Participatory Contour Hedgerow Initiative

Continuous crop production on steep slopes in Mindanao induces annual rates of soil loss often exceeding 100-200 t/ha (Garrity et al, 1993). The installation of contour hedgerows reduces these losses by 50-95% and creates natural terraces that stabilize the landscape and facilitate further management intensification. These advantages have led to wide promotion of hedgerow technology by the DENR and the Department of Agriculture (DAR). But adoption has been poor, and installed hedgerows are usually abandoned. This is because the increased labor demands in managing tree hedgerows are not sufficiently compensated by the yield increases observed (ICRAF, 1997). An adoptable technology must have minimal cost to the farmer as well as to the public agencies supporting the program. We have been working with an indigenous practice: natural vegetative strips (NVS). These very simplified hedgerows are made by laying out the contours and allowing natural revegetation of the site (Garrity et al, 1993). We found that NVS have exceptional effectivity in soil conservation. They require minimal maintenance and require no outside source of planting materials. The NVS concept was included in our farmer-to-farmer training program conducted in collaboration with the DA. We subsequently observed that some 200 farmers adopted the technique, most of them on the basis of observing a neighbor's success. NVS technology seems particularly well-suited to vegetable farming systems because there is a little possibility of competition between the NVS and the crops. Over 100 farmers from three target buffer zone villages in Lantapan participated in a series of cross-visits to the ICRAF site in Claveria, Misamis Oriental, to observe NVS and other types of hedgerow systems, and to discuss with the Claveria farmers their experiences.

We responded to farmer interest by combining our technical expertise with the extension skills of a technician from the Department of Agriculture, and the practical knowledge of a motivated farmer adopter to provide meaningful extension services. This Contour Hedgerow Extension Team (CHET), composed of these three individuals, initially worked with individual farmers who requested their assistance. This evolved into backstopping a peoples' conservation organization (Landcare Association) that took responsibility for technology dissemination. The approach has developed into a dynamic movement with 28 self-governing chapters, over 1000 members, and a municipal federation in Claveria (Garrity et al, 1998). Local government got involved in supporting the effort financially, with active involvement of the village leaders (a local-government-led process). The Landcare approach has been embedded in the Lantapan natural resources management plan. Currently about 75 farmers have established NVS systems on their farms in Lantapan. We will be testing the approach in collaboration with the Municipal Government, the Lantapan agricultural extensionists, and the Dept of Agriculture-NOMIARC. We look forward to scaling-up the method to the provincial and regional levels.

Indigenous Strategies to Intensify Shifting Cultivation

Since the end of World War II, high birth rates and heavy in-migration have dramatically increased land use pressures in the Lantapan watershed. In response, both Tala-andig and migrant farmers have been forced to modify traditional swidden practices into more exploitative versions. As fallows have shortened and cropping periods expanded, the ecological balance underpinning the sustainability of these systems has been lost, pushing them into a downward spiral of dwindling crop yields and degradation of the biotic resource base. During this intensification process, fallow successions have gradually evolved from secondary forest, to bush, and eventually to more pernicious floristic communities dominated by *Imperata cylindrica* and ferns. A wide band of this fire climax vegetation cuts across the mid-slopes of Lantapan's toposequence and is regarded as marginal for agricultural purposes. With decreasing returns to labor, farmers often abandon this degraded land and clear more forests further upslope with more fertile soils. It is this expansion of degraded land, and its subsequent abandonment, that has fueled much of the encroachment pressure on the forest margins of the Mt. Kitanglad Range Nature Park. Urgent solutions are needed to rehabilitate degraded lands on the park periphery and bring them back into productive cultivation. .

Recently, scientists have begun to focus on the soil-enhancing properties of *Compositae* species and their potential application to intervene in declining swidden systems and intensify farming towards permanent cultivation. A sparse but growing body of literature has argued that *Chromolaena odorata* (Dove, 1986; Agbim, 1987; de Foresta and Schwartz, 1991; Field, 1991; de Foresta, 1993; Derpsch, 1993; Slaats, 1993: Baxter, 1995; Roder et. al., 1995), *Astroeupatorium inulifolium* (Stoutjesdijk, 1935; Cairns, 1994), *Tithonia diversifolia* (van de Goor, 1953; Verliere, 1966; Nagarajah and Nizar, 1982; Pandosen, 1986; Adchak, 1993; Baxter, 1995;) and other *Compositaes* are desirable spontaneous fallow species that may provide the biological basis for intensification of swidden systems. If fire control mechanisms are effectively implemented, these species have the reputation of being capable of replacing grass or fern vegetation. When introduced by seed or stem cuttings into recently abandoned dryland or burned *Imperata* / fern areas, these *Compositae* species form dense thickets within one year. Unlike other perennials that are being tested in trials searching for improved fallow species, a key attraction of the *Compositae* is their spontaneity. They are aggressive, pioneer colonizers that will dominate fallowed fields with minimal farmer intervention if conditions are favorable for their growth. The critical challenge is how degraded lands can be effectively rehabilitated by resource-poor farmers - thus mitigating agricultural pressure on the forest margins.

