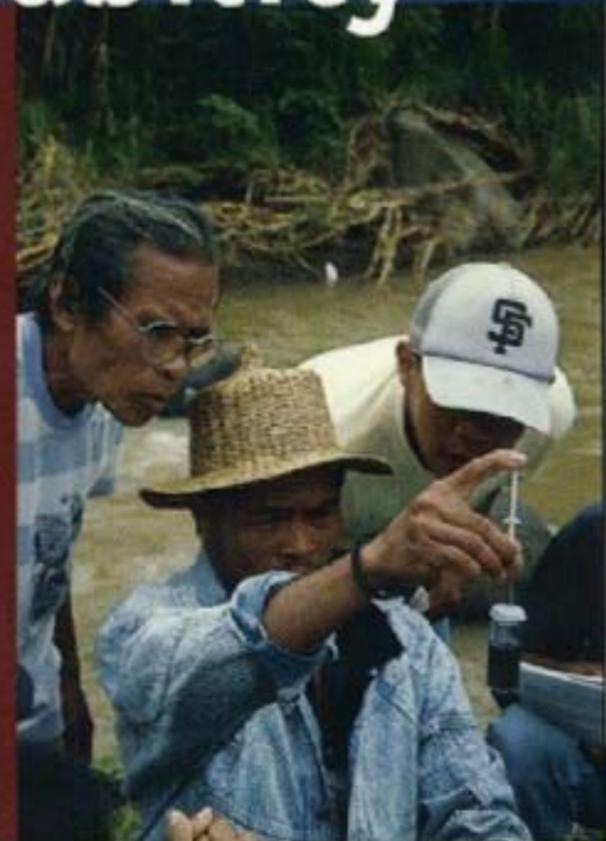




Seeking Sustainability

Challenges of agricultural development and environmental management in a Philippine watershed

Edited by
Ian Coxhead and Gladys Buenavista



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**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY AND NATURAL
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Foreword

The Philippine uplands comprise more than half the country's total land area. The nation's forests and watersheds, overwhelmingly located in uplands, play vital environmental roles. At the same time, the upland natural resource base also serves an important economic function, supporting about 20 million Filipinos engaged primarily in agriculture. Population growth, commercial opportunity, and the promise of "open access" resources continue to draw Filipinos to uplands. As a result, their natural resource wealth and environmental quality is under threat from logging, grazing, urbanization and the spread of upland agriculture.

Since 1993, the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP/Southeast Asia) has addressed the issue of sustainable development in Philippine uplands through a participatory program of research, outreach, and capacity building. SANREM, which is funded by the United States Agency for International Development (USAID), brings U.S. and international scientists together with their Philippine counterparts in universities, government, NGOs and local communities, with the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) as the national host institution.

This book features the innovative strategies and technologies that evolved in SANREM research on sustainable development in the fragile uplands. It is based on work at the project's primary research site in the Municipality of Lantapan, in the headwaters of the Upper Manupali River in Bukidnon Province, Northern Mindanao. It showcases the project's adherence to the principles of participation, interdisciplinary and intersectoral collaboration, and a landscape approach to resource and environmental issues. It reports on research and outreach work that is motivated by the need to balance economic aspirations with the need for environmental and natural resource conservation. It discusses lessons learned regarding the nature and degree of participation in the design and implementation of site-based research. It stresses the need for an approach to sustainable development that is cognizant of local as well as national conditions, markets and policies. The book highlights the

importance of building strong partnerships among scientists, farmers and community groups, and local government in the pursuit of sustainable upland development.

It is hoped that this book will serve as useful reference to development workers, planners, policy makers as well as other researchers not only in the Philippines but also in other Asian countries where similar problems of development in upland watersheds and forest areas are encountered.

Lastly, we wish to acknowledge our strong partnership and collaboration with both Philippine and United States institutions in the successful implementation of the SANREM program under the joint coordination of the University of Wisconsin and PCARRD.

PATRICIO S. FAYLON
Executive Director
PCARRD

Acknowledgment

This monograph and the research that it reports have been made possible with the assistance, support and encouragement of a large and diverse group of institutions and people. We wish to thank the people of the municipality of Lantapan, their community organizations, and their representatives in local and provincial government for their continuing support, cooperation and participation in the SANREM CRSP project. The authors of the contributed chapters, all of whom have long been involved in the project, deserve thanks for their efforts in preparing and revising manuscripts. The coordinating institutions of the project, especially PCARRD, Auburn University and the University of Wisconsin College of Agriculture and Life Sciences, Office of International Agricultural Programs, have provided essential organizational and institutional backup. Production and editorial assistance were very capably handled by PCARRD's SANREM staff and the staff of its Applied Communication Division, as well as by the staff of the SANREM site coordination office. At the University of Wisconsin, Brian Wiley provided valuable and dedicated assistance in making the manuscripts ready for publication.

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Chapter 1: Seeking Sustainability: A Synthesis of Research in SANREM CRSP- Southeast Asia, 1993-98

Ian Coxhead
Gladys Buenavista

Origins of the SANREM CRSP

It is barely more than a decade since the UN Commission on Environment and Development (the “Brundtland Commission”) presented its famous definition of sustainable development as “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”. In pursuit of that goal, the Commission identified the needs to conserve exhaustible and renewable natural resources and to ensure the conservation of plant and animal species (WCED 1987). Though these ideas were neither new nor fully articulated, the report generated a great deal of momentum for activities addressing interactions between development and environment. Some of these were research and educational ventures, many of which began to bear fruit in the mid-1990s, as can be seen in the surge of publications on development and environment in the second half of the 1990s. Others were policy initiatives both at national and international levels, the latter reaching a peak with the 1992 Earth Summit held in Rio, Brazil.

In the U.S., the Brundtland Commission report can be credited with having helped motivate some searching re-evaluations of the use of environmental and natural resources in domestic agriculture (*e.g.* Pimentel *et al.* 1995; Karlen *et al.* 1997) as well as in developing country natural resource sectors (WRI 1989; TSC and WRI 1991). The Commission’s emphasis on interactions between human and biological systems also resonated with a rapidly growing body of social science research that identified tensions between the goals of social and economic development and the use or misuse of natural resources in developing countries (*e.g.* Blaikie and Brookfield 1987; Southgate 1988; Anderson and Thampapillai 1990; World Bank 1989, 1990). These studies in turn drew upon a growing set of biological research findings that quantified the long-term trends of resource depletion and degradation in upland and highland agriculture,

in forests and at forest margins, and in the hydrological systems that depend on them (*e.g.*, Lal *et al.*, 1986; Lal 1990; Blair and Lefroy 1991; IBSRAM 1995, 1996). A major, and as yet unresolved, question arising from interdisciplinary work concerns long-term development in natural resource-based systems. Is there a trade-off between economic well-being and the maintenance of stocks of natural and man-made capital such that future generations will not be left worse off than today?

A key insight for the environment and development debate was that sustainable natural resource use depends critically on the private decisions of primary resource managers,¹ such as farmers and fishermen. In developing countries, these individuals are typically poor, risk averse and highly constrained in terms of access to credit, information and technology. Their behavior is driven by the desire to maximize the well-being of their household, or at best of their local community. These actions may impose social costs when legal institutions (such as land tenure laws) are imperfect or absent, when markets do not convey clear and true signals of relative scarcity, or when their actions impose costs on others through downstream effects. In this setting, sustainable development cannot be achieved merely by signing national legislation and international conventions. Operationally, to achieve global or national goals, the sustainable development community must understand the actions of millions of individual resource managers and be prepared to engage them directly.

Within the U.S. development community, the aftermath of the Brundtland Commission report saw a concerted effort to think about sustainable agricultural development in relation to the resources and skills available. This was the beginning of the SANREM CRSP. In response to a request from the U.S. Congress, the Agency for International Development (USAID) created a new Collaborative Research Support Program (CRSP)² with responsibility for promoting sustainable agriculture and natural resource management—hence the acronym, SANREM. USAID then commissioned the National Research Council (NRC) to recommend a design and a set of research priorities for the CRSP. In defining sustainable agriculture, this panel adopted a modification of the Brundtland Commission phrase, in which *sustainable agriculture*

¹ We use this term as a general label for individuals and groups whose decisions affect the use of a natural resource, whether forest, land or water, in some way.

² Collaborative Research Support Programs (CRSPs) were created under the U.S. International Development and Food Assistance Act of 1975. This Act “supports long-term agricultural research of benefit to developing countries and the United States” (NRC 1991:vii). The CRSPs consist primarily of research grants to U.S. Land Grant universities and their developing country research partners.

connoted “approaches to agriculture that provide for the needs of current and future generations while conserving natural resources” (NRC 1991: 2). The panel then defined the mission of the SANREM CRSP as addressing

...the need to promote integrated, multidisciplinary, research across agroecological zones, among departments and institutions of U.S. universities, and in collaboration with other institutions, research institutes, national agricultural research systems, and the international agricultural research centers. Its principal objectives [are] to foster a truly collaborative and participatory approach to the design of research and to involve the ultimate beneficiaries of the research: the small-scale farmers and rural and urban poor in developing countries (NRC 1991: viii).

The panel reasoned that previous approaches to resource-conserving agricultural development had been flawed in failing adequately to involve primary natural resource managers as active participants in the design and implementation of research and action for sustainable development. Rather than prescribe a specific model, however, the Council chose simply to recommend that the SANREM program adopt as principles a “systems” approach to agricultural and resources research, interdisciplinarity, and a commitment to broad participation by farmers and institutions. It was also strictly results oriented; the panel concluded that the SANREM research approach

...must take into account those factors that influence the ability of people to improve their livelihood, income and health. It must make use of and strengthen existing pools of indigenous knowledge available for the design and adoption of sustainable production systems. Research projects [within SANREM] should seek to understand how physical, biological, economic and social factors interact and must be balanced to manage agro-ecosystems in a sustainable manner. The SANREM program should primarily seek to promote research that adds to this understanding and that works with the farmer and across disciplines and institutions to fashion the tools, perfect the techniques, and design the farming systems that can shape a sustainable future (NRC 1991: 21-22).

Responsibility for the implementation of SANREM was awarded to the University of Georgia (UGA), as head of a consortium of U.S. universities, NGO/PVO organizations, and developing country partners in 1992. In the

spirit of the NRC recommendations, the UGA proposal set out a broad plan for participatory, farmer-focused and policy-oriented research directed at the diagnosis and rectification of problems of non-sustainability of agricultural and natural resource use, designed and conducted in ways sensitive not only to ecology but also to economic, social and cultural conditions.

The SANREM Approach to Agricultural Development

In SANREM, the ideas expressed in the NRC report and echoed by Agenda 21 are summarized in four “cornerstones” or research design principles: a landscape approach, interdisciplinarity, inter-institutional collaboration, and participation. The first three of these principles were justified in the SANREM proposal as follows:

We propose to utilize a landscape ecology approach to the study of sustainable agriculture and natural resource management in the tropics. We use the term “landscape” to indicate the appropriate scale of our approach, which emphasizes interactions between ecosystems. The landscape is a mosaic of interacting ecosystems with both commonalities such as soils, climate, and natural vegetation; and uniqueness, such as biodiversity, land use patterns, and socioeconomic structure. The landscape is the niche with human beings as inhabitants, and, more significantly, as manipulators of the component ecosystems. In this way, these end-users become the “lifescape” that is superimposed onto the landscape. By definition, agricultural sustainability requires the recognition of not only the complex array of interactive processes ongoing within an ecosystem, but also of the interactions among ecosystems on a landscape scale... Additional requirements of this approach include integrating scientific disciplines more fully than traditional agricultural, ecological, or social science approaches, and inclusion and integration of service groups, such as private voluntary organizations (PVOs), into the research process (SANREM CRSP 1992: 1).

The fourth cornerstone, participation, underpinned a philosophical commitment within SANREM to a relatively new view of the farmer not merely as the beneficiary of research and development, but as the central

player in a set of relationships linking researchers, policy makers and resource managers. The idea of “putting the farmer first” (Chambers 1983; Chambers *et al.* 1989) was expressed operationally as a commitment to farmer-led research, or “farmer-back-to-farmer research” (Rhoades 1984). In this view research begins with farmer-led identification of a research agenda and concludes with the results of research, carried out both on-site and elsewhere and in collaboration with farmers, being returned to the community in the form of usable innovations in technologies, practices and policies.

