

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 and the farming systems intensification aspects of our work. Now we turn to the third component, 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 13 of the 14 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 1 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 an undisturbed forest than in a 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 the undisturbed forest were different than those seen in the 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

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 3. 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

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.

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 its 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 Soil and Water Consotia. 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.



References

- Adchak, C.L. 1993. Effect of different rates of inorganic nitrogen in combination with chopped wild sunflower (*Tithonia diversifolia*, Gray) on the growth and yield of cabbage. Abstract.
- Agbim, N.N. 1987. Carbon cycling under *Chromolaena odorata* (L.) K. & R Canopy. In: Biological Agriculture and Horticulture, Vol. 4. 203-212.
- Amoroso, V.B. 1997. Pteridophyte diversity in the Philippines: Status, issues and conservation initiatives. Paper presented during the National Seminar-Workshop on Environmental Education and Management held at CMU on July 2-3, 1997.
- Amoroso, V.B., Acma, F., and Pava, H. 1996. Diversity, status and ecology of Pteridophytes in three forests in Mindanao. In: J.M. Camus & R.J. John (editors). Pteridology in Perspective, pp. 53-60. Royal Botanic Gardens. Kew.
- Arnold, 1997.
- Banaynal, R.A. 1996. COPARD 2: NECI Annual Progress Report. Network for Environmental Concerns, Cagayan de Oro City. 24p. - (With Annexes).
- Bawang, F.T. 1995. Farmer management of the wild sunflower (*Tithonia diversifolia*). Lecture paper delivered to graduate school students in farming systems, second semester 1994-95. Benguet State University, Philippines.
- Baxter, J. 1995. *Chromolaena odorata* - weed for the killing or shrub for the tilling?. Paper submitted to Agroforestry Today.
- Baxter, J. (ed.). 1995. *Tithonia* - more than meets the eye. In: ICRAF Updates, September 1995.
- Brandon and Wells, 1992. Planning for people and parks: Design dilemmas. World Development (forthcoming April).
- Byron, 1998.
- Cairns, M.F. 1996. Ancestral domain and national park protection: A mutually supportive paradigm? A case study of the Mt. Kitanglad Range National Park, Bukidnon, Philippines. In: Summary Report of a National Workshop on Buffer Zone Management and Agroforestry. Central Mindanao University, Bukidnon. 15p.
- Cairns, M.F. 1994. *Eupatorium inulifolium*: Noxious weeds or multipurpose shrub? Chapter 3 in Stabilization of Upland Agroecosystems as a Strategy for Protection of National Park Buffer Zones: A Case Study of the Co-evolution of Minangkabau Farming Systems and the Kerinci Seblat National Park. MES Major Paper, York University.
- Cernea, M.M. 1989. User groups as producers in participatory afforestation strategies. World Bank Discussion Paper No. 70.
- COPARD. 1996. Community Organizing Participatory Action Resource Development Research. Terminal Report (Cycle 1). Network for Environmental Concerns, Cagayan de Oro City. 30p.
- Dagondon, G., Canoy, Ma. E., Mabaquiao, A., Muyco, Ma. E. and Ang, J. 1997. Current findings on policies related to the natural resource management of Mt. Kitanglad. Green Mindanao Report. Cagayan de Oro City.
- de Foresta, H. and Michon, G. 1994. Agroforests: A new model for rural development, sustainable forest management and reforestation of degraded land. Paper presented at the Workshop "New Directions in the Forestry Sector in Indonesia", Jakarta (FAO, World Food Program), February 1994. 9p.
- de Foresta, H. 1993. *Chromolaena odorata*: Calamite ou chance pour l'Afrique Tropicale? Paper presented at Troisieme Atelier International sur la Lutte Biologique et la Gestion de *Chromolaena odorata* at Abidjan, Cote d'Ivoire, Nov. 15-19, 1993.
- de Foresta, H. and Schwartz, D. 1991. *Chromolaena odorata* and disturbance of natural succession after shifting cultivation: An example from Mayombe, Congo, Central Africa.



