (Peruvian Navy 2003). Although the dynamism that characterizes rivers in the Upper Amazon has been recognized in the literature (Salo *et al.* 1986), its social and economic implications have rarely been systematically studied (see Salo *et al.* 1986; García Sánchez 1987; García Sánchez and Bernex de Falen 1994; Kalliola *et al.* 1999).

The *terra firme* and the floodplain are the main landforms in the region. The *terra firme* comprises Tertiary alluvial plains that rise about ten meters above the active floodplain (Bergman 1980, 45); these plains contain soils that are generally acidic and nutrient poor (i.e., Oxisols and Ultisols) (Nicholiades *et al.* 1984, 339; Sioli 1984, 676; Sombroek 1984, 525). The floodplain comprises low-lying and heterogeneous terraces of more recent formation (i.e., Holocene) which, depending on their elevation, are susceptible to more or less periodic flooding. The highest levees flood only every few years; lower levees are submerged for several days or a few weeks each year. Backswamps, sandbars and mudflats are the last to be exposed upon the low water season and are the first to flood when the river begins to rise again; they remain dry barely long enough for rice and other annual crops to mature. Their soils vary in texture, tend to be chemically neutral, and of high to moderate fertility (i.e., Fluvisols, Gleysols, and Entisols) (Petrick 1978; Sombroek 1984, 532-533).

According to official estimates, approximately 70,000 people lived in rural settlements in the Coronel Portillo Province in 1993, most of them along the Ucayali River, its tributaries and lakes (INEI 2006).[4] Most floodplain villages have an elementary school and receive precarious medical attention by an itinerant nurse. There are two main cultural groups living in the Central Ucayali region: the *ribereño* (mestizo) and the Shipibo (Amerindian). Both groups have a long history of occupation and traditional resource use on the floodplain, and of partial integration with regional, national and international markets (Bergman 1980; Eakin *et al.* 1986; Padoch 1988; Padoch and de Jong 1990; Hiraoka 1992; Coomes 1995; Tournon 2002). Despite their differences, Shipibos and *ribereños* may be both considered people of the floodplain. They make a living from farming, fishing and forest extraction within the floodplain and nearby upland areas. Both groups practice swidden-fallow agriculture on higher areas of the floodplain and nearby uplands, and plant lower areas exposed during the low water season (i.e., floodplain farming). Land — their main asset — is typically held in usufruct and is transferred along kin lines. Although formal tenure rules are increasingly being used to back claims, land markets remain incipient (see Chapter 4). The high dynamism of the Ucayali makes land an ephemeral resource,

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4 Official statistics published by INEI (National Institute for Statistics and Informatics) fail to provide details on the distribution of the population between upland and floodplain areas. As such, the number of rural people is not necessarily equivalent to that of people who inhabit the Ucayali floodplain. In 1993, the districts that encompass predominantly the Ucayali floodplain (i.e., Callaría, Iparía, Masisea and Yarinacocha) accounted for 81% of the rural population in the Coronel Portillo Province.

creating a space for unclear rights and overlapping claims. As a result, tenure rights are typically defined by the interplay between formal and customary rules.

In addition to floods and river channel dynamics, local residents are also exposed to various health problems. Malnutrition, diarrhea and respiratory infections are common along the Central Ucayali (Goy and Waltner-Toews 2005). Furthermore, the risk of snake bites and accidents while clearing and tending their agricultural fields, or while in the forest, is considerably high.

Like much of the peasantry in developing nations, rural residents along the Ucayali remain marginalized from formal credit and insurance. Overall, these people must cope with shocks on their own or with the help of informal (mutual) insurance systems and money lenders.[5] The fact that peasant households are so marginalized in such a dynamic environment makes the Central Ucayali a unique setting to study the links between shocks and asset evolution.

5.3 Methodological approach and sample characteristics

For comparative purposes, three riverine peasant villages were selected for this study. Exito, Puerto Angel and Monte de los Olivos (henceforth Los Olivos) are located within four hours of travel upstream from Pucallpa (i.e., < 75km), in an area under the influence of a recent anthropogenic meander cut-off (see Chapters 2 and 3). The villages are small (i.e., <100 households); they also capture some of the ecological heterogeneity of the floodplain (i.e., floodplain/upland, different floodplain land types) and differential changes introduced by the cut-off (i.e., travel distance, flooding patterns and natural resource availability) (see Chapters 2 and 3). Found on a levee within the floodplain at the confluence of the Ucayali River and the Mashangay creek, Exito is many kilometers away from the nearest upland area. Puerto Angel is situated on a bluff upstream from the cut-off; it has access to both upland and floodplain areas for settlement and farming. Los Olivos, the third site, is a lowland

5 The Peruvian Navy, INDECI (National Institute for Civil Defense), and the Municipal Government provide assistance for disaster relief. Their scope, however, is limited to temporary relocation and the provision of emergency food and blankets.

community located immediately downstream from Puerto Angel. Surrounded by other (older) villages (i.e., Puerto Angel and Santa Isabel), Los Olivos has no access to the uplands just behind it.

Each village has a distinct history with floods and floodplain dynamics, and all three were affected — though differently — by the 1997 meander cut-off at Bahuanisho (see Chapters 2 and 3). Exito, which is situated on the outer bank of a meander, has periodically lost land to riverbank erosion since it's formation in the early 1900s. However, since the 1997 cut-off, riverbank erosion into village lands intensified dramatically and the high levees — which used to flood only every seven to ten years — flooded for at least four consecutive years following the cut-off. According to residents in Exito, the village — which stands on a levee that is more or less perpendicular to the Ucayali — had already moved back its entire length three times since its foundation in 1908, making it the fourth Exito (E26 2002).[6] When I conducted research in this village in 2002-03, the village was located in what used to be agricultural land behind the community, approximately two hours by foot (i.e., approximately 6 km) from the site it occupied in the 1970s (E05 2002). By then, the boundary between Exito and Santo Domingo —the neighboring village behind — was located less than one kilometer from the bank of the Ucayali.

Puerto Angel was founded within the floodplain on the true right bank of the Ucayali, in the 1930s. However, the village relocated on a bluff across the river, on the site of a former estate following a major flood a few years later (PAKI01 2003).[7] Up until the cut-off at Bahuanisho, the river threatened the homes and farms of Puerto Angelinos. Since the cut-off, erosion shifted to the opposite bank (i.e., right bank) and by the time I conducted fieldwork in the village, the river had begun depositing sediment in front of the bank it previously eroded; residents with fields across the river (i.e., on the right bank) were experiencing land losses. In contrast with Exito, flood levels since the cut-off

6 Informants are identified by the village and household identification number, followed by the year of communication.

7 PAKI01 denotes Puerto Angel key informant # 1; this informant was not part of the stratified random sample.

have become consistently lower in Puerto Angel and in other upstream communities.

Finally, the formation of Los Olivos, the smallest village in my sample, is directly linked with the cut-off and its effects on nearby reaches. Most residents in Los Olivos first arrived to the site in response to higher flood levels experienced in Ega (i.e., their former site) after the river took a new course. They established plantations and spent the flood season at Los Olivos, returning to Ega to plant annual crops between the floods. In 2003, these people moved permanently to Los Olivos due to riverbank erosion in Ega.

The data used in this chapter were gathered through a survey with 73 *ribereño* households between June and December 2003, capturing 53, 33 and 93 percent of the total sample population in Exito, Puerto Angel and Los Olivos, respectively. The survey, which was conducted in Spanish by the author and a local field assistant, focused on various aspects of peasant livelihood and floodplain dynamics and paid particular attention to households' experience with shocks. As part of the survey, respondents were asked to recall any health (i.e., illnesses and accidents) and environmental shocks (i.e., floods and riverbank slumps)[8] experienced since household formation, about the timing of each shock, and how they coped with them.[9] In addition, local residents were asked to single-out shocks that were particularly difficult to cope with for further questioning. For each "major shock" households were asked several questions about land holdings, land use and assets to enable me to better assess the effects of different types of shocks on wealth (i.e., land and assets) and peasant livelihood. For each major shock, I recorded any losses or liquidation of assets, as well as assets remaining. Placing emphasis on major shocks had two significant advantages: 1) it served as a concrete point of reference that aided respondents in the recollection of information about the past and thus helped to reduce problems of respondent accuracy (see Peters 1988; Beckett *et al.* 2001); and 2) it accounted for those

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8 Respondents sometimes reported combined floods with riverbank slumps; these are treated as a separate category called "flood-riverbank slump."

9 Health and environmental shocks were the main types of shocks identified by local informants.

moments with the greatest potential to reshape wealth holdings and asset evolution. In the end, this information was grouped into a unique retrospective dataset that captures the complete shock history of 68 households[10] between 1952 (i.e., since household inception) and 2003 to study the links between health and environmental shocks and land holding evolution. Unfortunately, due to time and logistical constraints the author was unable to systematically locate and interview households that had migrated from these villages, thus creating a potential source of bias.

Culturally, the three study communities are inhabited by one of the main cultural groups in then region, the *ribereño* — mixed descendants of Amerindians and European migrants who use traditional methods to farm, fish and extract products from the forest (Padoch 1988; Padoch and de Jong 1990; 1992; Hiraoka 1992; Chibnik 1994; Coomes and Burt 1997; Barham *et al.* 1999; Coomes *et al.* 2000) and sometimes engage in seasonal wage labor. Although *ribereño* livelihoods are typically diverse, farming and fishing are the main economic activities in the study sites.[11]

Local income levels are typically low and assets are few (Table 5.1). In 2002, households in my sample earned, on average, approximately US$ 3,490/yr including subsistence and cash income. There are, however, significant differences in income, both across and within the three sites (for more details see Chapter 2).

Asset holdings consist of land and non-land assets (e.g., fishing nets, boats and canoes, shotguns, radios, livestock, etc.). As is common in other agrarian societies, land is the main asset held by *ribereños*. Households hold, on average, 9.5 ha distributed across the different landforms within the floodplain (63%) and nearby uplands (37%). *Ribereños* in the study sites typically use the highest areas of the floodplain (i.e., the high levees), which tend to remain dry during the flood

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10 Five households were excluded from the analysis. One of them was a former village resident who had migrated to Pucallpa before forming a household. Two others were households that arrived to the site(s) within the six months prior to the interview. Finally, two additional households that had been temporarily absent from their respective villages and whose land holdings had been shaped primarily by gift were also excluded.

11 Economic importance is based on household participation rates and economic reliance (i.e., share of households that derive 50% or more of their income from a given sector).

Table 5.1 Selected sample characteristics, Central Ucayali 2003 (n=68 households).

	Exito (n=28)			Puerto Angel (n=31)				Los Olivos (n=9)				All villages (n=68)			Anova	
	Mean	S. D.	Range	Mean	S. D.	Range		Mean	S. D.	Range		Mean	S. D.	Range	F	Sig.
No. of years since household formation	18.3	10.8	(2-41)	16.6	10.8	(3-47)		15.2	15.1	(2-38)		17.1	11.3	(2-47)	0.31	
Age of the household head at formation (yrs)	25.8	6.6	(17-38)	27.3	6.2	(18-46)		26.9	9.6	(20-51)		26.6	6.8	(17-51)	0.36	
Adult males (15-64 yrs)	1.7	1.0	(1-4)	1.8	1.0	(1-4)		1.9	1.8	(1-6)		1.8	1.1	(1-6)	0.15	
Adult females (15-64 yrs)	1.3	0.5	(0-2)	1.2	0.6	(0-3)		1.0	0.0	n.a.	**	1.2	0.5	(0-3)	1.18	
Household size	5.6	2.1	(1-10)	5.5	1.9	(1-11)		4.6	1.9	(3-9)		5.4	2.0	(1-11)	1.05	
Total assets (S/.)	2507	4641	(35-20958)	3777	4152	(0-18700)		2334	1886	(805-5390)		3063	4154	(0-20956)	0.84	
Total land holding size (ha)	7.3	6.0	(0.25-30.7)	10.3	9.4	(0.79-33.18)		4.0	3.6	(0.35-12.25)	**	8.2	7.8	(0.25-33.17)	2.80	*
Area in upland (ha)	0.1	0.8	(0-4)	5.6	8.21	(0-28)	***	0.0	0.0		▲▲▲	2.6	6.2	(0-28)	8.24	***
Area in high levee (ha)	0.9	2.3	(0-10.5)	2.5	2.6	(0-12.5)	**	3.9	3.6	(0.35-12.25)		2.04	2.79	(0-12.5)	5.52	***
Area in low levee(ha)[1]	4.4	3.0	(0.25-12)	1.1	1.9	(0-9)	***	0.1	0.2	(0-0.5)	***▲▲	2.3	2.9	(0-12)	19.17	***
Area in mudflat (ha)	1.3	4.8	(0-25)	0.7	0.8	(0-3)		0.0	0.0		▲▲▲	0.8	3.1	(0-25)	0.60	
Area in sandbar (ha)	0.7	1.2	(0-4.86)	0.3	0.4	(0-1.5)		0.0	0.0		**▲▲▲	0.4	0.8	(0-4.86)	2.88	*
Total income 2002 (S/.)	7759	7436	(1264-40791)	13264	10843	(250-43230)	*	15700	9273	(1570-29384)		11320	9556	(250-43230)	3.83	**
% of hhlds that experienced shocks*	96	19		94	25			100	0.00			96	21		0.37	
% of households with illness	68	47.6		81	39.7			70	50			74	44		0.73	
% of households with flood	61	49.7		35	48.2			70	50			50	50		2.52	*
% of households with riverbank slump	89	31.4		68	48			30	50		**	72	45		6.35	***
% of households with flood-riverbank slump	21	42.8		6	25			0	0		**	12	32		2.34	
No. of shocks*	5.3	3.1	(0-13)	2.5	1.6	(0-6)	***	2.6	1.9	(1-6)	***	3.7	2.7	(0-13)	10.72	***
Health shocks	1.04	1.14	(0-4)	0.87	0.56	(0-3)		0.77	0.66	(0-2)		0.93	0.85	(0-4)	0.43	
Floods	1.00	1.50	(0-7)	0.48	0.85	(0-4)	*	1.20	1.56	(0-5)		0.81	1.27	(0-7)	1.99	
Riverbank slumps	2.82	2.00	(0-8)	1.16	1.16	(0-4)	***	0.56	1.01	(0-3)	***	1.76	1.78	(0-8)	11.57	***
Flood-riverbank slumps	0.32	0.72	(0-3)	0.06	0.25	(0-1)		0.00	0.00		*	0.16	0.51	(0-3)	2.53	*
No. of major shocks*	1.9	1.0	(0-4)	0.9	0.7	(0-2)	***	1.0	0.5	(0-2)	***	1.32	0.92	(0-4)	10.20	***
% of hhlds that relocated their house*	71	46		35	49		**	0	0		***▲▲▲	46	50		10.29	***
No. of times relocated house*	2.2	2.06	(0-7)	0.5	0.67	(0-2)	***	0.00	0.00		***▲▲▲	1.12	1.67	(0-7)	14.85	***

* Since household inception.

Note: 3.47 S/. = 1 US$

1. Also includes backswamp areas.

Tamhane test [unequal variances assumed] for mean difference with Exito *** : ≤ .01; ** : ≤ .05; * : ≤ .10.

Tamhane test [unequal variances assumed] for mean difference with Puerto Angel ▲▲▲ : ≤ .01; ▲▲ : ≤ .05; ▲ : ≤ .10.

season, to grow perennials (e.g., plantains, citrus, papaya, etc) or to establish home gardens; annual crops are sometimes sown there too (e.g., rice, maize, beans, also manioc and legumes). Annuals crops (i.e., maize, beans, manioc, rice, melons) are planted between the floods on lower land types, which flood for several weeks each year (i.e., low levee and backswamp). On the lowest and more unstable areas within the floodplain (i.e., mudflats and sandbars) *ribereños* grow primarily rice (mudflat), cowpeas and peanuts (sandbar). Upland areas are mainly used with short rotations of rice and manioc, followed by pasture, or a fallow period.

The availability of such landforms, and thus the potential to grow different crops, varies across the three study sites. For instance, Exito has access to land within the floodplain only. High levee land in this village has become increasingly scarce due to riverbank erosion and higher flood levels; the main existing land types are low levee, backswamp, and a newly-deposited area of sandbar and mudflat. Residents in Puerto Angel have access to both upland and floodplain areas; within the floodplain they have access to the broadest range of land types among the three sites (i.e., high and low levees, backswamps, mudflats and sandbars). High levee is the predominant land type available in Los Olivos. Non-land assets (i.e., fishing capital, other productive assets, consumer goods and livestock) held in 2003 were valued at approximately US$925; except for livestock and food stocks (e.g., manioc flour, rice, etc), they are not easily transferable.

Practically every household in the sample has endured a health or an environmental shock since household inception (96%, n=68), and on average, has experienced 3.6 shocks over their lifespan as a household (mean: 17 years) (Table 5.1). However, some respondents in Exito have experienced as many as 13 shocks between 1962 and 2003; a shock every third year or so.

Among the types of shocks considered in this study, health shocks and riverbank erosion were the most common, affecting on average, 74 and 71% of sampled households, respectively. In terms of incidence, respondents had twice as many riverbank slumps than health, or flood shocks (i.e., 1.7 vs. 0.9 and 0.8

shocks, respectively), though households may have experienced flooding or a riverbank slump as many as seven or eight times. Forty-five percent of respondents relocated their house due to riverbank erosion on at least one occasion (and up to seven times) since they established as a household.

5.4 Results

5.4.1 Incidence of shocks

My analysis begins with an assessment of the incidence of "major shocks" among residents in the three study sites (Figures 5.1 and 5.2 and Table 5.2). Rather than defining "major shocks" in absolute terms, for the purpose of this study they are considered to be those shocks that respondents reported to have difficulties coping with. In other words, these are shocks against which local residents felt most vulnerable and that could have affected their ability to cope with subsequent contingencies.

Results suggest that *ribereños* have a high probability of experiencing a major shock (i.e., > 80% of the entire sample) and have been affected by more than one, and up to four major shocks during their lifetime as a household. Although health shocks and major floods are common in the region, riverbank erosion is by far the main type of shock, both in terms of probability of a major riverbank slump and number of times affected. Close to 50% of respondents reported major riverbank slumps and on average experienced more riverbank slumps than other types of shocks.

Shock exposure varies considerably across the three study sites. For instance, exposure to major riverbank slumps is significantly higher in Exito than in Los Olivos, in terms of probability and number of times affected. Two-thirds of the residents in Exito had experienced riverbank slumps, whereas less than 25% of the residents in Los Olivos had suffered a similar shock. The number of riverbank slumps was also much higher in Exito than in Los Olivos (i.e., 0.7 vs. 0.2, respectively), forcing as many as 75% of its residents to disassemble and relocate their house an average of two times during their lifespan. Such results

Figure 5.1 Probability of major shocks during lifespan as a household (n=68).

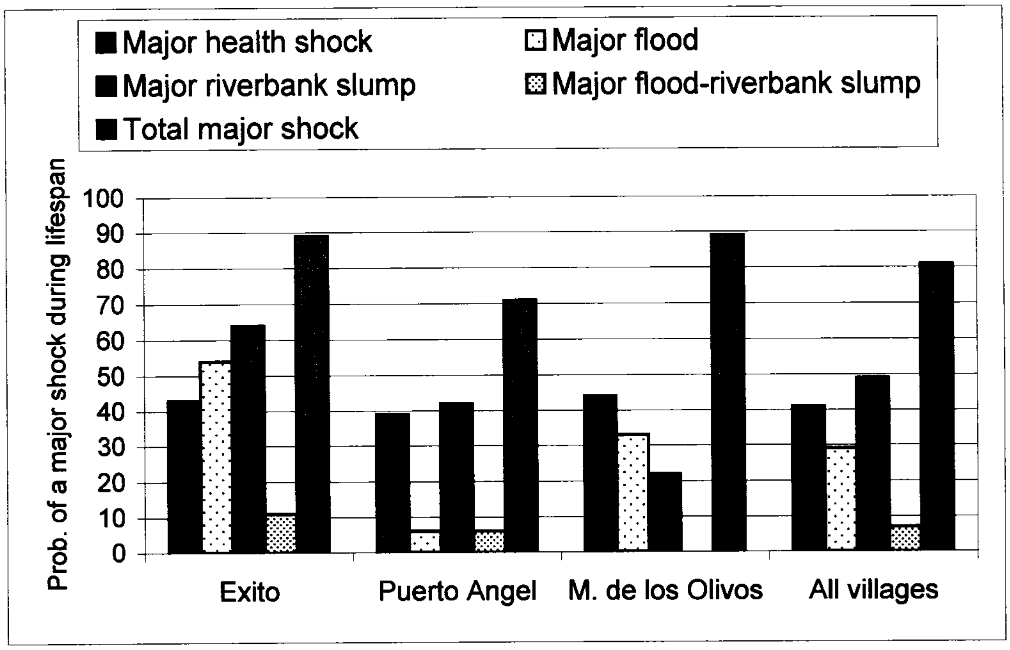
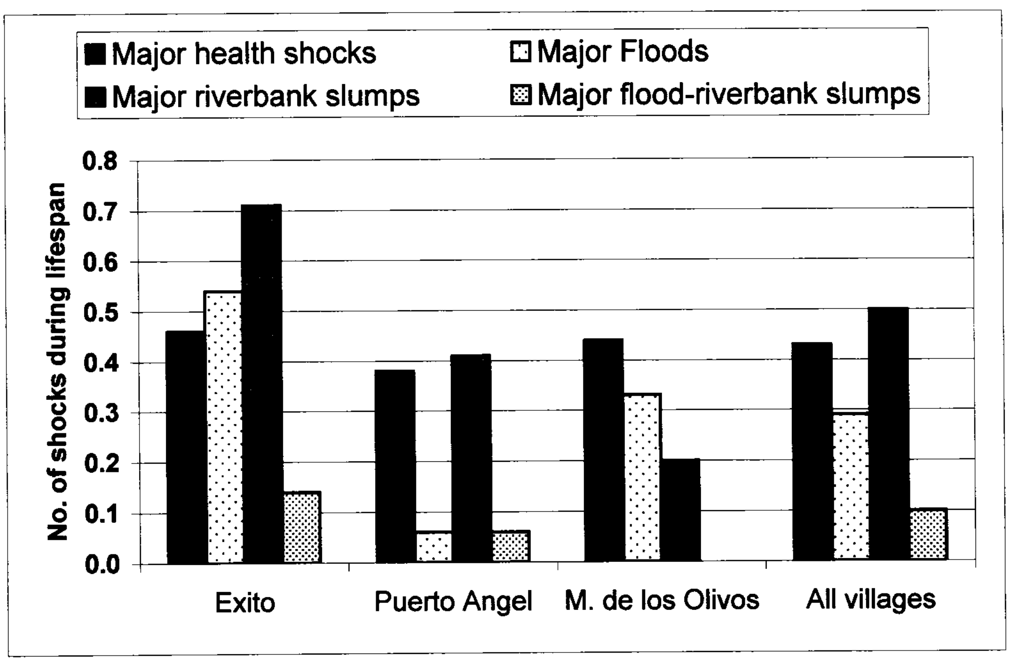


Figure 5.2 Mean number of major shocks since household formation (n=68).



Major shocks	1.9	0.9	1	1.3

Table 5.2 Major shock history in study villages, Central Ucayali, 2003 (n=68 households).

	Exito (n=28)				Puerto Angel (n=31)				Los Olivos (n=9)				All villages (n=68)			Anova	
	Mean	S. D.	Range		Mean	S. D.	Range		Mean	S. D.	Range		Mean	S. D.	Range	F	Sig.
Probability of experiencing a major shock	89	31			71	46			89	33			81	39		1.83	
Prob. of major health shock	43	50			39	50			44	53			41	50		0.07	
Prob. of major flood	54	51			6	25		***	33	50			29	46		9.85	***
Prob. of major riverbank slump	64	49			42	50			22	44		*	49	50		3.04	**
Prob. of major floods-riverbank slumps	11	31			6	25			0	0			7	26		0.59	
Total no. of major shocks	1.9	0.97	(0-4)		0.9	0.73	(0-3)	***	1.0	0.50	(0-2)	***	1.3	0.92	(0-4)	10.20	***
No of major health shocks	0.5	0.58	(0-2)		0.4	0.50	(0-1)		0.4	0.53	(0-1)		0.4	0.53	(0-2)	0.16	
No of major floods	0.5	0.51	(0-1)		0.1	0.25	(0-1)	***	0.3	0.50	(0-1)		0.3	0.46	(0-2)	9.85	***
No. of major riverbank slumps	0.7	0.60	(0-2)		0.4	0.50	(0-1)		0.2	0.44	(0-1)	**	0.5	0.56	(0-2)	3.74	**
No. of major flood-riverbank slumps	0.1	0.45	(0-2)		0.1	0.25	(0-1)		0.0	0.00			0.1	0.33	(0-2)	0.76	

Tamhane test [unequal variances assumed] for mean difference with Exito *** : P≤ .01; ** : P≤.05; * : P≤ .10.
Tamhane test [unequal variances assumed] for mean difference with Puerto Angel ▲▲▲: P≤ .01; ▲▲: P≤ .05; ▲: P≤ .10.
Significance of Anova *** : P≤ .01; ** : P≤.05; * : P≤ .10.

are not surprising given Exito's location on the outer bank of an active meander bend, without access to the uplands. As expected, major floods were less common in Puerto Angel, where there is access to upland areas, *vis-à-vis* the lowland villages. Exposure to health shocks is consistently high across the study sites.

The next step was to explore whether the Bahuanisho cut-off, which transformed environmental conditions in the area of study, had also modified shock exposure among respondents (see Table 5.3 and Figure 5.3). Overall, the number of major shocks increased by one-third since 1997 (i.e., the year of the cut-off) due primarily to the intensification of major riverbank slumps, which rose by 75% (t = -1.59, sig. < .15) after the cut-off. Since 1997, respondents in both lowland villages have also suffered from more major floods. These results, although only statistically significant for riverbank slumps and flood-riverbank slumps, are consistent with reports of more frequent flooding (i.e., downstream) and less frequent flooding (i.e., upstream), and of the intensification of riverbank erosion following the cut-off (see Chapter 2).

