SMALL-SCALE FARMERS' LAND MANAGEMENT STRATEGIES IN THE UPPER AMAZON: AN ACTION RESEARCH CASE STUDY

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SUMMARY

Local agricultural knowledge in the Amazon and its processes of experimentation and diffusion continues to receive scant attention from researchers despite its growing regional importance. This case study has documented and evaluated the broad variety of land management activities which small-scale farmers perform in the Peruvian Upper Amazon in terms of slope-, fallow-, fire-, weed- and agro-biodiversity management. The research shows that local non-indigenous farmers are testing different strategies in order to handle their situation of erosion and land degradation, and that these land management techniques are relevant from a larger land management perspective. The research also shows that farmers prefer to re-direct soil management related questions to a "forest perspective", that is, considering the spatial and temporal dynamics of agriculture as related to fallowing cycles and spatial rotation of gardens. This highlights the importance of reflecting on the farmers' point of departure when talking about agriculture and soil. The conception of soils as a property of the forest, and forest management as the driver of the forest-soil complex, has important implications on how to develop land management processes in the region. The action research approach used in the study strongly supports participatory methods and local, contextually adapted, knowledge and skills in land management programs.

Land management is of direct relevance to both the development and the understanding of human-environment linkages in the Amazon. Land management research has mainly focused on implementation of external expert knowledge based on "best management practice" research at universities and experimental stations. There has been limited success in transferring these results to the farmers' reality of constantly varying and changing conditions, and few results of major adoptions or long-term maintenance by local farmers (Scoones, 2001; Meza *et al*., 2006). Lately, a growing number of researchers are highlighting the need to involve local land users, and their local contextual knowledge, in strategies for land management and natural resource management (Defoer, 2002; Posey and Balick, 2006; Turner and Berkes, 2006). Research on Amazonian land users' ecological knowledge has, however, focused mainly on the traditional ecological knowledge indigenous groups. Less attention has been given to non-indigenous farmers' and colonist farmers' ecological knowledge and land management activities, even though these groups are the dominant land managers today (Padoch and de Jong, 1992). This article describes, classifies and evaluates, at a farming systems level, the variety of land management strategies practiced by non-indigenous farmers, and, from an integrated farming systems level, highlights how small-scale farmers in the Upper Amazonian region of Peru deal with land management problems. The objective is to point out and describe farmers' own land management actions as highly relevant local land management alternatives, in terms of slope-, fallow- and fire- management, based on their own experimentation and learning as activi-

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ties integrated with their farming system management.

From a land use perspective, farmers' innovations in management techniques represent a response to feedback from environmental and economic signals (e.g., soil erosion, labor cost) affecting their livelihoods. Coupled with population pressure and reduced available land area, the cases presented here illustrate farmers' responses to a typical "Boserupian scenario" of shortening fallow cycles, caused by demographic change (Boserup, 1965). Changes in the amount and quality of labor, agricultural inputs, knowledge diffusion, and farmer experimentation illustrate the variety of mechanisms of potential interest to agricultural extension and conservation initiatives. Farmers seek to minimize risks at low cost to cope with conditions of uncertainty and lack of support and infrastructure (Chibnik, 1994; Netting, 1993). The range of intricate techniques used by farmers constitute a valuable local agricultural knowledge reserve. Understanding the role of small farmers' own experimentation would add value to the regional economy (Brondízio, 2004). Acknowledging the broad array of agricultural strategies and land management systems used by non-mechanized small-scale farmers is an important step towards what Cernea (2005) calls "putting the culture back into agriculture". This may contribute to broadening the aims and roles of international and national extension research agencies in promoting forms of agricultural extension that are compatible with local conditions, needs, and goals.

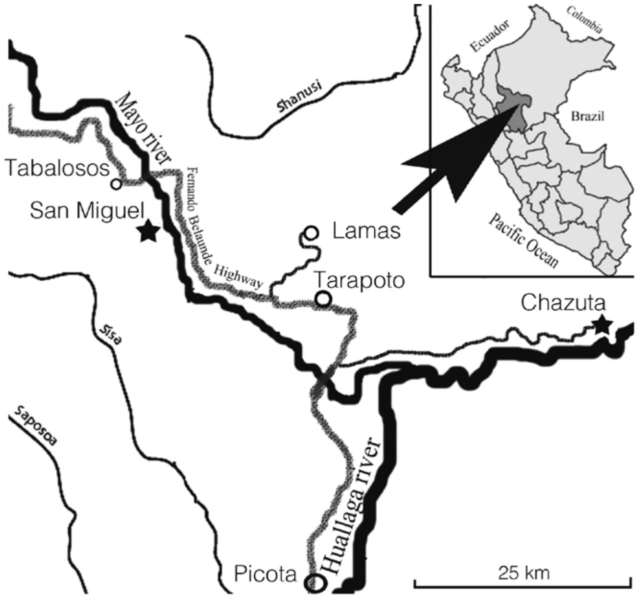

Figure 1. Map of the study are in the province of San Martín, Peru, where the two villages of San Miguel and Chazuta are located (stars).

Study Area and the Action Research Process

The project area is in the highland forest (*selva alta*) of Peru, in the province of San Martín (Figure 1) on the eastern side of the Andes, where it meets the Amazon forest. The construction of the Fernando Belaunde Terry highway in the 1960s, which connects San Martín with the coast, caused large scale (mainly) Andean immigration (INEI, 2006) and the transition from mainly household production to cash-crop production for the market (INEI, 1996). San Martín is a biodiversity "hotspot" area, and is increasingly considered by some as a priority for conservation (Myers *et al*., 2000). Small-scale farmers work on marginal lands and face widespread deforestation, decreasing fallow periods, field burning, soil erosion, land degradation, and high rates of immigration. Many farmers face the difficult task of performing a long-fallow rotational agriculture on small areas of land.