The commitment to a landscape approach, interdisciplinarity, inter-sectoral collaboration, and participatory, “farmer-back-to-farmer” research distinguished the SANREM approach from more standard procedures for conducting results-oriented scientific research in developing country agriculture. Conventionally, projects and programs are guided by a model that helps ensure that activities fit neatly within defined stages of implementation. In the SANREM case, neither a model nor a blueprint was prescribed in the original conceptual framework prepared by the NRC panel. Indeed, the panel had written that:

"No single, established model exists for the successful conduct of the integrated, multidisciplinary research and development efforts that the SANREM program would require. Thus, the grant program should be designed so that maximum reliance is placed on the ingenuity of the researchers who will do the work (NRC 1991: 5)."

In practice, the lack of a “blueprint” for a project committed to wide-ranging participation and cooperation across disciplinary and institutional lines meant that the early years of SANREM were characterized by an exceptionally high degree of emphasis on *process*. Among the procedural questions debated were the exact meaning of the cornerstones in a specific setting, the relationship between the cornerstone principles and scientific method, the appropriate scope and type of participation in research activities, and the distribution of effort between research and “action” (extension, outreach, and advocacy). To the extent that the project is now able to present a “blueprint” for others with similar goals, it is due to having confronted these questions in the course of implementing site-based research. We return to these points, and to an evaluation of the project’s achievements and methodological contributions, in Chapters 8 and 14.

The Southeast Asia Site

Addressing site selection criteria, the NRC panel had emphasized the need to identify and work in sites that are representative of a broad cross-section of ecological conditions, and stressed that “research must be responsive to local constraints and concerns...a learning process must take place, not only at the scientific level, but at the policy level, in the host country’s capital” (NRC 1991: 45). The SANREM partners identified the southern Philippines as broadly representative of upland agricultural conditions in the humid tropics, and as displaying common forms of environmental stress associated with unchecked resource exploitation. From the set of feasible sites, the Municipality of Lantapan in Bukidnon province, Northern Mindanao was chosen for a variety of reasons relating to the landscape-based approach to SANREM research (see below).

By the early 1990s the extent to which the Philippines had depleted its natural resource base and environmental quality was beginning to become apparent. A major natural resources inventory conducted in the 1980s quantified the resource base and also indicated some ways in which it was being degraded (ENRAP 1994), as did several prominent studies by international organizations (*e.g.* World Bank 1989). Total forest cover in 1995 covered only 6.8 M ha in 1995, down from 11.2 M ha in 1980 and declining at more than 3% per year; closed forest covered only 6% of land area, and none of that was classified as frontier (*i.e.* undisturbed) forest (WRI 1998). Early concerns were being voiced about the potential costs of losses in biodiversity and watershed function associated with deforestation. Irrigated area had remained essentially unchanged for more than a decade, forcing agricultural expansion into unirrigated areas; and growth of agricultural yields, and especially that of rice, the main crop in lowland irrigated areas, appeared to be reaching a plateau, after many years of increase (Cassman and Pingali 1995).

The Philippines was undergoing several other forms of change that in retrospect made it a very valuable choice of location for SANREM field and research activities. At the same time, these other changing conditions have challenged and at times threatened the integrity and viability of the project’s methods and activities. Most importantly, the Philippines -- like many of its Southeast Asian neighbors -- was undergoing very rapid economic growth and structural transformation during the period before 1997, and these changes had direct implications for deforestation rates, agricultural practices, and natural resource management in upland areas. Second, as a result of earlier economic and political crises, in 1991 the Philippines began a major change in its system of government. A sweeping revision of the administrative code led to wide-ranging devolution of

power and authority from central government to provinces and municipalities. Local changes in administrative and political institutions engendered by this devolution have presented SANREM with arguably its greatest challenges and opportunities in the Philippines. Ultimately, key aspects of the project's methodologies and activities underwent a transformation as a response to these changes.

From a policy point of view, the timing of SANREM's inauguration in the Philippines was propitious. It followed by just a few months the establishment, by presidential decree, of the Philippine Council on Sustainable Development (PCSD). The decree, issued in September 1992, followed the Rio de Janeiro Earth Summit by just three months. One of the major tasks with which the PCSD was charged was that of converting the global Agenda 21 document into a set of specific analyses and recommendations for action in the Philippines (subsequently published as PCSD 1997). Thus a project emphasizing sustainable development in agriculture, a key sector of the Philippine economy, was welcomed at the national level as expressing goals consistent with the thrust of national policy.

Economic Growth and Structural Change

Within rural areas of developing countries, concerns about unsustainable development are keenest "at the margin" — that is, in areas close to the cultivated frontier, where poor households farm sloping lands that are frequently poorly suited to intensive cultivation. The "margin" thus represents a constellation of ecological, economic and political conditions in which stress is endemic and the security of human welfare, soil and water resources, and biological diversity is under constant threat. Until comparatively recently, settlement and cultivation at the frontier was driven primarily by demographic change -- rapid population growth and internal migration -- in relatively poor, unindustrialized economies. Upland populations relied almost exclusively on agricultural production and gathering of forest products, and were largely subsistence-oriented. The influence of government and the market were relatively weak, indirect and subject to the vagaries of weather and the passability of roads. Land use decisions, land expansion and agricultural technology were, therefore, largely driven by local demographic, economic and biophysical conditions.

Assuming, perhaps, that these conditions continued to apply uniformly in developing countries, early SANREM documents justified the choice of a regional research site in the Philippines largely on the grounds that its ecological conditions and state of agricultural development were

broadly representative of Southeast Asian conditions. However, it quickly became clear that by comparison with other regions of the developing world, the Philippines and Southeast Asia offered another distinctive feature: the unusually rapid pace of their economic development. In this region of the developing world, economic conditions have changed fundamentally within the present generation, and sometimes in the space of just a few years. In the early 1990s the Northern Mindanao region as a whole experienced an accelerating rate of economic growth, matching that of the Philippine economy as a whole (Fig. 1.1). In addition to raising average incomes, growth was accompanied by improvement and expansion of infrastructure, markets, financial systems, and educational opportunities. Interregional and intersectoral labor mobility has increased. Rapid growth of urban population and employment, spurred in part by the globalization of trade and investment, generated high rates of demand growth for consumer goods, including an ever-increasing variety of agricultural products.

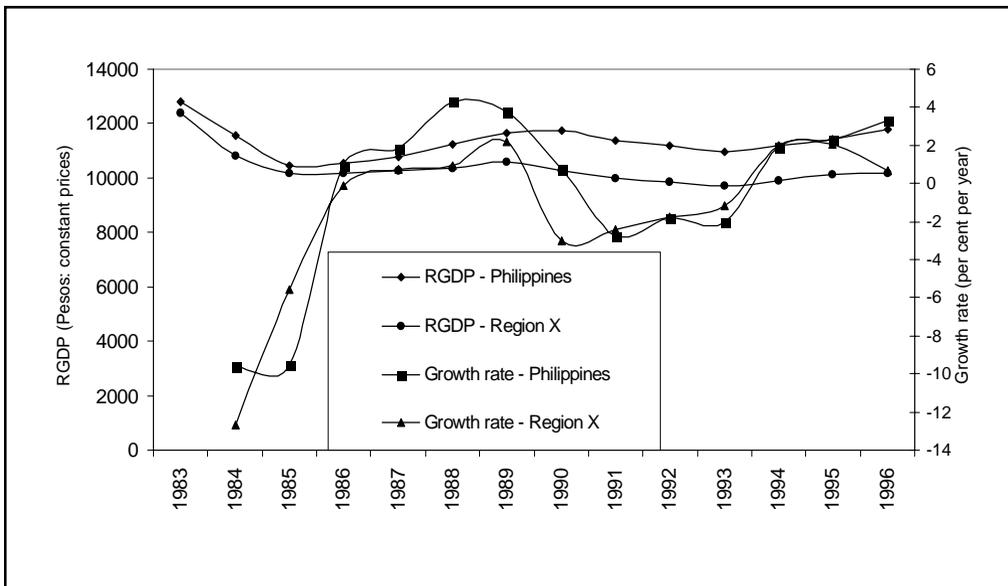


Fig. 1.1. Real per capita gross domestic product: Philippines and Region X.
Source: World Bank

The changes due to rapid economic growth and transformation often imply major departures from established patterns of agricultural development. In particular, upland and highland communities have found their activities increasingly closely integrated with national and global markets. Resource managers in these formerly remote areas now receive

market and related signals that play major roles in determining land use, technology adoption and adaptation, and investment plans, and thus exert a powerful influence over long-term environmental health and economic welfare.

Land-degrading patterns of agricultural growth are often taken to be promoted by adverse economic conditions -- poverty -- and malfunctioning institutions -- tenure insecurity or open access to land without restraints on the uses to which it is put. The combination may cause land managers (such as small farmers) to discount the future very heavily, or to adopt very short planning horizons, thereby introducing a bias in favor of short-term land uses. Rates of return to long-term investments in perennial crops and soil-conserving structures are also reduced by high capital costs in 'thin' local credit markets. For these reasons and more, farmers in steeply sloping upland areas close to the frontier of cultivation or in the buffer zones of forested areas are frequently observed to engage in land-degrading agricultural practices, even when they are clearly aware of the long-term consequences of their actions.

Unfortunately, recent Southeast Asian experience makes it clear that economic growth alone is not automatically a panacea for unsustainable upland land management practices. In some of Southeast Asia's very rapidly growing economies the demand for new products, especially temperate-climate vegetables, is now driving the conversion of land to intensive commercial vegetable garden systems in upland areas where climatic conditions make cultivation possible (Hefner 1990; Lewis 1992; Librero and Rola 1994; Scott 1987). Although the area planted to such non-traditional crops is relatively small, their expansion is nevertheless highly influential since it represents a move in the most ecologically fragile areas from soil-conserving tree crops, pasture and long-fallow systems to highly intensive vegetable gardening in which frequent tillage and thorough weeding greatly increases the exposure of soils to the leaching and eroding effects of monsoon rains. Moreover, pesticide and fertilizer use levels on vegetables are extraordinarily high under conventional crop management regimes.

Similarly, burgeoning meat demand by growing urban populations is fueling massive expansion of feed-corn production in upland areas. Under typical technologies -- that is, without special allowances for the erodibility of sloping land in the form of contour plowing, hedgerows or other erosion-inhibiting structures -- corn cultivation is a major contributor to soil erosion in the uplands and highlands of Southeast Asia. Moreover, continuous or long-term corn cultivation is known to generate large demands on soil nutrients; their (partial) replacement by means of the application of inorganic fertilizers can itself contribute to further long-

term soil quality decline through acidification, diminished cation exchange capacity and possibly irreversible acceleration of soil weathering (Barak *et al.* 1997). The same trends may underlie observed long-term declines in yields of monocropped rice and corn in experiment stations, a very disturbing trend that has only recently come to light (Cassman and Pingali 1995; Kim *et al.* 2000).

These instances of the expansion and intensification of upland agriculture also have national policy dimensions. Grain production is supported by special policy measures in most Southeast Asian countries, and expansion of potato, cabbage, and other temperate climate crops in the steep lands of the region has been stimulated by widespread import restrictions and input subsidies aimed at promoting expanded production of such 'high-value' crops. Accumulated evidence suggests that while overall economic growth rates are important predictors of declines in poverty-related migration and land degradation, crop-specific and sector-specific policies (or policy failures) exert substantial influence over land resource allocation and soil management, even in apparently remote upland areas.

Changing Role of Government

Economic and market development throughout Southeast Asia is also extending the reach and responsibility of all levels of administration, imparting a new emphasis on government as both resource manager and market intermediary. In the Philippines, the devolution of fiscal and planning powers to provincial and municipal levels that began with the passage of the revised Local Government Code in 1991 presented local officials with new challenges as well as opportunities. For the first time they (and those who elect them) can take major decisions affecting local economic and social development. Devolution has a price; however, local governments are increasingly responsible for raising the revenue required to fund local infrastructure, health, education and social services. In upland and highland areas where reliance on the natural resource base as a source of income remains high, the responses of local governments to this ongoing devolution of power and responsibility will be critical determinants of long-term trends in economic welfare and environmental stresses. For local administrations, the question of a tension between economic growth and the conservation of natural resources and environmental quality is not abstract and academic, but a very real policy challenge.