5.4.2 Immediate effects of shocks

How do different types of shocks affect asset holdings among *ribereño* households along the Central Ucayali? Figures 5.4-5.8 present changes in land and non-land assets (i.e., due to direct losses or asset liquidation) following major shocks among our respondents.

Three main findings emerge from the data. First, major shocks had a greater impact on land than on non-land assets in the three communities (see Figures 5.4 and 5.5). On average, households lost one third of their land holdings following a major shock; non-land assets were reduced by less than five percent. Second, asset holdings were more severely affected by shocks directly (i.e., losses) rather than indirectly (i.e., asset liquidation). For instance, shocks involving the loss of land to riverbank erosion (i.e., riverbank slumps and floods with riverbank slumps) caused a contraction in land holdings of 46%, or more; land holdings remained stable following health shocks and major floods (Figure

Table 5.3 Mean number of major shocks relative to the Bahuanisho cut-off (n=68).

	Health shocks		Floods		Riverbank slumps		Floods-r. slumps		Major shocks	
	Cut-off		Cut-off		Cut-off		Cut-off		Cut-off	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Exito	0.25	0.21	0.21	0.29	0.29	0.46	0	0.14+	0.75	1.11
Puerto Angel	0.19	0.19	0.03	0.03	0.16	0.25	0	0.06	0.38	0.54
Los Olivos	0.2	0.2	0.1	0.2	0	0.2	0	0	0.3	0.7
All villages	0.22	0.21	0.11	0.16	0.19	0.34+	0	0.09*	0.53	0.79*

T-test significance: *** : P ≤.01; ** : P ≤ .05; * : P ≤ .10; + : P ≤ .15
Note: Numbers represent the mean number of major shocks experienced during that period. For example, residents in Exito experienced, on average, 0.29 major shocks before the cut-off; 0.46 major shocks after the cut-off.

Figure 5.3 Mean number of major shocks in relation to the Bahuanisho cut-off, by village (n=68).

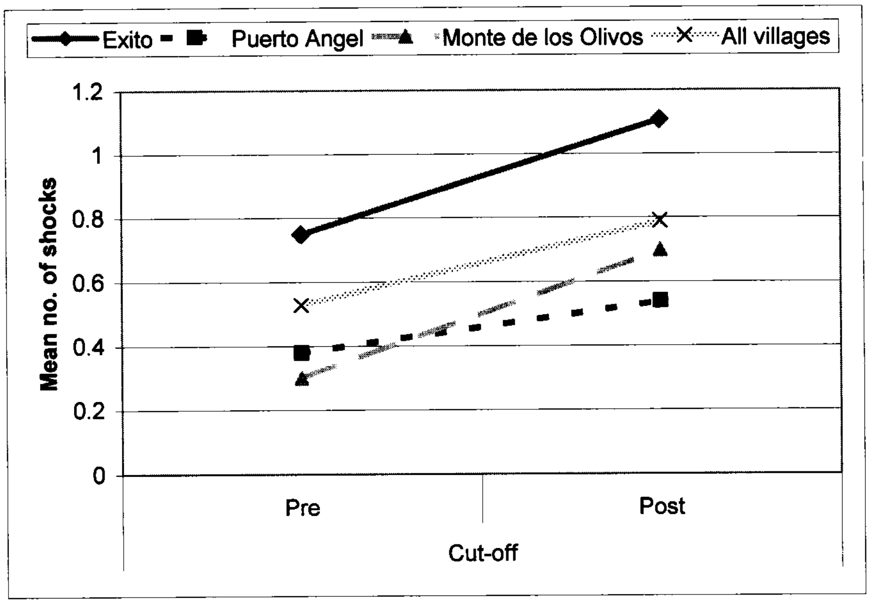
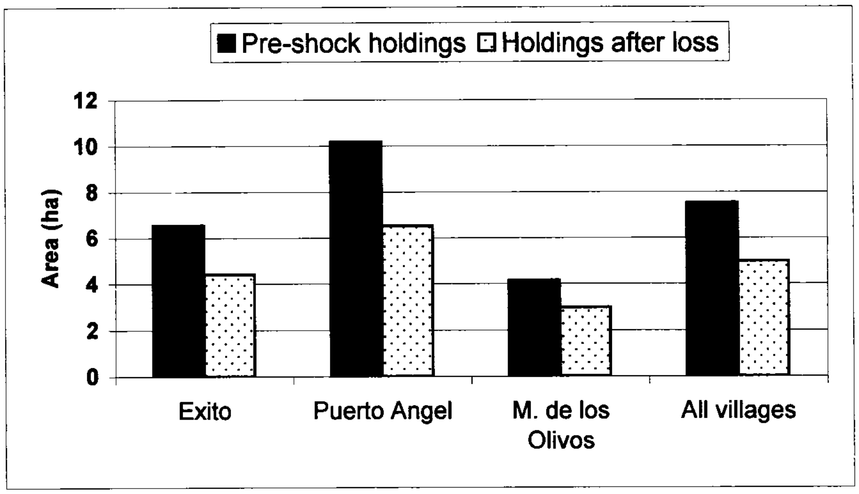
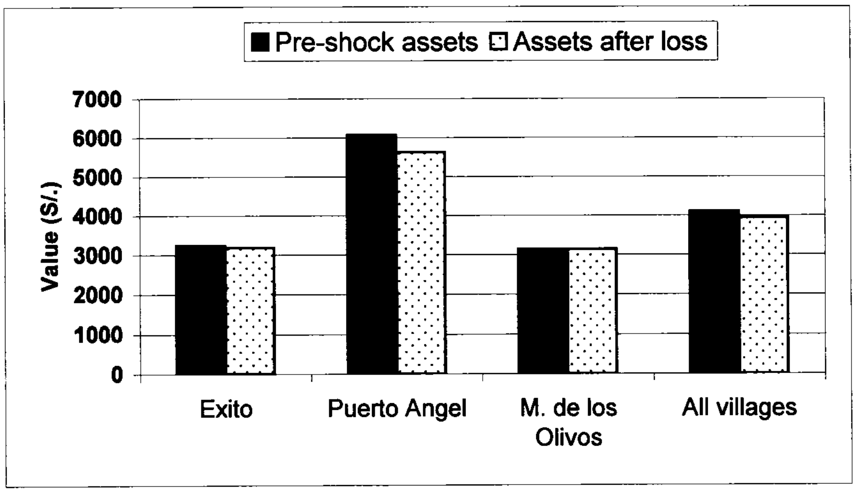


Figure 5.4 Immediate effect of shocks on land holdings, Central Ucayali. (n=87 shocks).



Land losses (%)	32	36	28	34

Figure 5.5 Immediate effect of shocks on non-land assets, Central Ucayali. (n=85 shocks).



Non-land asset losses (%)	2	7	0	4

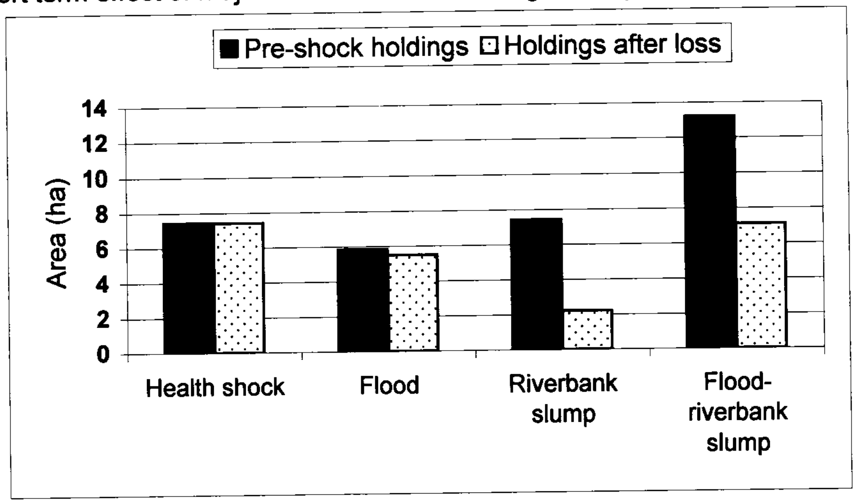
5.6). In turn, the liquidation of non-land assets in response to shocks was less common and was limited almost exclusively to health shocks (Figure 5.7). This finding is not surprising given that health shocks typically increase cash needs to pay for medications and travel to the city, and contract labor supplies within the household. The remainder of this chapter focuses specifically on the links between shocks and land holdings.

Third, besides affecting land holding size, shocks involving riverbank slumping had an impact on the different types of land held by respondents (Figure 5.8a-d). The data suggest that riverbank slumps (and flood-riverbank slumps) affected primarily higher areas of the floodplain (i.e., high levees), which are key for subsistence and cash income and serve as a refuge during the flood season. This situation has been particularly critical in Exito, where residents have no access to upland areas. The average resident in Exito that has experienced a major riverbank slump has gone from holding 2.3 hectares in high levee before the slump, to less than 0.2 hectares; high levee holdings shrank from 2.2 hectares to 0.9 after major flood-riverbank slumps (Figure 5.8. Low levee areas have also been affected by riverbank slumps, and although low levees are used for agriculture, they are not as critical because of their high susceptibility to floods.

5.4.3 Household responses to shocks

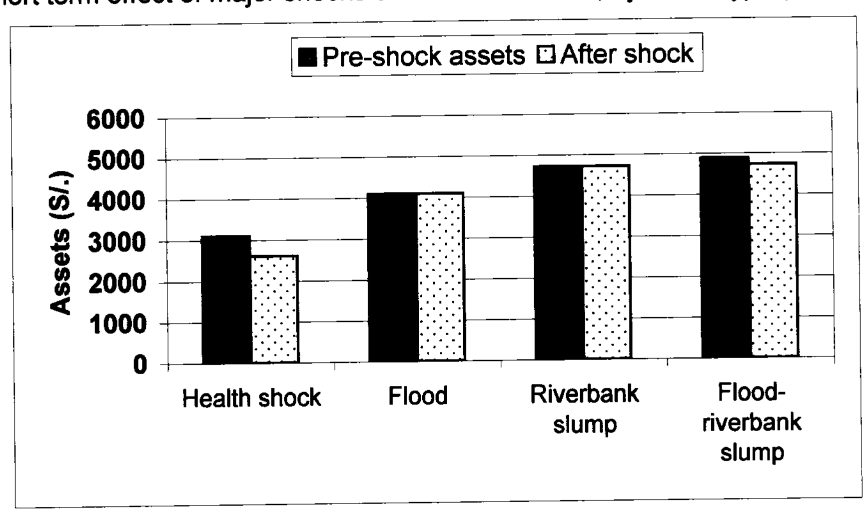
How do *ribereños* respond to major shocks? Respondents reported a variety of strategies to cope with major health and environmental shocks. Based on the literature (see Fafchamps 1999; World Bank 2000 for some reviews), I have organized responses from my informants into two general categories: those used to mitigate the effects of shocks (i.e., *ex ante*), and strategies used to cope with shocks after they have occurred (i.e., *ex post*). Although household responses vary depending on the nature of the shock, it appears that *ribereños* tend cope with, rather than mitigate, the effects of major shocks. Listed below are the main responses to health shocks, floods, riverbank slumps and flood-riverbank slumps reported by my informants.

Figure 5.6 Short term effect of major shocks on land holding size, by shock type (n=87 shocks).



Land losses (%) 0 6 70 46

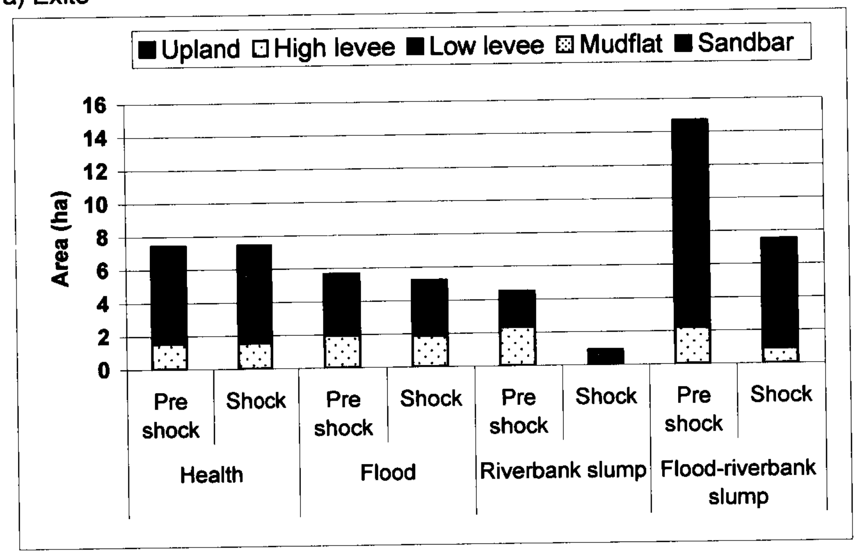
Figure 5.7 Short term effect of major shocks on non-land assets, by shock type (n=87 shocks).



Non-land asset losses (%) 16 0 0 4

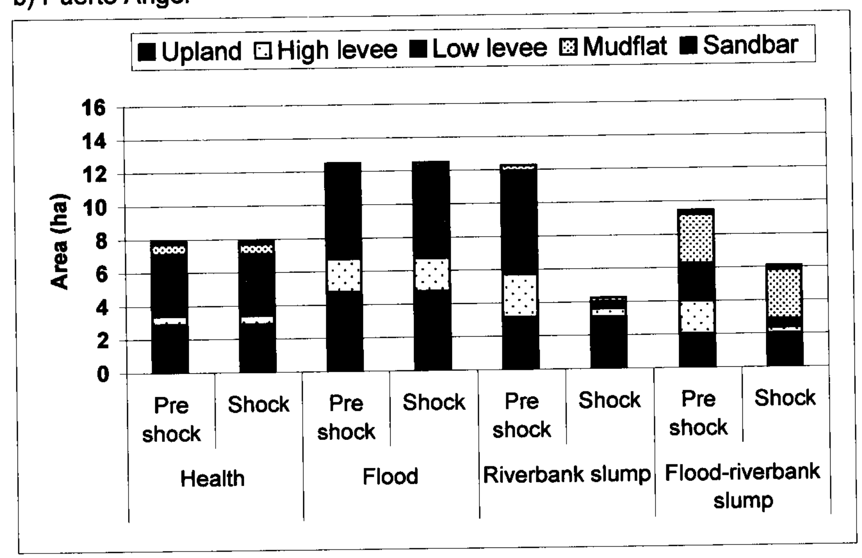
Figure 5.8 Effect of major shocks on land holding portfolios by shock type (n=87 shocks).

a) Exito



	T-test	*T*-test	*T*-test	*T*-test
Upland	--	--	--	--
High levee	--	1.02	3.49 ***	1.34
Low levee	--	1	3.215 ***	2.32 *
Mudflat	--	--	--	--
Sandbar	--	--	--	--
N	13	15	19	5

b) Puerto Angel

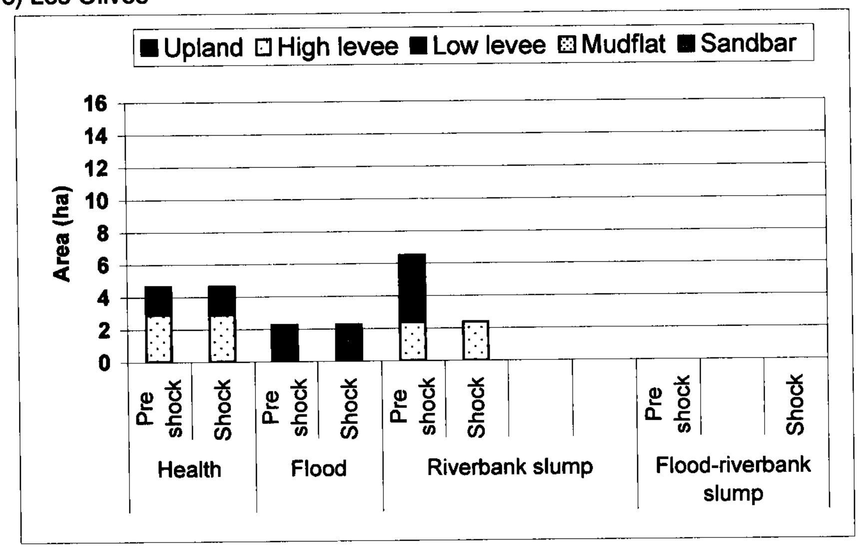


	T-test	*T*-test	*T*-test	*T*-test
Upland	--	--	1	--
High levee	--	--	6.66 ***	2.6
Low levee	--	--	2.57 **	1
Mudflat	--	--	1	--
Sandbar	1	--	--	--
N	12	2	12	2

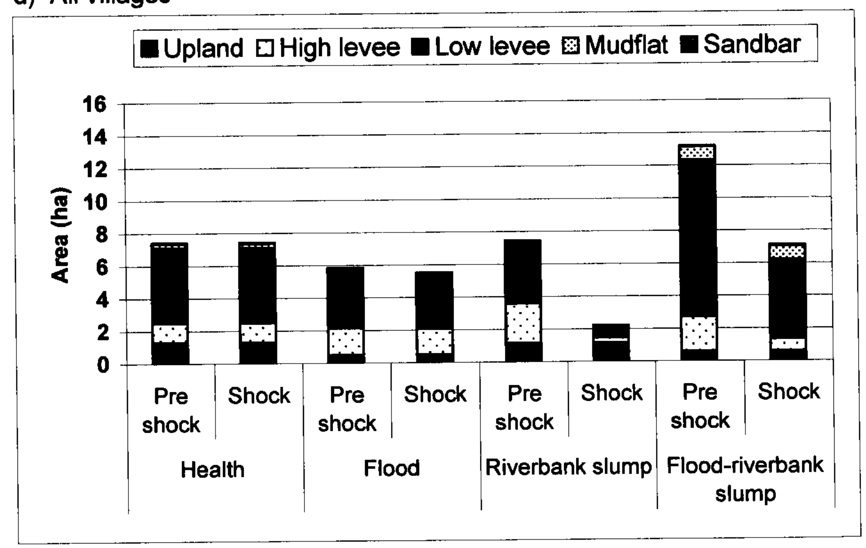
T- test significance: *** : P≤ .01; ** : P≤.05; * : P≤ .10.

Figure 5.8 Effect of major shocks on land holding portfolios by shock type (n=87 shocks) (continued).

c) Los Olivos



d) All villages



	T-test	*T*-test	*T*-test	*T*-test
Upland	--	--	--	--
High levee	--	--	--	--
Low levee	--	--	1.435	--
Mudflat	--	--	--	--
Sandbar	--	--	--	--
N	2	3	2	--

	T-test	*T*-test	*T*-test	*T*-test
Upland	--	--	1	--
High levee	--	1.1	5.96 ***	2.03 *
Low levee	--	1	3.35 ***	2.42 *
Mudflat	--	--	1	--
Sandbar	1	--	--	--
N	27	20	33	7

T- test significance: *** : P≤ .01; ** : P≤.05; * : P≤ .10.

Responses to health shocks

When dealing with an illness or an accident, *ribereños* in the study sites typically used up savings, sold their livestock (i.e. chickens, pigs and in some cases cattle), or used income from a store, if they owned one (Figure 5.9). Subsequently, they sought help from kin (e.g., mutual insurance, informal loans), used cash derived from rice or plantains, or engaged in fishing and wage labor. Non-land assets were typically liquidated as a last resort.

Responses to floods

Residents of the Central Ucayali mitigated the effects of floods by storing manioc flour, rice and other foods (see Figure 5.10).[12] Once affected by a flood, households bought food and turned to fishing, off-farm work and extraction to meet subsistence and cash needs until the river receded and annual crops could be planted again. Exchanging fish for plantains or manioc flour (i.e., a form of barter) was an important coping strategy for some households. Other forms of mutual insurance were less common for covariant shocks such as floods. Mutual insurance was important only in the village that had access to the uplands (i.e., Puerto Angel). In some instances local residents migrated, temporarily or permanently, in response to major floods.

Responses to riverbank slumps

The predictability of riverbank erosion along meandering rivers like the Ucayali, to some degree, allows *ribereños* to mitigate the effects of riverbank erosion. Local residents often anticipated a riverbank slump and cleared new plots for cultivation, preparing themselves for eventual land losses (Figure 5.11); livestock was sometimes used to mitigate riverbank slumps. If caught off-guard, *ribereños* turned to some of the same strategies used for coping with floods,

[12] Spreading risk over multiple plots and different crops was only reported in one case (i.e., 5% of the cases). However, based on field observations, I believe that this practice might be more common.

Figure 5.9 Selected household responses to major health shocks, Central Ucayali.

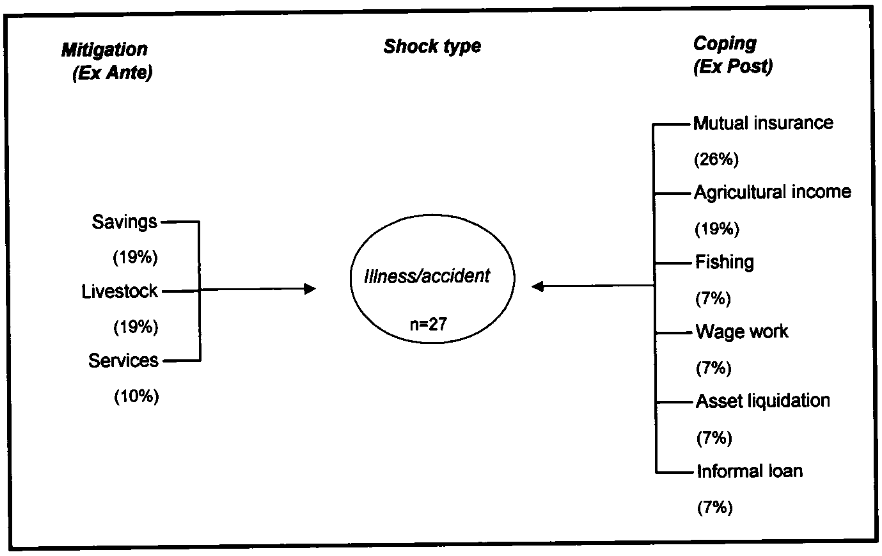
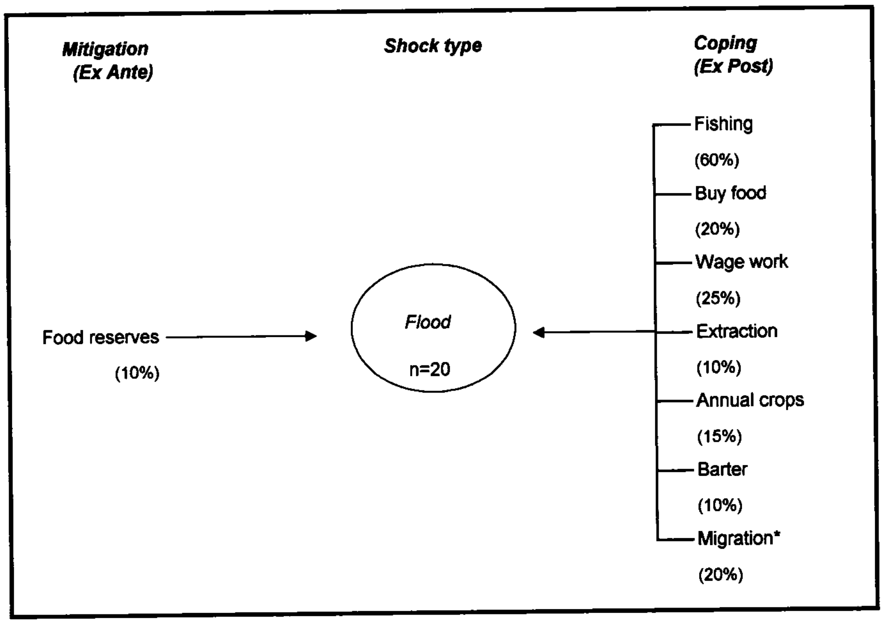
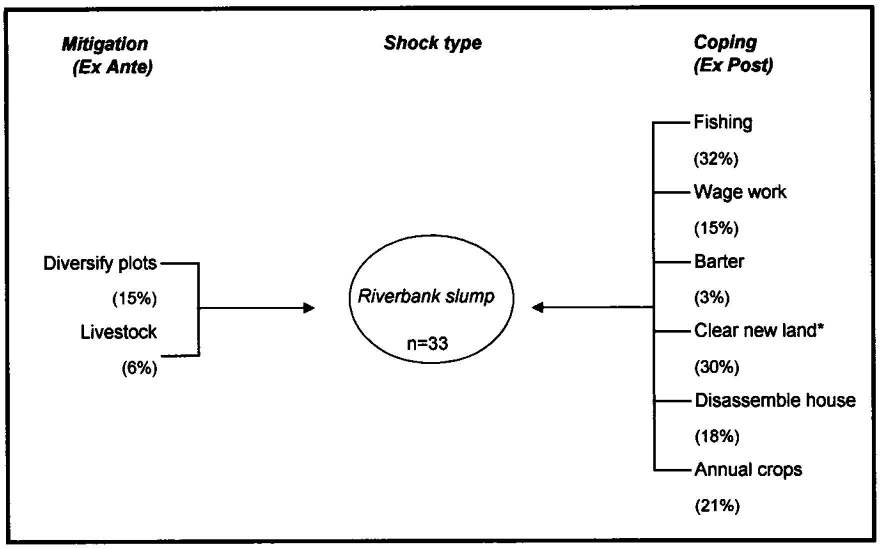


Figure 5.10 Selected household responses to major floods, Central Ucayali.



