Tropical Rhythms and Collective Action

Community-based Fisheries Management in the Face of Amazonian Unpredictability[1]

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1 Community-based Fisheries Management in Amazonia

Human life in the Amazonian *varzea*, the resource-rich floodplain of the Amazon river, depends on the aquatic resources found in the rivers and lakes as a primary source of food and cash income. With increasing frequency, Amazonian communities are closing off to outsiders the lakes they consider to be theirs and creating social institutions for managing these fisheries more sustainably (de Castro *et al.* 2000; McGrath 1993; Oliveira and Cunha 2000; Pinedo *et al.* 2000; Pinedo-Vasquez 1992). To survive, these communities have to adapt to the heterogeneous and dynamic world in which they live. Flexible institutions are key to the viability of management systems which must bend with the chaotic rhythms of social life, whether it be power struggles among family groupings, or constant variations in the legal and policy framework defined in the distant national capital (McCay and Jentoft 1998).

At the same time, the communities, their livelihoods and the fisheries they depend on are rooted in a natural system that is diverse and heavily marked by an annual alteration between flooding and low water. This dynamic and heterogeneous world gives rise to a wide range of uncertainties and ambiguities that challenge the long-term viability of community management efforts (Mehta *et al.* 2000; Scoones 1999). In this article we focus on the unpredictable nature of the hydrologic regime which not only governs the annual cycle of fisheries production and availability, but also determines the timing and intensity of productive activities such as agriculture, extraction of forest products, and hunting.

Our approach for analysing the evolution and performance of this community-based natural resources management (CBNRM) system takes into consideration the resource-use choices made by individuals within their domestic group, the relationships between individuals and broader society, and the social institutions developed for the sustainable use of a common resource (McCay and Acheson 1987; Smith 2000). Because the relationships that underlie these institutions are dynamic, we suggest that CBNRM systems must be analysed as historical processes in which many

different factors appear, interact and disappear over time to encourage and discourage a group's resolve to invest in the management of a common resource, and to shape the efficacy of their institutions for doing so.

2 The Tahuayo River Basin and the Community of El Chino

The community of El Chino is located along the Tahuayo river within the upper Amazonian floodplain in northeastern Peru, a region characterised by its geographic isolation and an economy that has long depended on the international demand for forest products (Hiraoka 1985; Coomes 1992). In this region, rivers are the main source of communication, transportation and commerce. The Tahuayo river, draining approximately 1400 km≈, runs its entire length of more than 80 km parallel to the Amazon river. Its floodplain is constrained to the east by upland forests. The black water of the Tahuayo differs considerably from the brown Amazonian waters as the Tahuayo waters have mostly an underground origin and are more acidic and nutrient poor.

Although black water rivers are considered to have poor productive potential, the Tahuayo basin has proven otherwise (Coomes 1992). Production from agricultural and extractive activities has long been sent to Iquitos, the largest urban center in the Peruvian Amazon located only 40 km down river from the mouth of the Tahuayo River. Today the river basin supports a population of 3,734 inhabitants distributed in 15 small, nucleated villages and 4 agricultural colonies.[2]

The territory of El Chino is composed primarily of a floodplain or *varzea* ecosystem. During high water up to 90 per cent becomes flooded, temporarily transforming the landscape into one enormous forested lake. When waters recede, they become restricted to the main river channel and to the numerous lakes that dot the floodplain. During the early 1980s many communities in this watershed saw their game and fish depleted by outsiders, which motivated several of them to take control of the lakes and/or forest (Bodmer 1994; Penn 1990; Puertas 1999). Initiatives varied among communities, but in the case of fisheries, communities generally prohibited commercial fishing and the use of nets, traps and poisons in the lakes within their jurisdiction.

The community of El Chino has 52 nuclear families distributed in 41 domestic units, most of whom live in a small settlement on the banks of the river. Six larger extended family groupings link domestic units and play important roles in community politics and decision making.