A little-recognized aspect of this problem is that devolution -- in the Philippines and elsewhere -- is typically incomplete. Shifting responsibility for resource management and infrastructure development (among other

functions) from central to local governments without a corresponding outward shift of the power to raise revenue and decide on its distribution raises the problem of overlapping “control areas”. Local initiatives to pursue environmental policy might be undermined by lack of funds. Alternatively, local regulations or other efforts to influence forest, land and water use in a sustainable direction might be undermined by central government actions, for example agricultural policies that raise the prices received by farmers for crops that are erosive, or that are very demanding of inorganic fertilizers or pesticides.

Finally, the rapid development of markets for old and new agricultural products as well as the development of new market institutions poses additional challenges to local administrations. Even in relatively remote areas, governments in decentralizing political systems must now continually re-evaluate and redefine their roles in relation to changing economic and institutional conditions. As an example, the recent deregulation of the Philippine banking sector has brought about a rapid increase in the number of banks, the spread of rural bank branches, and the range of products and services offered by the banking system. This trend is bringing highland farmers within reach of affordable long-term formal-sector credit, arguably for the first time. Local governments must now seek ways to maximize the benefits that this opportunity presents by providing the necessary institutional underpinnings of a successful financial system. Another example of specific interest in our study site is the spread of agribusiness ventures that promote wholesale land use changes, such as the establishment of industrial and plantation crops. Such arrangements often also entail a loss of individual control over land use (as when farmers lease their land long-term to companies). In these cases local government increasingly finds itself thrust into the unfamiliar role of acting as intermediary between corporations and a variety of community interest groups.

Baseline: Lantapan

Within the Philippines, the main center of SANREM activity is the Municipality of Lantapan, in Bukidnon province, Northern Mindanao. The Lantapan economy and political system, and the landscape of the upper Manupali River watershed in which they are located, all exemplify the tensions we have just surveyed between rapid growth, economic change, and environmental stresses.

Landscape and Population

The study site, Lantapan municipality, is located in a river valley that is crossed by Mindanao's major north-south highway some 15 km south of the Bukidnon provincial capital Malaybalay, and 100 km southeast of Cagayan de Oro, the closest city and port (Fig. 1.2). The site is an hour's drive from the campus of Central Mindanao University in Musuan, Bukidnon, which has served as a base for many SANREM operations. Lantapan is contained wholly within the Upper Manupali River watershed (Fig. 1.3). Its northern border is the boundary of a major national park —

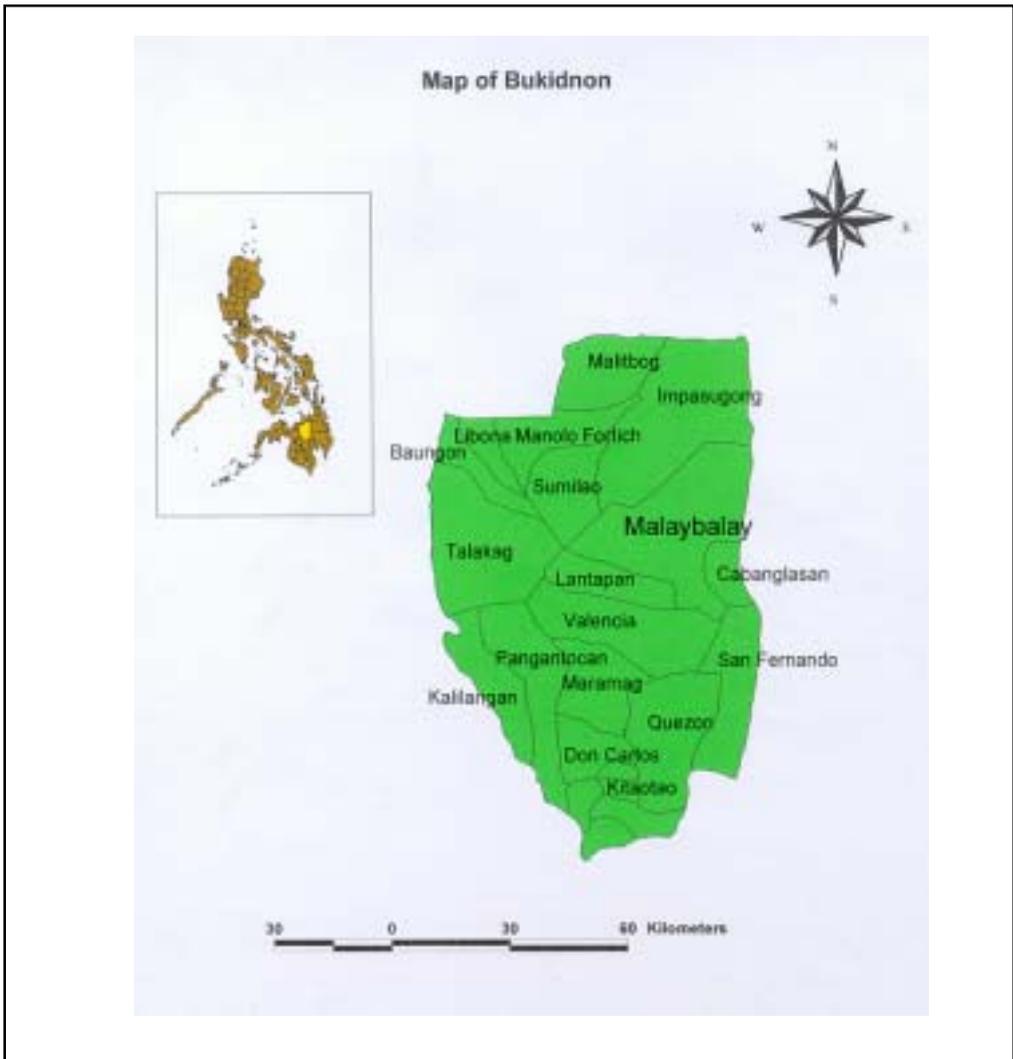


Fig. 1.2. The Philippines and the study site.

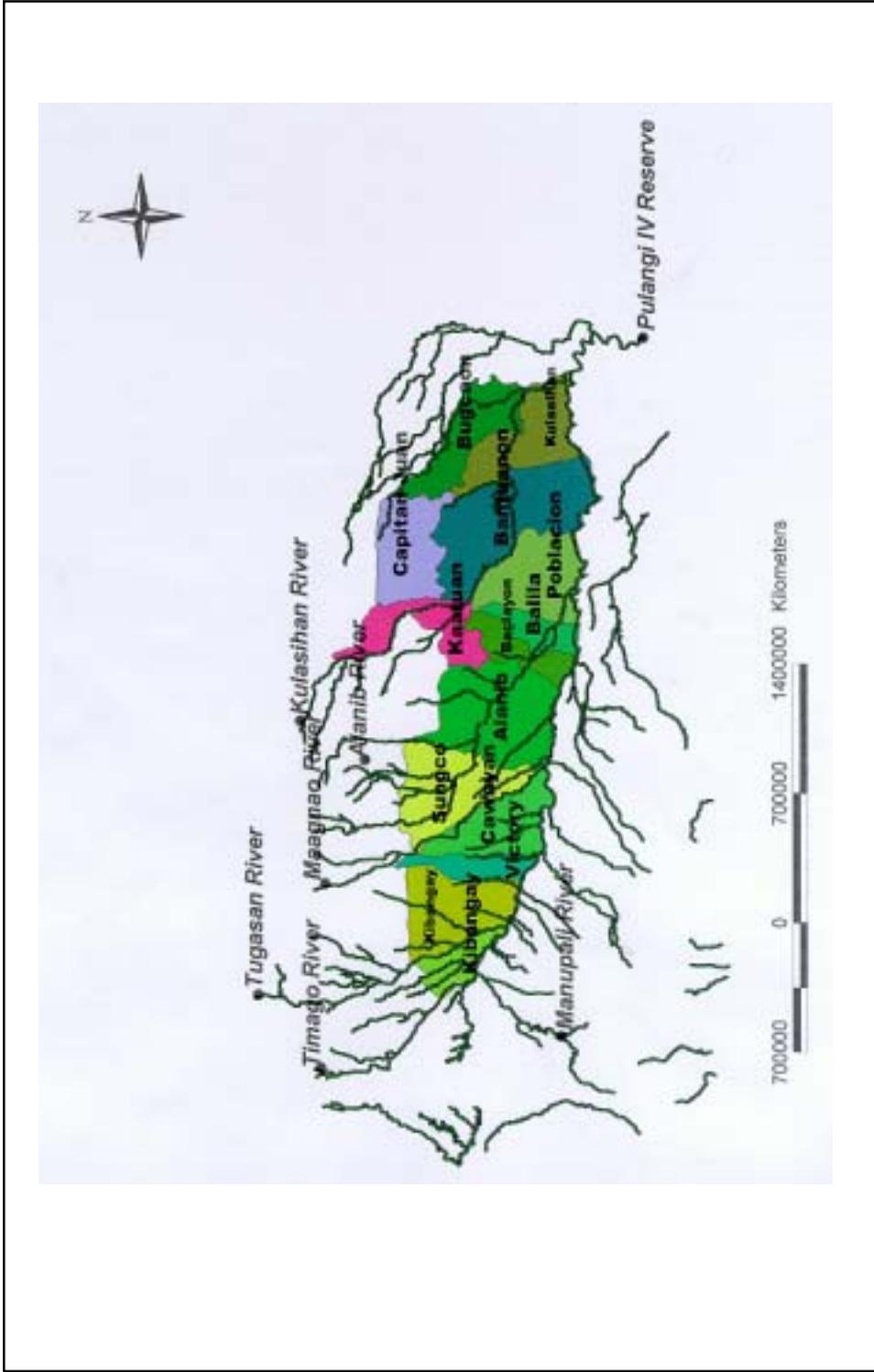


Fig. 1.3. Lantapan municipality.

the Mt. Kitanglad Range Nature Park. Peaks in the Kitanglad Range rise as high as 2500 m, among the highest in the nation. Lantapan's southern boundary lies on the left bank of the Manupali river. The municipality thus consists of several sub-watersheds draining south or southeast from the Mt. Kitanglad range to the Manupali river. In the lower part of the municipality, the river runs into a dam that diverts flow into a network of canals comprising the Manupali River Irrigation System (MANRIS), a 4000-ha system constructed by the National Irrigation Authority in 1987. The entire system ultimately drains into the Pulangi River, one of the major waterways of Mindanao Island, a few kilometers upstream from the Pulangi IV hydroelectric power generation facility.

Lantapan's landscape climbs from river flats (400-600 m) through a rolling middle section (600-1100 m) to high-altitude, steeply sloped mountainsides (1100 m-2200 m). A SANREM soil survey identified four broad geomorphic units: mountains, upper footslope, lower footslope, and collu-alluvial terraces. Soils in all units are generally well-drained, have clayey surface and subsoil horizons, are slightly to moderately acid, have low organic matter and high P fixation capacity, and have a low capacity to retain nutrients (West 1996). Differences among soils in each of the units are related to the age of ash deposits from which they are formed, with soil age and development increasing downslope (West 1996).

Lantapan is relatively wet, with annual rainfall of 2,470 mm. While the onset of the rainy season occurs during the first two weeks of May, monthly rainfall approaches a bimodal distribution because of dry spells during the months of July and November. The wettest month (369.7 mm) is August and the driest is November with 92.9 mm (Fig. 1.4). Across the landscape, air temperature and solar radiation decrease with elevation. The coolest months are January and February, with temperature ranges from 15.2°-19.2°C. April and May are the hottest months with temperature ranges from 24.5°-32.1°C. Air moisture content is lowest during the months of March and April and highest during the months of June and August (Laurente and Maribojoc 1997).