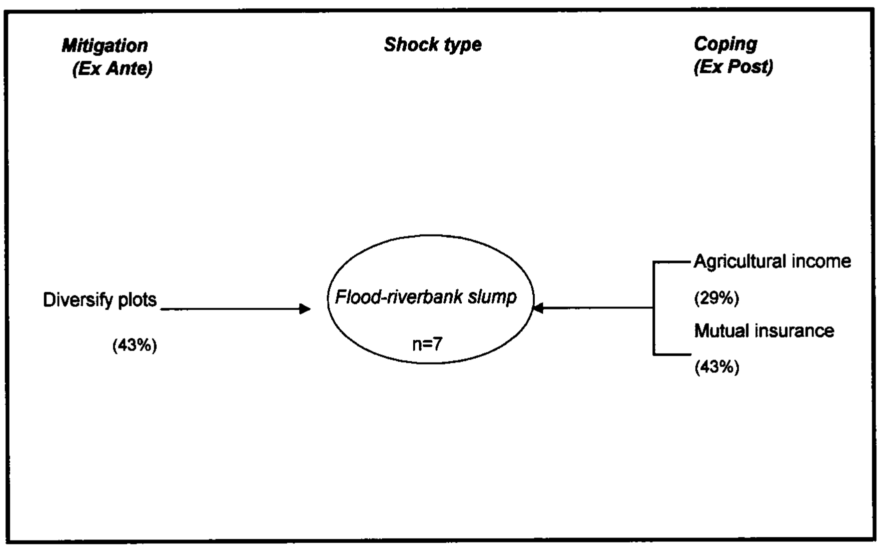
* Includes temporary and permanent migration.

Figure 5.11 Selected household responses to major riverbank slumps, Central Ucayali.



*includes upland and floodplain

Figure 5.12 Selected household responses to major flood-riverbank slumps, Central Ucayali.



namely fishing, wage labor and barter. They also looked for new land further from the river's edge to establish annual crops for subsistence and cash income. Though houses were rarely destroyed by riverbank slumps, in many instances local residents disassembled their houses and relocated. Riverbank erosion was the reason that most households in Los Olivos moved permanently from Ega, where they had continued to live and work during the months that the river was low.

Responses to floods with riverbank slumps

As with regular riverbank slumps, plot diversification was the main mitigation strategy against flood-riverbank slumps (Figure 5.12). To cope with this type of shock, local residents relied primarily on assistance from kin and friends (i.e., mutual insurance) and income from annual cash crops.

These results are consistent with recent studies from the Peruvian Amazon which suggest that fishing is a key coping strategy against shocks (Takasaki *et al.* 2004). Fishing is a comparatively lower risk and higher return activity *vis-à-vis* other economic activities, and although often seasonal, returns are virtually immediate and labor demands are relatively low.[13] In comparison with other studies on tropical forest peoples, extractive activities seem to play a minimal role for shock insurance/coping among *ribereño*s of the Central Ucayali (e.g., Hecht *et al.* 1988; Cavendish 2000; Wunder 2001; McSweeney 2002; Takasaki *et al.* 2004). Extraction was present as a coping strategy in only one of the study sites (i.e., Exito). It was most common following a major flood, typically as a source of emergency food (e.g., breadfruit), but was still minimally used (i.e., ~10% of the cases in the village); extractive activities were used less frequently to cope with a riverbank slump and were not used to deal with health shocks. In the vicinity of

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[13] For instance, in terms of cash, *ribereños* are able to sell their catch on the same day, instead of having to wait several weeks or months for crops to mature. Nevertheless, fishing efficiency is lower during the flood season because fish tend to disperse within the floodplain forest. As such, fish are less abundant in *ribereño* villages during the flood season (Hiraoka 1995, 218).

Pucallpa extractive resources are scarce in many localities due to both human exploitation and river channel migrations.

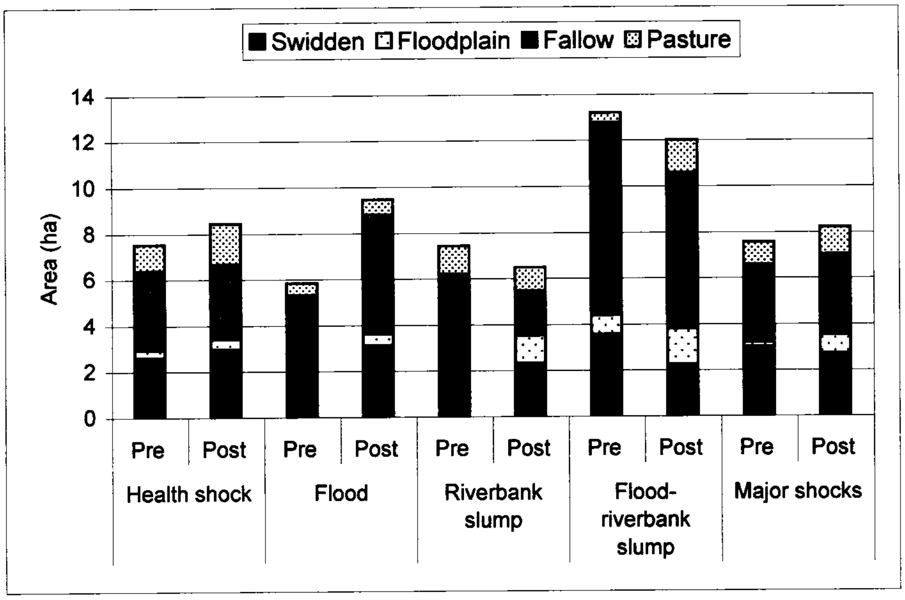
Working for kin or friends living nearby (especially along upstream reaches from the cut-off) or exchanging fish, both to obtain plantains — a major staple — is another interesting risk coping strategy. Such exchanges, although reported only for a small fraction of the cases, are probably more common than the data suggest, and might be especially important for poorer households. Exchanges of this sort are consistent with other studies among the Shipibo along the Ucayali. For instance, Tournon (1988, 61; 2002, 151-156) reported how, following major floods in 1984 and 1994, residents from lowland villages along the Central and Upper Ucayali exchanged fish and bush meat for plantains, manioc and other agricultural products with relatives and friends from upland villages.

5.4.4 Livelihood responses to major shocks

But beyond initial responses, to what extent did *ribereños* modify their livelihood strategies in response to major shocks? An obvious way to explore this issue would have been to compare economic reliance before and after each major shock. However, this was not possible due to difficulties in reconstructing income data back in time. Instead, land use and crop land data before and after major shocks — which were readily available — served to tease out livelihood changes related to major shocks. Although shocks may have an impact on other economic activities, such as fishing, extraction, etc., my analysis is limited exclusively to agricultural uses.

The results suggest that *ribereños* responded more by modifying the nature of their cropping portfolios rather than by changing land use practices (Figures 5.13 and 5.14). In terms of land use, the only observed change was an increase in the areas in floodplain farming and in fallow (t= -2.49, sig. <0.05; t= -2.51, sig. <0.05, respectively). In response to major floods, respondents planted a

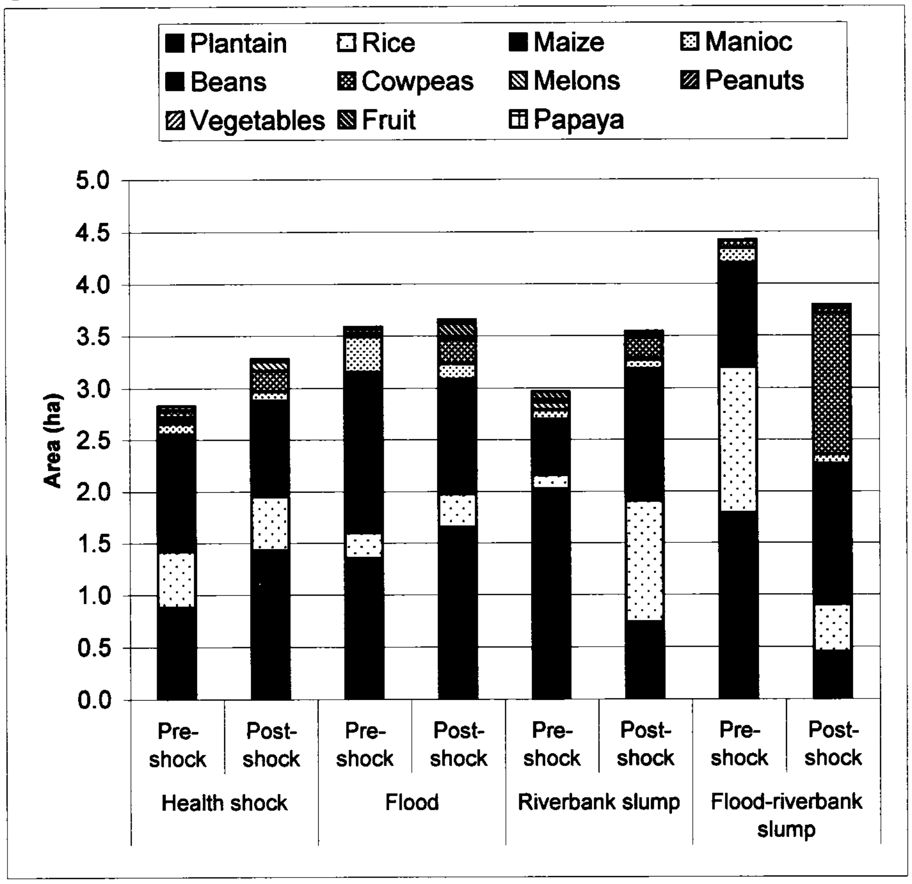
Figure 5.13 Land use before and after a major shock, by shock type (n=87).



	Health shock T- test Sig.	Flood T- test Sig.	Riverbank erosion T- test Sig.	ood-r.erosion T- test Sig.
Swidden	-0.72	1.02	0.89	1.87 +
Floodplain	-0.56	-2.50 **	-1.46	-0.63
Fallow	0.15	-2.51 **	1.44	0.55
Pasture	-1.57 +	-0.27	0.72	-1.00

T- test significance: *** : P≤ .01; ** : P≤.05; * : P≤ .10; + P≤ .15

Figure 5.14 Crop portfolios before and after major shocks, by shock type (n=87)



	Health shock	Flood	Riverbank erosion	Flood-r. erosion
	T- test Sig.	T- test Sig.	T- test Sig.	T- test Sig.
Plantain	-1.60 +	-0.97	2.77 ***	2.71 **
Rice	0.09	-0.32	-1.33	1.38
Maize	0.65	0.93	-2.05 **	-0.47
Manioc	0.25	1.55 +	-0.05	0.64
Beans	1.57 +		-1.00	
Cowpeas	-1.05	-1.81 *	-3.19 ***	-1.84 +
Melons	-1.00	1.00	1.39	
Peanuts	-1.00	1.26	-1.39	-1.00
Vegetable:	1.00	0.43	1.21	
Fruit	-1.00	-1.15	1.16	-1.00
Papaya		-1.00	-1.36	

T- test significance: *** : P≤ .01; ** : P≤.05; * : P≤ .10; + P≤ .15

larger area in cowpeas (i.e., an annual crop);[14] they shifted from perennials to annual crops following riverbank slumps, and reduced the area in plantain in response to floods with riverbank slumps (Figure 5.14).

Livelihood responses also varied across three study sites (Figure 5.15). In Exito, floodplain farming allowed respondents to maintain and actually increase the area in cultivation, off-setting reductions in the area in swidden observed following floods and riverbank slumps.[15] Residents in Los Olivos and Puerto Angel, in turn, altered their crop mix in response to major shocks; they turned increasingly to plantains (i.e., a perennial crop) and cowpeas (i.e., an annual crop), respectively.

Overall, these results suggest that *ribereños* adjust their livelihoods in response to major shocks. They do so according to the set of natural resources available to residents at their respective sites and according to the evolution of such endowments over time.

5.4.5 Short-term and long-term implications of shocks on land holding evolution

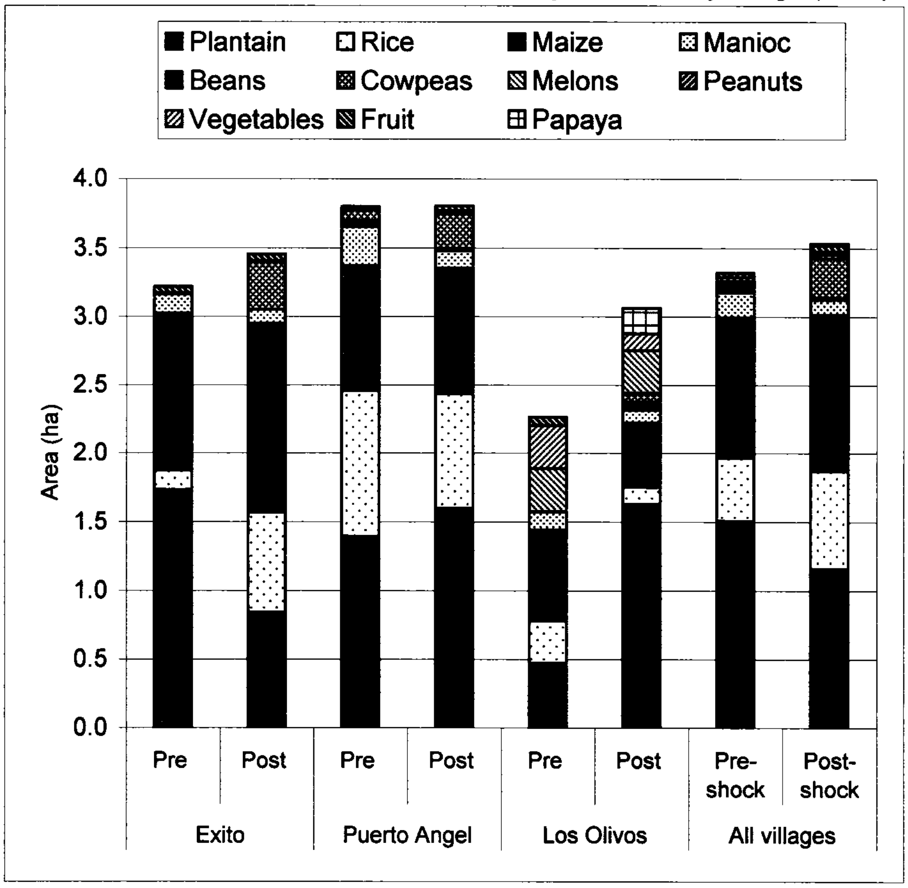
Are *ribereños* able to recover from land losses due to shocks, or do the effects of shocks tend to persist over the household life cycle? To what extent do major shocks affect the prospects for land accumulation, both in the sort-term and over time? What are the main factors that influence the ability of different households to recover from shocks? In this section descriptive and econometric techniques are used to answer these questions.

Figure 5.16 provides a graphical representation of various scenarios of the potential effects of shocks on land holdings. In the first scenario (i.e., Scenario A), land losses due to a shock do not hinder the ability of households to accumulate land, thus allowing them to continue expansion of their holdings. Scenario B

[14] Cowpeas have been typically planted in small areas for subsistence. However, recent initiatives in the Ucayali region to market cowpeas through international markets have bolstered local prices, creating incentives for local farmers to plant cowpeas in larger areas for cash income.

[15] Changes in the area in swidden and floodplain farming in Exito are both statistically significant ($t = 2.42$, sig. $\leq .05$ and $t = -1.975$ sig. $\leq .10$, respectively).

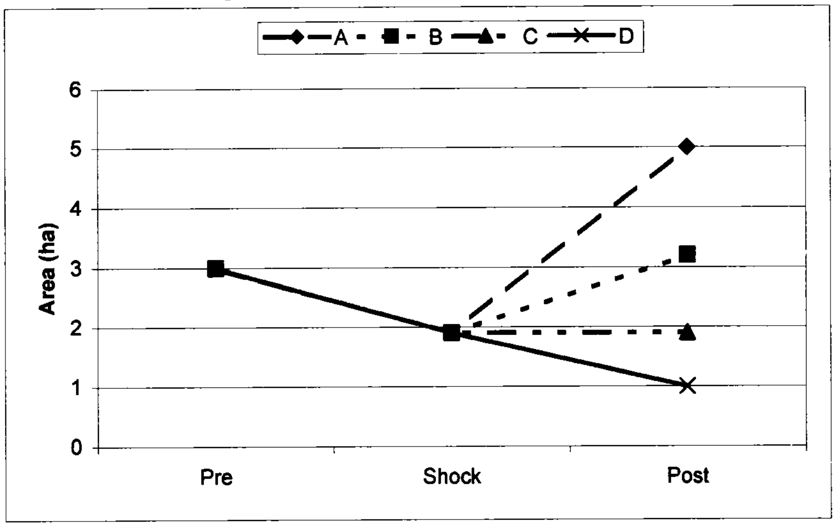
Figure 5.15 Crop portfolios before and after major shocks, by village (n=87).



	Exito		Pto. Angel		Los Olivos		All villages	
	T- test	Sig.	T- test	Sig.	T- test	Sig.	T- test	Sig.
Plantain	3.16	***	-0.61		-1.93	+	1.50	+
Rice	-1.17		-0.06		1.00		-1.04	
Maize	-0.78		-0.39		1.11		-0.66	
Manioc	0.71		1.14		0.76		1.44	
Beans	1.00		0.65				1.00	
Cowpeas	-2.76	***	-1.94	*	-1.00		-3.33	***
Melons			0.00		0.00		0.00	
Peanuts	-1.00		0.37				-0.19	
Vegetables			-0.87		1.52		1.34	
Fruit	-0.09		-1.00		1.00		-0.27	
Papaya					-1.87	+	-1.62	+
Cana	-1.00						-1.00	
Timber	0.00						0.00	

T- test significance: *** : P≤ .01; ** : P≤.05; * : P≤ .10; + P≤ .15

Figure 5.16 Schematic diagram of possible effects of shocks on land holding evolution



suggests that households are able to recover from land losses related to a shock, but are unable to accumulate much land beyond the pre-shock levels (i.e., at least, they regain pre-shock levels). Finally, scenarios C and D are the least optimistic; they depict cases in which households are unable to recover from losses, or even lead to further reductions in land holdings.

5.4.5.1 Descriptive analysis

5.4.5.1.1 Land holding evolution following a major shock: short-term vulnerability and resilience

The descriptive analysis begins with the examination of the evolution of land holdings following major shocks. I contrast land holdings prior and after each major shock, noting land losses for all major shocks experienced by 68 households (n=87 shocks). This approach offers the opportunity to assess the prospects for recovery from shocks among the rural poor.

The line labeled "all villages" in Figure 5.17 suggests that, in general, *ribereños* were able to recover from shocks (i.e., similar to Scenario A in Figure 5.16). Despite average losses of 33% of their holdings, households increased their holdings by 18% in relation to pre-shock levels; only in Los Olivos respondents seemed to fail to recover, probably due to land scarcity.

Contrasting the data across different shock types I found that *ribereños* were unable to recuperate from losses to riverbank erosion in the short-term (Figure 5.18). Although they accumulated land after a slump, respondents, on average, showed losses ranging between nine and thirteen percent. This finding is not surprising given the magnitude of land losses to riverbank erosion (i.e., mean = 70 % of pre-shock land holdings) and suggests that riverbank erosion increased vulnerability in the short-term.

Land holding evolution following major shocks varied across the study sites. The main difference was found after riverbank slumps and floods with riverbank slumps in Exito and Puerto Angel. Residents in Exito were resilient to riverbank slumps, but not to floods combined with riverbank slumps; Puerto

Figure 5.17 Mean land holding trajectories following major shocks, by village (n=87).

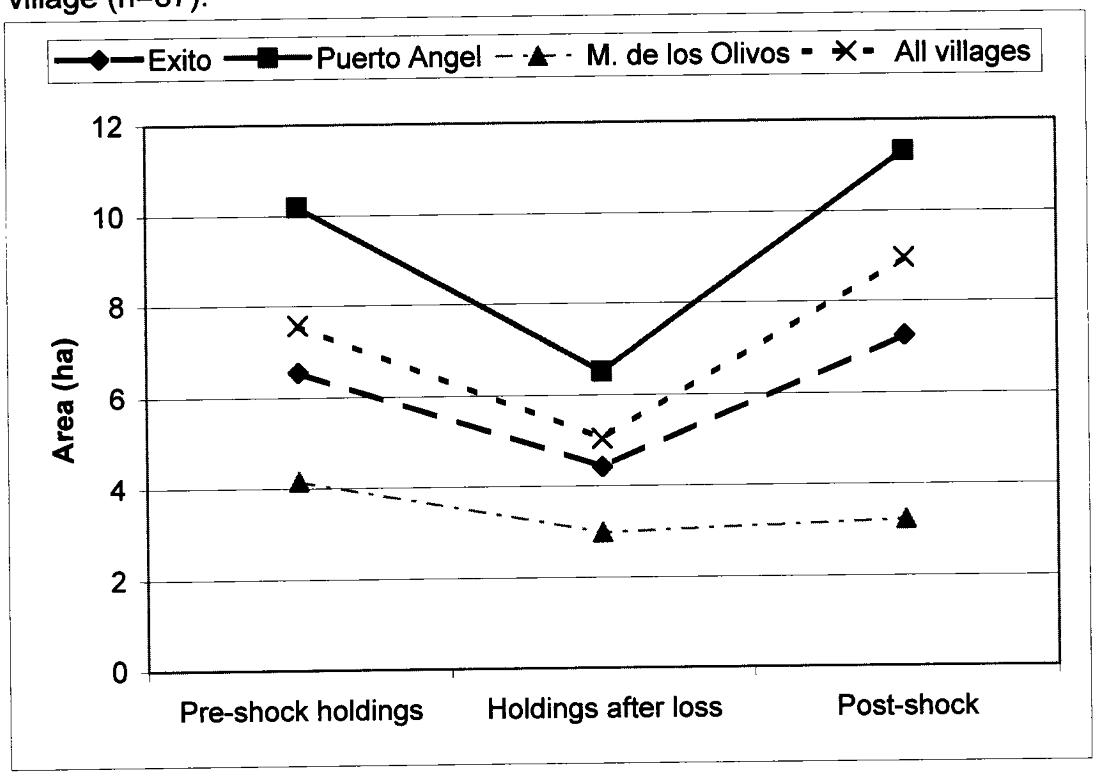
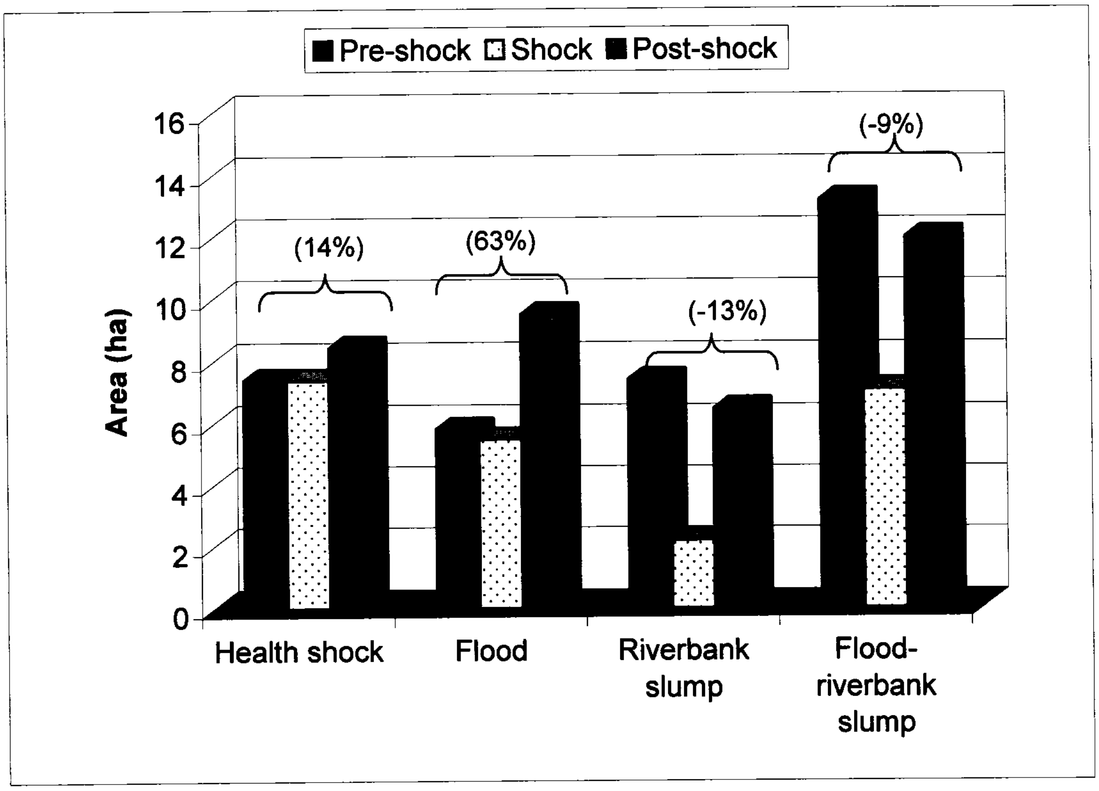


Figure 5.18 Mean land holding evolution following a major shock, by shock type (n=87 shocks).



Angelinos recovered from floods with riverbank slumps, but failed to recuperate from riverbank slumps (Figure 5.19a-b). It is possible that the combined-effect of a flood with riverbank slumping makes it more difficult to bounce back without access to flood-free areas. As such, it seems that resilience to riverbank erosion may be nuanced by differential access to upland areas. Land de-accumulation following major shocks in Los Olivos, may be taken as a sign of greater difficulties recovering from shocks in lowland villages with restricted access to land beyond the community.

The results also point to qualitative changes in land holding composition in the short- term (Figure 5.20). Following major shocks, *ribereños* continued to use a variety of land types, however, they began to rely increasingly on upland areas, and less so on land types within the floodplain (especially low levee). In villages without access to upland areas (i.e., Exito and Los Olivos), respondents sought-out higher ground (i.e., high levee), if available, or accumulated land on mudflats and sandbars for floodplain farming.