The study has been carried out in two villages, San Miguel del Río Mayo and Chazuta (Figure 1). The villages were selected with a common agricultural history of extensive swidden agriculture, but providing contrasting current conditions and contexts of incremental changes in soil fertility, erosion vulnerability and decreasing land access. San Miguel is a village of 282 households (latest available statistics; INEI, 1993), principally making their living from agricultural production. It is located along the Fernando Belaunde highway, in an area deforested to a very large extent, degraded and densely populated (in a Peruvian Amazonian perspective, meaning ~17 persons/km^2). Chazuta is also a village living mainly from farming. It has 710 households (Banda Chazuta included) located on the banks of the Huallaga river, at the end of a poor quality road, with areas of primary forest still accessible to the village (latest available statistics; INEI, 1993). As Chazuta is located close to the border of the lowland forest, the climate is more humid than in most of San Martín. The farmers participating in this study are native non-Indians, as are the majority of the inhabitants in Chazuta and San Miguel, who have made their living from agriculture in the area for generations. In the lowland forest literature they could be compared with the farmers often called *ribereños* and, in the Brazilian context, *caboclos*. There are also minority groups of the indigenous *Kechwa-Lamista* people in the area, who represent ~3% of the population in San Martin (INEI, 1993). For more details about the villages see Marquardt (2008).

The present report is part of an action research methodology project aimed at facilitating a learning process on land degradation management and strategies, planned and implemented together with farmers (Marquardt Arévalo and Ljung, 2006). The methodology is based on the participants' experiences and is innovative in so far as it focuses on facilitation of interaction and quality of dialogue (Ljung, 2001). The research unfolds as an iterative engagement with a concrete situation, and aims at action and change through learning; the researcher contributes to and facilitates learning in the specific problem situation. The core of action research is the rigorous learning spiral that includes planning, action, observation and reflection. The action research process in this study passed through four phases: "reading the context", "exploring farmers' land management perspectives", "farmer experimentation", and "conceptualization of farmers' perspectives". The action research process has been carried out over a period of 29 months between 2002 and 2005, when data was collected data during interview series, workshops, field trips, field experimentations and participative observations, totaling more than 100 visits to the villages. Planning and implementation of the action research process were conducted in a cooperative agreement among farmers, researchers and a local NGO, PRADERA (*Proyecto de Apoyo Rural de la Amazonía*). The selection of the farms within the villages was done in cooperation with PRADERA, which has worked in both villages, by using mutually agreed criteria to identify farmers with an interest in farm development. A short description of the action research process used in this project follows. For a detailed description see Marquardt Arévalo and Ljung (2006).

The study was launched with a start-up phase with the purpose of creating a better understanding of the local agricultural system. During 10 farm visits in San Miguel and 9 in Chazuta, semi-structured, in-depth interviews (Kvale, 1996) were conducted in order to explore topics such as family status, ethnographic situation, infrastructure, farm sizes, current erosion and land degradation situation, and present the use of soil conservation methods. All in-depth interviews were semi-structured and based on a checklist. The interviews were recorded, transcribed and manually processed into categories according to farmers' and researchers' land management domains. Crop budgets were developed using data based on farmers' perceptions of the three crops generating most income for their households. A detailed diary was kept (McNiff, 2002) and the researchers used pictures to illustrate their understanding of the agricultural system (Checkland and Scholes, 1999). This generated a broad understanding of the farming systems as integrated biological, production and socio-economical systems.

The next stage emphasized the exploration of the diversity in land management techniques as responses to the adaptation processes. Together with PRADERA workshops (3 in Chazuta and 4 in San Miguel) were organized with the earlier interviewed farmers. The workshops took place in order to further explore the farmers' perspectives on land management, and their results included farmers' views on the present land degradation situation and their visions on the future of local agriculture. In addition to these workshops, the project assisted farm representatives from the two villages to visit each other. To get a more detailed understanding of their land management knowledge, the farmers from the workshops (13 from San Miguel and 11 from Chazuta) were interviewed a second time regarding issues such as weeding, problematic weeds, burning, soil classification, plant residue treatment, erosion prevention, landscape changes and experimentation. This research phase generated detailed data on local land management knowledge in the two villages, and examples of farmers' own ability to experiment with new land management techniques. Some of this material is used below in quotes with identifying initials of the participants.

After discussions and planning with farmers and PRADERA, experiments of land management techniques and skills were initiated on a range of locally known recuperation options, as well as some alternatives suggested by PRADERA and the researchers. The experimentation work on each of three degraded fields was carried about once a month. The recuperation process was constantly reflected upon jointly by the farmers, researcher and PRADERA during these working occasions. The experimental field studies were followed up with a new round of semi-structured in-depth interviews (with 6 farmers from San Miguel and 9 from Chazuta) which focused on the farmers' experience of the experimental activity, their understanding of land degradation processes and how they learn about these as well as discussions on the local institutions involved. The farmers also made a simple plan for individual land recuperation experimentation on their own farms. All farmers chose to work with reforestation by trying out different seeds and sprouts at different locations of their land. The researcher made field visits a few months and a year after the plan was made in order to follow up the individual experimentation.

The last stage of the work, "conceptualization of the farmers' perspective", has been an on-going process in order to clarify and deepen the understanding of the local land management activities. In these processes the researcher attempts to see the land management activities from a farmer perspective, but also to put their activities in a broader context. This was done by continuously generating open conversations, approaching the rich variety of farmers' activities and perspectives, including the worldview of the farmers in the Upper Amazon, and dealing with the sometimes contradictory answers from the farmers. This understanding was acquired through working with open interviews and participant observations in all kinds of agricultural work, household work and village celebrations.