Farmer management of *Tithonia diversifolia* (widely known as wild sunflower) as a green manure crop is widespread among the Igorot in northern Luzon (Maslan, 1989; Bawang, 1995; Ferrer, 1996). Many Igorot migrants have brought this technology with them to Lantapan, and awareness of its agronomic potential has gradually diffused among the wider farming community. We found that *T. diversifolia* accelerates nutrient cycling and enable soil rehabilitation during an abbreviated fallow period, through its rapid growth, efficient scavenging of soil nutrients, copious leaf litter, and rapid decomposition (Cairns, pers. comm.). Sunflower hedgerows maintained around the swidden perimeter provide the seed source to facilitate rapid colonization during the fallow. A two-year fallow appears to be the norm, after which the sunflower biomass is easily slashed by bolo and mulched or burned. Farmers in the study area are manipulating wild sunflower as a biological tool to eradicate *Imperata* and rehabilitate degraded grasslands. In this case, stem cuttings are planted at intervals throughout *Imperata* swards, or alternatively, seeds are sometimes broadcasted. Farmers claim that at the end of the first year, the cogon is almost completely choked out and displaced by sunflower; by year two, the sunflower fallow can already be re-opened and a good crop grown without fertilizer inputs.

Although *T. diversifolia* is widespread, and reportedly similarly perceived by farmers in other equatorial regions, there is little empirical evidence available to validate its agronomic potential. Much information appears to be anecdotal and undocumented. We are investigating the hypothesis that *Tithonia diversifolia* can be managed by farmers to intensify bush-fallow rotations as a tool for rehabilitating degraded land. We are implementing a series of agronomic trials to test how farmers can best intervene to ensure that *T. diversifolia* will be the dominant succession species when land is fallowed. This research is based on the premise that strategic introduction and management of *Tithonia diversifolia* will allow even labor-short farmers to intervene in the downward spiral of land degradation and begin a gradual process of rebuilding soil properties. The controlled variables tested in the field trials will emphasize a minimalist approach; what are the least interventions that will still ensure strong establishment of *T. diversifolia* and achievement of the desired results?

This research links directly with a wider regional initiative that ICRAF is coordinating on indigenous strategies in fallow management. It will be included as one component of a set of parallel research projects in S.E. Asia aimed at better understanding indigenous fallow management practices, validating their performance, identifying technological refinements, and elucidating under what conditions they are an appropriate response to swidden intensification pressures (ICRAF, 1996). The *Tithonia* work will link with global efforts to mitigate the impacts of deteriorating swidden systems drawing on methodologies developed by the Alternatives to Slash-and-Burn (ASB) Program. A Philippine ASB Program is currently being developed under the leadership of PCARRD.

Biodiversity Assessment, Protection, and Conservation

So far we have reviewed the social contract aspects and the farming systems intensification aspects of our work. Now we turn to the third component of work, which focussed on understanding the biodiversity resources of the watershed, and how this knowledge may guide the development of sound management plans. Mt. Kitanglad National Park is acknowledged as one of the most important parks in the Philippines. It supports the richest known vertebrate fauna in the country (Amoroso et al., 1996; Heaney, 1992). It is the habitat of many endangered, endemic, rare and economically important species of animals and plants. Heaney (1992) found thirteen of the fourteen species of birds endemic to Mindanao, including the critically endangered Philippine Eagle (*Pithecophaga jefferyi*). One genus of mammal is endemic to the park alone, the poorly known *Alionycteris paucedentata*. Kennedy's (1995) inventory of the vertebrate fauna in the Northern portion of the park revealed the presence of 28 species of birds, 12 species of mammals, and 6 species of amphibians and reptiles. Tabaranza (1995) and Pipoly and Madulid (1996) made a one-hectare tree inventory in submontane forest of Mt. Kinasalapi and observed 43 species, 47% of them endemic to the Philippines. They noted an extremely high tree density, the highest known figure for any published tropical tree inventory.