- In: Ecology and Management of *Chromolaena odorata* (ed. R. Mumiappau and P. Ferrar). BIOTROP Special Publication No. 44. 23-41.
- Derpsch, R. 1993. "Description de un sistema de produccion sostenible, basado en la siembra directa, en laderas con 100% de declive, desarrollado por un pequeno agricultor del Sur de Honduras. Relato de experiencias, exposicion oral en el "10 Encontro Latino Americano sobre Plantio Direto na Pequena Propriedade, 22 a 26 de Novembro de 1993. Ponta Grossa, Brasil.
- Dove, M.R. 1986. The practical reason of weeds in Indonesia: Peasant vs. State views of *Imperata* and *Chromolaena*. In: Human Ecology, Vol. 14, No. 2. 163-190.
- Ferrer, E.M. 1996. Response of white potato to different sources of organic matter. Manuscript of research study re: Sunflower. Baguio National Crop Research and Development Center, Philippines.
- Field, S.P. 1991. *Chromolaena odorata*: Friend or foe for resource poor farmers. In: *Chromolaena odorata* Newsletter, No. 4. May 4-7.
- Fisher, B. 1994. Creating space: Development agencies and local institutions in natural resource management. *Forest, Trees and People Newsletter*, 22: 4-11.
- Gakou, M. and Force, E.J. 1996. Learning with farmers for policy change in natural resource management. *Forests, Trees and People Newsletter*, 31: 14-20.
- Garrity, D.P., Mercado, A.R. Jr, and Stark, M. 1998. Building the smallholder into successful resource management at the watershed scale. In: de Vries, P., Frits, W.T., Agus, F. and Kerr J. (eds.) Soil Erosion at Multiple Scales: Principles and Methods for Assessing Causes and Impacts. CABI and IBSRAM. (In press).
- Garrity, D.P. and Agus, F. 1997. Natural Resource Management on a Watershed Scale: What Can Agroforestry Contribute? Paper presented in the Global Conference on Watershed Management, Soil and Water Conservation Society, July 25-26, 1997, Toronto, Canada. 34p.
- Garrity, D.P. 1996. Buffer Zone Management and Agroforestry: Some Lessons from a Global Perspective. In: Summary Report of a National Workshop on Buffer Zone Management in Agroforestry. Central Mindanao University, Bukidnon. 11p.
- Garrity, D.P. 1994. The importance of agroforestry and ICRAF's mission in Southeast Asia. In: Present situation, problems, prospects and practical implementation program of education and research on forestry for sustainable agriculture and natural resources conservation in Asia. Tsukuba, Japan. University of Tsukuba.
- Garrity, D.P. and Mercado, A.R. Jr. 1994. Reforestation through agroforestry: Smallholder market-driven timber production on the frontier. In: Raintree, J. and Fernandez, H. (eds.). Marketing Multipurpose Tree Species in Asia. Winrock International, Bangkok.
- Garrity, D.P., Kummer, D.M. and Guiang, E.S. 1993. The Philippines: In: Agricultural Sustainability and the Environment in the Humid Tropics. 549-624. Washington, D.C.: National Academy Press.
- Glynn, C. 1996. Overcoming constraints to agroforestry adoption in tropical highlands: Part 1: An investigation of performance by elevation patterns for some commonly grown timber species in the Manupali Watershed, Bukidnon, Philippines. M.Sc. Thesis, Tropical and Subtropical Horticulture and Crop Science, Wye College, University of London.
- Heaney, L. 1993. Survey of vertebrate diversity in Mt. Kitanglad Nature Park. Unpub. Manuscript, Philippine National Museum, Manila.
- Heaney, L. and Peterson, A.F. 1992. Inventory of the vertebrates of Mt. Kitanglad Nature Park. Final Report, 12p.
- ICRAF. 1997. Annual Report for 1996. International Centre for Research in Agroforestry, Nairobi, Kenya.
- ICRAF. 1996. Indigenous strategies for intensification of shifting cultivation in Southeast Asia: Workshop and Regional Research Network. Proposal submitted to International Development Research Centre (IDRC) in Ottawa, Canada.