Active Management of Agro-diversity

Farmers' land management logic is not always directly visible to an outsider (Brondizio, 2004). The transitional stages of land management in swidden agriculture are highly diverse and dynamic processes (Wilken, 1987; Padoch, 2002). Many activities in a swidden agriculture field are concurrent and 'invisible' processes if not deliberately looked for, and are not well described (Padoch and Pinedo-Vásquez, 2006). In this section, the results of farmers' land management activities in terms of slope-, fallow-, fire- and weed management are presented.

Slope management

The landscape in both San Miguel and Chazuta is hilly, and the fields are often found in the steeper areas. Table I presents the slope management techniques found among the farmers in San Miguel and Chazuta and their use. The land and slope management techniques practiced by the farmers include different forms of impediment to surface runoff placed in the sloping field; if effectively done, these techniques will slow down water and catch/deposit nutrient rich sediments. The farmers also use reforestation techniques or leave small forest reserves in particularly steep zones or plant tree seedlings as the tree roots help to hold the soil during heavy rains. A few farmers deliberately plant N_2 fixing species in their fields while still producing food crops, and yet others do not plant, but leave saplings of voluntarily appearing tree seedlings (wildings) while weeding. Several farmers also have adopted the practice of living barriers using *Erythrina* spp., a technique introduced by extensionists in the area. During weeding there are two ways of leaving the weed residue. One is to gather the cleared plant material in piles, called *shuntos*, mentioned by Hiraoka (1986), who points out that the *shunto* accomplishes at least three objectives: soil erosion control, cropping area expansion and nutrient concentration. In the present study, when asked, the farmers stated that the advantages of *shunto* are that it decreases the evaporation of water from the soil; they said the soil under the *shunto* is always humid and full of soil fauna. It is another way of getting rid of the weeds in rainy periods, when these should not be left scattered, as they may set roots again. These nutrient enriched piles are later scattered over the fields by the hens. If the weeds are left spread over the field during weeding, instead of leaving them in *shunto*, they serve to decrease

TABLE I
SLOPE MANAGEMENT TECHNIQUES FOUND IN SAN MIGUEL AND CHAZUTA

Techniques	Description	Use
Fallow	Land left as fallow, which means that the land quickly becomes covered by different plants, bushes and with time, trees	A ground covering vegetation Slow down the water speed Catch silting mineral material Produce green manure Roots holding the soils
Forest reserves	Forest groves saved in especially steep areas not suitable for agriculture	Same as fallow
Natural reforestation	Steep areas left to become forest again	Same as fallow
Living barriers	Hedges of nitrogen-fixing *Erythrina*	Slow down the water speed Catch silting mineral material Produce green manure Roots holding the soil
Scattered weeds	Weeded plants left scattered in the field	Decrease water evaporation Nutrients more evenly spread over the field Prevent weeds from growing
Shuntos	Weeded plants left in piles	Slow down water speed Decrease water evaporation from the soil Leaving areas cleared for cropping Concentration of nutrients
Sloping terraces	Logs are laid perpendicular to slope gradient made of e.g. unburned debris and plantain stems	Partially slows down slope-surface wash
Tree planting	Deliberate tree planting, or leaving tree saplings to grow when weeding, both nitrogen-fixating and other species in fields with food crops	Slow down the water speed Green manure Roots holding the soil
Trincherita	Piled plant residue arranged in rows across the slope or stuffed in ditches	Slow down the water speed Catch silting mineral material

water evaporation from the soil and as a mulching “rug”, preventing weed regrowth. Plant residues may also be arranged in long rows against the slope or gathered in ditches (*trincheritas*) in areas where water runs downhill, in order to slow its flow, as described in Mexico by Bocco (1991).

Fallow management

The number of hectares available per family in San Martín has diminished drastically during the last years (Arévalo Rivera *et al*., 1999). Among the families participating in this study; 80% of the interviewed farmers in San Miguel had 10ha or less, while the farmers interviewed in Chazuta had access to larger land holdings (50% of the interviewed farms in Chazuta had 25ha or more). The area cultivated for agricultural crops by a family in any one year is 2-3ha, and the rest is left fallow. The average size of land for a farming family today is one third of that 30 years ago, which has led to drastic shortening of the fallow periods. Several authors refer to the problematic situation of fallow shortening, sometimes called the fallow crises (Richards, 1997; Jansen, 1998), when other variables remain constant. The consequences of a shorter fallow are visible not only in terms of diminishing productivity, but also as an increase of labor spent on weeding (most smallholders in the area do not use herbicides). When a field becomes too depleted for acceptable production, or the weed pressure requires too much labor, farmers prefer to leave the field unplanted in order to become a forest fallow. As in other areas of Western Amazonia (Denevan and Padoch, 1987) the farmers in this case study use several techniques for speeding up the fallow re-establishment, such as leaving sprouts to stand in producing fields while weeding other plants, and planting the N_2 fixing guaba trees (*Inga edulis)* in the field so that the fallow will produce lush growth in less time. Palm species such as *shapaja* (*Attalea butyracea*) and *poloponta* (*Elaeis oleifera*) are also resources used to speed up secondary vegetation growth. These palms often exist in the fallow preceding the field burning, survive the burning and grow parallel with the planted annual crops in the field. The farmers care for these palms as they are important roof construction material, and *poloponta* has edible fruits as well.