Population data on Lantapan are available only from the first census after its establishment (in 1966), but they reveal a rate of increase even more precipitous than that for Bukidnon as a whole. In the decade from 1970 Lantapan's population increased at an average annual rate of 4.6%, from 14,500 to 22,700 (NSO 1990); in 1994, municipal records show that the population was 39,500. Since 1980 the annual population growth rate has thus averaged 4%, much higher than the Philippine average of 2.4%. Ethnically, the population is a mix of about 15% Talaandig indigenous people, 51% *Dumagat* (in-migrants from coastal areas and other islands), and 32% from Bukidnon and other groups (Rola *et al.* 1996).

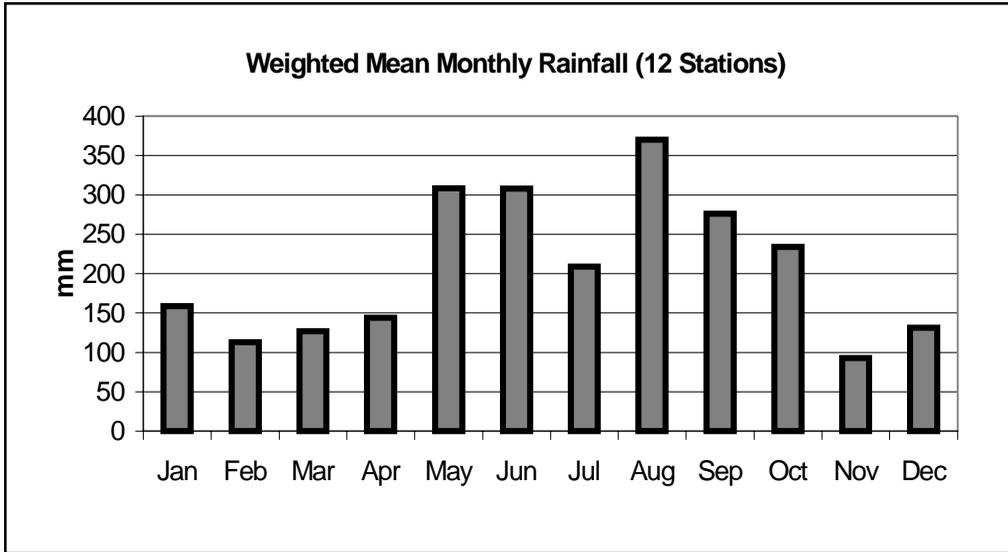


Fig. 1.4. Monthly average rainfall in Lantapan, 1994-1998.
Source: Launte and Maribojoc, 1997.

Economy and Land Use

In spite of rapid growth in recent decades, agriculture continued to dominate the economy of the municipality and of the province. In 1988, 71% of provincial employment was in agriculture, 5% in industry, and 23% in services; agriculture provides the primary income source for 68% of Bukidnon households (NSO 1990). In Lantapan, dependence on agriculture almost certainly exceeded the provincial average. Farm sizes were small by upland standards: in 1980, the modal farm size class (1-2.99 ha) contained 46% of farms, and 75% of all farms were smaller than 5 ha. Most households therefore lived close to the poverty line; in 1988 food, fuel and clothing accounted for 59, 4, and 5% respectively of household expenditures in the municipality (NSO 1990).

Lantapan's agricultural land area in 1980 totaled 14,400 ha, more than half of which was classified as being under temporary crops. A small fraction of this, at the eastern boundary of the municipality, was irrigated; this area was devoted almost exclusively to rice production. The moderately sloped and rolling lower footslopes immediately to the west produced corn and sugarcane; further up the watershed sugarcane planting diminished as increasing distance and lower road quality raised the cost of travel to the Bukidnon Sugar Milling Corporation (BUSCO), rendering

production of this high-valued crop less profitable. In the upper footslopes that made up the largest agricultural area of the watershed, corn was the dominant crop. At middle altitudes coffee is an important secondary crop, while at higher elevations corn was planted alongside coffee and temperate-climate crops: beans, tomatoes, cabbages and potatoes. Other minor agricultural enterprises included cassava, abaca, and tree plantations for firewood, livestock and non-timber forest products.

In addition to expansion at forest margins and intensified use of agricultural land already cultivated, the history of land use in Lantapan since the 1950s involved substantial crop substitution in response to new commercial opportunities. At the end of World War II, most sloping and high-altitude land was forested. Agriculture in the mid-and high altitude *barangays*³ consisted primarily of corn, cassava and coffee production — and presumably the harvesting of logs and non-timber forest products. Corn and cassava were grown primarily for subsistence, and to a lesser extent for feed, sold locally to Bukidnon’s cattle ranching industry.

In the 1950s, migrants from Benguet province in Northern Luzon introduced commercial cultivation of potatoes, cabbages, and other temperate-climate vegetables to the locality. In 1977, construction of the BUSCO sugar central about 25 km south of Lantapan spawned the sugar sector now dominant in the lower reaches of the watershed. More recently, improved integration of the Bukidnon economy in national agricultural markets, coupled with increasing demand for some crops, has ensured that commercial agriculture in the province continues to adapt and thrive. Road improvements and the 1986 expansion of the Cagayan de Oro port stimulated agricultural exports from Northern Mindanao to markets in Cebu and Manila. These infrastructure investments greatly increased the profitability of growing corn and (especially) vegetables for processing or sale in Manila and Cebu, where formerly transport costs and bottlenecks had maintained relatively low returns to such activities. Corn production has flourished, becoming primarily a commercial crop where formerly it had been little traded outside the locality. Vegetable cultivation also continued to increase in area and economic importance; the upper watershed area of Lantapan is now sometimes described as a “second Benguet”, a reference to the Philippines’ primary temperate-climate vegetable production area in Northern Luzon.

³ *Barangay* (village) is the smallest political unit in the Philippines.

Land Use Change and the Environment

Agricultural expansion has largely involved the replacement of forest and permanent crops by annual crops. This can be seen very clearly in data constructed from satellite imagery in a SANREM study conducted in 1994 (Fig. 1.5). Over a twenty-year period to 1994, the area of permanent forest shrank from about one half to a little over one-fourth of the total area. Part of the converted land went into shrubs or secondary forest, but a much larger part was converted to annual agricultural crops, especially corn and vegetables, which expanded from 20% to 40% of total land area.

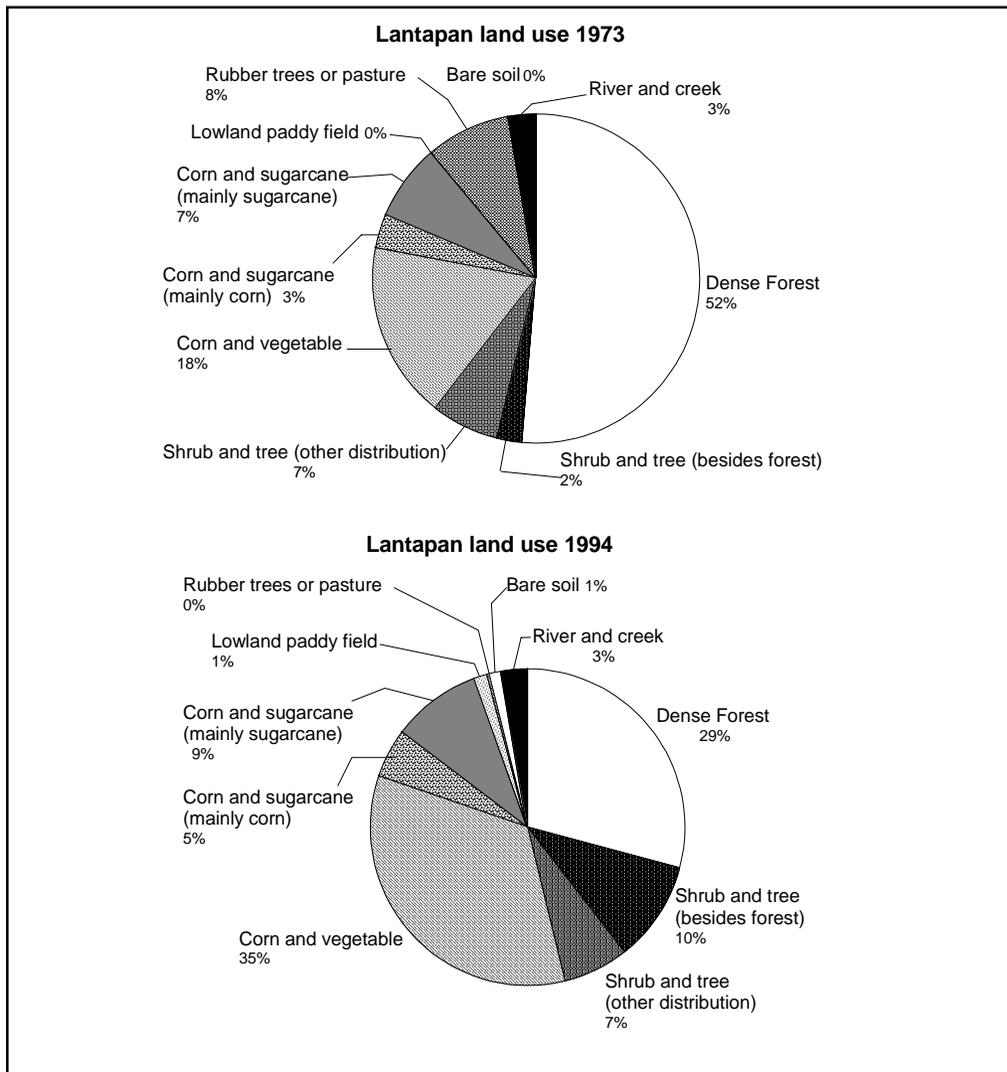


Fig. 1.5. Lantapan land use, 1973 and 1994. Source: Li Bin 1994.

From the same source we see that land conversion has also meant the spread of annual cropped area into higher-altitude areas (Fig. 1.6). Given the topography of the site, this also means that agriculture has spread up-slope (Fig. 1.7). Studies conducted in other Philippine watersheds and elsewhere in the humid tropics identify annual crop expansion and the intensification of cultivation on sloping lands as the causes of dramatic increases in soil erosion rates (David 1988; Lal 1990).

SANREM Research, Findings and Impacts

Overview of Project Activities

SANREM work in the Philippines began with an informal survey of ecological and economic conditions in the Manupali watershed and Lantapan municipality. The organization of this activity emphasized participation as opposed to mere data gathering, and its scope stressed human interactions with the environment. To reflect these concerns, the project described this activity as a *participatory landscape-lifescape appraisal* (see Bellows *et al.* 1995). Subsequent meetings of interested researchers, community members and NGO groups used the PLLA to formulate broad guidelines for SANREM research and development activities at the site. Proposals were solicited and work began in earnest in the first half of 1994.

The work plans funded in Phase I, with summary details of their institutional partners, duration and funding, are listed in Table 1.1. Since the later chapters will present more detail on the major research activities, we will limit ourselves here to a very brief overview of the types of work that were funded, the relationships among these, and their overall relationship to the conditions of the research site and the goals of the SANREM CRSP (parenthetical numbers refer to entries in Table 1.1).

Several work plans were funded initially to provide a characterization of the watershed, community, and natural resource or agricultural practices, both in the Philippines and in other SANREM sites [G7, G8, P9, P12], and to work with the community and local institutions to increase awareness of the project and its goals [P1, P5, P14 and P15].