- Kennedy, 1995.
- Koffa, S.N. and Garrity, D.P. 1996. A user-sensitive approach to planning and establishing timber tree production systems initiative for smallholders. Unpublished.
- Kramer, R., van Schaik, C. and Johnson, J. 1997. Land Stand: Protected areas and the defences of tropical biodiversity. Oxford, New York. 242p.
- Maslan, F.K. 1989. Utilization of azolla in the Cordillera. Paper presented at the Bio and Organic Fertilizers Symposium at UPLB, Laguna. Oct. 11, 1989.
- Michon, G. 1993.
- Michon and de Foresta, 1990.
- Nagarajah, S. and Nizar, B.M. 1982. Wild sunflower as green manure for rice in the mid country wet zone. In: Tropical Agriculturist, 138. 69-80.
- Palis, H. 1997. Domestication initiatives of indigenous tree species in Mt. Kitanglad. Final report on Phase 1. SANREM.
- Palis, H. 1996.
- Pandosen, M.D. 1986. Potential of Wild Sunflower (*Tithonia diversifolia*) as an organic fertilizer. MS Thesis submitted to Benguet State University.
- Pasicolan, 1995.
- Pipoly, J. and Masdulid, D. 1996. Tree inventory in submontane forest of Mt. Kitanglad. Proceedings of the Flora Malesiane Symposium. Kew Garden-UA.
- Pipoly, J. and Masdulid, D. 1995. The vegetation of a Philippine submontane forest, Kitanglad Range. Pers. Communication.
- Postel, S. and Heise, L. 1988. Reforestation with a human touch. In: Grassroots Development, 12:38-40.
- Prein, L.M. and Lopez, T. 1995. Bioresource flow modeling with farmers: Making resource flow visible. *Forests, Trees and People Newsletter*. 26/27: 77-78.
- Rao, Y.S. 1985. Community forestry: Building success through people's participation. *Unasylva*, 34: 29-35.
- Roder, W., S. Phengchnah, Keouboulapha, B. and Manivong, S. 1995. "*Chromolaena odorata* in slash-and-burn rice systems in Northern Laos - Weed or useful plant?"
- Sayer, J.A. 1995. Science and international nature conservation. Occasional paper no. 4. Center for International Forestry Research. 14p.
- Slaats, J.J.P. 1993. The use of *Chromolaena odorata* as fallow in a semi-permanent cropping system in S.W. Cote d'Ivoire. Paper presented at Third International Workshop on Biological Control and Management of *Chromolaena odorata*, Abidjan, Cote d'Ivoire, Nov. 15-19, 1993.
- Stoutjesdijk, J.A.J.H. 1935. *Eupatorium pallescens* DC op Sumatra's westkust (*Eupatorium pallescens* DC on the West Coast of Sumatra) in Tectona, Vol. 28. 919-926.
- Tabaranza, B. 1995. Fauna survey in Songko, Lantapan. Narrative Report submitted to SANREM.
- van de Goor, G.A.W. 1953. An investigation on the relative issue of various legumes and non leguminous plants as green manure. In: *Tehnik Pertanian*, No. 3, Tahun ke II. March 1953.
- van Noordwijk et al. 1995.
- Verliere, G. 1966. Valeur fertilisante de deux plantes utilisees dans les essais de paillage du cafeier: *Tithonia diversifolia* et *Flemingia congesta*. In: *The Café Cacao*, Vol. X, No. 3. July-September 1966.
- Wells, M. and Brandon, K. 1992. People and Parks: Linking protected area management with local communities. World Bank/World Wildlife Fund/USAID. Washington, D.C.
- World Conservation Strategy. 1980.
- Wynter, P.E. 1993. Legalize it: Community participation in natural resource management. *Unasylva*, 44.
- World Commission on Environment and Development. 1987. Our common future. New York: Oxford University Press.