Fire management

Burning is often a sensitive topic (Brookfield, 2001). While it is seen as a destructive agent by conservationists, the Amazonian farmers see it as a necessary and a nuanced tool, particularly given the lack of support small farmers receive for agriculture in general, and the lack of available equipment adapted to work steep terrains in particular. The interview results show a surprising variety in burning strategies, and also that most burning is patchy and not necessarily severe. There is a broad range of burning techniques, such as milder burning, complete burning, burning of piled plant material (*shuntos*), in-field burning and no burning at all. The choice is influenced by several factors such as the farmers’ weed management strategy, weather conditions, the kind of vegetation being cleared and access to labor. An overview is given in Table II. Depending on the kind of vegetation that has been cleared and set on fire in preparation of the field, the burning temperature will vary. The distinction between a strong and a mild burning is made using the color of the ash as a guide (Peters and Neuenschwander, 1988). When the vegetation burns hard most of the carbon is volatized and the ash tends to stay white; when it suffers a milder burn much of the carbon remains and the ash tends to be black. A field with primary forest or old fallow (*machu purma*) will contain a lot of biomass because of the presence of big trunks and branches and will burn with a higher temperature and for a longer time. After a successful burning of primary forest the field should be covered with white ash. When the burning is interrupted by rain the field will burn less fiercely and the ash will be black. The farmers then say that the field is “ugly” (*feo*) and *uchku uchku* (Quechua for hole), meaning that the field is not liberated enough to be worked easily, and has to be sown

TABLE II
FIRE MANAGEMENT TECHNIQUES IN THE STUDY AREA AND THE PARAMETERS OF PRECEDING VEGETATION, CLEARING TECHNIQUES, WEATHER CONDITIONS AND ACCESS TO LABOR THAT INFLUENCE THE CHOICE OF TECHNIQUES

Burning technique	Preceding vegetation	Vegetation clearing or weed management techniques	Weather conditions	Access to labor
Complete burning (white ash)	Primary forest, old fallow (*machu purma*)	Forest felling followed by *pachqueo* when the plant material is chopped to smaller pieces	When there is a continuous period of dry weather	The field preparation is very heavy and labor intensive
Milder burning (black ash)	Secondary succession, younger fallows	Forest felling followed by *pachqueo* Clearing younger fallows with machete, *picacheo*	When the climate is humid, making a more complete burning difficult	The field preparation is less labor intensive
Burning of piled plant material (*shuntos*)	Primary forest, old fallow (*machu purma*), secondary succession, younger fallows Producing fields	When the plant material has not burned well and needs a re-burn When the weeds have been cultivated at root level and piled (*cultivado* y *shunteado*)	Dry weather	Piling plant material for a re-burn is labor intensive Cultivating the weeds at root level and piling them (*cultivo y shunteo*) is more labor intensive than weeding and leaving the weeds spread (*chaleo* y *regado*)
In-field burning	Long term producing fields i.e. a plantain field	Land with heavy weed infestation	Dry weather	Not so labour intensive (in relation to cultivating the weeds instead of burning them)
No burning at all	In harvested fields prepared for a continued production period	No preparation at all, new crop sowed directly	Very humid conditions making burning impossible, possible mulching	Used in order to save time

wherever you can find a hole. The farmer may pile unburned plant material into *shuntos* that will be re-burned and crops will be sowed in between the *shuntos*. Such patchy burning is labor demanding, especially as a preparation for a burning which failed has already been done. In areas with frequent rain adequate burning is tricky. The farmers' burning strategy in these areas is therefore to prepare the fields for a patchy burning from the start by piling the debris while opening the field and burning *shunto* for *shunto*, and there are even farmers who deliberately do not burn the debris at all, but leave it as mulch.

In San Miguel the cleared fields are developed from younger fallows, sometimes no more than bushes and very small trees 3cm in diameter. Most of the young fallows stay black after leaves and thin trunks have burned, leaving a lot of unburned debris in the fields. Only where there are fallows with larger biomass and during long periods of dry weather the cleared material can burn completely. The farmers state that it is a problem working among all the unburned debris in the field that gets in their way during weeding. However, the farmers also declare that the problem can partly be solved by the kind of crops chosen to sow. A low-growing crop like beans does not produce well in between unburned plant material, whereas maize and cotton, growing taller quickly, do quite well in such field conditions. The main reason for burning the fields is to clear the soil of trees, bushes and weeds, but the farmers also recognize the fertilizing effect it has on the crops. The positive fertilizing effect of the fire is a marked increase in soil pH by the production of potash from burning woody materials. This increase in soil pH will convert inaccessible phosphorous to a plant-accessible form (Ewel *et al*., 1981), and will also lower the toxic levels of some elements, mainly aluminium, by converting them to less plant-accessible forms (Jordan, 1989). The farmers state that burning also has a sterilization effect, as it kills pests and weeds, but clarify that there are weeds like *Imperata* which are favored by repeated burning, and some cultivated plants which are encouraged by repeated burning such as *shapaja* and *polopon-ta*.

During the last decades there has been a change in fire management in San Martín (Marquardt, 1998). When the farmers described how their ancestors had worked in the field, many explained that their grandparents mostly used to work with *cultivo*, which means cutting the weed off at its roots some centimeters into the soil. The cleared plant material was then piled and burned. The farmers state that they have abandoned the practice of burning the piles of weeds as this is a waste of plant material's manuring effects. When burning the piles within the producing field, there is also a risk that the fire might escape and burn productive crops.

The changes in burning practice as well as the experimentation with slope and fallow management activities mentioned above are examples of the dynamism within cropping systems, which are constantly changing. All of the slope management techniques included in Table I and the practice of speeding up fallow reestablishment can be found in San Miguel, a more degraded area than Chazuta. The interviewed farmers in San Miguel stated that they knew about all the land management techniques presented in Table I and the fallow management section; however, all farmers did not necessarily implement all practices. In Chazuta the experimentation and application of slope management techniques is less diverse, and the idea of recuperating degraded land was new. For instance, *trincheritas* and fields and fallows deliberately enriched with N_2-fixing trees were not found. This suggests that farmers in San Miguel respond and adapt to the new erosion and land degradation conditions, and handle the situation by

TABLE III
WEED MANAGEMENT TECHNIQUES FOUND IN SAN MIGUEL AND CHAZUTA

Technique	Description	Advantage	Disadvantage
Chaleo	The weed is cut at ground level and the cleared weeds are left spread	It is done quickly	The weeds are left scattered, and during wet conditions they may establish new roots and start to re-grow
Cultivo	Weeding some cm under the soil in order to cut of the weed roots, done with a short, wide type of machete called *balisha*. The cleared weeds are left in piles (*shunto*) or scattered	The weeds take longer to re-grow The piled weeds are left and burnt if necessary	It is more time consuming
Huactapeo	A faster growing variant of *chaleo*, the vegetation is cut about 30cm above ground level, less carefully done in the plantain fields	It is done very quickly	Possible damage to other plants
Raleo	Thinning out the plant collection at the same time as the plantain shoots appear	The remaining shoots get more light and space to develop well	Possible damage to other plants
Rozo	Thinning the forest or fallow from bushes and vines. Normally made before clearing an area with primary forest or larger secondary succession	The remaining shoot gets more light and space to develop well Facilitates tree felling	Requires a lot of labor
Shade	Shading out weeds	Not very time consuming	The process takes several seasons and occupies space

experimenting with different land management techniques.