The community has no traditional authority system. However, in a community assembly, they elect on a rotational basis a *teniente gobernador* and an *agente municipal*, both part of a national system of local authorities. The functions of the two overlap and include maintaining order, ensuring compliance with community norms, looking after public works, and leading the community assemblies and workdays. Community norms are rarely formalised; compliance is loosely negotiated daily among many different subsets of community depending on how the variables line up at that point in time. Occasionally after the sum of these negotiations has produced a major shift in a norm, community members will give the change formal recognition in a community assembly, and it will be written down in the formal record of the meeting.

2.1 Economic activities and natural resource use

The inhabitants of El Chino, like most riverine people throughout the Amazon basin, practice a diversity of livelihood strategies as a direct adaptation to the dynamic environmental and economic conditions in the area (Coomes 1992; Coomes and Barham 2001; Hiraoka 1985; Padoch and Jong 1990). Seasonal as well as annual variations in the environment force them to recombine their economic strategies continually and to diversify their production in order to satisfy subsistence and monetary needs. In addition, changes in conditions of access to capital, land, or political power, the evolution of the age cycle in the domestic unit, and the presence of external agents influence shifts of economic strategy at the household level (Coomes and Barham 1999; Pinedo *et al.* 2000). The implications of these variations are enormous since economic strategies can strongly alter the balance between productive and extractive activities.

Fishing is essential for the subsistence economy of El Chino throughout the year, being the main source of protein in the daily diet. For some families, it is also the main source of cash income. However, our research confirms Coomes's (1992) observation that fishing is the second ranking income-generating activity for the community as a whole, after the sale of agricultural products, while direct measurements through a three month period in 1994 show fishing to rank fourth after agriculture, hunting and *aguaje* extraction (McDaniel 1995).

3 The Lake Management System in El Chino: The Evolution of Community Institutions

The real importance of fish for the Tahuayo communities lies in the fact that it provides a mainstay of the diet of each domestic unit every day of the year. For this reason, the 13 lakes that surround the village are of vital importance to El Chino, and this we believe stimulated the community of El Chino to organise itself to protect those lakes from over-fishing by commercial interests from Iquitos and to regulate the fishing practices of all Tahuayo fishermen. Distance from the community, size of the lake, access from the main channel and current vegetation cover, among other parameters, have influenced human pressure on the lake fisheries.

During the 16-year period from 1984 to the present, the residents of El Chino formalised a number of decisions in their community assembly and took a series of collective actions to exercise greater control over and regulate access to their lake fisheries (McDaniel 1997). We refer to this body of decisions with their resulting actions and institutions as the community-based management system for lake fisheries. It had four basic components.

Norms and rules. One of the first norms agreed on was to prohibit non-resident, commercial fishermen from entering the community lakes. Though applicable year round, this prohibition was applied most stringently during the two-to-three month period when floodwaters recede and fish are concentrated in the lakes. The community also divided the lakes within its jurisdiction into two categories: lakes for subsistence use and lakes for multiple use. Use of the former was restricted during the low water months when fishing was permitted only with hooks.

One of the central tenets of the management system is the restriction on types of fishing technology that can be used during certain times of the year. The use of all types of nets is prohibited in the subsistence lakes during the low water season, along with all fish poisons, dynamite and other explosives. At the same time, the community agreed to ban all fishing techniques that destroy fish habitat, restrict their migration or limit their reproduction.

At about the same time that the lakes were closed to outside commercial fishermen, the community established a quota system for all the resources harvested for commercial use within community boundaries. In the case of fish, a limit of three tubs of fish per workday was established.[3] Finally, the community incorporated regulations from the national fisheries legislation that establish a closed season and size limitations for fishing certain species.

Vigilance and monitoring. During almost a decade, the community implemented a vigilance system, carried out by an elected fisheries inspector, to ensure that the norms were respected: to ensure that people from other communities and commercial fishermen were not entering the lakes at night, and that community members were not using nets in the lakes. After an initial period of confrontation with commercial fishermen during which the community successfully established its jurisdiction over the lake fisheries, the incidence of infractions fell. The system of vigilance was deactivated in 1996.