Other research efforts were explored biophysical and social relationships with the goal of producing information about resource use, or techniques or technologies promoting more sustainable resource use [P5–P8; P10–P13; P16]. Some of this information was intended for direct use by farmers; others for the consumption of researchers, policy analysts and policy makers in local and national government units. The output of

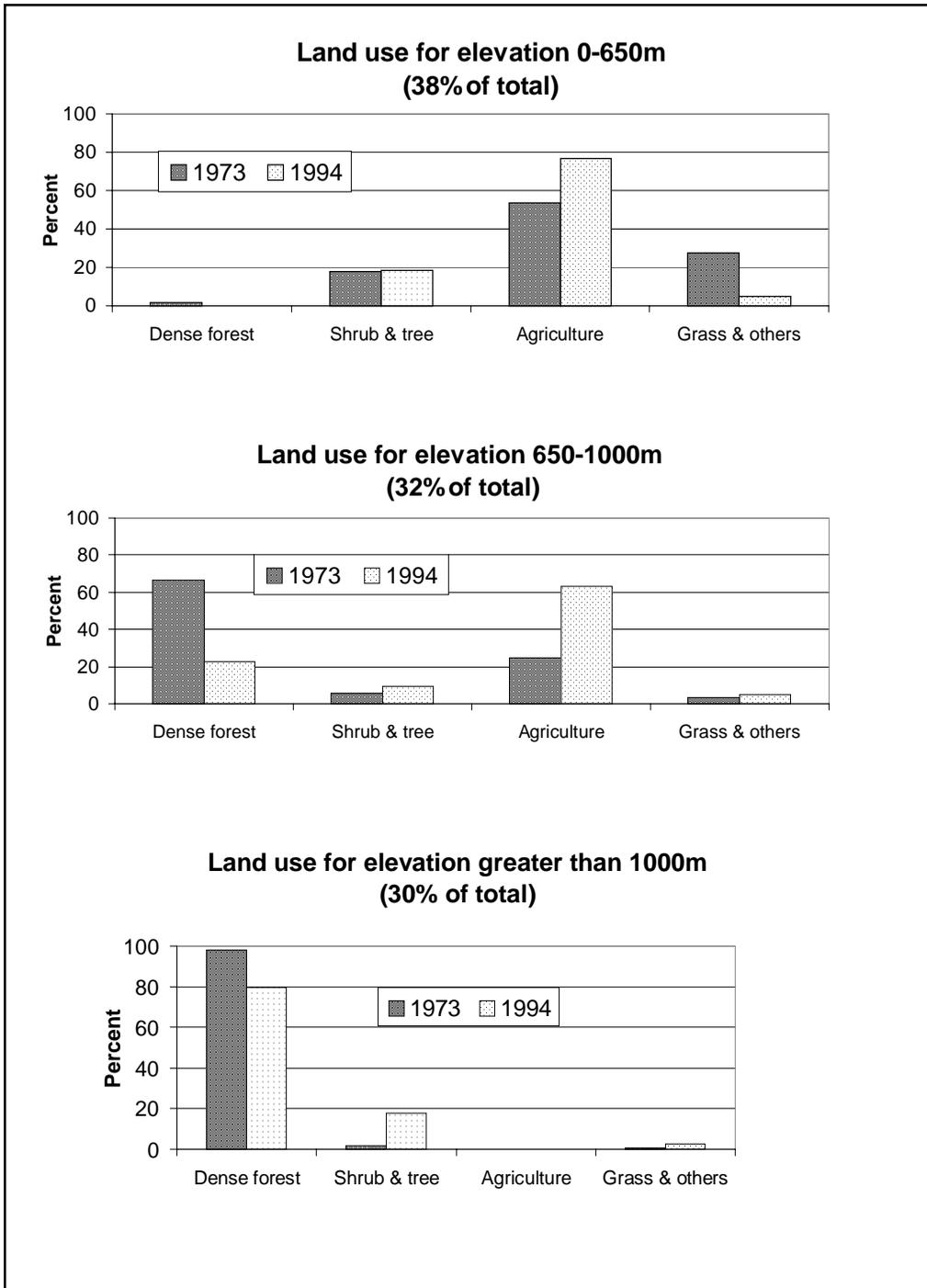


Fig. 1.6. Lantapan: Land use by elevation, 1973 and 1994.
Source: Li Bin 1994.

Table 1.1. Workplans funded by SANREM CRSP-Philippines, 1994-97.

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- G1 – Communication and Information Exchange. PIs: C. Neely and G. T. Cameron, UGA
- G2 – SANREM CRSP Monitoring and Evaluation: Expectations, Reality and the Value of an Iterative Plan. PIs: Jim DeVries, Heifer Project International and C. Neely, UGA
- G3 – SANREM CRSP and INFORUM Collaboration on an Electronic Conference of Indicators of Sustainability and in the Development of SARD-FORUM. PIs: R. D. Hart, INFORUM
- G4 – Learning in the Lifescape: The Gender/User Working Group of the SANREM CRSP. PIs C. Flora, Iowa State, R. Rhoades, UGA, I. S. Barbeau, Silva Associates and R. Montee, Western Carolina University
- G5 – Indicators of Sustainability. PIs: W. R. Butcher and B. Bellows, Washington State University
- G6 – Linking Research and Education: The Global Working Group. PIs: W. Deutsch, Auburn University and C. Neely, UGA
- G7 – Characterizing the Climate of the SANREM CRSP Research Sites. PIs: I. D. Flitcroft and E. T. Kanemasu, UGA
- G8 – Using Geographical Information Systems as a research tool in the SANREM CRSP program. PIs: I. D. Flitcroft and E. T. Kanemasu, UGA
- G9 – An Assessment of Modeling Needs. PIs: D. M. Swift, Colorado State University
- G10 – The Center for PVO/University Collaboration in Development Western Carolina University. PIs: R. B. Montee, R. Gurevich, M. L. Surgi, R. Hussein, W. Collins, Western Carolina University
- G11 – Engaging the Whole: Operationalizing the Spread Effect at SANREM CRSP Sites. PIs: M. G. Buenavista, W. D. Dar, PCARRD, H. Valdebenito, San Francisco University, W. Deutsch, Auburn University, R. Rhoades, UGA, C. del Castillo
- P1 – The Priming Program of SANREM CRSP/Philippines. PIs: J. L. Orprecio, Heifer Project International, R. Banaynal, Network for Environmental Concerns, Inc. G. Tan, SHAIS Foundation, Inc.
- P2 – Enhancing Biodiversity Conservation and Family Security through Homegardening and Sustainable Field Production of Vegetables: Community-based Pest Management for Sustainable Vegetable Production. PIs: G. Prain, CIP-UPWARD and L. Ramos, NOMIARC-DA
- P3 – Towards Optimizing Land Use Through Water Quantity and Quality Modeling. PIs: E.T. Kanemasu and I. D. Flitcroft, UGA
- P4 – Integration of Gender Activities in Work Plans. PI: R. Balakrishnan, Virginia Tech
- P5 – User-First Research for Sustainable Development and Natural Resource Management. PIs: J. Shumaker, Heifer Project International, J. Orprecio, Heifer Project International and L. Ramos, NOMIARC-DA
-

Table 1.1. Continued.

- P6 – The Economics of Sustainability: Production, Prices, and Policies in the Manupali Watershed, Bukidnon, Philippines. PIs: I. Coxhead, U. of Wisconsin-Madison and A. C. Rola, Center for Policy and Development Studies-UPLB
- P7 – Sustaining Commercial Vegetable Production in the Manupali Watershed, the Philippines. PIs: D.J. Midmore, AVRDC and L. Ramos, NOMIARC-DA
- P8 – Farming Systems Interactions in the Landscape/Lifescape of the Manupali Watershed in Lantapan, Bukidnon, Philippines. PIs: A. R. Josue, Central Mindanao U. and D. Carandang, Farming Systems and Soils Resources Institute-UPLB
- P9 – Characterization of the Soil Resource in the Lantapan Area of the Manupali Watershed. PIs: L. T. West, UGA and the Philippine Bureau of Soil and Water Management
- P10 – Water Resource Management and Education in Watersheds of Bukidnon, Philippines. PIs: W. G. Deutsch, Auburn U. and J. Orprecio, Heifer Project International
- P11 – Assessing and Developing the Contribution of Home Gardening to Biodiversity Conservation and Household Nutrition. PIs: G. Prain, CIP-UPWARD and L. Ramos, NOMIARC-DA
- P12 – Sociodemographic, Technological, and Economic Factors Affecting Biodiversity in Lantapan, Philippines. PI: A. C. Rola, Center for Policy and Development Studies-UPLB
- P13 – The Ethnoecology of the Manupali Watershed. PIs: V. Nazarea, UGA and L. Burton, Xavier U.
- P14 – Environmental Awareness Of, By, and For Empowerment of the Manupali Watershed Farming Families. PI: G. Tan, San Herminigildo Agro-Industrial School
- P15 – Assembling the Elements for a Realistic Buffer Zone Resource Management Plan in the Philippines. PIs: D. P. Garrity, ICRAF and R. Banaynal, NECI
- P16 – Development of Sustainable Production Systems for Different Landscape Positions in the Manupali Watershed. PI: V.P. Singh, International Rice Research Institute
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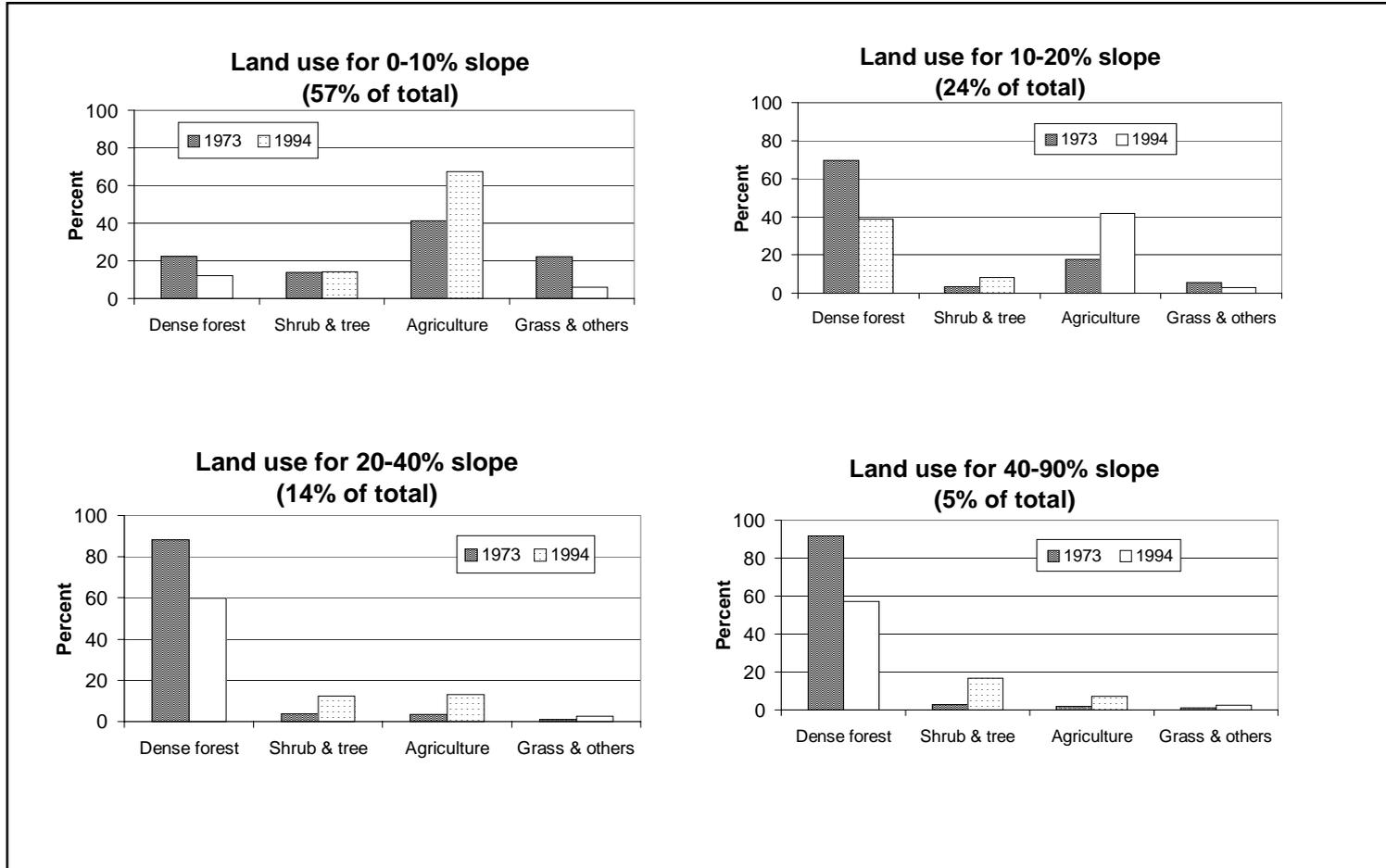


Fig. 1.7. Lantapan: Land use by slope, 1973 and 1994. Source: Li Bin 1994.

key work plans in this group is presented as Chapters 3-7 in this volume.