Weed management

The more "tired" (*cansado*) the land is, the more undesirable competitive weeds will appear and the need for labor increase. In the area of this study the two weeds, *arocillo* (*Rottboellia cochinchinensis*; also called *calvin ukcha* or *ishelin*) and *kashu ukcha* (*Imperata brasiliensis)* are the most problematic. The farmers in Chazuta and San Miguel know well the weeds and their propagation strategies. There are several weeding techniques which are distinguished by how the work is carried out, the type of vegetation and the kind of tool used, (see Table III). *Imperata*, for example, is a root weed and the farmers say that nothing makes the infestation worse than weeding it in such a way that the plant is cut off but the root system continues intact, such as in a *chaleo* or *huactapeo* (Table III). The way to combat *Imperata* is to shade it out with other crops such as cassava or fallow. Some farmers combat *Imperata* by carefully weeding all the roots after rain, when the soil is humid. *Arocillo* spreads by its numerous seeds and the farmers' strategy in handling it is to weed before it seeds.

A technique of careful weeding where the farmer cuts off the plants' roots some centimetres below soil level is termed *cultivando*. The technique is then adjusted for the different kind of weeds found in the field. For example, the weed *puyu uksha* (no botanical classification is available) grows in tufts and when it is pulled, a lot of soil remains attached to the roots. This soil clod is shaken so that most of the soil falls off to prevent regrowth, especially important in the wet season. The *machete vaina* (*Cannavalia ensiformis*) has a tap root, and is treated differently: it is chopped into pieces. As far as the *yana bolaina* (a tree, *Guazuma* spp.) is concerned, the shoots are cut down as far as the roots. Techniques such as *chaleo* and *huctapeo* are faster, but the weed returns more quickly. In some fields or fallows the weeding consists of thinning the vegetation stand in a similar way as that applied to *rozo* and *raleo*. The farmers are well aware of shading as a useful and efficient way of controlling weeds. When there are too many weeds and the labor input exceeds what seems reasonable, the field is left to become fallow and the shade from bushes and trees assists the farmer to control the most problematic weeds.

Weeds are a minor problem in Chazuta, according to farmers and the observations made during field visits. When the farmers from Chazuta visited the farmers in San Miguel they were amazed at the fields there, and made comments on the quantity of weeds and the amount of labor the weed control meant for the family. In Chazuta most farmers have enough land to be able to afford longer fallow periods, and fields with the level of weed infestation they experienced in San Miguel would have been transformed into fallow. The farmers in San Miguel use their fields for crop production during a longer period, especially plantain fields, which can be kept up to ten years, than the farmers in Chazuta, and accept a higher weed pressure before they let the field become fallow, due to the scarcity of land. Several authors have noted that it is the weed pressure, and not the decrease in the production due to nutrient depletion, although it is connected, that is the decisive factor in deciding when the fields shall go into fallow (Clarke, 1976; Staver, 1989; Castellanet and Jordan, 2002).

A Forest-Focused Agrocentric Perspective

During an early stage of the work with the experimental fields and the farmers' individual experimentation there was interest in the idea of using the manure found around the poultry-house and the pigsty, were the households' hens and pigs slept at night, on the farms. In the discussions concerning the experimental work on recuperating degraded land and what measures were necessary to manage the problems, the researcher made efforts to include the idea of using animal manure in the recuperation work. However, no farmers supported the idea and there was no interest in testing whether the land might respond to such a treatment. In all land recuperation discussions the farmers put forward the use of trees and reforestation as the preferred recuperation method. During the conversations, the farmers very clearly stated that soil fertility comes from the forest in terms of leaves and trunks falling down to the ground, decomposing and turning into soil:

"A good soil is a recuperated soil, a recuperated forest. …In primary forest everything that used to live, the leaves, the trunks have rotted. Because of this it (the soil in primary forest) has manure, because of this it produces everything" (T.T., Chazuta, 010503).

"What is falling from the trees rotten, the leaves and sometimes (even) the trunks. Why think of other things that could give some substance to the soil? What more can give it (fertility)? There is no other (thing). You see that the leaves, the trunks fall and this rots. It stays there as manure for the soil" (J.I., Chazuta, 140503).

During the course of this study an understanding emerged of how the farmers perspective on soil fertility, when practicing agriculture, has its focus on the forest-soil complex as the driver of agricultural biomass, rather than soil related biomass management. Consequently, the physical, biological and chemical "capital" of the soil in a field depends on the quality, composition and age of the fallow or forest which occupied the land before. This redirecting of what might be seen as soil-related questions is interpreted as a perspective of soil as a property of the forest in a forest-soil complex rather than soil as the fundamental element for the agricultural production, and has been termed a "forest-focused agrocentric perspective". The collaborating PRADERA organization calls this the farmers' *cosmovisión* (Rengifo *et al*., 1993; Arévalo Rivera *et al*., 1999). The local agricultural approaches based on forest perspectives have been documented by PRADERA (Arévalo Rivera *et al*., 1999) and PEAM (*Proyecto Especial de Alto Mayo*; Spittler *et al*., 2003).