In Puerto Angel, for instance, I observed a sharp increase in the area and share of holding in the upland, and a reduction of floodplain holdings (especially low levee) following major floods and riverbank slumps (Figure 5.21b). With sedimentation in front of the village, Puerto Angelinos diversified their floodplain holdings to include mudflat and sandbar. The shift toward the uplands could be interpreted as sign of greater reliance on higher ground for flood insurance. However, considering that flood levels in Puerto Angel (and other villages upstream from Bahuanisho) have dropped since the cut-off, it is possible that, rather than seeking flood insurance, residents in Puerto Angel may be investing profits derived from the floodplain into upland areas. For households in Los Olivos, shocks (indirectly) led to the most dramatic re-composition of land holdings (Figure 5.21c). Indeed, although households in this village continued to hold land exclusively within the floodplain, there was a systematic substitution of high levee for low levee following floods (which drove them to plant crops at Los Olivos) and riverbank slumps (the reason for the permanent move to Los Olivos). By moving to a new site, residents in Los Olivos gained access to higher ground

Figure 5.19 Mean land holding trajectories following major shocks, by village.

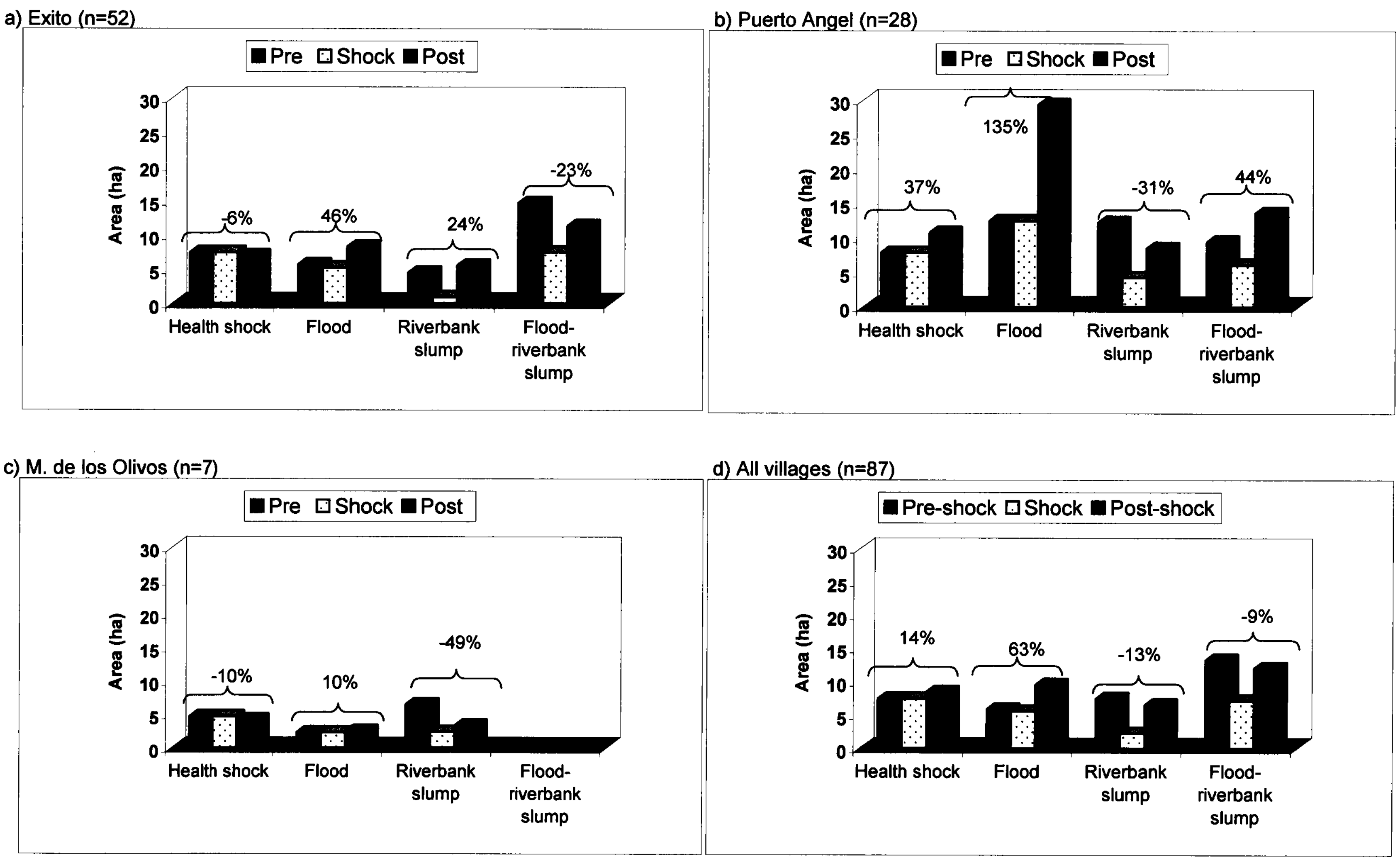
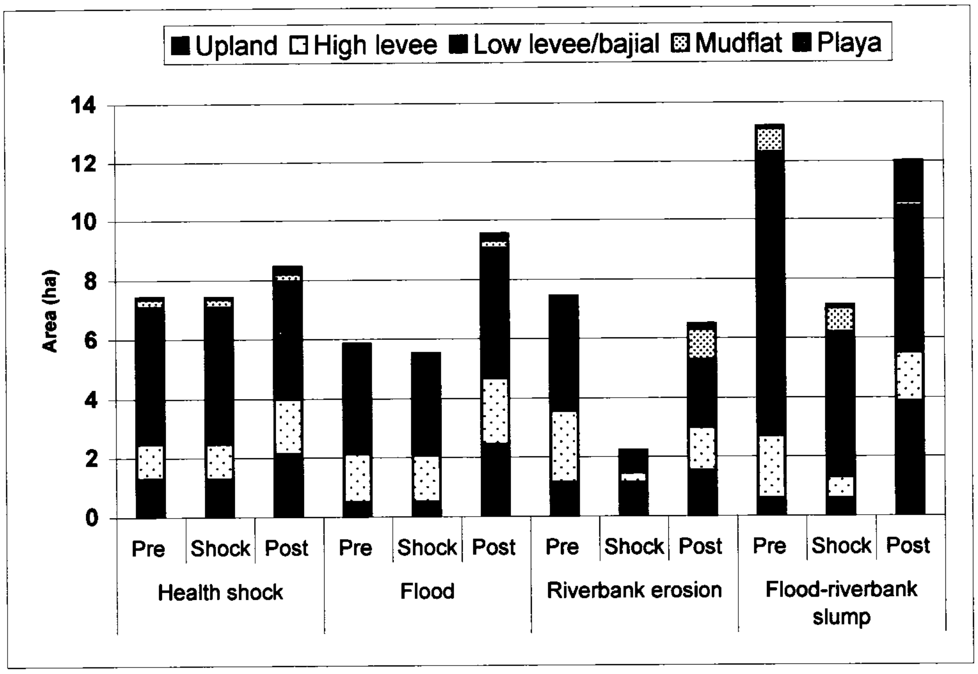


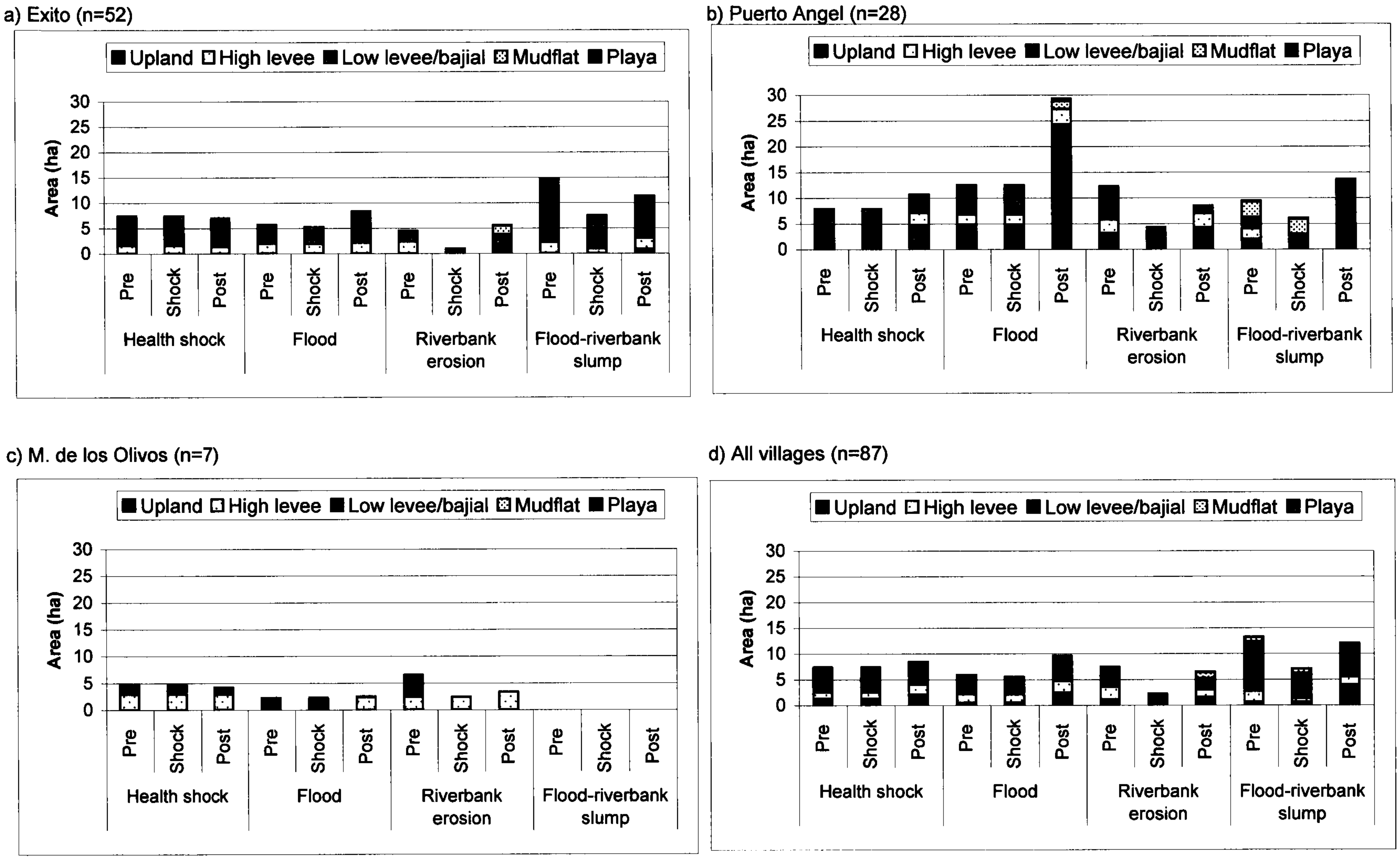
Figure 5.20 Evolution of mean land holding portfolios, by village (n=87 shocks).



	Health shock Pre	Health shock Shock	Health shock Post	Flood Pre	Flood Shock	Flood Post	Riverbank erosion Pre	Riverbank erosion Shock	Riverbank erosion Post	Flood-riverbank slump Pre	Flood-riverbank slump Shock	Flood-riverbank slump Post
% Upland	17	17	25	8	9	25	15	51	24	4	8	32
% High levee	16	16	22	28	29	24	33	15	23	16	11	14
% Low levee	62	62	46	64	62	46	50	30	35	73	68	41
% Mudflat	4	4	3	0	0	3	2	4	16	6	12	1
% Playa	1	1	3	0	0	2	0	0	3	1	1	12
Total	100	100	100*	100	100	100	100	100	100*	100	100	100

* Adds up to more than 100% due to rounding of numbers.

Figure 5.21 Evolution of mean land holding composition following a major shock (n=87 shocks).



(which was not available in Ega) and were able to hold on to it following riverbank slumps.

Finally, households that have experienced riverbank slumps in Exito were unable to regain land on high levee areas as higher ground became increasingly scarce locally (Figure 5.21a). Instead, respondents in Exito made up for the loss by claiming land on newly-formed mudflats and sandbars for floodplain farming. Growing crops on these low-lying biotopes is attractive, but risky due to fluctuations in the water level. Claiming land on mudflats and sandbars requires no labor investment for clearing and crops grow within three to four months; some of the crops planted on these biotopes, such as rice, are commercially important. Overall, it seems that in Exito shocks that have directly affected land holdings pushed local residents to engage in higher risk and higher opportunity options.

In sum, major shocks seem to have reshaped land holdings in terms of size and their composition in the short term. Such re-composition of land holdings appears to be strongly related to the array of natural endowments available at each site and on the evolution of such endowments over time (due to shocks and other factors).

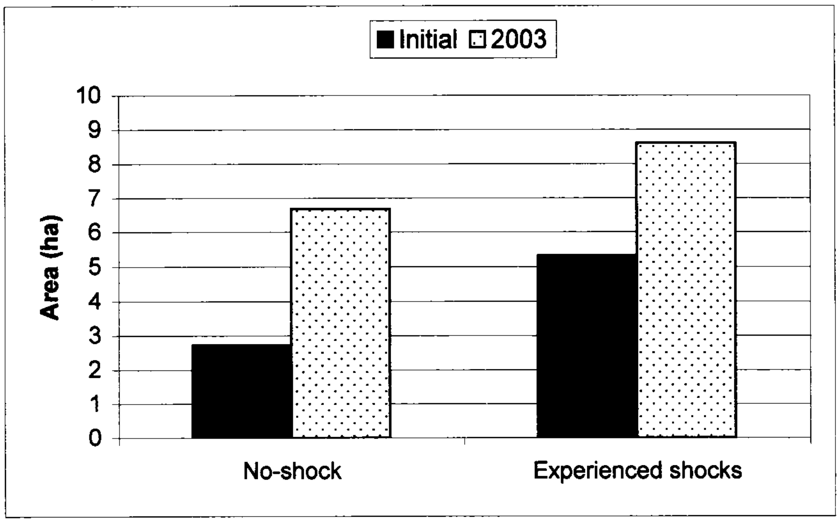
5.4.5.1.2 Long-term and aggregate effect of shocks on asset accumulation over time

Beyond the immediate hardship that shocks induce on the poor, there is even greater concern about the potential role that shocks may play in increasing poverty and vulnerability, and in restricting livelihood opportunities in the long term. Shocks may disrupt land accumulation patterns associated with the household lifecycle (Ellis 1993). Furthermore, shocks may shift investment towards other forms of capital, thus diverting asset accumulation paths (Skidmore and Toya 2002). This sub-section examines whether major shocks contributed to reshape land holdings in the long run, and if so, contrast the effects of different types of shocks and multiple shocks on land holding evolution over the household lifecycle. To do so, land holdings at the time of household inception were compared with 2003 land holdings, noting the particular shock history of different households. First, the (general) effect of major shocks by contrasting households with and without shock experience (i.e., shock vs. no shock) was explored. Second, households that experienced different kinds of shocks were compared in order to isolate the effect of particular shocks. Finally, to assess the potential cumulative effect of shocks, I contrasted households according to the number of shocks suffered. My main findings for the sample as a whole are presented below.

Shocks and long-term land accumulation

Descriptive analysis suggests that, over time, shocks do not have a statistically significant effect on land holding evolution (initial holding $t = -1.35$, n.s.; 2003 holding $t = 0.8$, n.s.). Despite significant land losses in many cases, households that experienced shocks managed to accumulate land over time, suggesting that in the long term, *ribereños* may be more resilient to major shocks than is acknowledged. However, shocks did slightly curb land accumulation over time and in doing so, they may have contributed to reduce land inequalities. Indeed, households that experienced major shocks accumulated only two-thirds of a hectare less over a period of 19 years than households with no shock experience did in nine years (i.e., 3.3 vs. 3.97 ha) (Figure 5.22). To further explore this issue the sample was divided into two categories according to (initial) wealth (i.e., land-rich and land-poor) at the median (2.86 ha), in order to contrast initial holdings and holdings in 2003. In addition, the distribution of land using the Gini coefficient was also examined. Results from these analyses also suggest that land has become more equally distributed over time (Table 5.4; Gini for initial holdings = 0.6 vs. 0.5 for 2003 holdings), although it remains unclear whether the trend is due to shocks or other factors.

Figure 5.22 Initial and 2003 land holding size among households with and without shock experience (n=68).



	No-shock	Experienced shocks
No. of years since formation	9	19
Total land accumulated (ha)	3.97	3.3
Annual rate of accumulation (ha)	0.44	0.17
% of difference (shock vs. no shock)	0.40	0.62
Ratio of accumulation*	1:2.5	1:1.6
N	13	55

Table 5.4 Initial and 2003 land holdings by initial land wealth categories (n=68).

	Wealth groups[1]			
	Land-poor (n=34)	**Land-rich** (n=34)	**T-test**	**Sig.**
Initial land holdings (ha)	0.9	7.2	-6.48	***
2003 holdings (ha)	8.7	9.3	-1.08	
Number of years since hhld inception	16	19	-1.07	

1.Wealth categories are defined in terms of land holding size at household formation (median values)
Significance: *** : ≤ .01; ** : ≤ .05; * : ≤ .10

Effects by shock type

To capture the effect of different shocks I focused on a sub-sample that included all households that had experienced only one major shock (n=28), divided by shock type.[16] Figure 5.23 shows land holdings at household inception and in 2003 for households that experienced a major illness/accident, flood, riverbank slump, or flood with riverbank slump. The results suggest that *ribereños* accumulated land over the household lifecycle irrespective of the type of shock they suffered. Interestingly, even households that had severe land losses due to riverbank erosion appear to be resilient in the long-term. In other words, it seems that the negative effects of riverbank erosion tend to dissipate over time; households held a positive balance through the household lifecycle. Indeed, *ribereños* affected by riverbank slumps seemed to recover, but along with those that suffered health shocks, they accumulated less than one hectare of land during their lifespan, and showed a very low annual rate of accumulation (i.e., 0.03 ha/yr). Upon examination of land accumulation paths of those that suffered major riverbank slumps and of households with no shock experience I found that although both groups accumulated land, riverbank slumps may have contributed to reduce land inequalities over time.

Cumulative effect of shocks

What about the aggregate or the cumulative effect of shocks? Do repeated shocks affect land accumulation and land holding evolution over time? To examine this issue, initial land holdings and holdings in 2003 were contrasted, dividing the sample into four categories according to the number of major shocks experienced (i.e., no shocks; 1 shock; 2 shocks; 3-4 shocks). Descriptive analysis shows that multiple shocks do not appear to erode the capacity to accumulate land over time. Relative accumulation of land is reduced significantly with the first major shock, but builds up again after subsequent shocks. In fact, households that experienced three major shocks have accumulated more land, in relative terms,

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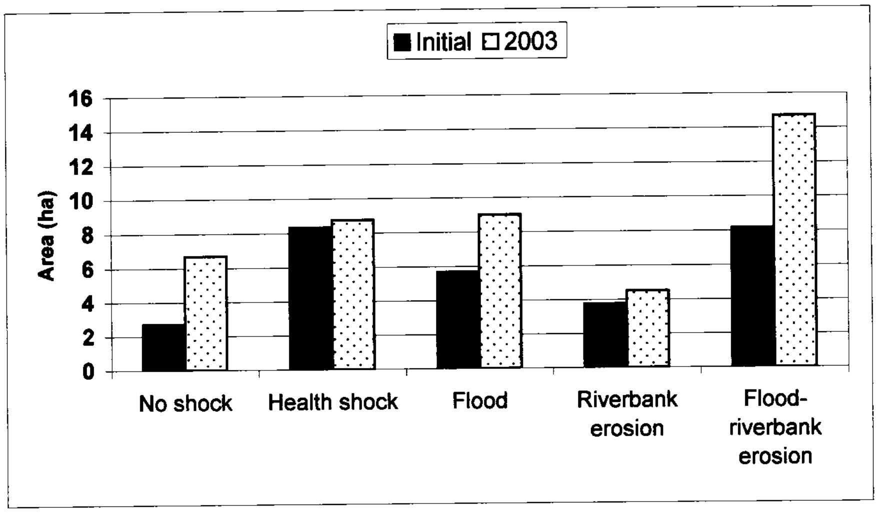
[16] Cases in Exito are under-represented because the majority of residents in this village experienced more than one major shock.

Figure 5.23 Initial and 2003 land holdings by shock type (n=42).[1]



No. of years since formatioı	9	18	18	24	13
Total land accumulated (ha	3.97	0.43	3.31	0.77	6.53
Annual rate of accumulatioı	0.46	0.02	0.19	0.03	0.52
Relative accumulation*	1.46	0.05	0.58	0.21	0.80
N	13	12	4	9	3

1. N denotes all households that experienced one or no major shocks during their lifespan.

* Relative accumulation = total land accumulated / initial holdings

than households without shock experience (i.e., 3.5 vs. 1.5 times their respective initial holdings) (Figure 5.24).[17] As such, the analysis suggests that, in the long run, *ribereños* may have become more resilient with every additional shock suffered. The formation of mudflats and sandbars through sedimentation, which enabled households to accumulate land after multiple shocks, seems to have been key to such apparent resilience. Land claims on low levee areas have also been important.[18]

In sum, descriptive results suggest that although *ribereños* are unable to recover from significant land losses related to riverbank erosion in the short-term, they do recuperate and accumulate land over the household lifecycle, even if land accumulation over time is curbed by riverbank slumps (and health shocks). As such, descriptive results suggest that *ribereños* are perhaps not as vulnerable as we might think and actually may be quite resilient to shocks in the long term. In the next sub-section I turn to multiple regression analysis to examine whether that is the case.

5.4.5.2 Econometric analysis

5.4.5.2.1 Determinants of resilience: short-term recovery and land accumulation following a major shock

The econometric analyses begin with an assessment of the main factors that influence the ability of peasant households to buffer and recover from major shocks in the short-term. Different regression techniques were used to explain: 1) the probability of recovery, relative to pre-shock levels (i.e., the probability of regaining any land lost to a shock or to accumulate land), and; 2) the total area accumulated during the same period, even after losses to a major shock. Probit models served to estimate the probability of recovery; OLS and Tobit models

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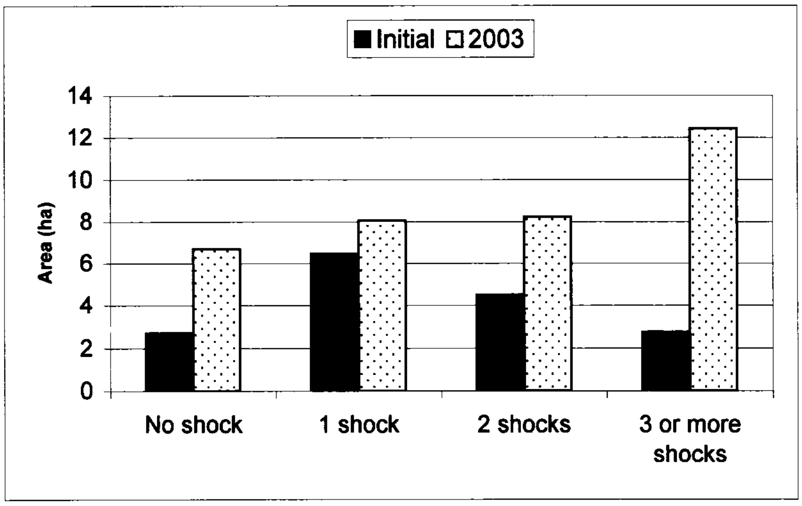
[17] All cases that suffered three or more shocks lived in Exito.

[18] Mudflats and sandbars are relatively unstable and are susceptible to flooding. As such, land holding portfolios among households that have experienced several shocks may have become riskier over time.

Figure 5.24 Initial and 2003 holdings according to the number of shocks suffered (n=68)



	No shock	1 shock	2 shocks	3 or more shocks
No. of years since formation	9	19	17	29
Total land accumulated (ha)	3.97	1.61	3.73	9.68
Annual rate of accumulation (ha	0.46	0.08	0.22	0.33
Relative accumulation*	1.46	0.20	0.82	3.50
N	13	28	21	6

* Relative accumulation = total land accumulated / initial holdings

provided results for total land accumulation among households that recovered. Finally, a Heckman-selection model was used to eliminate potential bias related to a censored sample (Heckman 1979). A Heckman regression consists of a two-step model that first estimated the probability of recovery (i.e., 1= regained or accumulated land; 0=otherwise) with a Probit specification. In the second step it applied an OLS equation to estimate the amount of land accumulated, relative to pre-shock levels, for a sub-sample of all cases where households regained or accumulated land relative to pre-shock levels (Heckman 1979; Maddala 1983).

Explanatory variables tested in the models sought to capture the following sets of factors: household lifecycle factors (i.e., household age, size, and structure), assets (i.e., land and non land assets), social capital (i.e., number of adult siblings and parents in the village), geographical and environmental factors (i.e., village dummies), characteristics of the shock (i.e., shock type and magnitude of loss, shock number), and time-related factors (i.e. timing relative to the cut-off, year of shock, etc.) (Table 5.5). Furthermore, an additional variable was added to the model to control for the duration of the pre-shock to post-shock period (i.e., number of years since shock).[19]

The final models are shown on Tables 5.6-5.9; except for the OLS model, they are all statistically significant. The Probit model suggests that the probability of recovery is dependent on land wealth at the time of the shock, geographical factors, shock characteristics, and time factors (Table 5.6). Households in Los Olivos with larger land holdings at the time of the shock and who have experienced shocks after the Bahuanisho cut-off have a lower probability of recovery (i.e., regaining any losses or accumulating land); households in Puerto Angel who have experienced a major flood and have previous experience with shocks, in turn, have a higher probability of recovery.

[19] Such duration was determined by the number of years between critical moments within the household life cycle (i.e., household formation, and major shocks) and the year in which the survey was conducted — in other words, for years in which more detailed information about land and asset holdings was able to be reconstructed. For instance, consider a respondent that experienced two major shocks (i.e., 1998 and 2001) and was interviewed in 2003. The number of years after the first shock would be three (i.e., 2001-1998); the number would be two for the second shock (2003-2001).

Table 5.5 Summary of regressors and dependent variables used in final regressions on land accumulation following a major shock, Central Ucayali.