Recent Biodiversity Assessment in the Park. Amoroso, et al. (1996) conducted ecosystematic studies on the pteridophytes in Mt. Kitanglad and Mt. Apulang and have shown the presence of one endangered species, 89 endemic species and 81 economically important species. During the first cycle of SANREM, Amoroso (1997) inventoried the flora in an intact forest of Mt. Apulang, and a disturbed forest in Mt. Kinasalapi. He compared the diversity indices of species richness, density, frequency and dominance, and revealed a number of endangered, endemic and economic species of plants. A higher number of species and individuals of trees and epiphytes were present in undisturbed forest than in disturbed forest. However, more species and individuals of lichens were observed in the disturbed forest (Table 2). The undisturbed forest had more endemic, rare and economic species of plants. Except for the fern allies, the dominant species observed in undisturbed forest were different than those seen in disturbed forest. A low percentage (0-18%) of species similarity in trees, shrubs, herbs and epiphytes was noted between the undisturbed and disturbed forests. However, a high percentage (24-33%) of species similarity was observed in ferns, fern-allies, bryophytes and lichens. The endangered rootless vascular plant (*Tmesipteris lanceolata* Dang.) grows on Mt. Kinasalapi.

Amoroso (1997) noted an alarming rate of habitat destruction due to human activities such as illegal cutting of trees, over-harvesting of minor products, shifting cultivation, and conversion of forest lands to agricultural zones. The habitats and the organisms need to be protected and conserved since there is rapid forest destruction. The biodiversity inventory work to date is inadequate. There is still a need to conduct a thorough inventory of the flora and fauna in the southern part of Mt. Kitanglad and protect the endangered, endemic, rare, and economically important species by ex-situ and in-situ conservation techniques. Mt. Apulang should be developed and maintained as a "laboratory for biodiversity studies" since it has the presence of high species diversity, endemism and economic species. Likewise, the disturbed forest in Mt. Kinasalapi can be developed and managed to enhance the biodiversity by planting trees and shrubs species found in Mt. Apulang. Planting these species of trees and shrubs would enhance the growth of other plant groups like ferns, lichens and bryophytes.

A thorough inventory on the flora and fauna in several vegetation types is needed to describe the flora and fauna profile of Mt. Kitanglad and to discover more endangered, endemic and economic species. These data are needed to properly manage the park.

Table 2. Number of species and individuals in three zones* of undisturbed and disturbed forests in kitanglad national park in bukidnon (From Amoroso, 1997).

PLANT GROUP	ZONE 1				ZONE 2				ZONE 3			
	N U M B E R O F											
	Species		Individuals		Species		Individuals		Species		Individuals	
	U	D	U	D	U	D	U	D	U	D	U	D
Trees	15	5	24	8	12	11	21	15	15	4	24	5
Epiphytes	64	21	543	253	55	46	505	461	57	10	516	99
Ferns	87	54	1190	2510	100	77	1935	1956	83	22	1208	377
Fern Allies	5	4	1273	86	4	9	794	256	4	2	173	10
Lichens	12	15	48	111	14	42	132	168	17	29	125	162

LEGEND:

U - Undisturbed forest in Mt. Apulang
D - Disturbed forest in Mt. Kinasalapi
* - 200 sq. m.
ZONE 1 - Near stream with less than 20% slope gradient
ZONE 2 - More or less middle portion of ravine with more than 40% slope gradient
ZONE 3 - Topmost portion of ravine and gently sloping (-20% slope)

Table 2. Number of species and their status by plant group

PLANT GROUP	NUMBER OF SPECIES							
	ENDEMIC		RARE		ECONOMIC		ENDANGERED	
	U	D	U	D	U	D	U	D
TREES	18	4	24	3	15	10		
SHRUBS AND HERBS	8	3	39	12	10	11		
VASCULAR EPIPHYTES	3	2	34	9	25	24		
FERN-ALLIES			2	5	3	5	1	1
FERN	27	9	22	9	25	14		
TOTAL	56	18	121	38	78	64	1	1

LEGEND:

U = Undisturbed Forest in Mt. Apulang
D = Disturbed Forest in Mt. Kinasalapi

Ravines as Corridors of Biodiversity. Numerous steep ravines emanate from the Kitanglad range out into the agricultural landscape. These valleys are the least disturbed part of the agricultural area, and in part, harbor diverse natural communities. They may be valuable in radiating and maintaining strands of biodiversity outward from the protected area through the farmed parts of the landscape. We worked to develop an appropriate strategy to enhance the biological integrity of the ravines. Glynn, Amoroso, and Garrity (1997) developed a methodology to survey and map the vegetative communities of major ravines of the Alanib River. They surveyed the spatial relationship between natural vegetation, agroforestry, and field crop systems on a transect basis. These maps provided a basis for identifying the hot spots where change is needed in land management practices to protect the streams and the biodiversity along them. Based on this information, ravine habitat management has been incorporated into the municipal natural resource management plan.