Discussion

A forest focus on soil related questions

The landscape of the Upper Amazonian forest is a diverse and heterogeneous one, and the conditions for agriculture may vary quite drastically from one valley to another, between neighboring farmers and even within a given field. This work calls attention to the richness of the management strategies that small scale farmers use in San Miguel and Chazuta when adapting to land pressures and absence of technological support. Farmers actively respond to land degradation signals using their existing knowledge basis and an integrated perspective of the interaction between vegetation-slope-soil. Their techniques are highly relevant from an Amazonian land management perspective, not only from a biological and agronomic perspective, but also adapted to the local farming context, when it comes to the resource base and worldview. The most common use of farmers' techniques in handling erosion and land degradation in the study was found in San Miguel, the most degraded area. This suggests that the farmers in San Miguel, where land is scarce, are responding in a contextually adequate way to the new conditions of greater pressure on the land (shorter fallow periods, erosion and land degradation) and that they are handling this situation by experimenting with different land management techniques. The degradation level, expressed in terms of weed pressure and labor in San Miguel, has forced farmers to experiment more in their land degradation strategies and to look for other marketable options, in comparison to the farmers in Chazuta.

When the farmers described the land types and the variations within their fields, they showed a detailed knowledge of the different field conditions in terms of soil color, humidity, texture, gradient, etc. However, when talking about describing specific aspects of these soil conditions as different soil categories, the farmers mainly categorized soils in approximate terms according to color and texture. This brings the question of why do some agrarian societies and cultures, while skilful in growing a huge variety of crops and varieties, and in associating crops, do not pay as much attention to the soil types as other farming groups might do. Jansen (1998) suggests that farmers' responses to soil fertility reduction often go beyond conventional pedological classifications and are therefore not recognized by the researcher (Zimmerer, 1994; Blaikie *et al*., 1997; Jansen, 1998). In their Latin American ethnopedology work, WinklerPrins and Barrera-Bassols (2004) point out that the many Amazonian peoples have complex and profound relationships with plants and forests, whereas soil is seen as a property of the forest and is treated as an extension of the quality of the forest. Several researchers note that forests and fallows have an essential role in Amazonian agriculture and that tropical land management in the Amazon and parts of Central America is based on a "forest and tree perspective" (Staver, 1989; Alcorn, 1990). The evidence from San Miguel and Chazuta supports this hypothesis. It suggests that the use of a roughly dichotomous soil classification in a very complex farming system is because farmers in the Upper Amazon do not relate agriculture to the soil, but to the forest-soil complex.

The conception of soils as a property of the forest and forest management as the driver of the forest-soil complex has important implications on how to develop land management processes. Recognizing the importance of reflecting on farmers' point of departure when dealing with agriculture and soil is crucial in land management development work, and may open up for new learning, where different kinds of action and solutions might be considered. Farmers' experimentation and innovation in land management has so far only been partly explored by researchers. Padoch notes that farmers' land management logic is not always directly visible to an outsider. It is easy for an outsider to walk across a *trincherita* without even seeing it or reflecting on the fact that the sticks are intentionally placed there by the farmer for a particular reason. Padoch (2002) mentions, for example, how it took years before she understood the farmers' logic behind using a great deal of labor on what looked to her as low producing, dry, weed-infested fields in Borneo, and how she came to realize that these fields were an "invisible" indicator of the farmer-managed dynamism of the system and manipulation of resource use. Gadgil *et al*. (1998) refer how the famous ethnobiologist D. Posey understood that the *apête* forest patches were created by humans after seven years of field research. Local land management strategies that do not coincide with a conventional agricultural science approach to handling land management problems are often overlooked, and might not ever be recognized. Not only are the resulting farm systems diverse; they are also in a continuous process of change. It is important to describe and understand the agricultural production activities as integrated actions carried out from the farmers' "forest-focused agrocentric perspective". As the farmers' actions are scaled to fit their resource base in time and space, we find a participatory approach, involving the development of the understanding of farmers' activities in a wider systemic perspective, including their worldviews and family goals, to be a relevant way of facilitating development processes that are adapted to the local context. This is particularly important concerning the micro-scale management of biophysically diverse landscapes largely independent of our own industrialized fossil fuelled production systems.

The value of an action research methodology in land management

The iterative and reflexive nature of action research made it possible to grasp the research problem with a contextual and holistic approach. Apart from findings on the farmers' land management strategies, the action research methodology generated findings on the local point of departure when dealing with agriculture and soil, here called a forest-focused agrocentric perspective, which are dimensions that conventional land management research often does not include or capture. A lot can be learned from the farmers who have inhabited and managed these areas for a long time or, conversely, development problems can be avoided when attention to local perspectives are included as part of the process (Posey, 1985; Gómez-Pompa and Bainbridge, 1995; Blaikie *et al.*, 1997). The greatest methodological advantage of working with action research methodology might be that the iterative, reflective way of handling research problems has a lot in common with the farmer's own experiential learning style. This overlapping in learning approach enables a shared learning and innovation between farmer and researcher, where local and scientific knowledge may blend into something new.

REFERENCES

Alcorn J (1990) Indigenous agroforestry strategies meeting farmers' needs. In Anderson A (Ed.) *Alternatives to Deforestation: Steps Toward Sustainable Use of the Amazon Rain Forest.* Columbia University Press. New York, USA. pp. 141-151.

Arévalo Rivera M, Panduro R, Quinteros A, Rengifo G (1999) *Hacer Brillar la Chacra.* Agricultura Campesina Alto Amazónica, San Martín PRATEC - Proyecto Andino de Tecnologías Campesinas. Lima, Perú. 168 pp.

Blaikie P, Brown K, Stocking M, Tang L, Dixon P, Silltoe P (1997) Knowledge in action: Local knowledge as a development resource and barriers to its incorporation in natural resource research and development. *Agric. Syst. 55*: 217-237.