Taxes. In a communal assembly the community created a tax on game meat, timber, palm fruit and fish extracted for commercial purposes. This was first implemented at the beginning of the 1980s when many outsiders were entering the area to extract resources for the Iquitos market. The taxes collected are put into a communal fund used for buying tools or materials for communal work, or for supporting community members when they are in need. *The teniente gobernador* and his inspectors

are in charge of collecting the taxes at the moment the products are placed on the boat that goes daily to market.

Sanctions. According to the community's public discourse on management, those who fail to comply with certain norms receive sanctions, including confiscation of nets and/or fines. However, McDaniel (1995: 71–2) reports that in the early 1990s, only one or two people were caught fishing with nets in lakes for subsistence use during the low water season. While our field team witnessed no such sanctions applied during their fieldwork, community members insisted that in some cases the community might confiscate the catch which would then be sold at a low price to community members and the money given to the transgressor.

4 Tropical Rhythms and Fisheries Management

Since its inception in 1984, the implementation of this management system for lake fisheries in El Chino has not been a continuous, linear process. Rather, the community has approached each component with a varying degree of commitment and resolve, resulting in a series of ups and downs for the overall system (Pinedo *et al.* 2000).

An analysis of the variables that determine this dynamic behavior of the management system requires both an interdisciplinary and an historical approach. One needs to look at how both people (men/women, domestic units, kin-based 'clans') and the resource (fish stocks) respond to the cyclical changes in the local environment (rainfall, water level) over a period of years. At the same time, one must address the impact of the changing social composition of the user group, as well as external forces such as regional political shifts or fluctuations in prices at the Iquitos market. In the case of El Chino, these variables influence the management system through time in two ways: they determine people's interest in maintaining the management system as a whole; and they oblige the community members to reevaluate continuously, in terms of cost, benefit and effectiveness, the different components to the management system.

4.1 Variation in flooding cycles, El Niño events and *varzea* ecosystems

El Chino is located where the Tahuayo river floodplain reaches its widest point and consequently where flooding exerts its most extended influence. Every year between March and May water levels reach their maximum at seven to nine metres above the minimum, inundating both sides of the river for kilometres inland for a period ranging from a few weeks to more than three months. During the high water season many households choose to migrate to the uplands, either near the edge of or outside the community's territory.

Only the forest in the higher parts of these alluvial terraces remains out of the water during the entire year. These forests are productive and sought out for planting important annual crops, perennials and trees not adjusted to the flooding regime. The tall forests of the low terraces flood every year and are repeatedly felled during low water for short season crops. The swamp forests, the most extensive types in the community territory, have very limited direct economic value, although they are ecologically important as fish habitat during high water periods.

For *varzea* ecosystems, the flooding pattern is the most important environmental factor influencing the landscape and the livelihood strategies of its inhabitants (Goulding *et al.* 1996; Hiraoka 1985; McGrath *et al.* 1993). The annual floods follow the seasonal pattern of the Amazon river, rising between November and February and reaching their highest levels between February and May, then dropping with increasing speed to their minimum level by August and September. Significant variations exist within and between years in the intensity, timing and duration of the floods, influencing enormously the success of people's livelihood strategies and the outcomes of their lake fisheries management initiative.

The dynamism of this hydrologic regime is influenced largely by non-local factors. The timing and intensity of flooding in the Iquitos area depends on the rise and fall of the Amazon river, itself influenced by rainfall in the watersheds of three major sub-systems: the Ucayali which drains the central and southern Andes, the Marañon

which drains the central and northern Andes and, to a lesser extent, the Napo which drains the northern half of Ecuador. Furthermore, variation is influenced by the global phenomenon of the El Niño-Southern Oscilation (ENSO),[4] although in ways as yet little understood and subject to scientific uncertainty. In general, it appears that ENSO events intensify rainfall in the northern portion of the upper Amazon watershed and produce drought conditions in the southern portion, while years of La Niña or anti-niño produce the opposite effect. Thus, during the ENSO event, the water levels of the Napo and Marañon subsystems would be higher than usual, while those of the Ucayali subsystem would be lower than usual.[5]