Variable name	N	Mean	s.d	(range)
Predictors				
Household lifecycle factors				
Age of the male head of household (at time of shock	87	38.34	10.49	(21-64)
No. of adult males (at time of shock) (15-64 yrs)	87	1.34	0.71	(0-4)
No. of adult females (at time of shock) (15-64 yrs)	87	1.21	0.59	(0-4)
Social Capital				
External labor (No. of siblings and parents in the village)	87	2.20	1.59	(0-5)
Assets				
Total land holding size (at time of shock) (ha)	87	7.52	6.38	(0-25)
% of holding in high levee (at time of shock)	86	29.36	32.94	(0-100)
Total value of assets (at the time of shock) (S/.)	85	4092.5	5061.6	(0-22670)
Geographical factors (village dummies)				
Exito (1/0)	87	0.60	0.49	(0-1)
Puerto Angel (1/0)	87	0.32	0.47	(0-1)
Los Olivos (1/0)	87	0.08	0.27	(0-1)
Shock characteristics				
Shock was a major health shock (1/0)	87	0.31	0.47	(0-1)
Shock was a major flood (1/0)	87	0.23	0.42	(0-1)
Shock was a major riverbank slump (1/0)	87	0.38	0.49	(0-1)
Shock was a major flood-riverbank slump (1/0)	87	0.08	0.27	(0-1)
Time				
Prior to cut off (1/0)	87	0.51	0.50	(0-1)
No. of years since shock	86	5.26	4.39	(0-18)
No of major shock	87	1.49	0.68	(1-4)
Independent variables				
Prob. of land accumulation (relative to pre-shock period) (1/0)	87	0.54	0.50	(0-1)
Total land accumulated since the pre-shock period (ha)	87	0.71	7.90	(-21.05-32.18)

Table 5.6 Probit regression for the probability of recovery following a major shock.

Variable name	**Prob. of recovery (Probit)**	
Predictors		
Constant	-0.02 (0.66)	
Household lifecycle factors		
Age of the male head of household	0.00 (0.02)	
No. of adult males (at time of shock) (15-64 yrs)	0.25 (0.29)	
No. of adult females (at time of shock) (15-64 yrs)	-0.19 (0.38)	
Social Capital		
Direct kin (No. of adult siblings and parents in the village)	0.16 (0.12)	
Assets		
Total land holding size (at time of shock) (ha)	**-0.11 (0.04)**	***
% of holding in high levee (at time of shock)	0.00 (0.01)	
Total value of assets (at the time of shock) (1,000 S/.)	0.01 (0.04)	
Geographical factors (village dummies)		
Puerto Angel (1/0)	**1.25 (0.47)**	***
Los Olivos (1/0)	**-1.08 (0.70)**	+
Shock characteristics		
Shock was a major flood (1/0)	**1.25 (0.51)**	**
Shock was a major riverbank slump (1/0)	-0.66 (0.53)	
Shock was a major flood-riverbank slump (1/0)	-0.11 (0.65)	
Time		
Occurred after cut-off (i.e.,1997) (1/0)	**-0.82 (0.47)**	*
No. of years since shock*	**-0.08 (0.05)**	+
Big shock number	**0.48 (0.32)**	+
Chi^2	36.64	
Prob. P > Chi^2	< 0.01 ***	
Pseudo R^2	0.27	
N[§]	82	
Log Likelihood	-43.41	
Censored observations		
Uncensored		

*** : P≤ .01; ** : P≤.05; * : P≤ .10; + : P≤ .15
Robust standard errors ( )
§ Five observations were ommited due to missing values on some variables.

OLS results highlight the role of household demographics and in-household access to labor in shaping the amount of land accumulated among respondents (Table 5.7). Households with more adult males tend to accumulate more land following major shocks. Tobit results for land accumulation among those who have recovered point to access to labor, assets, geographical factors and shock characteristics (Table 5.8). According to this model, more land was accumulated by households with smaller holdings and better access to labor, both internal (i.e., adult males) and external (i.e., kin), by those who lived in Puerto Angel and not in Los Olivos, and by households that experienced major floods.

The final Heckman selection model is consistent with the results above (see Tables 5.9 and 5.10). Again, this model suggests that the probability of recovery is related to wealth (i.e., total land holding prior to the shock), geographical factors (i.e., Puerto Angel and Los Olivos dummy variables) and shock type (i.e., flood and riverbank slump dummies), and to whether the shock occurred after the cut-off, much like the original Probit model. Results from Step 2 of the Heckman model also indicate that households with better access to male labor accumulated more land following a shock and that accumulation was greater after shocks that occurred after 1997. According to this model, households tend to accumulate 0.33 hectares/yr following major shocks.

The effect of male and external labor (i.e., proxied by the number of kin) in the models is intuitive. Households with more adult males, or with larger social networks in the village, have access to a greater pool of labor resources to clear new land following a major shock, and thus for subsequent land accumulation. However, only access to adult males was significant in the final land accumulation models.

The finding that land-poor households (i.e., those with smaller land holdings prior to the shock) have a higher probability of recovery following major shocks (although they do not necessarily accumulate more land than land-rich households) challenges prevailing views about the poor found in the vulnerability/entitlements literature. As such, it suggests that there may be

Table 5.7 OLS regression for land accumulation following a major shock.

Variable name	Total land accumulated (ha) (OLS)	
Predictors		
Constant	-5.36 (4.31)	
Household lifecycle factors		
Age of the male head of household	-0.03 (0.084)	
No. of adult males (at time of shock) (15-64 yrs)	**3.74 (1.81)**	**
No. of adult females (at time of shock) (15-64 yrs)	-0.71 (1.29)	
Social Capital		
Direct kin (No. of adult siblings and parents in the village)	0.65 (0.66)	
Assets		
Total land holding size (at time of shock) (ha)	-0.23 (0.16)	
% of holding in high levee (at time of shock)	0.03 (0.03)	
Total value of assets (at the time of shock) (1,000 S/.)	0.18 (0.25)	
Geographical factors (village dummies)		
Puerto Angel (1/0)	1.88 (2.05)	
Los Olivos (1/0)	-1.18 (1.54)	
Shock characteristics		
Shock was a major flood (1/0)	0.98 (1.85)	
Shock was a major riverbank slump (1/0)	0.63 (1.65)	
Shock was a major flood-riverbank slump (1/0)	2.32 (3.75)	
Time		
Occurred after cut-off (i.e.,1997) (1/0)	3.32 (2.32)	
No. of years since shock*	0.32 (0.27)	
R^2	0.44	
F	0.95	
Prob. > F	0.52	
N	43	

*** : P≤ .01; ** : P≤.05; * : P≤ .10; + : P≤ .15
Robust standard errors ( )

Table 5.8 Tobit regression for land accumulation following a major shock.

Variable name	Total land accumulated (ha) (Tobit)	
Predictors		
Constant	-5.69 (3.08)	
Household lifecycle factors		
Age of the male head of household	0.03 (0.08)	
No. of adult males (at time of shock) (15-64 yrs)	**3.34 (1.18)**	***
No. of adult females (at time of shock) (15-64 yrs)	-1.27 (1.38)	
Social Capital		
Direct kin (No. of adult siblings and parents in the village)	**0.78 (0.45)**	*
Assets		
Total land holding size (at time of shock) (ha)	**-0.41 (0.16)**	**
% of holding in high levee (at time of shock)	0.02 (0.02)	
Total value of assets (at the time of shock) (1,000 S/.)	-0.08 (0.18)	
Geographical factors (village dummies)		
Puerto Angel (1/0)	**4.14 (1.84)**	**
Los Olivos (1/0)	**-5.07 (2.77)**	*
Shock characteristics		
Shock was a major flood (1/0)	**4.23 (1.88)**	**
Shock was a major riverbank slump (1/0)	-0.49 (1.84)	
Shock was a major flood-riverbank slump (1/0)	0.85 (2.61)	
Time		
Occurred after cut-off (i.e.,1997) (1/0)	0.40 (1.71)	
No. of years since shock*	0.08 (0.20)	
Chi^2	29.83	
Prob. P > Chi^2	<0.01 ***	
Pseudo R^2	0.09	
N	82	
Log Likelihood	-150.66	
Censored observations	39	
Uncensored	43	

*** : P≤ .01; ** : P≤.05; * : P≤ .10; + : P≤ .15
Standard errors ( )
Note: Tobit models do not account for fixed effects (household id)

Table 5.9 Heckman selection model for recovery following a major shock.

Variable name	Step 1 Prob. of recovery (Probit)	
Predictors		
Constant	-0.02 (0.85)	
Household lifecycle factors		
Age of the male head of household	0.00 (0.02)	
No. of adult males (at time of shock) (15-64 yrs)	0.25 (0.31)	
No. of adult females (at time of shock) (15-64 yrs)	-0.19 (0.38)	
Social Capital		
Direct kin (No. of adult siblings and parents in the village)	0.16 (0.13)	
Assets		
Total land holding size (at time of shock) (ha)	**-0.11 (0.04)**	***
% of holding in high levee (at time of shock)	0.00 (0.01)	
Total value of assets (at the time of shock) (1,000 S/.)	0.01 (0.05)	
Geographical factors (village dummies)		
Puerto Angel (1/0)	**1.25 (0.51)**	**
Los Olivos (1/0)	**-1.08 (0.70)**	+
Shock characteristics		
Shock was a major flood (1/0)	**1.25 (0.57)**	**
Shock was a major riverbank slump (1/0)	**-0.66 (0.44)**	+
Shock was a major flood-riverbank slump (1/0)	-0.11 (0.63)	
Time		
Occurred after cut-off (i.e., after 1997) (1/0)	**-0.82 (0.48)**	*
No. of years since shock*	-0.08 (0.06)	
Big shock number	0.48 (0.34)	
	Step 2 Land accumulated (ha) (OLS)	
Constant	-5.11 (3.35)	
Household lifecycle factors		
Age of the male head of household	-0.03 (0.10)	
No. of adult males (at time of shock) (15-64 yrs)	**3.64 (1.31)**	***
No. of adult females (at time of shock) (15-64 yrs)	-0.62 (1.52)	
Social Capital		
Direct kin (No. of adult siblings and parents in the village)	0.62 (0.51)	
Assets		
Total land holding size (at time of shock) (ha)	-0.21 (0.19)	
% of holding in high levee (at time of shock)	0.03 (0.03)	
Total value of assets (at the time of shock) (1,000 S/.)	0.18 (0.26)	
Geographical factors (village dummies)		
Puerto Angel (1/0)	1.72 (2.23)	
Los Olivos (1/0)	-0.92 (3.52)	
Shock characteristics		
Shock was a major flood (1/0)	0.77 (2.04)	
Shock was a major riverbank slump (1/0)	0.75 (2.30)	
Shock was a major flood-riverbank slump (1/0)	2.29 (3.16)	
Time		
Occurred after cut-off (i.e., after 1997) (1/0)	**3.44 (2.03)**	*
No. of years since shock*	**0.33 (0.22)**	+
Chi^2	44.9	
Prob. P > Chi^2	0.05 **	
Log Likelihood	-159.7	
N[§]	82	
Uncensored observations	43	
Censored observations	39	

§ Five observations were ommited due to missing values on some variables.

*** : P≤ .01; ** : P≤.05; * : P≤ .10; + : P≤ .15

Standard errors ( )

Table 5.10 Summary of results on short-term recovery and land accumulation following a major shock.

Variable name	(Probit)	(OLS)	(Tobit)	Heckman model Step 1 (Probit)	Heckman model Step 2 (OLS)
Household lifecycle factors					
Age of the male head of household					
No. of adult males (at time of shock) (15-64 yrs)		+	+		+
No. of adult females (at time of shock) (15-64 yrs)					
Social Capital					
Direct kin (No. of adult siblings and parents in the village)			+		
Assets					
Total land holding size (at time of shock) (ha)	-		-	-	
% of holding in high levee (at time of shock)					
Total value of assets (at the time of shock) (1,000 S/.)					
Geographical factors (village dummies)					
Puerto Angel (1/0)	+		+	+	
Los Olivos (1/0)	-		-	-	
Shock characteristics					
Shock was a major flood (1/0)	+		+	+	
Shock was a major riverbank slump (1/0)	-			-	
Shock was a major flood-riverbank slump (1/0)					
Time					
Occurred after cut-off (i.e.,1997) (1/0)	-			-	+
No. of years since shock*	-				+
Big shock number	+				

instances in which poorer households are more resilient than households that are better-off.

Consistent with the descriptive analyses presented earlier, the regression results also point to the difficulties that *ribereños* face in recovering from losses to riverbank slumps in the short term (i.e., the probability of recovery). Nonetheless, riverbank erosion does not seem to affect the amount of land accumulated among households that recovered.

Finally, the findings suggest two final insights. First, it became increasingly difficult for *ribereños* to recover from shocks following the 1997 meander cut-off, although those that recovered did accumulate more land. Second, the finding that residents in Puerto Angel recovered more easily points to the role of upland areas as a buffer against major shocks.

5.4.5.2.2 Shocks and land holding evolution over the household lifecycle

Regression analyses were also used to examine the role of shocks in shaping land holding evolution over the household life cycle. OLS and Tobit regressions served to explain land holding size in 2003 and land accumulation since household inception. Following Barham and colleagues (2002), initial land endowments, household life cycle factors and geographical factors were controlled. Having shock history data readily available allowed for the inclusion of variables that captured exposure to major shocks, both in terms of shock type and number of times affected.

The final models are all statistically significant and explain between six and 50 % of the observed variation in current land holdings and land accumulation over time (Table 5.11). The first model used an OLS specification to explain land holding size in 2003. In addition to the variables mentioned above, this model included variables that capture land accumulation on key biotopes, as well as labor availability within the household. According to this model, the amount of land held by respondents is dependent on their initial land endowments and on the amount of land accumulated on key land types (i.e., high levee and

Table 5.11 Regressions for current holdings and land accumulation since household inception.

Variable name	Model 1: Current land holding size (ha) (OLS)		Total land accumulation since household formation (ha): Model 2[1] (OLS)		Model 3 (OLS)		Model 4 (Tobit)	
Predictors								
Constant	2.66	(4.60)	0.74	(5.89)	4.42	(5.64)	3.68	(5.33)
Household lifecycle factors								
Age of the household head at time of formation (yrs)	-0.02	(0.11)	0.01	(0.14)	0.01	(0.13)	0.03	(0.15)
No. of years since inception	-0.39	(0.25) +	-0.20	(0.50)	-0.34	(0.41)	-0.41	(0.34)
(No. of years since inception)^2	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)
Assets								
Initial land holding size (ha)	**0.60**	**(0.17)** ***	0.02	(0.27)	**-0.82**	**(0.17)** ***	**-0.75**	**(0.24)** ***
Total land accumulated on high levee (ha)	**0.68**	**(0.26)** ***						
Total land accumulated on mudflat (ha)	**1.09**	**(0.16)** ***						
Total land accumulated on playa (ha)	-1.54	(1.22)						
No of adult males (15-64 yrs)	**1.58**	**(0.74)** **						
No. of adult females (15-64 yrs)	1.47	(2.58)						
Geographical factors (village dummies)								
Puerto Angel (1/0)	2.66	(2.22)	**7.09**	**(2.51)** ***	**5.61**	**(2.45)** **	**6.02**	**(2.52)** **
Los Olivos (1/0)	**-4.76**	**(1.88)** **	-2.94	(2.42)	-2.87	(2.23)	**-6.56**	**(3.54)** *
Shock characteristics								
No. of major health shocks	**2.41**	**(1.55)** +	0.69	(2.16)	2.54	(1.93)	2.75	(1.98)
No. of major floods	**3.91**	**(2.06)** *	**4.09**	**(2.23)** *	**5.81**	**(2.60)** **	**5.96**	**(2.44)** **
No. of major riverbank slumps	-0.19	(1.48)	1.61	(2.27)	0.12	(1.83)	0.60	(1.98)
No. of major flood-riverbank slumps	**6.98**	**(3.09)** **	**4.56**	**(2.55)** *	4.01	(2.92)	**4.51**	**(3.02)** +
R^2	0.53		0.28		0.42			
F	9.8		3.09		4.2			
Prob. > F	< 0.01 ***		< 0.01 ***		< 0.01 ***			
N	68		51		68		68	
Chi^2							25.78	
Prob. P > Chi^2							< 0.01 ***	
Pseudo R^2							0.060	
Uncensored Observations							51	
Censored observations							17	
Log Likelihood							-182.55	

*** : P≤ .01; ** : P≤.05; * : P≤ .10. Robust standard errors ( ); standard errors for Tobit model.

1. This model only includes households that recovered from land losses over time (i.e., initial holdings ≤ 2003 holdings).

mudflats). Land holdings tend to be larger among younger households with better access to male labor; they are smaller among residents of Los Olivos, where land is locally scarce. Interestingly, riverbank slumps, which affected land holdings more severely and directly, did not have a significant effect on land holding size in 2003, thus suggesting that riverbank slumps do not exacerbate existing land inequalities.

OLS and Tobit regressions served to explain land accumulation between household inception and 2003, for households whose land holdings did not contract over time. Results from the OLS and Tobit models for land accumulation over time are consistent with the 2003 land holding model. According to the OLS model, households that live in Puerto Angel, and have experienced more floods and floods with riverbank slumps, accumulated more land by 2003. Besides pointing to those factors, the Tobit model also suggests that households with larger initial endowments, and those that live in Los Olivos, accumulated less land over time. Strikingly, none of the shocks considered seem to deter land accumulation among the respondents. In particular, the effect of riverbank slumps in both models (which accounted to average losses of 70%) is not significant, suggesting that severe land losses due to shocks are smoothened over time.

In sum, the results from the regression analyses are fairly consistent with the descriptive results presented earlier. Regressions suggest that in the short-term *ribereños* face difficulties recovering from land losses due to riverbank erosion, but that over time, riverbank slumps do not alter their land accumulation paths, controlling for other factors. Therefore, highlighting the capacity of *ribereños* to recover from major shocks in the long term. These results, however, merit some caution because households that failed to cope may have already left the villages and thus could have been underrepresented or absent from the sample.

5.5 Discussion

This study among the *ribereños* of the Central Ucayali provides insights into the links between shocks and assets among the rural poor in developing countries. It sheds light on how health and environmental shocks affect asset holdings and land accumulation among peasant households, and on peasant responses to major shocks. Below I report the main findings of this chapter to the Amazonian literature and more broadly, to the vulnerability, risk and environment literature.

1. Is flooding the main form of environmental risk in the Amazon floodplain?

According to the Amazonian literature, flooding is the greatest source of environmental risk and a major constraint for human settlement in the floodplain (see discussion in Denevan 1996, 654-655). The findings of this chapter, however, challenge this view, at least for the Upper Amazon (where rivers tend to be more dynamic). For people living along rivers in the Upper basin, riverbank erosion constitutes a far greater source of risk, in terms of probability and incidence, than flooding. Not only are *ribereños* more exposed to riverbank erosion, but their assets are also more severely affected by riverbank slumps. In this case, average losses to riverbank erosion, reported by respondents, were far greater than those related to floods with riverbank slumps, or the equivalent of almost three quarters of the total area they held. As such, the threat of losing one's farm (or at least a significant part of it) within a short period of time, as implied by Denevan (1984, 320), is very high among people living along dynamic rivers in the Upper Amazon. Furthermore, this study suggests that it may be more difficult for Amazonian people to recover from riverbank slumps than from other types of shocks (i.e., health shocks, floods, flood-riverbank slumps). *Ribereños* in the study seem to have recovered from riverbank erosion only in the long term. As such, development and vulnerability reduction policies in the region must consider the implications of riverbank erosion for peasant households, in addition to flooding. For instance, they must consider that the high risk of riverbank erosion is likely to favor investments with a short-term horizon. Local residents may be less willing to establish agroforestry plots and timber plantations if the river might destroy such lands before they benefit from them. They must also bear in mind that the risk of land destruction in the floodplain creates a need to accumulate land (i.e., to make up for any losses), but makes land accumulation in the floodplain a risky investment. Efforts to help the poor to build an asset base should concentrate in areas that are less likely to be affected by the river, but still attractive to local residents (e.g., floodplain areas that are not adjacent to the river, upland areas), or should be directed towards other forms of assets that may increase livelihood opportunities, such as fishing capital.

2. The poor are not necessarily the most vulnerable

Much of the literature in recent decades has emphasized the constraints that poor people have when faced by calamity. Marginalized from formal insurance systems and with few assets at hand to cope with shocks, the poor are considered to be the most vulnerable. Poor people tend to find it more difficult to recover from shocks and are caught in what has been termed the "poverty ratchet" (Chambers 1983). Evidence from this case, among the *ribereño* of the Central Ucayali, suggests more resilience among the poor than has been acknowledged to date. Indeed, the respondents showed a remarkable capacity to respond to different types of shocks, reflected both in the variety of ways in which they dealt with shocks and in their ability to bounce back afterwards. Such resilience is particularly salient given that their resources are very limited and their exposure to major shocks is not only high, but may also significantly affect household land holdings — the main productive asset — as is the case with riverbank slumps. The fact that the average *ribereño* in the sample regained, and even accumulated, land beyond pre-shock levels suggests the need to re-examine current views about vulnerability among the rural poor. This finding is consistent with an emerging body of literature that suggests resilience among the poor in tropical forest regions. For example, McSweeney (2002, 20-21) found that the context created following Hurricane Mitch allowed younger (and poorer) households to benefit more than older households, by claiming land in non-traditional ways. Along the similar lines, Manzi (2005) reported a case in which poorer households were able to derive significant benefits from a major environmental shock in a *ribereño* village along the Marañón River in northeastern Peru.

By no means, is it suggested here, that the poor do not suffer from calamity, or that they are always and completely resilient to shocks. There are, certainly, multiple instances in which the poor are indeed extremely vulnerable — even in this study I found several households that were unable to bounce back following a major shock. However, the findings of this study suggests that in some cases, the poor are quite resilient, calling into question prevalent views about the poor being inevitably vulnerable and helpless.

3. Combined use of floodplain and upland resources

There has been much discussion in recent years about the complementarity between the main two landforms in the Amazon: the floodplain and the *terra firme* (i.e., the uplands). So far, this debate has centered on how the upland provides insurance against floods and contributes to smooth incomes (Denevan 1996; Tournon 2002; WinklerPrins 2002). The finding that households in Puerto Angel (i.e., the upland village in this study) were more resilient to major shocks suggests that access to *terra firme* may help *ribereños* to respond to other types of shocks, including riverbank erosion. Bluffs are more cohesive and resistant than the riverbanks within the floodplain and thus do not erode as easily. In the Upper Amazon upland areas may well provide insurance against riverbank erosion. Furthermore, for some *ribereños*, the uplands may well represent a more secure investment, especially if they establish pasture and raise livestock, while still benefiting from the use of floodplain areas.

4. The importance of geographical factors and natural endowments

Recent works within the forest-peasant literature have stressed the importance of geographical factors and natural endowments in shaping the livelihoods of tropical forest peoples (Barham *et al.* 1999; Takasaki *et al.* 2001). This chapter suggests that location and natural endowments (and how they change over time) also affect shock exposure and household responses to major (health and environmental) shocks. It was observed, for example, that floods and riverbank erosion were more common in Exito (i.e. a floodplain village located on the outer bank of meander) than in Puerto Angel (i.e., a village with access to the uplands). It was also found that the particular characteristics and the evolution of natural endowments at each location played a key role in allowing *ribereños* to bounce back, and in the definition of the specific strategies they employed to do so. For example, access to upland areas in Puerto Angel, the destruction of high levees (Exito), the formation of new mudflats and sandbars (Exito and Puerto Angel), and the migration to a site with high alluvial soils (Los Olivos) all altered the range of strategies used and the prospects for recovery among respondents.

5. Shocks may not always increase wealth inequalities

Shocks are considered to be at the root of persistent inequalities throughout the developing world. It is commonly argued that the effects of shocks are socially differentiated and that they contribute to make the rich even richer, while the poor become poorer (Hewitt 1983a; Blaikie *et al.* 1994). In terms of assets, the poor tend to loose proportionately more to shocks, thus making it difficult for them to rebuild their asset holdings; richer households, in turn, have fewer problems recovering and expanding their asset base following shocks, even after greater losses. Findings presented in this chapter suggest that there may be instances in which shocks do not contribute to increase wealth differences and may actually help to attenuate them.

The Probit and Heckman models (Step 1) showed that households with larger land holdings prior to the event had lower probability of recovering from major shocks in the short term, controlling for other factors. Furthermore, the finding that *ribereños* who experienced major riverbank slumps did not accumulate less land than those who have never experienced a shock, suggests that in this setting, severe land losses to major shocks do not accentuate the gap between richer and poorer households. Interestingly, in this case, convergence is achieved in a way in which everyone accumulates land, but the poor tend to accumulate proportionally more, eventually catching up with better-off households.

6. Poor people take risks

The finding of a high incidence of major riverbank slumps could be surprising to some degree, given that the patterns of erosion and sedimentation along meandering rivers, such as the Ucayali, tend to be more predictable than those along braided and anastomosing rivers (Puhakka and Kalliola 1993, 131). I would expect *ribereños* along the Ucayali to have a general sense as to whether their land is likely to be destroyed by the river's lateral migration, and presumably they would try to mitigate its effects by clearing a new plot further inland before their land is eroded. With average losses to riverbank erosion of 70 percent of their land holdings, it would be imperative to do so! Surprisingly, this behaviour was only observed in less than 20 percent of the cases in which respondents experienced major riverbank slumps (n=33). The gradual migration from Ega to Los Olivos is a clear sign that local residents do, at times, prepare themselves in advance, yet there is an element of risk-taking in the behaviour of *ribereños* in the Ucayali that cannot be easily dismissed. These people often continue to grow crops until the last minute (keeping labor inputs low) in areas where riverbank erosion is imminent, and only clear new plots once their land has been lost. *Ribereños* appear to take their chances for different reasons and there are times in which they make mistakes. Some households know that if they lose land, they may fall back on help from kin, or on other resources, such as fishing; others may not have the choice and are only able to pool enough labor resources within the village after they have been hit by the slump (i.e., help is more easily obtained in cases of idiosyncratic misfortune).