Bocco G (1991) Traditional knowledge for soil conservation in central Mexico. *J. Soil Water Cons. 46*: 346-348.

Boserup E (1965) *The Conditions of Agricultural Growth. The Economics of Agrarian Change under Population Pressure.* Allen and Unwin. London, UK. 124 pp.

Brondízio E (2004) Agriculture intensification, economic identity, and shared invisibility in Amazonian peasantry: Caboclos and colonists in comparative perspective. *Cult. Agric. 26*: 1-24.

Brookfield H (2001) *Exploring Agrodiversity.* Columbia University Press. New York, USA. 348 pp.

Castellanet C, Jordan C (2002) *Participatory Action Research in Natural Resource Management. A Critique of the Method Based on Five Years' Experience in the Transamazônica Region of Brazil.* Taylor and Francis. London. UK. 231 pp.

Cernea M (2005) Studying the culture of agri-culture: The uphill battle of social research inn CGIAR. *Cult. Agric. 27*: 73-87.

Checkland P, Scholes (1999) *Soft Systems Methodology in Action.* Wiley. Chichester, UK.

Chibnik M (1994) *Risky Rivers: The Economic and Politics of Floodplain Farming in Amazonia.* University of Arizona Press. Tucson, AZ. USA. 267 pp.

Clarke W (1976) Maintenance of agriculture and human habitats within tropical forest ecosystem. *Human Ecol. 4*: 247-259.

Defoer T (2002) Learning about methodology development for integrated soil fertility management. *Agric. Syst. 73*: 57-81.

Denevan W, Padoch C (1987) *Swidden-Fallow Agroforestry in the Peruvian Amazon* New York Botanical Garden. New York, USA. 107 pp.

Ewel J, Berish C, Brown B, Price N, Raich J (1981) Slash and burn impacts on a Costa Rican wet forest site. *Ecology 62*: 816-829.

Gadgil M, Berkes F, Folke C (1993) Indigenous knowledge for biodiversity conservation. *Ambio 22*: 151-156.

Gómez-Pompa A, Bainbridge D (1995) Tropical forestry as if people mattered. In Lugo A, Lowe C (Eds.) *Tropical Forests: Management and Ecology.* Springer. New York, USA. pp. 408-422

Hiraoka M (1986) Zonation of mestizo riverine farming systems in Northeast Peru. *Nat. Geogr. Res. 2*: 354-371.

INEI (1993) *IX Censo Nacional de Población y IV de Vivienda* (CPV). *San Martín.* Instituto Nacional de Estadística e Informática. Lima, Peru. www.inei.gob.pe/

INEI (1996) *Perfil Agropecuario del Departamento de San Martín.* Instituto Nacional de Estadística e Informática. Lima, Peru. www.inei.gob.pe/biblioineipub/bancopub/Est/ Lib0210/N00.htm

INEI (2006) *Compendio Estadístico 2006 Población e Indicadores Demográficos. Migración Interna.* Instituto Nacional de Estadística e Informática. Lima, Peru. www.inei.gob.pe/Sisd/index.asp.

Jansen K (1998).*Political Ecology, Mountain Agriculture and Knowledge in Honduras.* Thesis. Wageningen University. Netherlands. 277 pp.

Jordan C (Ed.) (1989) *An Amazonian Rainforest. The Structure and Function of a Nutrient Stressed Ecosystem and the Impact of Slash-and-Burn Agriculture.* Vol. 2. UNESCO/Parthenon. Carnforth, UK. 176 pp.

Kvale S (1996) *InterViews.* Sage. London, UK. 354 pp.

Ljung M (2001) *Collaborative Learning for Sustainable Development of Agri-Food Systems.* Thesis. Swedish University of Agricultural Sciences. Uppsala, Sweden. 291 pp.

Marquardt K (1998) *Locally Developed Agriculture - A Possibility or Obstacle for Preventing Soil Degradation? An Exploratory Study with Farmers and Agronomy Students in San Martín, Peru.* Thesis. Swedish University of Agricultural Sciences. Uppsala, Sweden. www.sol.slu.se/publications/masters_3.pdf

Marquardt Arévalo K (2008) *Burning Changes: Action Research with Farmers and Swidden Agriculture in the Upper Amazon.* Thesis. Swedish University of Agricultural Sciences. Uppsala, Sweden. 209 pp.

Marquardt Arévalo K, Ljung M (2006) Action research on land management in the Western Amazon, Peru - A research process, its outcomes and the researcher's role. *Syst. Pract. Act. Res. 19*: 309-324.

McNiff J (2002) *Action Research: Principles and Practice.* 2nd ed. Routledge Falmer. New York, USA. 163 pp.

Meza A, Sabogal C, de Jong W (2006) Rehabilitación de áreas degradadas en la Amazonia peruana. Revisión de experiencias y lecciones aprendidas. CIFOR. Bogor, Indonesia. 136 pp.

Myers N, Mittermeier RCM, da Fonseca G, Kent J (2000) Biodiversity hotspots for conservation priorities. *Nature 403*: 853-858.

Netting R (1993) *Smallholders, Householders.* Stanford University Press. Stanford, CA, USA. 389 pp.

Padoch C (2002) Spotting Expertise in a diverse and dynamic landscape. In Brookfield H, Padoch C, Parsons H, Stocking M (Eds.) *Cultivating Biodiversity. Understanding, Analysing & Using Agricultural Diversity.* ITDG. London, UK. pp. 203-220.

Padoch C, de Jong W (1992) Diversity, variation, and change in ribereño agriculture. In Redford K, Padoch C (Eds.) *Conservation of Neotropical Forests. Working from Traditional Resource Use.* Columbia University Press. New York, USA. pp. 158-174.