Since 1968, when the Peruvian government began collecting daily water-level measurements for the Amazon river at Iquitos, there have been three mega-ENSO events: 1972, 1982–83 and 1997–98.[6] The data do not show a conclusive connection between these ENSO events and the flooding regime in Iquitos, but they do suggest that water levels may reach record high and low water marks during the La Niña years following a sizable El Niño event. The data also demonstrate the tremendous variability and unpredictability of the hydrologic regime on the upper Amazon *varzea* (Figures 1 and 2). Figure 2 which compares the average monthly levels for 6 different 12 month periods during the 32 years that data was collected, shows that the peak of flooding occurred as early as January for 1983 and as late as May for 1979 and 1999, while intensity varies both in terms of the height of the flood waters and the length of time the flood waters remained high.

4.2 Hydrologic regime and fisheries management on the Upper Amazon

Fish stocks, as well as the relative abundance of the different fish species in the area, vary seasonally, and for some species are greatly influenced by the annual variations in water level. Research into the impact of the hydrologic regime on breeding habits and productivity is at an early stage, but generally indicates a vital link between the rising and falling of the waters in the river and lake systems and the natural life-cycle rhythms of most fish species (Goulding 1980; Goulding *et al.* 1996). According to many authors, the months of rising waters are the spawning period for most commercial species. However, a few important species spawn during the periods of high-water peaking (Barthem *et al.* 1995).

Goulding (1980; see also Barthem *et al.* 1995) distinguishes among fish species whose reproductive cycle includes a pattern of extensive migrations, those of moderate migration and those that do not migrate. There is accumulating evidence that the migratory patterns of some species of the genus Brachyplatystoma may include the entire length of the Amazon from its estuary to the Andean foothills where they spawn (Goulding 1980; Barthem *et al.* 1995: 90). The migratory pattern of those species with a more moderate range, many of which, like the *bocachico*, are important for the local economy, has been subdivided into three types of movements (Goulding 1980). During the high water period, they disperse into the rich feeding grounds of the flooded forests. When the flood waters begin to recede, they make their way into the main river channels and, with a slow upriver movement, gather into large shoals awaiting the first indications of rising waters. When this occurs, the shoals move quickly upriver to spawn, before returning downriver to their flooded forest feeding grounds in the *varzea*. Other species, such as the economically important *paiche*, do not migrate as part of their reproductive cycle.

A key aspect of the flood cycle is annual flushing of the numerous lakes during the high water season. The lakes reappear during low water when they trap different species of fish, both migratory and non-migratory, once dispersed in the flooded forest. This causes a substantial increase in fishing productivity. Although this productivity diminishes by the time the water begins to rise, a small rise and fall of the water level in November, and the annual rise and subsequent fall of water, serve constantly to renew the system.

While the data available unfortunately make it impossible to ascertain the exact causes of a rise or decline in fish population in any given year, the quantity and quality of fish appear to be directly affected by the timing, intensity and duration of the flooding cycle, as well as the availability of quality

Figure 1: Average Monthly Water Level for Amazon River at Iquitos, Peru, 1969–2000