CHAPTER 6. CONCLUSIONS

This dissertation has examined the dynamics of peasant livelihood of the *ribereños*, one of the main cultural groups living along the dynamic rivers of the Upper Amazon, under conditions of uncertainty brought by environmental change. *Ribereños* and their ways of life have captured much attention in the literature on Amazonian cultural ecology in recent decades. Researchers have documented the farming practices, fishing and extractive activities and forest resource extraction among these peoples, and in many cases, *ribereños* have been presented as models for sustainable resource use in the tropics. Yet, one important element that has escaped most studies on riverine livelihoods in Amazonia is the importance of the ever-changing nature of floodplains in the basin. This study contributes to filling this gap by examining how peasant households make a living within a setting in which the natural resource base available for livelihood activities is marked by abrupt changes. Using an asset-based approach and a conceptual framework on peasant livelihood and resource use, this dissertation explored the challenges and opportunities for livelihood associated with river channel changes among natural resource-reliant peoples along the Central Ucayali River, a major actively meandering river in the Peruvian Amazon. The topic is of interest to Amazonian scholars and practitioners, but should also have resonance beyond Amazonia, given the growing concern about vulnerability and the fate of the poor, and about the prospects for human adaptation to global environmental change — being inconsistently dynamic, the Central Ucayali serves as a unique "natural laboratory." This study adds an Amazonian case to an emergent literature that suggests greater adaptability and resilience among the poor than we have previously acknowledged. Although living in an environment that is particularly challenging and despite having few resources to do so, *ribereños* are not necessarily vulnerable, nor are they passive victims of change. Overall, the results of this dissertation suggest that *ribereños* have a remarkable capacity to anticipate, mitigate and respond to change, and to actively use it to derive new livelihood opportunities.

In the remainder of this chapter, I summarize the contents of each of the substantive chapters of the dissertation (i.e., Chapters 2 through 5). I, then, present the main cross-cutting findings of the dissertation.

Chapter summaries

Chapter 2 sets the stage for the remainder of the dissertation by using household survey data from three peasant villages, affected by a recent meander cut-off near the city of Pucallpa, to provide an overview of peasant livelihood along the Central Ucayali in 2003. In this chapter I combine data and observations from twelve months of fieldwork with remote sensing imagery and river-level data to show that the cut-off at Bahuanisho caused biophysical changes with profound implications for peasant livelihood in nearby areas: the cut-off altered flooding patterns locally, travel distances and river channel geometry. I then use survey data from a sub-sample of all households for which data could be reconstructed within six years prior to the cut-off to illustrate how livelihoods changed along nearby reaches (i.e., upstream and downstream) in response to the cut-off. Results from the chapter show how downstream residents shifted from perennials to annual crops or migrated upstream in response to higher flood levels and increased riverbank erosion after the cut-off. Upstream residents, in turn, continued to grow annuals and perennials, but were no longer seriously threatened by flooding. *Ribereños* who migrated from downstream reaches gained access to resources upstream and, without hesitation, seized new opportunities derived from the shortening of the channel and lower flood levels; they began growing vegetables and other marketable crops normally planted within a short radius from urban centers, and in contrast to *ribereños* that remained in downstream villages, they were able to grow these crops in the off-season.

In Chapter 3, I combine information derived from focus-group discussions and semi-structured interviews with key informants in Puerto Angel, with informal conversations with boatmen and other residents in the region, seismic data, and river-level data, to show that the Bahuanisho cut-off was triggered by human action. This mixed-method approach served to triangulate and verify information accuracy. The topic of this chapter was unanticipated at the onset of the project and came to my attention in the summer of 2002, during a conversation with local farmers while traveling on a local public riverboat. This chapter shows how Amazonian peoples accelerated the cut-off of a meander on a major Amazon tributary that would have taken decades or centuries to occur, using rudimentary tools, limited amounts of labor and the force of the water in motion. The chapter argues that *ribereños* had sufficient knowledge of fluvial geomorphology to understand the potential for the cut-off and were seeking to reduce travel distance to Pucallpa (i.e., 71 vs. 7.5 km) — the main regional market — and to make river travel safer. Findings from this chapter highlight that riverine peoples not only anticipate and respond to rapid environmental change, but have also learned to use or manage change in order to improve their welfare and livelihood opportunities. Furthermore, they point to the role of humans in shaping the landscape of Amazonia.

Chapters 4 and 5 shift the focus of analysis away from the meander cut-off at Bahuanisho to include floodplain dynamics more broadly. In Chapter 4 I use insights gained from twelve months of participant observation and survey data from 67 households to examine land tenure along the Ucayali River floodplain. The chapter examines the historical evolution of tenure rules in the Peruvian Amazon since the demise of the rubber boom with the aim of tracing the coexistence and interactions between formal and customary rules during different periods. I then contrast basic tenure rules governing access to, transfers of and disputes over land, under both the formal and the customary tenure regimes, and use empirical data from two of my study communities to show that environmental change may serve as a window during which tenure rules are renegotiated and reworked, as the land-base changes due to riverbank erosion (i.e., land destruction) and sedimentation (i.e., land formation). Findings from this chapter suggest that the fluid nature of rules and arrangements, and the coexistence of formal and customary rules, make the tenure regime viable in a context in which the resource base is remarkably dynamic itself, as it is in the Central Ucayali. In other words, the very characteristics of a tenure regime that in other contexts lead to unclear rights and overlapping claims, appear to work in the context of the Ucayali, alleviating tensions and avoiding outright violence in dispute resolutions. The chapter also suggests that the outcomes of tenure rules negotiated at a given moment can vary dramatically — some are more egalitarian than others. For instance, in Exito, where village land was severely destroyed by riverbank erosion, a handful of households in the village went beyond securing a claim to a new mudflat through the formal regime to using formal tenure rules as a tool to monopolize access to an emergent mudflat. The second case, in which new land was created by sediment deposition (i.e., Puerto Angel), provides an example in which the majority of village residents used customary rules to successfully contest an attempt by a few households to secure a claim through the formal regime.

In Chapter 5 I use retrospective data from a 2003 household survey in three peasant villages in the Central Ucayali (n=68) to construct a panel dataset to assess the impact of major health and environmental shocks on land holdings and land accumulation over time. I use descriptive and regression techniques to gauge the effects of major health shocks, floods and riverbank erosion on land holding size and land holding composition, both in the short-term and over the household life cycle (n=87 major shocks), in order to determine the extent to which shocks contribute to increase vulnerability. This chapter also examines the different strategies that *ribereños* from the Ucayali use to mitigate and cope with such shocks, and how they adapt their livelihoods subsequently.

Findings from this chapter suggest that riverbank erosion deserves far more attention than it has been given to date. Riverbank slumps were not only the most common type of major shock reported in this study, but also had the greatest direct effect on land holdings among *ribereños* at the three study sites. Results suggest that following a river bank slump, local residents tend to become more vulnerable in the short-term (i.e., they are unable to fully regain their losses), but surprisingly seem to escape from such condition over time, becoming more resilient. The chapter also shows that household responses vary depending on the nature of the shock, although fishing, bartering, working for food with kin or friends in other villages, and having access to higher ground were particularly salient. Beyond preventive and immediate responses, households modified their crop portfolios following major shocks, according to the natural resources available locally at different points in time. Findings from this chapter suggest that flooding is not the main form of environmental risk in the Amazon floodplain, that the poor are not necessarily as vulnerable as we are accustomed to think, and that shocks do not always exacerbate wealth inequalities, as the literature seems to suggest (Hewitt 1983a; Blaikie *et al.* 1994). Furthermore, they highlight the importance of geographical factors, local natural endowments and access to upland areas, in helping *ribereños* respond to health shocks and floodplain dynamics.

In sum, by focusing on assets, natural endowments, institutions, livelihood responses to river channel changes, and agency, the chapters in this dissertation provide an important contribution to the understanding of peasant livelihood in the floodplains of the Upper Amazon, and more broadly to the understanding of how human respond to rapid environmental change.

Main findings of the dissertation

1. Environmental change creates challenges and opportunities for peasant livelihood

A major motivation for this study was to understand how the rural poor managed to make a living in an extremely dynamic riverine environment. The thought of people living in a setting such as the Ucayali invokes images of hardship and challenge in the minds of an outsider. In such a setting not only is flood risk high, but people could suddenly lose all of their land to riverbank erosion or be left stranded kilometers inland due to changes in the river's course. Findings from this study confirm that rapid environmental change (i.e., river channel dynamics) creates immense challenges to livelihood, but at the same time suggest that change may also bring significant opportunities. For example, I show how the alteration of local flooding patterns and river channel geometry, resulting from a large meander cut-off, created important opportunities for upstream residents. Such changes significantly reduced travel time and transportation costs and allowed upstream residents to grow different crops (e.g., perennials and vegetables) and market them in the off-season; for downstream residents, the meander cut-off opened up new areas for resource use (Chapters 2 and 3). Similarly, the availability of new land created by sedimentation increases the prospects for cash income through rice production and allows *ribereños* to accumulate land without substantial labor investments in clearing, within prevailing land tenure arrangements (Chapter 4).

Findings from this study, however, also suggest that challenges and opportunities are for the most part ephemeral and livelihoods evolve based on the range of natural endowments available at different times. *Ribereños* were aware that the challenges and opportunities that existed one year may not be there in the near future, and were thus keen to take advantage of opportunities when they arose.

The extent to which people are able derive opportunities from environmental change in rural areas of developing countries is an area that deserves further attention in the literature. In particular, there is a need to understand what kinds of opportunities arise from environmental change, when they arise, who benefits from them, and whether such opportunities can be translated into long-term improvements in well-being.

2. Agency, resilience, and adaptability among the rural poor

When I first arrived to the Ucayali and was trying to make sense of how river channel dynamics could affect peasant livelihood in the region, *ribereños* often expressed that the river was very capricious. They consistently claimed that the Ucayali changed all the time and that there was not much that they could do to stop it. According to *ribereños*, river changes sometimes brought benefits to them, but other times had very negative impacts. During those early conversations, *ribereños* explained to me the hardships that they endured when the river damaged their crops or destroyed their land, and then in a seemingly conformist tone stated that they simply started over again. As an outsider, I was shocked to hear such claims which permeated a sense of powerlessness, impotence, and vulnerability. How can you start over after you have lost your entire land holdings? How many times can you possibly start again during your life? As research progressed and I began to understand how *ribereños* respond to river dynamics, those early claims took a very different meaning. I no longer felt the same initial sense of conformism or of passiveness among them. What I perceived, instead, was a straightforward realization among *ribereños* that they must accept and learn to live with change in order to make a living in a highly dynamic setting, such as the Ucayali (Pinedo-Vasquez *et al.* 2002).

This study argues that agency, resilience, and adaptability among the poor may be more common than previously acknowledged. Results from Chapters 2, 3, and 5 provide ample evidence on how *ribereños* anticipate, cope with, and respond to floods and floodplain dynamics, in order to reduce their negative effects or to take advantage of emergent opportunities. Perhaps the strongest sign of agency found in this study was the role that *ribereños* played in facilitating a large meander cut-off to reduce travel distance and to make boat travel safer (Chapter 3). This study not only suggests that *ribereños* are active and adaptable, but also exhibit a remarkable capacity to recover from shocks with very limited resources. I found, for example, that even after major riverbank slumps, which on average destroyed 70% of the mean household land holdings, *ribereños* were able to regain, over time, any land lost.

This study's findings suggest that vulnerability assessment will be strengthened by paying closer attention to the capacities of poor people to successfully recover, or derive benefits from environmental change. Future research should focus on the identification of the factors that help to explain agency and resilience, and on the assessment of long-term responses to environmental change and their welfare outcomes.

3. Environmental change and the fate of the poor

In recent decades there has been much concern about the role that shocks play in furthering poverty and threatening livelihood security. This study, however, shows that poorer households were not necessarily sunk into further destitution; they were able to recover from major shocks, and in some instances, derived substantial benefits from floodplain dynamics (Chapters 2, 4, and 5). As such, these results suggest that adaptability and resilience may be not exclusive to those that are better-off, and that environmental change may, in some instances, provide a window of opportunity for the poor to improve their well-being. Further research will be needed to identify the specific circumstances in which the poor actually benefit and the factors that allow them to do so.

4. Social networks

This study also highlights the importance of social and kin networks, both within and across communities, as a form of *ex post* insurance among the rural poor, who tend to be excluded from formal credit and insurance (Chapters 2 and 5). Exchanges of fish or labor for plantains among *ribereños* living along downstream and upstream reaches, after the cut-off, were based on kin and friendship relationships. Receiving assistance from kin or friends sometime in the future is important to explain why, in spite of the potential for conflict due to overlapping claims and seemingly unclear rights, land disputes along the Central Ucayali do not translate into outright violence (Chapter 4). The acceptance of particular tenure arrangements, whether egalitarian or not, and the constant renegotiation of rules might be influenced by the need of others to secure a livelihood.

5. Local knowledge about fluvial geomorphology

Findings from Chapters 3, 4 and 5 point to the existence of a well-developed understanding of fluvial geomorphology among *ribereños* of the Ucayali. Local environmental knowledge about fluvial systems and processes is an area in ethnoecological research that deserves further attention. Chapter 3 argues that *ribereños* understand the processes of erosion and sedimentation in relation to river channel geometry and water velocity. Local knowledge of fluvial geomorphology is key for riverine livelihood; it allows *ribereños* to mitigate the effects of floods and river channel dynamics, and to derive new opportunities. Chapter 5 shows that, based on such knowledge, riverine peoples anticipate potential land losses to riverbank erosion and in many instances seek land in advance elsewhere. As argued in Chapter 4, *ribereños*' ability to claim land on newly created mudflats is closely related to their capacity to identify new depositional areas before the waters recede. Finally, Chapter 3 suggests that local knowledge of fluvial geomorphology was key to the facilitation of the meander cut-off at Bahuanisho.

6. Floodplain dynamics and fishing

Although this dissertation focuses primarily on agriculture, my results point to the centrality of fishing to *ribereño* livelihood. Fish is a major source of protein and for some households it was also found to be an important source of cash income. Furthermore, *ribereños* rely on fishing as *ex post* insurance; fishing was often used to cope with major floods and riverbank slumps. The importance of fish for riverine livelihood requires further attention in the future.

Policy implications

In sum, this dissertation shows that peasant households living along the Central Ucayali are not passive victims of their environment, or an "accident waiting to happen." The dynamism of the Ucayali certainly makes it a risky and challenging environment, but also one that affords attractive livelihood opportunities. *Ribereños* are active agents that respond to and even seek to facilitate environmental change, although they are not always successful.

The findings presented herein have important implications for poverty alleviation and vulnerability reduction policies. At a broad level, they call into question the need for policy intervention in all cases and raise the challenge of determining *when* and *what* type of policies should be implemented. Policies aimed at reducing vulnerability among the poor, when needed, might yield better results if they recognize what the poor actually manage to do in order to cope with adversity, or to take advantage of economic opportunities. One recommendation in this direction would be for policy makers to complement risk management goals among the poor, by implementing policies that also assist them in capitalizing from opportunities that arise from environmental change. To do so may require a careful targeting of policies over space and time, based on the identification of "vulnerable" and "improved" zones, to complement disaster relief measures. For example, the case of the meander cut-off described in Chapter 2 called for the implementation of different policies along upstream and downstream reaches. Upstream from the cut-off, government programs should have been aimed at helping rural residents to take advantage of the opportunities created by the cut-off so they could translate into long-term improvements in well-being; downstream from the cut-off, where flooding had intensified, the aim of policy should have been in assisting rural households to secure a living. Nevertheless, policy makers seeking to reduce vulnerability among the poor are challenged by the fact that in dynamic environments, the factors are crucial for livelihood security can appear or disappear from one year to the next, thus making it difficult to identify vulnerable/resilient groups over time. As such, policies aimed at reducing vulnerability may not necessarily lead to investment and long-term economic growth, and in turn, policies that seek to foster investment and growth may not always contribute to enhance resilience.

Appendices

Appendix I Certificate of Ethical Acceptability of Research Involving Humans

McGill

Research Ethics Board Office
McGill University
845 Sherbrooke Street West
James Administration Bldg., rm 429
Montreal, QC H3A 2T5

Tel: (514) 398-6831
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Ethics website: www.mcgill.ca/rgo/ethics/human

Research Ethics Board I
Certificate of Ethical Acceptability of Research Involving Humans

Project TitleFloodplain Dynamics and Rural Livelihoods in the Upper Amazon: A Study Along the Central Ucayali, Peru

Applicant's Name: Christian Abizaid Department: Geography

Status: Ph.D. student

Supervisor's Name (if applicable): Dr. O. Coomes

Granting Agency and Title (if applicable): N/A

This project was reviewed on October 24, 2002 by

Expedited Review ____
Full Review ✓

[signature] 24/10/02
Signature/Date

John Galaty, Ph.D.
Chair, REB I

Approval Period: October 24, 2002 to October 24, 2003

REB File #: **154-1002**

Appendix II

Questionnaire administered to 73 *ribereño* households May -December, 2003

Ultima revisión 8 Octubre 10:12am

ENCUESTA SOCIOECONOMICA Y CAMBIOS EN EL RIO UCAYALI CENTRAL 2003

Caserio/comunidad ________________ Fecha________________

Código de casa______________

Nombre y apellido del Jefe (a) de familia ____

1. Demografía

1.1. Para comenzar me gustaría preguntarle acerca de quienes forman parte de la familia (presentes/ausentes)

[*Enliste cada uno de los miembros de la familia presentes y ausentes*]

Nombre completo	Edad	Relación	Tiene Familia	Donde Nació	Donde vive	Cuando se fue / llegó	Ocupación	Grado de educación

Código de ocupación:

AG:	Agricultura	EST:	Estudiante
PES:	Pesca	PEON:	Peón
MAD:	Madera	EMPL:	Empleado fijo
CASA:	Ama de casa	OTRO:	Otro __________ (especificar)

[*Notas: Marcar con* √ *en la columna si tienen familia. Para la columna correspondiente al año en que se fue/llegó anotar el año en que se quitó de vivir con esta familia si se fue. Si llegó, anotar el año en que llegó a vivir como parte de esta familia en esta localidad*]

Ultima revisión 8 Octubre 10:12am

1. 2 ¿Cuantos años ha vivido Usted en:

En la zona de Pucallpa (Ucayali Central) _________ (años)

En este caserío _________ (años)

En esta casa _________ (años)

1. 3 ¿Ha vivido Usted en otros caseríos o en alguna ciudad (Empiece por el más reciente)? [*Averiguar razones por las que se quitó de cada lugar, en particular atención a cambios del río*]

Si	No	Nombre del lugar	Año que se quitó	Actividades principales	Tiempo en ese lugar	¿Por que se quitó?

2.Actividades Económicas

Le voy a preguntar de las actividades importantes para Usted.

2.1 ¿Cuáles fueron las actividades económicas más importantes para Usted y todos los que viven en su su casa. [*Por ejemplo: Agricultura (cultivos), pesca, extracción (productos), crianza de animales, venta de comida, peón, empleo, comercio, etc*]

El año pasado (2002)	El año en que se hizo de familia	1er año en el caserío *[solo si vino de fuera]*

Ultima revisión 8 Octubre 10:12am

2.2 Usted empezó con ______________ (actividad mencionada), ¿A que se ha dedicado después (o con el tiempo):

...y después		... y después		... y después		... y después
Actividades	→	Actividades	→	Actividades	→	Actividades
Años:		Años:		Años:		Años:
Como trabajaba		Como trabajaba		Como trabajaba		Como trabajaba
Por qué trabaja así	→	Por qué trabaja así	→	Por qué trabaja así	→	Por qué trabaja así

[*Iniciar por año de formación familiar o el 1er año en el lugar, hasta llegar a las actividades importantes más recientes*]

Condiciones actuales

3. Terrenos y Agricultura

3 . 1 ¿Cuanto de tierras (incluyendo barrizales y playas) tienen Usted y los demás que viven en esta casa este año (2003)?

Superficie total (ha) __________ Número de parcelas __________

Tipo de terreno	Si	No	Superficie (ha)
Altura			
Restinga Alta			
Restinga Baja			
Bajial			
Barrizal			
Playa			
Otro:			

Ultima revisión 10 Septiembre 6:36 pm

3. 2 Terrenos

Uso de terrenos	Tipo de terreno y superficie (mts x mts)		Tenencia	No. de parcela	Forma en que lo adquirió	Año cuando hizo chacra por 1ª vez ahí
# Chacras:____						
1.						
2.						
3.						
4.						
# de Purmas ___						
1.						
2.						
3.						
4.						
# Barrizales-playa ____						
1.						
2.						
3.						
# Pastos						
1.						
2.						
3.						

[*Si se trata de terrenos no parcelados, marcar F en la casilla de No. de parcela.*]

Tipo de terreno:
- ALT: Altura
- REST A: Restinga Alta
- REST B: Restinga baja
- BAJ: Bajial
- BARRO: Barrizal
- PLAY: Playa

Formas de adquisición:
1. Tumbó monte
2. Herencia (sus padres o suegros)
3. Le cedieron (no padres)
4. Compró
5. Otro GUÍAS
   - BOTAR ARROZ
   - SACAR SU LICENCIA

Tenencia:
1. Precario
2. Certificado
3. Título
4. Alquilado/ prestado

Ultima revisión 8 Octubre 10:12am

4. Relación de Bienes y Animales

Bien	Si/No	Numero	Bien	Si/No	Numero	Bien	Si/No	Numero
Radio cassette			Motosierra			Otra casa		Lugar
Equipo de sonido								
TV			Triciclo					
Maquina de coser			Generador			Gallinas		
Escopeta			Batería			Patos		
Peque Peque (hp)			Trampa			Chanchos		
Fuera borda (hp)			Tarrafa			Vacas		
Bote (tamaño)			Ondera			Borregos		
Heladera-refriger			Rastrera			Otro:		
Mochila bomba								Valor
Canoa						Bodega		

[*Para chinganas y bodegas anotar valor aproximado de su mercancía en categorías:* 100 S/. , 500 S/. ó 1000 S/.]

5. Pesca

5. 1 ¿Dónde pesca más Usted (y su familia) en..? {*La casilla de nombre se refiere al nombre de las cochas*}

Verano			Nombre	Invierno			Nombre	En general	
Río	Cochas	Otros:		Río	Cochas	Otros:		Río	Cocha

6 Producción durante año pasado (Enero a Diciembre 2002)

Producto	Unidad	Si	No	Producción Total	Si	No	*Cantidad* Vendida
Yuca (fresca)	saco						
1							
2							
3							
4							
*Farina	Kg						
Plátanos	Racimo						
1							
2							
Arroz (barrizal / altura)	Kg						
Maíz (choclo)	Saco						
Maíz seco	Kg						
Frijol							
Chiclayo							
Maní							
Sandia/ melón	Unidad						
Soya							
Naranja							
Limón							
Papaya	Unidad						
Otro:_____							

Ultima revisión 8 Octubre 10:12am

(Producción continuación)...

Producto	Unidad	Si	No	Producción Total	Si	No	*Cantidad* Vendida
Pescado	Kg						
1							
2							
3							
Aves	Unidad						
Cerdos	Unidad						
Vacunos	Unidad						
Otro							
1							
Venta Comida							
Artesanía							
Aguaje	Saco						
Chonta	Palo						
Carbón	Saco						
Madera	Trozas						
Carne de monte	Kg						
1							
2							
Animal vivo							
1							
2							
Pieles	Unidad						
Salario							

7. Mano de obra

Ahora quiero preguntarle a cerca del trabajo y empleo.

7. 1 ¿Usted o alguien de los que viven en su casa ha trabajado para alguien por plata o producto durante el año pasado (Enero a Diciembre de 2002)?

Si	No	actividad	Forma de pago	Detalle
			Jornales	
			Contrato	
			Producto	

[*Detalle: Número de jornales, valor de contrato(s), productos recibidos en pago*]

Ultima revisión 8 Octubre 10:12am

7. 2 ¿Como trabajó Usted su chacra el año pasado (2002)? [*¿Trabajó con su familia, metió gente? Marcar cada forma de trabajo; puede ser más de una sola y anotar el número de jornales de trabajo para cada actividad*]

Tipo de chacra ______________ **Area trabajada** ________

Forma de trabajo	Rozar	Tumbar	Huactapear	Sembrar	Cosechar
La familia					
Cortamañana					
Minga					
Peonada					
Jornales					
Contrato					
Medias					

7. 3 Si tuviera Usted que abrir una chacra nueva de 1 cuadra para este año que viene ¿Cómo trabajaría?:

	Contrato	Jornales	Minga	Corta mañana	Familia	Otro
a) Si tuviera 300 S/. disponibles para el trabajo	[1]	[2]	[3]	[4]	[5]	[6]
b) Si tuviera 100 S/. disponibles para el trabajo	[1]	[2]	[3]	[4]	[5]	[6]
c) Si no tuviera plata para hacer el trabajo	[1]	[2]	[3]	[4]	[5]	[6]

8. Crédito

8. 1 ¿Ha recibido usted crédito o apoyo que tenga que devolver durante el año pasado (Enero a Diciembre 2002)?

Si	No	Fuente	Tipo o monto	Motivo o uso

Fuentes:
LOC: Locales (en el caserío)
EXT: Externas (familiares fuera
ONG: ONGs
REM: Rematistas
BAN: Banco OTRO: Otro

8. 2 ¿Tiene Usted alguna deuda pendiente?

Si	No	Monto (en Soles)

Ultima revisión 10 Septiembre 6:36 pm

9. Condiciones al momento en que se formó el hogar

9.1 Ahora le voy a hacer algunas preguntas a cerca de su situación el año en que se hizo Usted de familia...

Productos vendidos ese año (cantidad?)	Uso de terrenos	Tipo de terreno y superficie (mts x mts)		En Parcela	Forma en que lo adquirió	Tenencia
1	# chacras:____					
	1.					
2	2.					
	3.					
3	4.					
4						
	# de Purmas ___					
5	1.					
	2.					
	3.					
	4.					
	# Barrizales-playa ____					
	1.					
	2.					
	3.					
	# Pastos					
	1.					
	2.					
	3.					