Other work plans emphasized outreach and extension, including the adaptation and transfer of existing information or technologies to the community through a variety of channels [P5, P11, P14]. Some other activities were directed more at the project itself rather than at conducting research *per se*. These included a work plan on the integration of gender activities in work plans [P4], and process documentation. Finally, a work plan developed by the Lantapan local government addressed directly the goal of sustainable development [P17], and a survey-based activity towards the end of Phase I sought to assess the impact of SANREM activities on NRM and environmental awareness, attitudes and actions by the Lantapan communities.

As this list has revealed, several work plans combined more than one activity. As an example, participants in the water resource management work plan [P10] not only conducted research (water quality monitoring and analysis, Chapter 7), but used the activity as the core of an institution-building effort that led to the formation of a community-based environmental NGO (see Chapter 9). Moreover, there was some interaction among work plans in which research results from one activity informed the research design, outreach strategy or policy advice provided by another.

In the remainder of this section we provide a brief integrative overview of SANREM research reported in Chapters 2-7. Discussion of the research process is reserved for Chapter 8, and Chapter 14 provides a synthesis and critique of the accomplishments of the project as a whole.

Economic and Demographic Development

SANREM analyses demonstrate that demographic trends, ill-defined land rights and poverty (the need to assure subsistence) have all contributed to agricultural land area growth and intensification in Lantapan. Demography has clearly been a major factor associated with agricultural expansion (see Chapter 2). However, the rate of population growth within the municipality is subject to several important influences, including *in situ* property rights, the prevailing economic environment and of the opportunities presented by increasingly reliable and sophisticated physical and market infrastructure. The uplands of Bukidnon, only sparsely populated in the postwar years, constituted the Philippine land frontier through the 1950s-70s, an era during which economic growth strategies generated disproportionately small growth in non-farm employment for a rapidly growing labor force. Subsequent infrastructure and market

improvements further encouraged in-migration by presenting farmers with a range of commercial opportunities in corn and vegetable markets (Chapter 3). Clearly, then, “population pressure” is not a *fundamental* cause of unsustainable rates of resource exploitation. Net migration, a large component of overall population change, is a set of responses by individuals and households to economic opportunities within the watershed compared with those outside. In Chapter 4 we explore some of the ways in which regional labor market conditions influence land use and land management practices in Lantapan.

Turning to the economic and market context of Lantapan agriculture, SANREM-sponsored research reveals that the cultivation and spread of corn and vegetable crops has received considerable encouragement in form of restrictive trade policies and price supports (Coxhead 1997, 2000). Trade protection for Philippine producers of corn, potato and cabbage have raised domestic prices for these crops; conversely, direct and indirect export taxes on coffee, an important commercial crop in the watershed in previous years, have discouraged its cultivation. As a result, the stock of coffee trees has deteriorated in both quantity and quality, and processing and marketing infrastructure, extension support and other assistance to the industry have all but disappeared.

How important are such economic factors in determining land use? Although soil quality, moisture, temperature and (for some vegetable crops) the presence of soil-borne pathogens are important constraints, farmers in the municipality most frequently explain their land use decisions in terms of the relative profitability of different crops. Since land use decisions directly impact deforestation as well as on key indicators of environmental quality such as soil productivity and water quality, it is necessary to understand not only how and why farmers respond to prices, but how those prices are formed. SANREM research in Phase I built a large data set of commodity and input price trends and farmers’ responses. These have been used to examine the farmers’ land use responses to price signals, and also to identify the potential contribution of Philippine government trade and commodity pricing policies to recent land use shifts (Chapter 3). This and related research (Coxhead *et al.* 2001) reveals the importance of farmer characteristics, especially wealth and capacity to withstand shocks, as important constraints on their land use decisions. For example, poorer farmers typically opt to grow corn since this combines lower levels of uncertainty about price and yield with the “safety-first” option of consuming their product in the event of total market failure. Less risk-averse farmers demonstrate a preference for a mix of corn and vegetables. Changes in prices, and in the variability of prices and yields,

are thus likely to have differential effects on land use by different groups of farmers.

Environmental Consequences of Agricultural Development

In Lantapan, recent expansion of sugar and corn cultivation at low altitudes, and of vegetable and corn at higher altitudes, has occurred substantially at the expense of perennial crops, whether pasture/grassland, forest/bush fallow, or coffee. Other things equal, the replacement of perennial land uses with short-season and annual crops on sloping lands is associated with rapid increases in soil erosion and land degradation. Field measurements and experiments with the cultivation of corn and vegetable crops under a range of management regimes in Lantapan confirm rapid soil erosion rates and depletion rates of soil nutrient and organic matter content in soils that, although initially fairly rich, are readily depleted of nutrients and organic matter (Midmore *et al.*, Chapter 5 this volume; also West 1996).

In spite of an obviously widespread perception of the soil productivity-depleting effects of annual crops, few farmers display deep knowledge of soil degradation relationships. Land fallowing and rotation is rare and usually undertaken only when yields of commercial crops decline to the point of economic losses in the current season. Although soil erosion and land degradation problems appear to be widespread, very few farmers report significant investments in soil-conserving structures or technologies (Chapter 3, Chapter 5).

Agricultural intensification without adequate soil management has negative effects both on-site, as documented above, and off-site. Intensive cultivation of annual crops in general, and the increased use of fertilizer, pesticides and other chemicals on vegetable crops in particular, are likely to degrade water quality and may create health problems for farm families and those living downstream. The results of Lantapan-based water quality monitoring reported in Deutsch *et al.* (Chapter 7) reveal both qualitative and quantitative evidence of water quality degradation. Perceptions of pesticide residues have made some residents reluctant to water animals in streams during or after rainfall events. Measures on total suspended solids (TSS) across sub-watersheds were considerably higher in those where agricultural cultivation was more widespread, in spite of much lower average slope, and seasonal TSS peaks appeared to coincide with months of intensive land preparation activity. Deutsch *et al.* report that many of the more noticeable changes in water quality and seasonal flows have occurred “well within human memory”.

Other consequences of rapid and increasing soil erosion rates can be seen in the deterioration of the two water impoundment structures, the MANRIS diversion dam and the Pulangi IV hydroelectric power installation on the Pulangi River, a few kilometers below the debouchment of the Manupali. The Pulangi reservoir has become about half-filled with silt in less than a decade since its construction, and National Power Corporation (NPC) staff report that water supply and quality problems prevent the facility from running at full capacity for more than short periods. Erosion-related problems have also plagued the MANRIS irrigation network. In 1987 the Asian Development Bank funded the construction of a diversion dam and network of concrete-lined irrigation canals with a nominal service area of 3350 ha. However, as early as 1991, National Irrigation Authority data showed the area actually irrigated about 1000 ha in the wet season and about 790 ha in the dry season (CRC 1993). According to the staff of the National Irrigation Authority, the major reason for this very rapid degradation of the irrigation service area is sedimentation in the diversion dam and siltation of canals and other structures. Increased seasonal variance of water supply to the system—a problem exacerbated by more rapid rainy season runoff from denuded upland areas—may also play a role.

Finally, the unchecked expansion of agricultural production at the margins of the remaining forest systems poses a potential threat to the integrity of those systems, with possibly serious consequences. These include reductions in water retention capacity of the upper watershed and thus changes in the quantity and seasonal distribution of water flow in springs and rivers, and possibly irreversible changes in biodiversity. In the early postwar years, encroachment on forest areas was driven primarily by commercial logging, with occasional forest fires contributing to a large-scale deforestation by 1983. Both logging and forest fires facilitated agricultural expansion. In recent decades, however, the profitability of commercial vegetable cultivation has been the primary impetus for forest encroachment, with decisive contributions from road development and the lack of well-defined and enforced property rights in land (Cairns 1995). Concerns about the loss and degradation of forest resources include such specific phenomena as watershed degradation (especially with logging in the headwaters of creeks) and the loss of wildlife habitat and sources of forest-based foods and raw materials, as well as more general, and less easily quantified, phenomena such as the reduction in measures of biodiversity (Garrity *et al.*, Chapter 6 in this volume).

In summary, evidence gathered by SANREM researchers and their partners provides emphatic support for two arguments. First, the natural resource base of the Manupali watershed is undergoing degradation of a

nature and at a rate without modern precedent, with potentially serious consequences especially for water quality. Second, much if not most of the degradation can be attributed directly or indirectly to the spread of intensive agricultural systems based on corn and vegetables, without the concurrent adoption of appropriate measures for the prevention of soil erosion and land quality deterioration.

Clearly, some aspects of these environmental trends are specific to the study site. Most, however, are also to be found with minor variations in many sites across Southeast Asia and elsewhere in the developing world (Scherr 1999; WRI 1998). It follows that a research-based strategy for dealing with them in one location should result in methodologies that are applicable, either directly or with minor modifications, to similar sites in many other locations. The development of such methodologies was a major preoccupation, but also arguably a major achievement, of the project's first five-year phase. We return to a detailed discussion of methodological and process issues in Chapter 8, which also introduces several chapters dealing with institution building, local administration, and related concerns.

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Chapter 2:

Demographic Development of Lantapan

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Vel Suminguit

Introduction

This chapter report on the demographic situation in Lantapan since it became a municipality. It examines population attributes such as age distribution and composition, growth rate, its causes and likely implications for the size of future population and pressure on natural resources. It provides a brief ethno-historical account of migration to the area by *Dumagats*¹, and of interactions between migrants and the indigenous *Talaandig* people in relation to the acquisition of land.

Sources of Data

The three main basic sources of demographic statistics for Lantapan are the Census of Population and Housing; Registry Books of the Civil Registrar's Office; and testimony provided by key informants.

Data on size and age distribution of the population are readily available from the Census of Population and Housing conducted by the National Statistics Office (NSO). However, vital statistics (birth and death rates and marital rates) are not available for years prior to 1968, when Lantapan was declared a municipality. Thus, the computation of rates of natural increase that could be useful in identifying the sources of population growth, whether natural or social (migration) is confined to later years.

Additional details regarding migration during the last two to three decades were obtained through interviews with some of the relatively older members of the community. For this purpose informants were

¹ The word *Dumagat* is derived from the root word *dagat*, meaning sea. Most indigenous peoples in Mindanao call migrants who come from across the sea as *Dumagats*.

chosen using the “snowballing” technique. First to be interviewed were the older migrants in Lantapan followed by other informants suggested by earlier informants. Keeping in mind that the other *barangays* needed to be represented, the suggested person was then visited and interviewed, and, in the same way, was asked to recommend other possible informants from other *barangays*. This process was repeated for every new informant until the ethnohistorical accounts they provided became nearly identical to those of the previous informants. Through this process a total of 16 informants were interviewed (See Appendix 2.1 for the profile of the informants).

Inasmuch as the indigenous occupants of Lantapan have already been fairly well-studied by other social science researchers (*e.g.* Burton 1989; Nazarea and Rhoades 1995; Cairns 1995), this study tried to elicit information from older migrants to complement the oral story of the indigenous occupants. Some older indigenous occupants were also interviewed to corroborate the stories of the migrants.

Size, Growth and Composition

Lantapan first appeared in the 1948 Census of Population with a population of 668. It was listed as one of the *barangays* under the then Municipality of Malaybalay, Bukidnon until the 1960 Census of Population with 1,667 residents. In 1968, by virtue of Republic Act No. 7487, Lantapan, together with eight other *barangays* under Malaybalay was converted into a municipality and by the 1970 Census, there were already a total of 14,523 residents. As of 1995 there were already fourteen *barangays* within Lantapan with a total population of 36,943.

Population growth in the municipality during the three and a half decades was indeed very fast, registering an average of 4.26% between 1960 and 1995. This rate was much higher than the Philippine national average of 2.51% in the 1960 and 1995 inter-census period. Such population growth was typical of upland areas, particularly in Mindanao, which in the 1950s earned the title “land of promise” because of its sparse population and vast tracts of “uncultivated” lands.

The rapid increase in population growth in Lantapan is reflected in its increasing share of Bukidnon’s total population. Except for 1980, the percentage share of Lantapan has increased consistently since 1960 until 1990 (Table 2.1). It can be presumed that migration has contributed to this rapid increase.