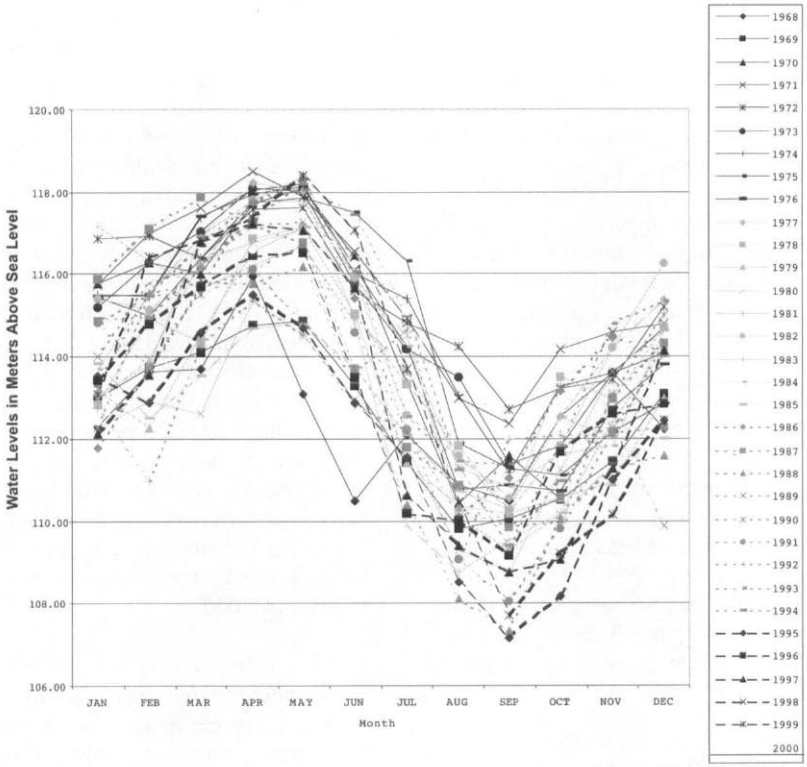
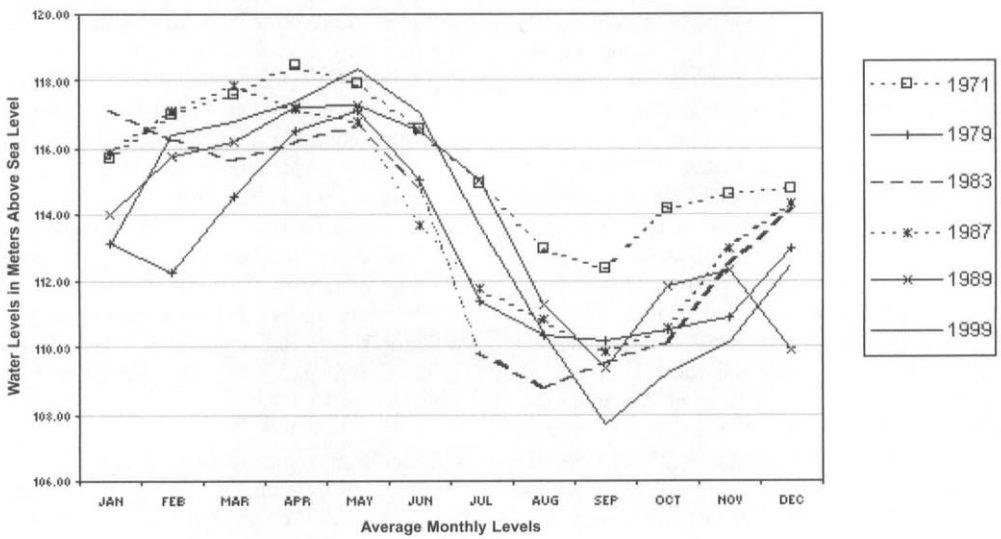


Figure 2: Variation in Timing and Duration of Flooding Regime, Amazon River at Iquitos, Peru



lake habitat during low water. Certainly, local fishermen have observed that during the year following a particularly high and long flooding cycle, fish stocks are up. The state of the fish stocks is one of the most important variables in El Chino, working both as an incentive for management when fish stocks are low and as a disincentive when fish stocks are high.

This was apparently an important factor in the decision to close access to the lakes in a first phase of the management initiative (1984–86) when over-fishing by outside commercial interests was blamed for threatening the annual fish stocks. Low fish stocks continued to be decisive in gaining ample support in the community at a later phase (1988–90) as well. As the most important source of protein for subsistence in the region, a widely shared goal for the community members is to keep a constant supply of fish on their table. After closing access to strategic lakes in the region, the fish population recovered (1990–94) and interest in maintaining the management system declined. Only recently (1997–99) have declining fish stocks once again acted as an incentive for renewed management efforts.[7]