Padoch C, Pinedo-Vásquez M (2006) concurrent activities and invisible technologies. An example of timber management in Amazonia. In Posey D, Balick M (Eds.) *Human Impacts on Amazonia. The Role of Traditional Ecological Knowledge in Conservation and Development.* Columbia University Press. New York, USA. pp. 172-180.

Parker E (1993) Fact and fiction in Amazonia: The case of the Apête *Am. Anthropol. 95*: 715-723.

Peters W, Neuenschwander L (1988) *Slash and Burn. Farming in the Third World Forest* University of Idaho Press. Moscow, ID, USA. 91 pp.

Posey D (1985) Indigenous management of tropical forest ecosystens: The case of the Kayapo Indians of the Brazilian Amazon. *Agrofor. Syst. 3*: 139-158.

Posey D, Balick M (Eds) (2006) *Human Impact on Amazonia. The Role of Traditional Ecological Knowledge in Conservation and Development*. Columbia University Press. New York, USA. 367 pp.

Rengifo G, Panduro R, Grillo E (1993) *Chacras y Chacareros. Ecología, Demografía y Sistemas de Cultivo de San Martín*. CEDISA-Fondo de Contravalor Perú-Candadá. Lima, Peru. 233 pp.

Richards M (1997) *Missing a Moving Target? Colonist Technology on the Amazon frontier* Overseas Development Institute. London, UK. 94 pp.

Scoones I (2001) Transforming soils: The dynamics of soil-fertility management in Africa. In Scoones I (Ed) *Dynamics and Diversity: Soil Fertility and Farming Livelihoods in Africa*. Earthscan. London, UK. pp. 1-44.

Spittler P, Villegas J, Ramos D (2003) *Plan General de Manejo Forestal de la Comunidad Nativa de Huascayacu, Alto Mayo, Perú*. Programa de Comunidades Nativas. Cooperación PEAM-KfW-GTZ-DED. Moyobamba, Peru. 98 pp.

Staver C (1989) Why farmers rotate fields in maize-cassava-plantain bush fallow agriculture in the wet Peruvian Amazon. *Human Ecol. 17*: 401-426.

Turner N, Berkes F (2006) Coming to Understanding: Developing Conservation through Incremental Learning in the Pacific Northwest. *Human Ecol. 34*: 495-513.

Wilken G (1987) *Good Farmers. Traditional Agriculture Resource Management in Mexico and Central America*. University of California Press. Berkeley, CA, USA. 302 pp.

WinklerPrins A, Barrera-Bassols N (2004) Latin American ethnopedology: A vision of its past, present, and future. *Agric. Human Val. 21*: 139-156.

Zimmerer K (1994) Local soil knowledge: Answering basic questions in highland Bolivia. *J. Soil Water Cons. 49*: 29-34.

ESTRATEGIAS CAMPESINAS DE USO DE TIERRAS EN LA SELVA ALTA PERUANA: UN ESTUDIO DE CASO DE INVESTIGACIÓN-ACCIÓN

Kristina Marquardt, Lennart Salomonsson y Eduardo Brondizio

RESUMEN

El conocimiento agrícola local en la Amazonía y sus procesos de experimentación y difusión siguen recibiendo escasa atención de los investigadores, a pesar de su creciente importancia regional. El presente estudio de caso ha documentado y evaluado la amplia variedad de actividades de manejo de tierras llevadas a cabo por campesinos de pequeña escala en la Alta Amazonía Peruana en su manejo de la biodiversidad en cuanto a pendiente, barbecho, fuego, hierbas, y agro-diversidad. El estudio muestra que los campesinos locales no indígenas ensayan diferentes estrategias a fin de manejar la situación de erosión y degradación de las tierras, y que tales técnicas de manejo son relevantes desde la perspectiva de un manejo de tierras más amplio. El estudio también muestra que los campesinos prefieren redirigir las cuestiones relativas al manejo del suelo hacia un contexto forestal, es decir, considerando la dinámica espacial y temporal de la agricultura en relación a los ciclos de siembra y rotación espacial de especies. Esto resalta la importancia de considerar los puntos de partida de los campesinos al tratar de agricultura y suelos. La concepción de los suelos como una propiedad de la selva y el manejo de ésta como el determinante del complejo selva-suelo tiene implicaciones importantes en cómo desarrollar los procesos de manejo de la tierra en la región. El enfoque de investigación-acción utilizado en el estudio apoya fuertemente los métodos participativos y los programas de manejo que utilizan el conocimiento y habilidades locales, apropiadamente adaptadas.

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RESUMO

O conhecimento agrícola local na Amazônia e seus processos de experimentação e difusão seguem recebendo escassa atenção dos investigadores, apesar de sua crescente importância regional. O presente estudo de caso tem documentado e avaliado a ampla variedade de atividades de manipulação de terras realizadas por camponeses de pequena escala na Alta Amazônia Peruana, seu manejo da biodiversidade quanto a pendente, barbecho, fogo, ervas, e agrodiversidade. O estudo mostra que os camponeses locais não indígenas ensaiam diferentes estratégias a fin de manipular a situação de erosão e degradação das terras, e que tais técnicas de manipulação são relevantes desde a perspectiva de uma manipulação de terras mais amplo. O estudo também mostra que os camponeses preferem redirigir as questões relativas à manipulação do solo para uma contexto florestal, quer dizer, considerando a dinâmica espacial e temporal da agricultura em relação aos ciclos de plantação e rotação espacial de espécies. Isto destaca a importância em considerar os pontos de partida dos camponeses ao tratar da agricultura e solos. A concepção dos solos como uma propriedade da selva e a manipulação desta como o determinante do complexo selva-solo têm implicações importantes em como desenvolver os processos de manipulação da terra na região. O foco da investigação-ação utilizado no estudo apoia fortemente os métodos participativos e os programas de manipulação que utilizam o conhecimento e habilidades locais, apropriadamente adaptadas.