[*Marcar F si se trata de terrenos fuera de parcela*]

Tipo de terreno:
- ALT: Altura
- REST A: Restinga Alta
- REST B: Restinga baja
- BAJ: Bajial
- BARRO: Barrizal
- PLAY: Playa

Formas de adquisición:
1. Tumbó monte
2. Herencia (sus padres o suegros)
3. Le cedieron (no padres)
4. Compró
5. Otro

Tenencia:
1. Precario
2. Certificado
3. Título
4. Alquilado/ prestado

Ultima revisión 10 Septiembre 6:36 pm

9. 2 Relación de Bienes y Animales

Bien	Sí/No	Numero	Bien	Sí/No	Numero	Bien	Sí/No	Numero
Radio cassette			Motosierra			Otra casa		Lugar
Equipo de sonido								
TV			Triciclo					
Maquina de coser			Generador			Gallinas		
Escopeta			Batería			Patos		
Peque Peque (hp)			Trampa			Chanchos		
Fuera borda (hp)			Tarrafa			Vacas		
Bote (tamaño)			Ondera			Borregos		
Grupo electrógeno			Rastrera			Otro:		
Heladera-refriger								Valor
Mochila bomba						Bodega /Chingana		
Canoa								

[*Para bodegas o chinganas anotar valor aproximado de su mercancía en categorías:* 100 S/. , 500 S/. ó 1000 S/.]

[*Si la familia se formó antes de venir a este lugar seguir con la Sección 10, si no, pasar a la Sección 11*]

Ultima revisión 10 Septiembre 6:36 pm

10. Condiciones cuando llegó a este caserío (o comunidad) [*Si vino de fuera*]

10. 1 Ahora le voy a hacer algunas preguntas a cerca de su situación el primer año que estuvo en este caserío (o comunidad)

Productos vendidos ese año (cantidad?)	Uso de terrenos	Tipo de terreno y superficie (mts x mts)		En Parcela	Forma en que lo adquirió	Tenencia
1	# chacras:____					
	1.					
2	2.					
	3.					
3	4.					
4						
	# de Purmas ___					
5	1.					
	2.					
	3.					
	4.					
	# Barrizales-playa ____					
	1.					
	2.					
	3.					
	# Pastos					
	1.					
	2.					
	3.					

[*Marcar F si se trata de terrenos fuera de parcela*]

Tipo de terreno:
- ALT: Altura
- REST A: Restinga Alta
- REST B: Restinga baja
- BAJ: Bajíal
- BARRO: Barrizal
- PLAY: Playa

Formas de adquisición:
1. Tumbó monte
2. Herencia (sus padres o suegros)
3. Le cedieron (no padres)
4. Compró
5. Otro

Tenencia:
1. Precario
2. Certificado
3. Título
4. Alquilado/ prestado

Ultima revisión 10 Septiembre 6:36 pm

10. 2 Relación de Bienes y Animales

Bien	Si/No	Numero	Bien	Si/No	Numero	Bien	Si/No	Numero
Radio cassette			Motosierra			Otra casa		Lugar
Equipo de sonido								
TV			Triciclo					
Maquina de coser			Generador			Gallinas		
Escopeta			Batería			Patos		
Peque Peque (hp)			Trampa			Chanchos		
Fuera borda (hp)			Tarrafa			Vacas		
Bote (tamaño)			Ondera			Borregos		
Grupo electrógeno			Rastrera			Otro:		
Heladera-refriger								Valor
Mochila bomba						Bodega /Chingana		
Canoa								

[Para chinganas y bodegas anotar valor aproximado de su mercancía en categorías: 100 S/. , 500 S/. ó 1000 S/.]

11.Historia de Golpes (shocks)

Ahora me gustaría saber a cerca de los golpes que ha tenido Usted durante desde que se hizo de familia.

Crecientes

11. 1 ¿En que años le ha afectado a Usted y su familia las crecientes del río? (por ejemplo: a sus terrenos y cultivos, casa, animales

[Solamente crecientes que verdaderamente las hayan afectado. Marcar con (✓) las más importantes para su familia y preguntar de que forma le afectó y como se las arreglaron para salir adelante.]

Crecientes	(✓)	Efectos	Como se las arregló
2003			
2002			
2001			
2000			
1999			
1998			
1994			
1982			
Otro:			
Otro:			

[Marcar cuales fueron las formas principales en que se arregló (1 ó 2 más importantes)]

Formas de respuesta pueden agruparse en:

I. Reservas:
- Comida (fariña y otros)
- Venta de animales
- Ahorros (plata)

II. Uso de mano de obra
Agricultura en altura
Pesca
Extracción
Caza
Jornales (peón)

III. Otras
Prestamos formales
Prestamos informales (parientes, habilitadores)
Migración
Ayuda de otros (mutua)

Ultima revisión 10 Septiembre 6:36 pm

Barrancos

11. 2 Pérdidas por barrancos:

a) ha tenido que desarmar (o mover) su casa por motivo del barranco desde que se hizo de familia?
b) ha perdido terrenos por el barranco
c) ha perdido animales por el barranco
d) ha perdido otros bienes por el barranco

[Incluir veces en este y otros caseríos, empezando por la más reciente. Marcar con (✓) los años en que le afectó más].

Critico (✓)	Año	Casa	Área perdida (mts x mts) y tipo de terreno	Animales perdidos	Bienes perdidos	Respuestas (como se las arregló)
	2003					
	2002					
	2001					
	2000					
	1999					
	1998					
	1997					
	1996					

Otros golpes

11.3 ¿Ha tenido Usted algún otro tipo de golpe que haya puesto en una situación difícil o de emergencia a su familia (por ejemplo, enfermedad, accidentes, pérdida de cultivo, etc.)?

Si	No	Tipo de golpe	(✓)	Año	Respuestas (como se las arregló)

12. Cambios en el Río

Ahora quiero preguntarle un poco más acerca de los cambios en el río. Para eso le voy a pedir que mire este croquis de un río. El río corre en la dirección de la flecha y le voy a pedir que me ayude a entender unas cosas. *[Mostrar croquis adjunto]*

Marque en el croquis con este lapicero rojo donde cree Usted que golpea el barranco.
12. 1¿Podría explicarme porque en ese (os) lugar(es)?

____
____
____

Marque ahora con azul donde habría barrizales y playas
12. 2 ¿Podría explicarme porque en ese (os) lugar(es)?

____
____
____

Marque donde usted cree que podría ocurrir un rompeo si es que cree que podría darse en algún sitio
12. 3¿Podría explicarme porque en ese (os) lugar(es)?

____
____
____

12. 4 ¿Podría decirme que es lo que pasaría a la gente que vive en estos sitios (problemas y beneficios)? [*señalar la zonas de rio abajo, río arriba y en la zona de la tipishca, en relación al rompeo*]

	Problemas	Beneficios
Río arriba	____________	____________
Río abajo	____________	____________
Tipishca	____________	____________

13. Productos básicos (Plátano y Pescado)

Me dicen que para la gente de la ribera el plátano y el pescado son productos muy importantes. Ahora quiero preguntarle un poco sobre eso.

13. 1 ¿Han producido Usted y su familia plátano y pescado para el consumo familiar? {*Marcar si o no*}

	Año pasado (Enero - Diciembre 2002)	Un año anterior al rompeo (Enero-Diciembre)
Plátano		
Pescado		

13. 2 ¿De qué otra forma consiguieron plátano para el consumo familiar?

Año pasado (Enero - Diciembre 2002)							
	Si	No	No. de veces	Cantidad	Lugar	Términos	Con quien
Comprado							
Cambiado							
Trabajo							
Un año anterior al rompeo de Bahuanisho (Enero a Diciembre)							
	Si	No	No. de veces	Cantidad	Lugar	Términos	Con quien
Comprado							
Cambiado							
Trabajo							

[*Marcar con una X otras formas de conseguirlo. Términos: precio o equivalencia, jornal. Con quien se hizo (parientes, extraños, conocidos, etc). Cambio se refiere por ejemplo: pescado x platano, etc. En caso de que el entrevistado no pueda estimar cantidades, marcar si producía, compraba, cambiaba o trabajaba entonces y las transacciones eran con las mismas personas de ahora*]

Ultima revisión 8 Octubre 10:12am

13.3 ¿De qué otra forma consiguieron pescado para el consumo familiar?

Año pasado (Enero - Diciembre 2002)							
	Si	No	No. de veces	Cantidad	Lugar	Términos	Con quien
Comprado							
Cambiado							
Otro							
Un año anterior al rompeo de Bahuanisho (Enero a Diciembre)							
	Si	No	No. de veces	Cantidad	Lugar	Términos	Con quien
Comprado							
Cambiado							
Otro							

[Marcar con una X otras formas de conseguirlo. Términos: precio o equivalencia, jornal. Con quien se hizo (parientes, extraños, conocidos, etc). Cambio se refiere por ejemplo: platano x pescado, etc. En caso de que el entrevistado no pueda estimar cantidades, marcar si producía, compraba, cambiaba o trabajaba entonces y las transacciones eran con las mismas personas de ahora]

14. Vivienda *[Marcar los materiales de construcción]*

Techo: Palma Calamina Otros______

Paredes: Pona Tabla Otros______

Piso: Tierra Pona Tabla Otros ________

15. Expectativas para el Futuro

15. 1 ¿Qué planes tiene para la producción para el próximo año (2004)?

____

____

____

¡MUCHAS GRACIAS POR SU AYUDA!

Comentarios *{uso del encuestador}*

Grado de cooperación del entrevistado

Bueno Regular Malo

Observaciones :

____

____

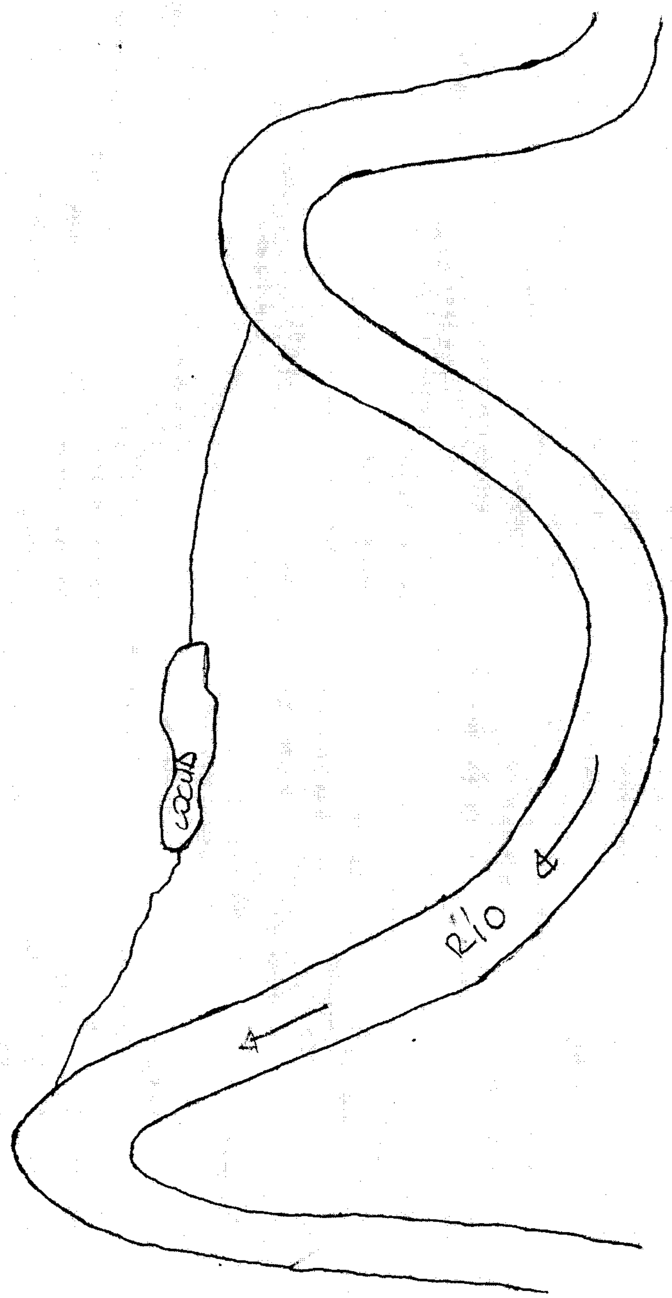
____

____

____

____

NOMBRE ______________ FECHA __________



Ultima revisión 10 Septiembre 6:36 pm

Localidad ___________

Fecha___________

Nombre_______________________________________

Código de casa ________

Año

Evento

Tamaño

Edad

Superficie perdida
(terreno)

Forma de trabajo

Formación:
Shock:

Llegada
Enfermedad / salud

Casa nueva
Creciente

Tamaño máximo
Barranco

Ultima revisión 8 Octubre 10:12am

[*Solo para los shocks más importantes. Empezar por el más reciente y avanzar hacia el pasado*]

Evento ______________ Año _________

Nombre ___________________________ Fecha____________

Productos vendidos (cantidad)	Forma de trabajo	Terrenos o cultivos (tipo) Perdidos	Dimensiones (mts x mts)	Terrenos o cultivos (tipo) que quedaron	Dimensiones (mts x mts)
•		# chacras:___ 1.	•	# chacras:___ 1.	•
•		2.	•	2.	•
•		3.	•	3.	•
•		4.	•	4..	•
•		# de purmas ___ 1.	•	# de purmas ___ 1.	•
•		2.	•	2.	•
		3.	•	3.	•
		4.	•	4.	•
	Razones:	# Barrizales-playa ___ 1.	•	# Barrizales-playa ___ 1.	•
		2.	•	2.	•
		# Pastos 1.	•	# Pastos 1.	•
		2.	•	2.	•
		3.	•	3.	•

[*Forma de trabajo se refiere únicamente a las chacras abiertas después del golpe. Respuestas pueden incluir: pesca, extracción, cace agricultura en la altura, jornales, migración temporal, venta de bienes, reservas, pedir ayuda, jornalear, salir*]

Bienes y Animales (al momento del golpe)

Bien	Si/No	Numero	Bien	Si/No	Numero	Bien	Si/No	Numero
Radio cassette			Motosierra			Otra casa		Lugar
Equipo de sonido								
TV			Triciclo					
Maquina de coser			Generador			Gallinas		
Escopeta			Bateria			Patos		
Peque Peque (hp)			Trampa			Chanchos		
Fuera borda (hp)			Tarrafa			Vacas		
Bote (tamaño)			Ondera			Borregos		
Grupo electrógeno			Rastrera			Otro:		
Heladera-refriger								Valor
Mochila bomba						Bodega		
Canoa								

[*Para bodegas anotar valor aproximado de su mercancía en categorías:* 100 S/. , 500 S/. ó 1000 S/.]

Ultima revisión 8 Octubre 10:12am

2. Cambios en el Río (y conocimiento local)

2. 1 ¿Usted cree que ... ha cambiado aquí desde que se dió el rompeo de Bahuanisho Bagazan (1997-98)?

(para crédito)	Mejor (mas)	Igual	Peor (menos)	Como/razones
Agricultura	______	____	______	______________________________
Pesca	______	____	______	______________________________
Transporte	______	____	______	______________________________
Calidad de vida	______	____	______	______________________________
Crédito	______	____	______	______________________________

[Para Éxito continuar con la pregunta siguiente. Para los otros caserios ir a la pregunta 2 .3]

2. 2 ¿Usted cree que ... ha cambiado aquí desde que el río ha tomado su curso por Independencia (2001-02)?

	Mejor	Igual	Peor	Como/razones
Agricultura	______	____	______	______________________________
Pesca	______	____	______	______________________________
Transporte	______	____	______	______________________________
Calidad de vida	______	____	______	______________________________

2. 3 ¿Ha notado algún cambio en las crecientes desde que se dió el rompeo de Bahuanisho Bagazan?

Si	No	Alaga...que antes		Observaciones
		Mas	Menos	

[Si la respuesta fue si, continuar con la siguiente pregunta, si no, continuar con 2.7]

2. 4 ¿Sabía o se imaginaba Usted que eso podía suceder? *[que el terreno iba a comenzar o dejar de alagar todos los años]*

Si No

2. 5 ¿Podría explicarme como podía saber?

a) Experiencia personal

b) Escuchado de alguien más (aquí)

c) Ha visto asi en otro sitio ________ (especificar)

d) Ha notado con el paso del tiempo

e) Otra forma __________ (especificar)

Ultima revisión 3 Octubre 10:12am

2. 6 ¿Qué hizo Usted para prepararse o arreglárselas el primer año que alagó (o dejó de alagar)? [*según sea el caso*]

El primer año ______________________________

Para el segundo año ______________________________

Para el siguiente ______________________________

Y el que sigue ______________________________

[*Para todos los sitios*]

2. 7 ¿Cree Usted que el terreno aquí puede alagar...

	Si/No	Razones (o señales)	Formas de respuestas
El próximo invierno (2004)	______	______________________________	
Para dentro de 2 o 3 años	______	______________________________	
Dentro de 5 años	______	______________________________	
Dentro de 10 años	______	______________________________	

2. 8 ¿Ha notado algún cambio con el barranco aquí después de que se dió el rompeo de Bahuanisho Bagazán?

Si	No	El barranco cae ...que antes		Observaciones
		Mas	Menos	

[*Si la respuesta fue si continuar con la siguiente pregunta. Si no, pasar a la pregunta 2.10*]

2. 9 ¿Por qué cree Usted que ha ocurrido eso (i.e., barranco ha golpeado más (o menos) desde el rompeo)?

____

____

____

2. 10 ¿Cree Usted que el barranco puede golpear aquí...? (en particular a sus terrenos)!!

	Si	No	Razones
El próximo año (2004)	____	____	______________________________
Dentro de 2 o 3 años	____	____	______________________________
Dentro de 5 años	____	____	______________________________
Dentro de 10 años	____	____	______________________________

[*Si sí, continuar con la siguiente pregunta*]

Ultima revisión 8 Octubre 10:12am

2. 11 ¿Qué esta haciendo o piensa hacer para asegurarse o poder salir adelante si le golpeara el barranco? *[marcar antes o después*

Reservas:		**Buscar terreno:**		**Otras Actividades:**		**Otros:**	
Alimentos (fariña, granos)		Altura		Pesca		Migrar:	
Venta de bienes y animales		Restinga (alta o baja)		Extracción		Crédito (formal)	
Ahorros		Bajial		Caza		Préstamos (informal)	
		Barrizal Playa		Jornalear –Peón		Ayuda mutua	

[*Preguntar a todos, haya o no barrizal este año*]

2. 12 ¿Cree Usted que podría haber barrizal en este sitio... [se refiere a los terrenos que trabaja la gente del caserío]
Explique...[*Si no hay este año ¿por qué podría haber? Si hay ahora pero esperan que no salga el próximo año ¿Por qué? Si saldrá, menos, igual ¿Por qué? PARA FORMAS DE RESPUESTA CONSIDERAR TAMBIÉN LAS LISTADAS EN LA TABLA DE LA PREGUNTA ANTERIOR.*]

	Si / No	Razones	¿Cómo se las arreglaría Usted?
El próximo año (2004)	____	____	____
Para dentro de 2 o 3años	____	____	____
Dentro de 5 años	____	____	____
Dentro de 10 años	____	____	____

2. 13 ¿Usted realiza algún tipo de trabajo o preparación para que vuelva a salir el barrizal de un año para otro?

Si	No	Tipo de trabajo para que salga barrizal

2. 14 ¿Le ha sucedido alguna vez que salga playa donde usted tenía su barrizal?

Si No

2. 15 ¿Qué ha hecho entonces?

a) Buscar otro sitio con barrizal ____

b) Aprovechar la playa con otros cultivos (chiclayo, sandia, melón) ____

c) Buscar otro barrizal, pero también aprovechar la playa ____

d) Dejar de trabajar en barrizales y playas ____

2. 16 ¿Por qué?[*razones o motivos*]

____
____
____
____

2. 17 ¿Le ha tocado alguna vez que alguien más haya querido trabajar el mismo barrizal o playa que Usted? [*Resultado se refiere a quien se quedó con qué*]

Si	No	Año	Area en disputa	Dentro o fuera del caserío	Resultado	Como se resolvió

2. 18 ¿Conoce Usted algún sitio cercano donde podría darse un rompeo?

Si	No	Lugares	

2. 19 ¿Sabe Usted de algún lugar donde la gente haya ayudado a que el río rompiera?

Si	No	Año(s)	Lugar	Tipo de trabajo	Duración	# de personas	Objetivo	Efectos

2. 20 ¿Ha participado Usted alguna vez en trabajos para ayudarle al río a que tome otro curso? ¿Podría explicarme lo que se hizo?

Si	No	Año(s)	Lugar	# de veces	Tipo de trabajo	Duración	# de personas	Objetivo	Efectos

3. Actitudes sobre riesgo

Me gustaría jugar un pequeño juego con usted con estas cartas. Ahora le voy a hacer algunas preguntas a cerca de lo que Usted preferiría como situaciones para la producción. [*Mostrar los tres tipos de cartas. Las que tienen plátanos y pescado representan el consumo para su familia y las cartas con dinero representan ganancias*]

Vamos a suponer que con su trabajo (y el de los demás miembros de su familia) en la chacra, la pesca, la extracción, jornales y otros (bodega, chingana, etc) puede mantenerse todas la necesidades de su familia.

3.1 Le sale una oportunidad de un trabajo que si sale bien le dejaría el doble de su ingreso actual, pero que si sale mal su ingreso sería de 2/3 de su ingreso actual (ganar el doble o perder 1/3) ¿Se animaría usted a hacer ese trabajo?

Si No

[*Si la respuesta fue "si" continúe con 3.2, si la respuesta fue "no" entonces continúe con 3.3*]

3. 2 Y si le sale la misma oportunidad de trabajo que si sale bien le dejaría el doble de su ingreso de ahora, pero que si sale mal le daría solo la mitad de su ingreso actual (ganar el doble o una perdida de la mitad). ¿Se animaría usted a hacer ese trabajo?

Si No

[*Si se hizo la pregunta 3.2, pasar a la pregunta 3.4 directamente*]

3. 3 Y si le sale la misma oportunidad de trabajo que si sale bien le dejaría el doble de su ingreso de ahora, pero que si sale mal l daría solo el 80% o 4/5 de su ingreso actual (ganar el doble o una perdida de 1/5). ¿Se animaría usted a hacer ese trabajo?

Si No

[*Continuar solo si se respondió si en la pregunta 3.2*]

3. 4 Y si le sale la misma oportunidad de trabajo que si sale bien le dejaría el doble de su ingreso de ahora, pero que si sale mal le dejaria a usted ninguna ganancia y le faltaría para cubrir las necesidades de su familia. ¿Se animaría usted a hacer ese traba

Si No

Appendix III

Chapter 3 published in *The Geographical Review* 95(1): 122 - 135

GEOGRAPHICAL FIELD NOTE

AN ANTHROPOGENIC MEANDER CUTOFF ALONG THE UCAYALI RIVER, PERUVIAN AMAZON*

CHRISTIAN ABIZAID

> *When the river is rising fast, some scoundrel whose plantation is back in the country, and therefore of inferior value, has only to watch his chance, cut a little gutter across the narrow neck of land some dark night, and turn the water into it, and in a wonderfully short time a miracle has happened: to wit, the whole Mississippi has taken possession of that little ditch.*
>
> —Mark Twain, [1874] 1923

In recent years a number of authors have advanced the discussion of human-environment interactions in the Amazon Basin by presenting evidence—both contemporary and archaeological—of anthropogenic management of an environment previously regarded as "pristine" (Balée 1989; Denevan 1992; Erickson 2000a). It is estimated that humans have intervened in Amazonia since about 11,000 B.P. (Cleary 2001). So far, attention has been given particularly to the management of (agro)forests (see Denevan and Padoch 1988; Balée 1989; Anderson and others 1995; Coomes 1995) and the widespread presence of anthropogenic black earths on both the floodplain and the *tierra firme* (Smith 1980; Woods and McCann 1999; Hecht 2003; Lehmann and others 2003; Glaser and Woods 2004). These works lend support to the active role of humans in shaping the forest landscapes and soils of the Amazon Basin.

Less attention has been devoted to the study of river-management practices among riverine populations (see Chernela 1989; Raffles 2002; Raffles and WinklerPrins 2003). Almost four decades ago William Denevan (1966, 76) reported that meander necks were intentionally cut off to create shortcuts for canoes on the Río Negro, a small tributary of the Baures River in the Llanos de Mojos region of Bolivia. More recently, Hugh Raffles and Antoinette WinklerPrins (2003) made the

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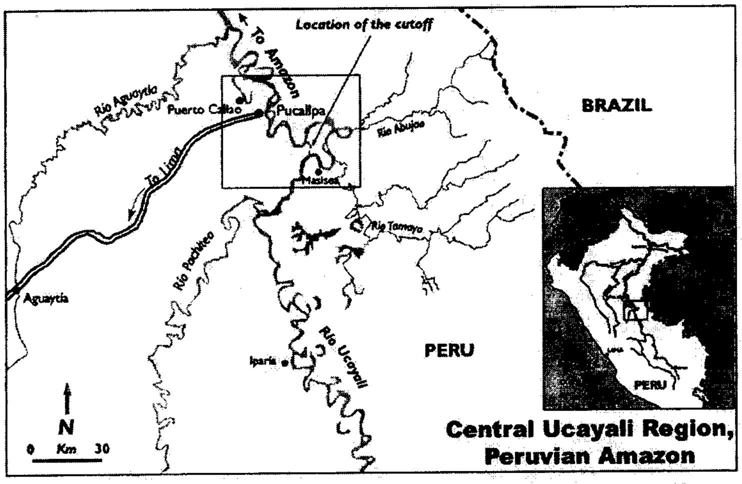

Fig. 1—The Central Ucayali Region of the Peruvian Amazon. The rectangular box on the main map surrounds the area shown in Figures 2 and 3; the heavy black lines on the inset show the major Peruvian and Ecuadorian rivers that join to form the Amazon River. *Sources:* Adapted from IGN 1989, 283; Goulding, Barthem, and Ferreira 2003, 72. (Cartography by the author)

case for extensive human intervention on Amazonian fluvial systems in a review of available evidence, including their own research, published materials, and previously unavailable reports. They, too, wrote of artificial cutoffs on a tributary of the Juruá River in the state of Acre, in the western Amazon of Brazil, and in the Arapiuns Basin, near Santarém, in the eastern Amazon (Raffles and WinklerPrins 2003, 175). This field note complements the literature by reporting on a case in which Amazonian people have played a key role in facilitating a meander neck cutoff that changed the course of one of the largest rivers in the Amazon Basin, the Ucayali River of Peru.