5 Community Management Institutions in the Face of Amazonian Unpredictability

Weather, floodwaters, politics and markets are just some of the variables over which rural people have no control; and yet, any of these variables can determine the difference between feast and famine. Each of the variables that impinge on rural lives and livelihoods is embedded in broader social and natural processes that are themselves dynamic, diverse and, in most cases, rooted in the history of relationships among humans and between humans and their environment. These relationships and interactions are complex and overwhelmingly difficult to discern and comprehend for rural people and researchers alike. Often political decisions, cultural perceptions, economic interests and other social factors well beyond the local community may influence or even determine the outcomes of household and community initiatives. Short- and long-term changes in global systems, such as the ENSO events, can have consequences at a particular place and time that science began to understand only a few years ago. Regardless of the scale, the construction and maintenance of collective institutions for resource management in such a dynamic and, at the same time, uncertain context is indeed a challenge.

As Scoones (1999) and others have suggested, to understand human institutions and their relationship with the environment, we need to question the notions of equilibrium ecology deeply embedded in Western cultural and scientific thinking. While such a view of homeostasis and harmony in nature may lead to success in marketing conservation programmes, it has little to do with the spatial and temporal dynamics of the world we live in. Scoones suggests that the insights offered by the 'new ecology' into complexity, non-linearity and variability in both natural and social systems provide us with a better basis for understanding the impact of uncertainty and unpredictability on human institutions, especially those dealing with resource use and management (Scoones 1999; Mehta *et al.* 2000).

That is certainly the case for the *ribereño* peasants of the upper Amazon valley. We have attempted to show the significant implications that the fluctuating natural environment in which the Amazonian *ribereños* live has had over their choice of livelihood strategies. Living with a dominant river system whose waters rise and fall precipitously, and to a large extent unpredictably, has obliged the *ribereño* population to adopt a 'flexible' attitude towards daily life, allowing them to patch together new livelihood strategies continuously, depending on the timing, intensity and duration of flooding, in conjunction with other variables such as market conditions, current rainfall, or cultural variables such as perceptions of pleasure and boredom. Family members may give more emphasis to subsistence agriculture or extraction of forest products, to small commercial ventures or hunting, to crafts production or fishing, depending on the opportunities and limitations that change with the short- and longer-term cycles (Coomes 1992; Goulding *et al.* 1996; Padoch and Jong 1990).

This is a similar process to that expressed by the concept of 'institutional bricolage', or the patching together of institutional arrangements from the

cultural resources available to a people in response to changing conditions (Cleaver 2000). The dynamism of *ribereño* livelihood strategies through time is a consequence of a deeper adaptation by these peoples to living in the Amazon environment, itself a dynamic and heterogeneous system (Coomes 1992; Pinedo *et al.* 2000). This *ribereño* lifestyle and the cultural resources on which it depends, is partly indigenous to Amazonia and partly created by migrants who brought other lifestyle choices with them. The resulting menu of livelihood strategies is deeply embedded in the broader Amazonian sociocultural milieu which influences all attempts to manage local resources, be it for lake fisheries, soils or forest resources.

The lake management system in El Chino is both an intentionally designed system and an example of 'institutional bricolage'. It came into existence and evolved within an uncertain context as a new and more collective-action-oriented component of an important age-old subsistence strategy, fishing. It arose largely in response to the threat posed by commercial fishermen whose level of capital investment in larger boats and nets, along with freezers, allowed them to fish out the community lakes in a short time. In that sense, it combines the knowledge, accumulated experience and the cultural resources of these *ribereños* with the necessity of protecting their fishery resource from modern threats (de Castro *et al.* 2000; McGrath *et al.* 1993).

The community institutions for managing the lake fisheries that we described for El Chino also follow this logic of dynamic adaptation: the fact that not all norms are enforced or practiced with the same intensity or in the same way every year is both natural and reasonable for the residents of El Chino. The sinuous performance curve simply reflects the non-linearity of all other natural and social cycles in the Amazonian system.