Table 2.1. Population enumerated in various censuses, Lantapan: 1970-1990.

Year	Number	Percentage of Provincial Population
1970	14,523	3.5
1975	20,006	3.8
1980	22,678	3.6
1990	33,351	4.0

Source: NSO. Census of Population and Housing.

There have been recent indications of decline in the annual population growth rate. From 6.4% from 1960-70, the annual growth rate has declined until the present; most noticeable is the sharp drop from 4% in 1980-90 to 1.92% during 1990-95. However, according to NSO staff, part of the recorded drop in growth rate may be due to overestimation in previous censuses.

The population of Lantapan is quite young. A comparison of 1970 and 1990 age distribution reveals population pyramids characterized by a very wide base, which gradually narrows as age progresses. This connotes rapid population growth. The age group 0-14 constituted 50% in 1970, falling only to 42% by 1995. In 1995, close to half of the population belonged to the reproductive age group (15-49 years). In fact, the proportion of future parents increased from 42% in 1970 to 46% in 1995. The momentum provided by such a young population indicates that without out-migration, the population of the municipality will continue to grow well beyond the 21st century. Given the young age structure of the population, it is also not surprising to find that the youth dependency ratio was very high: 101 in 1970 and 82 in 1995.

There are more males than females in each age category, even at birth. However, the difference in the sex ratio is even wider among the older population, starting from 15-19 to the 60-64 age groups. This pattern suggests an imbalance in net migration between men and women. Presumably more than half of the in-migrants are male; moreover, more women than men migrate out of the municipality upon reaching working age, a phenomenon that was widely observed in the rural areas of Visayas and Mindanao in the 1980s and the 1990s. Out-migration upon reaching working age was also noted by the Research Institute for Mindanao Culture (RIMCU) in its recent census of the occupants of the buffer zone and protected area of the Mt. Kitanglad Range Nature Park (Suminguit

1998). Studies show that women moved out of the rural areas to work as domestic helpers, sales ladies, waitresses and factory workers in urban areas, while men remained to work on the farms. Key informants in Lantapan cited Malaybalay and Valencia towns in Bukidnon, the regional center Cagayan de Oro, and the national capital Metro Manila as popular migration destinations for women as well as for men.

Population Distribution

Among the 14 *barangays* of Lantapan, Alanib had the largest population in 1970, followed closely by Kulasihan, Poblacion (town center), Bugcaon and Bantuanon. These five *barangays* constituted 50-62% of the municipality's total population over the last 25 years. Except for Bugcaon, which was outranked by Kibanggay, these *barangays* remained the most populous *barangays* until 1995. *Barangay* Kibanggay in 1970 ranked number nine and climbed to number four in 1995. Kibanggay is the only upper-watershed *barangay* in this group; the others are all located in the lower portion of the watershed, at the eastern end of the municipality.

Population growth rates by *barangay* tell a somewhat different story. Bantuanon, a lower-watershed *barangay*, registered the highest average annual growth rate in the municipality (5.4%) between 1960 and 1995. However, four other *barangays* posted annual average growth rates of more than 4% during the same period: Cawayan, Songco, Kaatuan and Basac. All four are located in the upper part of the watershed. The lowest population growth rate during this period (1.62%) was registered by Capitan Juan, which is located in a relatively remote lowland area.

The high population growth rate in Bantuanon is attributable to the introduction of irrigation, which resulted in a shift from single-cropping in the wet season to cropping of rice and corn in both wet and dry seasons. The availability of land, and the development of a market for cool-climate vegetables could have attracted more people into the other four *barangays*. Another explanation could be that most of the earlier migrants from the Visayas and other parts of Mindanao have settled in these *barangays*. With chain migration, the new migrants might have preferred to settle in the *barangays* where their relatives were. The other source of population growth is natural increase, as will be discussed in the following section.

Sources of Population Growth

Natural Increase

Available data on birth and death rates suggest that the acceleration in the population growth rate, particularly in the period after 1985, resulted from a sharp decline in the death rate. This fell from 23 per thousand in 1985 to less than two per thousand in 1997, while the birth rate remained relatively stable at around 30 per thousand. This implies that population growth was largely due to a high natural rate of increase. The accelerating natural rate of increase can be seen in Figure 2.1, as a widening difference between crude death rate and birth rates from the mid-1980s until 1994. From the mid-1990s, the natural rate of increase began to exceed total population growth, suggesting that out-migration occurred in the municipality during this period and succeeding years.

The rapid rate of natural increase during the 1980s can be attributed to improved health and nutrition in Lantapan. As an illustration, Table 2.2 shows that the proportion of children who were malnourished dropped significantly between 1992 and 1998. The mild malnourishment rate

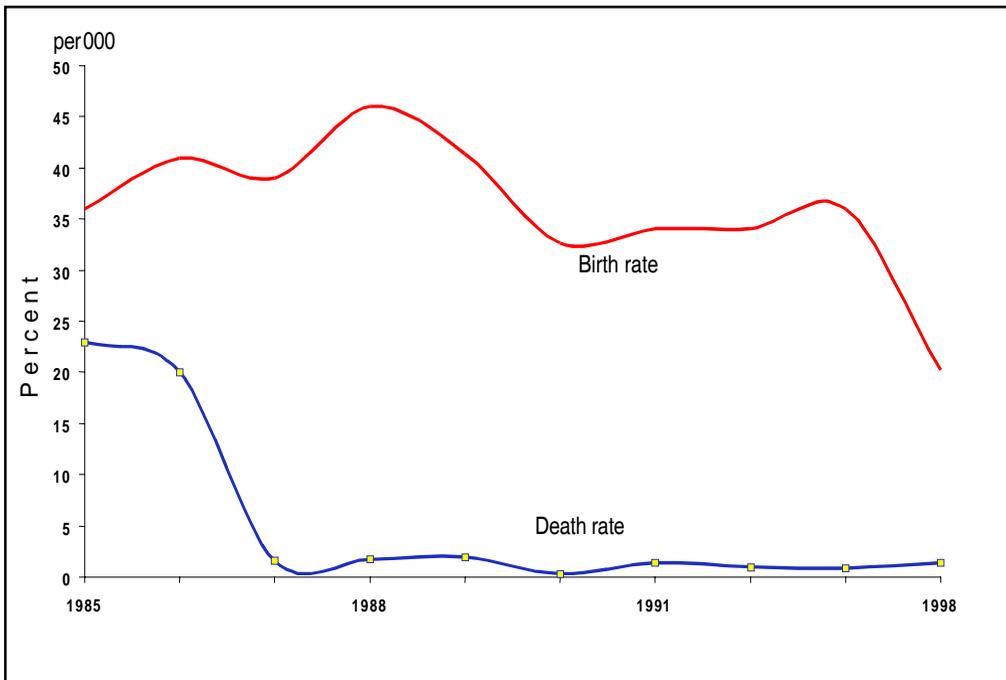


Figure 2. 1. Birth and death rates, Lantapan: 1985-1994 and 1998.
Source: Municipality of Lantapan Health Office.

Table 2.2. Malnourished children, Lantapan: 1992 and 1998.

	(In Percent)	
	1992	1998
Mild	69.18	36.12
Moderate	27.26	8.17
Severe	3.55	0.37

Source: Municipal Health Office, Municipality of Lantapan.

dropped sharply from 69% to 36% during this period. Of the 7,935 children weighed in 1998, only 27, or 0.37%, were severely malnourished—one-tenth of the 1992 figure.

As earlier revealed, Lantapan's rate of population growth declined continuously in the recent past. One possible source is decline in fertility due to late age at first marriage. In recent years, both women and men have married older, and childbearing years are shortened as a result. The mean age at first marriage was only around 19 for women in 1968, compared with 25.2 in 1994. Similarly, men's age at first marriage rose from 22.5 in 1968 to 27.6 in 1994. Analyzing the pattern of fertility and contraception use, Rele and Alam (1993) found that the late in age at marriage was perceived as one of the sources of fertility decline among Asian countries.

Though limited, the data also suggest the use of artificial contraceptives as a source of decline in the birth rate. As early as 1991, there were already women using artificial contraceptives, of which the pill was the most popular, followed by intra-uterine devices and condoms. Among the 2,353 cases of women practicing family planning, 51% or 1,198 women were taking the pill. The least method used was rhythm method, which is to be expected because of its unreliability in preventing pregnancies. According to Lucas (1994), out of the 100 women using the natural method, 18 to 25 women got pregnant as against 2-5 for pill users.

Another source of declining fertility is better education. There are two possible ways by which it can contribute to lower fertility. First, with increasing education, there are greater employment opportunities for both women and men, and this raises the age at marriage. Second, with higher education, people tend to be more informed and to have a better understanding of family planning. What are its advantages and disadvantages? Results of the 1980 and 1990 Census population showed a slight improvement in the educational attainment in Lantapan where the proportion with high school education increased between these years. Studies (Caldwell and Caldwell 1997; Hirschman and Guest 1990 cited in

Caldwell and Caldwell 1997) have associated declining fertility with certain levels of education.

Migration

Given the limited information on migration and given the mixed ethnicity of the Lantapan population, it can be deduced that in-migration contributed to the increase in the population growth of Lantapan, particularly in the middle of this century. A survey conducted in 1993 (Paunlagui 1996) revealed that most of the migrant respondents had moved to Lantapan between 1950 and 1989. Most migrants came from the Visayas, Cebu and Bohol in particular, while the rest were from other parts of Bukidnon. Similar results were also found in the ethnohistorical study conducted in year 2000, in which 16 middle-aged and elderly members of the community were interviewed.

Appendix 2.1 shows some selected socio-demographic characteristics of the informants in the survey of migrants to Lantapan. The ages of informants ranged from 46 to 75 years old. The mean educational attainment of the informants was 6.75 years, or barely completed first year high school. Three-quarters were affiliated with the Catholic religion. They earned income primarily from farming (50%), unskilled labor and retail activities.

The majority of the informants were born in the Visayan Islands, particularly Cebu (25%), Bohol (18.8%) and Leyte (6.3%). Twenty-five percent of the informants were born in Luzon and ethnically identified themselves as Igorots (18.8%) from Bontoc Province and Ilocanos (6.3%) from Ilocos Province. Some migrants, however, traced their ancestry from outside Mindanao but had settled elsewhere in Mindanao before moving to Lantapan (Paunlagui 1996).

Table 2.3 indicates that half of the informants came to Lantapan in the 1950s, while others came in later years. When asked why they came to Lantapan, the informants offered varied responses, most of which were economic in nature. Interestingly, one of the reasons cited by 29% of the migrant informants was that they found employment in Lantapan. This was the case of a 61-year old farmer-carpenter from Cebu who came to Lantapan in 1951 to work for his uncle as truck helper. He recalled that his uncle had enticed many Cebuanos to come to Lantapan saying "Let us go to Mindanao to own a piece of land. Land there is very cheap; we can buy it from the natives for 25 pesos. We can even exchange it with alcoholic beverages."

Table 2.3. Arrival date and reason for migration.

Year of Arrival in Lantapan	Frequency	Percent
1950s	8	57.1
1960s	5	35.7
1970s	1	7.1
Total	14	100.0
Reason for Migration		
To own a piece of land	3	21.4
To look for a job/got a job	4	28.6
Invited to come by a relative	4	28.6
To have a better life	3	21.4
Total	14	100.0
Situation Back Home		
Unproductive land	3	25.0
Landless	2	16.7
Own little land but have so many siblings	5	41.7
Employed, but paid very little	1	8.3
Jobless	1	8.3
Total	12	100.0
Process of Migration		
Came by myself	3	21.4
Came with family members	8	57.2
Came with employer	3	21.4
Total	14	100.0

Source: Key Informant Interview 2000.

Almost 90% of the informants in our survey of migrants claimed to own the land they currently occupy. The tenurial instrument possessed was either a Certificate of Land Title (50%), Tax Declaration (35.7%), or both (14.3%). It is important to point out that Tax Declaration *per se* is not a tenurial instrument in the sense of securing one's right over a piece of property. While it is recognized as proof of occupancy, Tax Declaration does not provide security of tenure because the land, even if it is classified "alienable and disposable", remains in public ownership until such time as the occupant has been issued by the government with a Certificate of Land Title. Consequently, much land acquired by in-migrants is held in legally insecure tenure.