During 2002 and 2003 I conducted twelve months of fieldwork for my doctoral dissertation along the Central Ucayali River, near the city of Pucallpa—the fastest-growing Peruvian city in the Amazon and the main road link with Lima on the Pacific coast (Figure 1). The purpose of my dissertation is to examine how *ribereños*—descendants of Iberian and Amerindian people who use traditional techniques of agriculture, fishing, and forest extraction to make a living—adapt their economic livelihoods in an extremely dynamic fluvial environment such as the Ucayali and to understand how floodplain dynamics reshape the challenges and opportunities for agriculture and for natural-resource use.

Together with the Marañón River, the Ucayali forms the Amazon River proper. This turbid river drains a basin of 337,500 square kilometers (Goulding, Barthem, and Ferreira 2003, 183), an area roughly the size of Germany. Near Pucallpa the

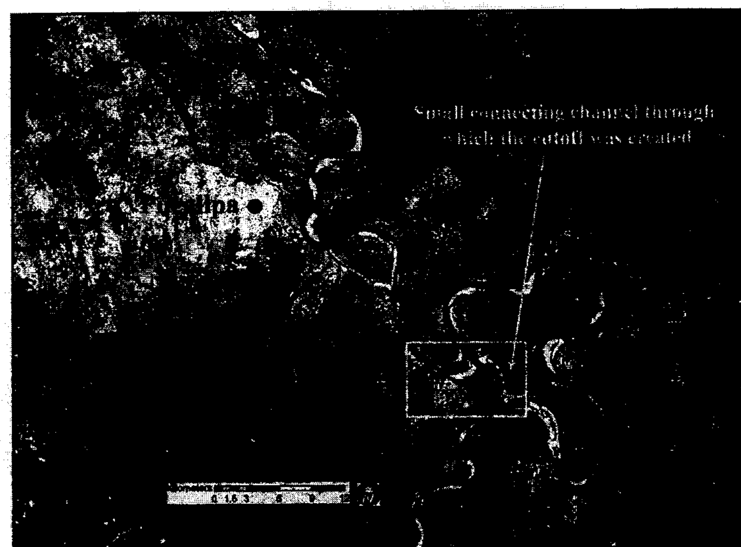

Fig. 2—The Central Ucayali River in the Peruvian Amazon prior to the meander cutoff through the oxbow lake of Bahuanisho *cocha*, from a Landsat 5 TM image taken on 12 June 1996 (low-water stage). *Source:* LANDSAT 5 data © NOAA 1996; received and processed by the USGS/EROS Data Center; processed and distributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University)

Ucayali is 0.7–1 kilometer wide (Bergman 1980, 47; Kalliola and others 1992, 77), but it can reach up to 2 kilometers in width at flood stage (Peruvian Navy 2003). The difference between low water and high water is approximately 9.3 meters at Pucallpa. At the low-water stage the discharge is 2,000 cubic meters per second; during the flood season, up to 22,000 cubic meters per second (Peruvian Navy 2003). Influenced by Andean tectonics and fluvial dynamics, the Ucayali is among the most dynamic rivers in the Upper Amazon Basin (Pärssinen, Salo, and Räsänen 1996) and one of the largest actively meandering rivers in the world. Studies suggest annual rates of lateral migration of 100–160 meters for the Lower Ucayali (Kalliola and others 1992, 77), although average rates of up to 285 meters per year have been reported for certain meanders near Pucallpa (Velásquez de la Cruz 2002, 53). The result of such change is a mosaic of meander scrolls and swales, along with narrow and oxbow lakes, not unlike those described for the Upper Solimões–Amazon in Brazil (Mertes, Dunne, and Martinelli 1996). Located more than 4,500 kilometers from the mouth of the Amazon in the Atlantic Ocean, Pucallpa is only 154 meters above sea level (IGN 1989, 283), and the Ucayali River has a very low gradient (approximately 5 centimeters per kilometer; see Peruvian Navy 2003). At least six meander cutoffs, in-

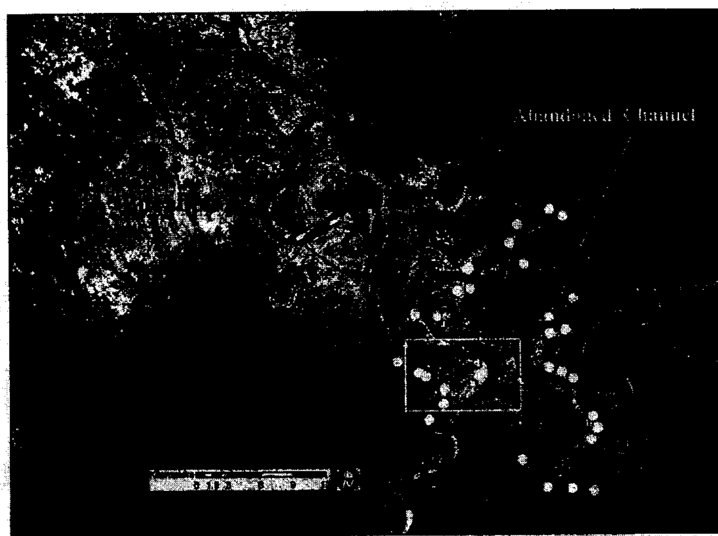

FIG. 3—The Central Ucayali River in the Peruvian Amazon after the meander cutoff, from a Landsat 7 TM+ image taken on 3 August 2001 (low-water stage). The white dots represent my study sites and other villages negatively or positively impacted by the cutoff. "A" marks the site of another suggested anthropogenic cutoff. *Source:* LANDSAT 7 ETM+ data © NOAA 2001; received by the USGS/EROS Data Center; distributed by RADARSAT International Inc., a subsidiary of MDA under license from Space Imaging. (Reproduced courtesy of McGill University Library; image prepared by Ben W. Heumann, McGill University)

cluding the one discussed in this note, have occurred along the Ucayali since 1981, between the mouths of the Pachitea and Aguaytía Rivers (Figure 1). Donald Lathrap (1968, 1970) recognized such dynamism and examined its implications for archaeology and Upper Amazonian prehistory.

Human modification of the course of a major Amazonian river was not something I expected to find when I began fieldwork. The issue was initially raised during a conversation with local farmers while we were traveling on a local public riverboat. We were going from Pucallpa to one of my prospective study sites, located near a large meander cutoff that occurred in 1997 a few kilometers upstream (Figures 2 and 3). According to my travel companions, the large cutoff of interest had been facilitated in a manner not very different from the one described by Mark Twain in his *Life on the Mississippi* ([1874] 1923; see the epigraph). A small channel connecting the Ucayali with an oxbow lake had existed there for years and served for travel during the flood season—a common practice in other parts of Amazonia. At first, it was barely wide and deep enough to be crossed by a dugout canoe at flood stage; today it has become the main course of the Ucayali year-round (Figures 4

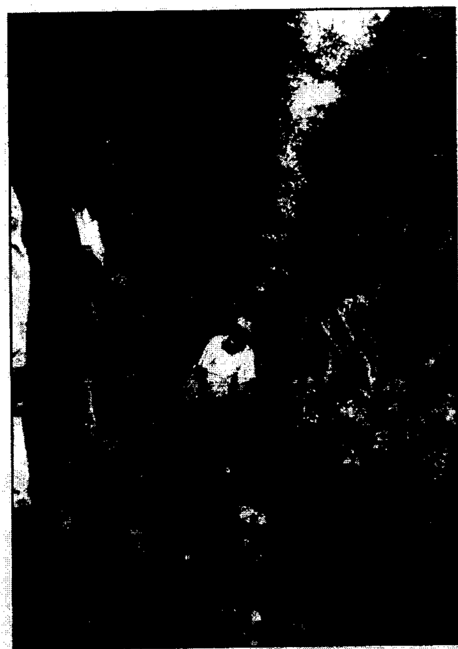

FIG. 4 (left)—A small channel in the Peruvian Amazon near the village of Santa Rosa de Capsinay, similar to the one described in this field note. (Photograph by the author, October 2003)

FIG. 5 (below)—The Ucayali River in the Peruvian Amazon. (Photograph by the author, July 2003)

and 5). The cutoff effectively reduced the length of the river channel from about 71 kilometers to roughly one-tenth of its former distance on the same reach in 1981; in so doing it wiped out one village and left at least a dozen more, as well as Masisea—a district capital—along the abandoned channel. This can be seen in Landsat scenes for precutoff and postcutoff periods (Figures 2 and 3). Figure 2 shows the sinuosity of the channel prior to the cutoff. The small channel that eventually became the main course of the Ucayali is marked with a dashed line in the box. Figure 3 shows the course of the Ucayali after the cutoff. Note how the former channel has infilled northeast of Masisea (bottom right). The potential for this cutoff was documented in the literature as early as the 1940s by Augusto Cabrera La Rosa (1943, 44), who suggested that it could occur within a short period due to the progressive narrowing of the neck in previous years.

Drawing from insights gained during fieldwork, I suggest that local people possess both a strong spatial sense, despite the lack of major differences in relief in the region, and sufficient knowledge of fluvial geomorphology to understand the potential for a cutoff. Such an understanding is not surprising, given that the river plays a central role in their lifeways and livelihoods. They were also aware of the potential benefits of broadening the small extant channel; that is, locals had an explicit purpose for investing labor in such activities. I argue that these actions did, in fact, trigger the meander cutoff.

Riverine Livelihood and Local Knowledge of Fluvial Geomorphology

Ribereños use the lower-lying areas on the floodplain—sandbars and mudflats—to grow annual crops between floods; perennials are grown on higher levee areas, which typically flood every 7–10 years. Even before the waters recede, knowledge of fluvial dynamics helps farmers to claim new land areas created by sediment deposition for agriculture. It also helps them anticipate and mitigate the effects of riverbank erosion and the risk of flooding. Local residents fish along the main river, side channels, and backswamps and in nearby lakes. Their understanding of fluvial dynamics allows them to identify the best areas for fishing at different times of the year.

Without any major roads, the river and other channels provide the main "highway" network for travel, by boat or canoe. Travel distance between two locations depends more on the number and size of meanders than on the actual areal distance that separates them. Local people typically measure distances in terms of the number of meanders rather than in travel time or kilometers.

The spatial sense of local people is also reflected in their search for the shortest fluvial route during the flood season (see Bergman 1980, 48). As soon as a channel that offers a more direct route is filled with water when the river begins to rise, people use it as an alternative to the meandering course offered by the river during the low-water season.

Ribereños have developed a strong intuition about fluvial geomorphology based on observation and a long history of occupation along the river. During my interviews, respondents were able to identify on a sketch map where erosion and deposition occur and to relate them to channel geometry and water velocity. Using the same understanding, they also accurately explained the process of how meanders are cut off when the neck becomes too narrow and erosion continues at both ends of the neck or where a small connecting channel serves as a shortcut to another segment of the river.

Why Facilitate the Meander Cutoff?

For local people to invest labor in removing vegetation and in widening and maintaining the channel, the benefits of their efforts must be clear. The main reasons reported are related to improving river transportation—namely, to reduce travel distance from upriver to Pucallpa, the main regional market—and to make river travel safer for goods and people.

Interviews conducted in Puerto Angel,[1] a village just upstream from the cutoff, reveal that, prior to the cutoff, local residents had to travel up to sixteen hours by boat to take their produce to the markets in Pucallpa. The cost of shipping produce or embarking on a boat reflected the distance traveled. Farmers often used the port of a neighboring village immediately downstream from the cutoff and traveled one hour by foot to and from Puerto Angel, thereby saving about twelve hours of boat travel along the meandering course of the Ucayali. It was not uncommon for produce to be shipped by boat at night; the owner would wait for the load at the port in the next village early the following morning to take it to Pucallpa. Loads were sometimes carried by tricycle or by foot to this advantageous port. During the flood season, boats used the small connecting channel,[2] but travel was contingent on the stage of the flood. Field observations suggest that this often occurs along the Ucayali.

The small connecting channel offered a shorter seasonal route at flood stage but was dangerous to travel. The relatively steep gradient (approximately ten times greater than that of the main channel) created a strong current, which, together with the debris in the channel, made it difficult for boatmen to maneuver their boats effectively. Respondents reported several accidents in which people had drowned and boats had been wrecked while traveling through the channel.

Another motive for maintaining the channel was the ribereños' intention to collect a toll from all transiting boats in order to bolster village finances. A collection booth was set up, and loggers and boatmen apparently welcomed the initiative for a more navigable channel because it allowed them to save much time and fuel by taking the shorter route. The booth was abandoned, however, after its crew was robbed during the flood season.[3]

It is unclear whether the people involved explicitly sought to divert the main channel of the Ucayali or simply wished to create a larger and deeper chute channel that served as a much shorter route to the market. Based on their knowledge of fluvial geomorphology, one would expect local residents to have foreseen that the cut could change the course of the Ucayali and lead to the abandonment of a large segment of the river, the whole Masisea meander complex, approximately 71 kilometers long. If that were the case, it seems that their intent was to alter the course of the Ucayali completely and to gain access to a shorter and safer route year-round. It is possible, however, that their intentions were more limited and their expectations more modest. Respondents reported that they sought to facilitate river transportation through an already existing channel during the flood season.

In either case, the ultimate outcome has been the complete alteration of the course of the Ucayali and the stranding of about a dozen villages as well as the town of Masisea (with a population of about 3,500 as estimated by my field sources; no up-to-date official numbers have been available since 1993), which is now 8 kilometers from the new course of the river. Some informants reported that, in response to the cutoff, the mayor of Masisea hired people to dig a short channel to the Ucayali in an attempt to force the river to flow back close to the town. Their channel swiftly filled in, however, and a dirt road had to be built instead. At least one village disappeared as a result of the cutoff. Its residents either formed new settlements upstream or migrated to Pucallpa. The people of Puerto Angel are aware of such implications, and they feel both uneasy and culpable. Whereas most residents consistently mentioned the activities documented below, some denied that any work actually took place. But local populations had the necessary understanding to conceive of the cutoff and a purpose that would, indirectly or directly, facilitate it.

The Anthropogenic Role in the Cutoff

Local reports suggest that several activities were undertaken over less than a decade. For the most part they were carried out with simple tools and did not require the high degree of social organization often assumed for this scale of landscape modification (see Doolittle 1984). The original channel connecting the Ucayali with the oxbow lake of Bahuanisho (Bahuanisho *cocha*) was barely wide or deep enough for a canoe during the flood season. Residents of Puerto Angel, on the Ucayali just upstream from the channel entrance, grew crops along both sides of the small channel until about 1990, a period when credit was available from the Agrarian Bank. According to respondents, the channel was only about 2 meters wide and 1 meter deep, and access was impossible when the river was low. Nevertheless, canoe and, later, motorboat traffic at high-flood stages gradually led to the widening and deepening of the channel through erosion by boat wash. The first concerted attempt to manage the channel was carried out in the late 1980s by about a dozen residents of Puerto Angel, who spent four to eight days in one year clearing the channel before the flood season, using machetes, axes, shovels, and a chain saw. They removed all debris and buried logs that blocked the flow and made travel dangerous. They also cleared the banks of all vegetation within 5–15 meters of the channel up to the entrance of Bahuanisho cocha in order to facilitate bank erosion by the stronger currents during the annual flood. My respondents claimed that they essentially failed, although the channel did become somewhat wider. Two or three years later, some of the participants, acting then as village authorities, convinced the community of the benefits of the chute channel and of maintenance work. Subsequent clearing of the channel was done as communal work once a year by some 40–50 men from the village,[4] who worked for a day before the onset of the flood. A few years before the actual meander cutoff occurred, Puerto Angelinos dug a series of circular holes, measuring 1–2 meters in diameter and 1 meter in depth in the bed of the channel and continued to clear the banks. The purpose of such holes, I was told, was to create a circular current that would further enhance the erosional power of the floodwater. The current did help widen the channel and created deep and wide pools from the scour holes. The final touch was applied before the 1997 flood, when the entrance of the channel was enlarged by a logger using a tractor. During the 1996/1997 flood season, after four or five years of modest labor investments through communal work by the people of Puerto Angel, the Ucayali cut its main course through that channel.

Small-scale incremental activities leading to significant transformations on the landscape have been reported elsewhere. Early canal systems in Peru were probably constructed and expanded gradually (Denevan 2001, 148), as was the largely anthropogenic landscape found around Lake Titicaca (including terraces, raised fields, sunken gardens, and irrigated pastures) (Erickson 2000b). The Safford Valley grids in the U.S. Southwest, which functioned as a horizontal water-control system for agriculture, were likely constructed in a similar fashion (Doolittle and Neely 2004). It is now believed that this may also have been the case for early irrigation systems in prehistoric Mexico (Doolittle 1990), Mesopotamia, and Persia (Downing and Gibson 1974). Thus modest amounts of labor invested incrementally but regularly by small social groups over long periods of time, or at critical moments, can make a significant impact on the landscape.

It is difficult to discern whether the meander cutoff would have occurred in the near future without human intervention. The Ucayali is, after all, under the influence of active Andean tectonics and fluvial dynamics. The cutoff is consistent in direction with an avulsion related to tectonic activity in the late 1700s, which rapidly shifted the course of the Ucayali River in this general area up to 45 kilometers west of its original location (Neller, Räsänen, and Salo 1992; Pärssinen, Salo, and Räsänen 1996). My visual examination of Landsat imagery prior to the cutoff (1987, 1988, 1993, and 1996) suggests that it would have taken decades or more for the cutoff to occur, due to low rates of lateral erosion at the neck.

What is now the course of the Ucayali is also a much more energy-efficient route than the meandering sequence prior to the cutoff. The fact that a channel, though small, had been there at least since the 1960s suggests that the river could have taken that course at some earlier time. Rapid changes in the course of a river are typically associated with intermittent phenomena such as extreme peak discharges and, in other regions of the world, ice jams, beaver dams, or side channels left by the river in the past (Törnqvist and Bridge 2002). I found no significant earthquake activity, either in the official records of the Peruvian Geophysical Institute or in local reports close to the date of the cutoff (compare Lathrap, Gebhardt-Sayer, and Mester 1985, 63).[5] I examined daily river-level records for Pucallpa in order to determine whether the cutoff may have been related to extreme discharge. The 1997 flood—when the cutoff occurred—was above the 1981–2003 average, but Pucallpa records show higher floods for three flood years prior to 1997, the highest flood being almost 0.5 meter higher than the 1997 peak level. If triggered by extreme discharge, the cutoff would have occurred during that higher flood (Lapointe 2004). None of those higher floods, however, was sufficient to trigger the cutoff. Flood-stage records therefore lend further support to the thesis of human facilitation of the cutoff.

The cumulative effect of less dramatic floods could also have led to the change in the river course (Leopold, Wolman, and Miller 1995, 80–94). In this case, however, the strong correlation between human action and the occurrence of the cutoff suggests otherwise. The cumulative effect of normal floods played a role in the creation of the setting (that is, the sequence of meanders) in which humans intervened, but I conclude that human action ultimately triggered the change. Clearly, people intervened in what was a highly attractive alternate route, one that bypassed a reach of tortuous meandering. The greater difference in gradient at that reach increased the likelihood that their actions would trigger the cutoff.

Anthropogenesis of Large Fluvial Systems

The observations reported in this field note suggest human intervention on riverine environments at a much larger scale than previously acknowledged: Amazonians may be able to accelerate changes in the course of large rivers that otherwise would take decades or centuries to occur, even if, in this case, their ultimate goal was only to improve transportation to the main regional market. Such interventions entail primarily the use of rudimentary tools, manual labor, and the force of the water in motion. Four insights derive from this study.

First, local environmental knowledge held by traditional peoples is complex and extends beyond areas currently identified in ethnoecological research (see Minnis 2000; Geoderma 2003). This study suggests that traditional peoples understand fluvial systems and processes, just as they understand plants, animals, soils, and weather. Widespread evidence of human management of wetlands and fluvial systems for irrigation, sedimentation, and flood control implicitly points to such complex understanding (see Downing and Gibson 1974; Rubin 1991; Doolittle 2000). However, local knowledge of fluvial processes is a field that has not been formally recognized and deserves much attention. In a setting such as the Ucayali, where change is part of the riverine way of life and the river is a dominant element in the ribereño environment, such knowledge is not surprising. Understanding that the river may erode one's farmland, form a new mudflat where rice can be grown, or change its course completely is a matter of survival. Yet local understanding is neither complete nor perfect; it is continually evolving. People living in the area reported more frequent flooding downstream from the cutoff and less frequent flooding upstream since the change in the river course, which is consistent with the literature on fluvial geomorphology. A steepening gradient due to channel shortening increases flow velocity and results in the degradation and aggradation of the riverbed upstream and downstream, respectively (see Brookes 1988; Talbot and Lapointe 2002).[6] According to local informants, no one anticipated local changes in flooding prior to the cutoff. Nevertheless, they rapidly perceived the change and adjusted their livelihoods accordingly.

Second, if contemporary traditional people were able to facilitate a meander cutoff along a major river such as the Ucayali, similar anthropogenic works may also exist along other meandering rivers—large and small—in the recent past or in prehistory. During fieldwork I obtained consistent reports from residents in one of my other study sites that suggested another anthropogenic cutoff along the Ucayali, a few kilometers upstream from Pucallpa (see the spot in Figure 3 marked "A"). Respondents at the site reported that males from villages in the vicinity, participating in communal work parties, had dug a 1.5-meter-wide channel alongside a path that crossed the neck of the meander to facilitate transportation to Pucallpa. According to them, it took a few flood seasons before the actual cutoff occurred.[7] An American pilot commented on meander cutoff canals near the mouth of the Aguaytía River, and villagers reported a 150-meter-long ditch near the mouth of the Tamaya River that substantially shortens the distance to the confluence of the Tamaya with the Ucayali.

Although no prehistoric anthropogenic meander cutoffs have been reported to date in Amazonia, the utility of improved water routes in the past is obvious, particularly because people traveled by canoe. Evidence of ancient artificial canals to improve communication by water in Bolivia's Llanos de Mojos Region attests to this (Denevan 1966, 74–76). The investigation of prehistoric anthropogenic meander cutoffs, however, is challenged by the difficulty of identifying material evidence of human intervention and by the constant reworking of the floodplain.

The third lesson is that the activities that ultimately triggered the cutoff, although they generated important benefits to some people, harmed people living in nearby areas. Villages were wiped out or left stranded kilometers away from the river; people drowned; and livelihoods were dramatically affected. These negative effects help to explain the sense of unease I perceived among some respondents.

The fourth lesson is that human intervention ultimately appears to have triggered the cutoff, although the cutoff would have occurred eventually even if local people had not taken part in the process. Ribereños understood enough about the river and its dynamics to envisage the possibility of altering the river's course, and the benefits of a cutoff were evident to those involved in its facilitation. The type of activities reported here are consistent with the literature (see Raffles 2002; Raffles and WinklerPrins 2003) and make sense in terms of enhancing the erosional force of the water along a channel that offered a more energy-efficient route. Change was induced with minimal investment of labor over a short period and in combination with natural fluvial processes. Raffles (2002) and Raffles and WinklerPrins (2003) have documented other instances in which humans have used and manipulated fluvial processes for a specific purpose. For instance, they report on channels that were dug to facilitate access to natural resources, such as forest products, game, fish, or agricultural land, or to shorten travel distances (Raffles 2002, 12–43; Raffles and WinklerPrins 2003, 169–170). Artificial crevasses cut through levees to create new land for agriculture have been documented in other parts of Amazonia (Sternberg 1995, 143; Raffles and WinklerPrins 2003, 172–174).[8] In the case discussed here, by managing a small connecting channel the residents of Puerto Angel effectively altered the process of fluvial geomorphological change along the Ucayali River, a main headwater tributary of the Amazon.

Notes

1. "Puerto Angel" is a pseudonym. To maintain the respondents' anonymity, the real name of the village is not disclosed.

2. Such channels, called "*sacaritas*," are small, natural depressions that carry water during the flood season. They may be crossed by canoes and facilitate communication across the neck of a meander or between one point near the mouth of an affluent and another point on the main river. They may be called "canoe paths" and are known in Brazil as "*furos*" (Cabrera La Rosa, 1943, 41).

3. According to one respondent, the village collected the equivalent of up to U.S.$1,400 (5,000 nuevos soles [new sols] in Peruvian currency) during the months in which the booth was in operation—a significant amount in a region where the daily wage is only 10 nuevos soles.

4. Respondents were unable to recall the exact number of participants in these works, and village records from those years are missing. The estimate provided here is based on current membership in the village assembly (approximately 110) minus possible absentees. Typically, unless otherwise specified, 50 percent of the membership must be present for the work to be done.

5. The earthquakes reported during the 1996/1997 flood season were similar to those experienced in other years at flood stage.

6. In fact, until the 1970s one of the main reasons for straightening river channels was to reduce flood levels upstream (Brookes 1988, 3–24).

7. One night during the flood season, a loud noise was heard in the middle of the night, announcing that the river had cut its main course through that channel. The next morning the river upstream from the cutoff had dropped by about 1.5 meters, leaving canoes and boats beached at the port.

8. A crevasse or levee breach occurs when a levee breaks during a flood event and allows silt-laden waters to spread over low-lying areas behind it, where sediment is deposited and the elevation of the land increases gradually (Boyer, Harris, and Turner 1997, 85).

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