Putting the Pieces Together

We envision the development of a natural resource management system for the buffer zone of KNP that is based on a holistic park management plan, coordinated with an ancestral domain management plan, which are in turn consistent with individual municipal-level conservation plans that are backed up by conservation plans developed at the village level. This is a tall order indeed.

Linking development to conservation. How is a social contract between local people and outside institutions for protected area to be institutionalized locally? In most cases it seems that implementation is made functional through village-level leadership and administration. The village leadership must 'buy-in' to the agreement for support to diffuse through the entire community. This suggests some form of formal village conservation agreement. Such an agreement would presumably include a land use plan for the village, specify boundaries, clarify land tenure, and indicate the community enforcement modalities. In terms of on-the-ground enforcement of the park boundaries, we observe that villages tend to occupy one or more interfluves between the ravines of respective streams emanating from the mountains. They are surrounded by private lands. Further up the interfluve is the boundary with DENR forest land (buffer zone) and yet further upslope is the boundary of the National Park. These interfluves thus embody a natural zone for resource management. The people of the village are in a favorable position to monitor activities that may occur in the buffer zone or within the park on the interfluve above.

Based on the accumulated experience from the activities of the Biodiversity Consortium, we are moving toward the establishment of appropriate links between development activities and enforcement. This will need to receive serious attention in the near future. As Wells and Brandon emphasized, to be effective, an ICDP agreement needs to specify explicitly the rights and obligations of the contracting parties. This remains to be done. We've deferred explicit linkages until we can prove that we have alternative farming practices that are sustainable, and a clear plan for biodiversity conservation. We feel justified in taking this approach. Developing people's environmental awareness is a crucial part of a success.

Conclusion

The IPAS program must come to terms with reconciling the need to protect the park with the legitimate claims of the indigenous peoples to their ancestral domains. It must also work out ways of implementing effective community involvement in park enforcement. Our methodology-building research will provide crucial guidance to the IPAS program. We are currently working with the Bukidnon Watershed Management and Protection Council, and the Bukidnon Provincial Planning Board to scale-up our outputs to the Pulangi River Basin and to the entire central Mindanao area. All municipalities in the Philippines are charged with taking a more serious approach to natural resource management planning. We are collaborating with the USAID-funded GOLD project to extrapolate methods of municipal natural resource management planning derived from our work and that of GOLD to a range of other Philippine municipalities. The provincial planning board and the Pulangi Watershed Council have approached us to use Lantapan as a model for municipal natural resource management training and implementation throughout the area.

Recently, we began work on a major scaling-up operation for the entire integrated conservation-development concept we have developed through SANREM. The outputs of our biodiversity project will be extended to four municipalities adjoining Lantapan through a new project proposal to Global Environment Facility. This project will provide the opportunity to extend the SANREM model on a major scale. It will test our whole-landscape approach in the challenging context of a large integrated conservation development project. Only with democratization and decentralization of power can natural resource management at the local level succeed. Fortunately, this process is well underway in the Philippines. Local governments have begun to have the resources and authority to respond to local needs. In other parts of Southeast Asia such devolution is farther down the road (Garrity and Agus, 1997). Participatory approaches transfer principles rather than standard solutions, and make available a basket of choices rather than a set package of practices. Problem analysis must not simply be done by outsiders for the community, but must be done by the community itself with backstopping by the outsiders. The solution is not to transfer some known technology, but to assist farmers to adapt technologies to their own circumstances.

Part of our efforts are directed to scaling up to the global level. Our work is directly tied-in with the global program on Alternatives to Slash and Burn coordinated by ICRAF. This will further ensure the global extrapolability of the participatory research methods and the management model developed in Manupali. The above indicates that our vision on disengagement is one of embedding SANREM's work into a range of bigger initiatives that build on the lessons we have learned. The success of our project depends heavily on strong linkages with the research in the Soils and Water Consortia. The strongest links with these projects is through the work on agroforestry practices, particularly in activities involving trees to enhance soil conservation. The work on ravine protection relates strongly to the water component (protection of quality water supplies). Wells and Brandon (1992) noted that the problems that all the ICDPs are grappling with appeared enormous, complex, and variable compared to the modest scale of the efforts invested so far. The pitfalls do appear sobering. The question is whether the effort of following an ICDP approach is really worth it. Their answer is that such approaches must be reinforced and expanded simply because there are so few viable alternatives.

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