Recognising the dynamic nature of *ribereño* adaptation to their environment and the importance of keeping resource management systems 'flexible' and capable of responding to ecological and social dynamics has important implications for further research, for public policy and for design and implementation of resource management systems. To begin with, it is not possible to understand the complexity and dynamic nature of these societies with 'snapshot' research that looks at a community system at one point of time or even for one given year. If we visit the community of El Chino in July or August, we will likely find most of the community members engaged predominantly in fishing, and very concerned about compliance with certain community norms for fishing. However, if we visit in January, fishing will not be a dominant activity, as families work intensely to harvest and store the crops planted along the river bank. In the same way, if we study the community during a year when the flood waters peak early and endure a short period, we may find a different attitude towards livelihood strategies and resource management than if we are there during a year in which flooding lasts for three months or more. Thus, we need to look at community resource management as an historical process over a long period of time.

Unfortunately, public policy in Amazonian countries recognises neither specific community property nor usufruct rights to most of the resources these communities depend on, nor community-based management systems. There is encouraging movement in this direction for community systems of fisheries management in the Brazilian *varzea* (de Castro *et al.* 2000). As community-based management systems gain recognition and are codified into regional and national norms, it is of utmost importance to take their dynamic nature into consideration. Most lawmakers have little understanding of the complexities and uncertainties that are part of rural life and little patience for developing norms that protect and promote flexible and difficult-to-define adaptive responses. However, rigidity in external norms, even those established with the best of intentions, can contribute to the undermining of local management systems.

Finally, many external agents (NGOs, government agencies, universities) are promoting and implementing projects for resource management among communities in the Amazon. Current project models tend to focus on technology, management technique or improving compliance with community norms and national law. These aspects may be important, but all too often external agents make little effort to situate their

model for resource management in the complexities and dynamics of community life. These models also tend to be linear, assuming that with an initial technical or financial input, management systems will take off on a straight upward curve towards progress. Rarely do they take into account the way local livelihood strategies are adapted to the complexities of local ecosystems or may be influenced by more global phenomena such as the ENSO. NGOs and government agents need to incorporate into their interventions a willingness to understand these dynamic systems, a research methodology to do so, and the patience to construct or redesign models in accordance with local realities. Models for resource management that do not have the capacity and adaptability to deal with changing conditions will likely last only as long as external funds are available as an incentive.

Notes

1. This article is part of a major study, the Amazon CBNRM Research Initiative (ACRI), aimed at determining factors that condition positive outcomes in community-based natural resource management in Amazonia. It is being carried out in Peru and Brazil by the Instituto del Bien Comun, the Instituto de Pesquisa Ambiental da Amazonia, The Woods Hole Research Center and Oxfam America, Inc. and is based on five months of fieldwork carried out in the first Peruvian case study. We would like to express our gratitude to the Ford Foundation for their support of this research initiative.
2. This information is taken from a socio-economic survey conducted by the ACRI team in June 1999. The first census in the basin was carried out in May 1989 and showed 3,150 inhabitants in 18 communities.
3. One tub is equivalent to 15–20 kilograms of fish.
4. The El Niño event refers to the reversal of the east–west warm water currents in the equatorial Pacific Ocean and the accumulation of masses of warm water along the Pacific coast of tropical South America. The Southern Oscilation refers to the total atmospheric-oceanographic changes caused by the El Niño event (Mörner 1993). Since the 1998 El Niño event, scientists have been describing the sudden reversal of the El Niño conditions in the following years as the La Niña event.
5. However, these rainfall patterns are apparently not constant from event to event, suggesting that other factors must be entered into the equation. Unfortunately, neither the rainfall nor the water-level data have been collected so as to enable science to make such inferences in a rigorous way.
6. ENSO events also occur irregularly, with 'mega-ENSO events' occurring every two to five decades. The last three occured in 1972, 1982–23 and 1997–98, suggesting to some a speeding up of the periodicity (Quinn 1993; Mörner 1993).
7. The years 1984 and 1999 marked the beginning of La Niña events after the major ENSO events of 1982–83 and 1997–98, suggesting a possible connection between the perception of the fishermen in El Chino of depleted fish stocks and the impact of the La Niña events.

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