A 70-year old Igorot from the Province of Bontoc in the northern Philippines shared a similar migration story. He came to Lantapan in 1952 because he and three other Igorots were hired by the Agricultural Development Corporation (ADC) as tractor drivers. The ADC was an agribusiness corporation owned by American nationals, and specializing

in the production of white potato. The company acquired 339 ha of land in *Barangay* Songco and *Barangay* Cawayan, which he along with other workers plowed using tractors before planting potatoes. The three other Igorots returned to their province one year after their job contract with the ADC expired. Wed to a Talaandig woman, one Igorot stayed. In 1953, the couple bought a hectare of land in Songco for just 80 pesos. In later years, a professional surveyor measured the land that he bought; it turned out to be four ha.

Our key informant continued to visit his home province in Bontoc. During his visits, he would share the story of his adventure and fortune in Lantapan to his relatives and friends. Some Igorots, who were willing to take the risk of venturing into relatively unknown territory would travel with him or follow him later, knowing that they already had a contact person in Lantapan. As the years passed by, the number of Igorots in Lantapan increased. The Igorots in Lantapan are known to produce high value cash crops in Kibangay and Basac and other *barangays* near the buffer zone of Mt. Kitanglad Range Nature Park.

To probe the reasons for migration further, informants were asked to describe the economic situation in their province of origin. Those who responded to the question were unanimous in saying that economic difficulty back home—and specifically the shortage of agricultural land and other productive resources—encouraged them to migrate. Migrants from Bontoc pointed out that while their rice terraces on the mountain slopes were quite productive, they had limited opportunities to venture into other activities because of poor natural resource endowments. In fact they were forced to carve the mountains into rice terraces because they had very few options—there was very limited flat land to till. Those who came from the Visayas cited unproductive land after years of repeated cultivation as a reason for leaving their provinces. The land required high labor and fertilizer inputs in order to maintain yields. Some informants cited having very little land with many mouths to feed as reason for their migration. Two informants cited having no land at all as reason for venturing into the unknown territories of Mindanao. For instance, a 58-year old farmer from the island of Negros Occidental lamented that most farmers like him could not cultivate farms of their choice because vast tracks of land in Negros were owned by a few landed elite. Landless farmers had to work as laborers in sugarcane plantations, or make the decision to migrate elsewhere in search of a better life. Farmers like him came to Mindanao with hopes that their dreams would be fulfilled in the so-called “land of promise.”

The process of migration to Lantapan was thus either spontaneous in nature, or the product of chain migration. The informants came either on

their own, while still single (21.4%) to explore better life opportunities; or with an employer (21.4%); or with family members (57.2%) (Table 2.3). Usually the adventurous individuals came first. As pointed out earlier, after finding a place they could call home, they occasionally visited their home province and encouraged relatives and friends to come with them. The second batch of settlers, therefore, already had contacts in Lantapan. These were the ones who immediately brought their families with them. No one mentioned coming to Lantapan due to government-sponsored migration, although some had heard of it taking place in other parts of Bukidnon. That there was no mass exodus to Lantapan was confirmed by the third wife of the former Talaandig chieftain Kinulintang. She pointed out that one of the early *Dumagats* who came to Lantapan was Jurolan. When Jurolan became the first mayor of Lantapan in 1968, the number of Cebuano migrants increased dramatically. This is because, like other early migrants, he encouraged people from his hometown in Cebu to come to acquire land in Lantapan.

Projections of Population Growth and Pressure on Land Resources

As noted earlier, population growth is a result of the interplay of three demographic processes: mortality, fertility and migration. The age-sex structure then defines a dependency level that is closely related with density and other land-related factors. As population increases beyond the limits of the resource base, new and more intensive techniques of resource use, which may lead to further degradation of the environment, are sometimes adopted.

The average land area owned by the informants in our migration survey is 12 ha. That the average farm size owned by the informants is fairly high is due to the fact that they came to Lantapan in the 1950s (57.1%) and 1960s (35.7%) when land in Lantapan was relatively abundant and cheap (see Table 2.3). This figure is also consistent with Huke's (1963) observation that in the 1960s, Mindanao was characterized by an average farm size of 12 ha. However, Costello (1986) noted that in the 1980s the average farm size for Mindanao had dropped to less than four hectares. Other survey data from Lantapan place the average farm size much lower still (see Chapters 2 and 3, this volume).

To examine the effect of population pressure on the environment, we computed the future path of population density, using the projected population until year 2030 and the total land area of Lantapan. We also computed the man-land ratio, the ratio between the total population (or

some segment of it) and the area of arable cropland. This ratio is more useful in Lantapan since many of the people in Lantapan are primarily dependent upon local agricultural resources, and much of the land is unsuitable for cultivation by virtue of slope, inaccessibility, or other factors.

Using a simple extrapolation, the population of the municipality is projected to increase from 36,943 in 1995 to 114,948 in 2030 (Table 2.4). After 35 years, it is projected that the population density will be 359 persons/km², 242 persons more per hectare than the computed population density in 1995. This means that more people will depend on the same land resource, which at the same time is also being used for purposes other than farming. Compared with the national density of 229 persons/km², the population density for Lantapan was much lower in 1995.

The computed man-land ratio suggests the increasing scarcity of agricultural land for cultivation among Lantapan residents. Table 2.4 shows that as early as 1995, there was less than half a hectare of cropland per person. Assuming that the area of arable land remains the same and will not be converted to other uses, the arable cropland per person will drop to only 0.15 ha, or 1,500 m², per person by 2030. The very low available cropland per person can be attributed to the fact that almost half of the land of Lantapan is considered forestland. With the implementation of the Community-Based Forest Management (CBFM) Program of the government, the people of Lantapan will have to depend heavily on arable cropland area for their source of income.

Table 2.4. Projected population projection, density and man-land ratio, Lantapan: 1995-2030.

Year	Projected Population	Density (No. of person/km ²)	Man-arable Land Ratio (hectares/person)
1995	36,943	116	0.46
2000	43,406	136	0.39
2005	50,999	160	0.33
2010	59,922	188	0.28
2015	70,405	221	0.24
2020	82,722	260	0.21
2025	97,194	305	0.17
2030	114,198	359	0.15

Source: NSO, various years.

As early as 1996, the people interviewed were already feeling the strain on land resources. They complained that there were times during the year that there were no jobs available in the area. Unless there is substantial growth of non-agricultural employment, and with the law prohibiting the opening up of new lands for agricultural production, people will have to rely on the available agricultural land for their farming and related activities.

Summary and Conclusion

Population growth in the Municipality of Lantapan was rapid until 1990, and was due to both natural increase and migration. From the 1950s until the 1970s, migration contributed largely to the rapid increase of population, but this was later substituted by natural increase. Migrants into the area arrived in the 1950s and the 1960s from the Visayas (mainly Cebu and Bohol) and Luzon (Mountain Province and Benguet). In the late 1980s, there was a rapid decline in the crude death rate. However, the crude death rate remained high, and this health and nutrition-driven transition contributed to the rapid increase in population.

There are indications, however, that the population growth rate is now declining. This trend can be attributed in part to declining fertility, which in turn can be due to increased age at first marriage, improved education, and use of artificial contraception. The data also suggests that Lantapan is becoming an out-migration area. The annual rate of natural increase is now greater than the average population growth rate. There is a need to further examine the robustness of this result once more and until better data becomes available.

Indicators measuring the pressure of population on land resources reveal that Lantapan is better off than the country as a whole. However, given limited opportunities for non-agricultural economic activity and stricter laws on the use of forest resources, the municipal government in cooperation with the provincial government must institute programs to increase agricultural productivity and ensure the sustainability of agricultural development in the area.

There are couples using artificial contraception to limit their number of children, thus the local government must provide a range of family planning methods available, often referred to, as the "method mix." The more methods available, the better chances that couples can find the best method for their needs. Seemingly, late age at marriage contributes to declining fertility, thus educational, as well as, economic opportunities for the youth must be made available. Although the proportion of well-

nourished children in Lantapan is increasing, it remains still below figures for the country as a whole. Thus, the program of the local government must also ensure food availability and food quality. Some of the policy considerations related to nutrition are as follows: increasing local production of nutritious food, better nutrition education and provision of safe water and basic sanitary facilities.

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Appendix 2.1. Selected demographic characteristics of informants, Lantapan: 2000.

Item	Frequency	Percent
Barangay where Informants Currently Live		
Alanib	4	25.00
Baclayon	1	6.25
Balila	2	12.50
Basac	2	12.50
Kibangay	1	6.25
Songco	4	25.00
Victory	2	12.50
Total	16	100.00
Age of Brackets		
45-49 years	2	12.50
50-54 years	2	12.50
55-59 years	2	12.50
60-64 years	4	25.00
65-69 years	2	25.00
70-74 years	3	18.80
75-79 years	1	6.30
Total	16	100.00
	Minimum= 46 years	Maximum = 75 years
		Mean = 61.25 years
Educational Attainment		
Elementary	10	65.50
High School	4	25.00
College	2	12.50
Total	16	100.00
	Minimum=2	Maximum=14
		Mean=6.75
Religious Affiliation		
Seventh Day Adventist	2	12.5
Catholic	12	75.0
Four Square	1	6.3
Baptist	1	6.3
Total	16	100.0
Occupation/Livelihood		
Farmer	8	50.00
Farm caretaker	1	6.25
Farmer and carpenter	2	12.50
Farming and sari-sari store	3	18.75
Farming and photography	2	12.50
Total	16	100.00

Appendix 2.1. Continued.

Item	Frequency	Percent
Place of Birth		
Within Lantapan	2	12.50
Outside Lantapan but w/in Bukidnon	1	6.25
Outside Bukidnon but within Mindanao	1	6.25
Outside Mindanao but within Visayas	8	50.00
Luzon	4	25.00
Total	16	100.00
Ethnicity		
Boholano	3	18.75
Cebuano	4	25.00
Igorot	3	18.75
Talaandig	3	18.75
Leyteno	1	6.25
Ilocano	1	6.25
Mixed Ethnicity	1	6.25
Total	16	100.00
Ownership of Land		
Land owner	14	87.50
Does not own land	2	12.50
Total	16	100.00
Area of Land Owned		
<2.4 hectares	2	14.30
2.5-4.4 hectares	4	25.00
4.5-6.4 hectares	3	21.40
6.5-8.4 hectares	1	7.10
>10.5 hectares	4	28.60
Total	14	100.00
Minimum=	0.2 hectares	Mean=
Maximum=	50 hectares	11.73 hectares
Tenural Instrument		
Certificate of Land Title (CLT)	7	50.00
Tax Declaration (TD)	5	35.70
A few hectares of land owned have CLT, the rest only have TD	2	12.50
Total	14	100.00
Less than 19 years	2	15.40
20-29 years	3	23.10
30-39 years	4	30.75
40-49 years	4	30.75
Total	13	100.00
Minimum=	15 years	Mean=
Maximum=	48 years	32.46 yrs

Chapter 3: Philippine Development Strategies, Price Policies and National Markets: What are the Linkages in Lantapan?¹

Ian Coxhead
Agnes Rola
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Introduction

Poor farmers in developing countries are the primary managers of an increasingly scarce natural resource, productive agricultural land. Their decisions, while they may be privately optimal, often conflict with social goals of resource conservation. This is clearly true when farmers intensify production on soils that are easily eroded, and when agricultural expansion takes place through the conversion of forests and other permanent cover to seasonal crops.

The empirical literature on tropical deforestation and land degradation is rich with studies of resource use by households whose actions are constrained by poverty, market failures, and risk aversion (*e.g.* Anderson and Thampapillai 1990; Southgate 1988; Shively 1997). The literature typically locates such immediate motivational factors within a broader context of absence or non-enforcement of property rights (resulting in open-access forest lands and tenure insecurity on farmed lands), and population pressure. These are identified as providing the enabling environment for forest clearing and unsustainable patterns of agricultural land use by upland farmers (for an excellent survey of technical and economic issues within this tradition see Pingali 1997). There are also a number of analytical models exploring the influence of broader economic forces like price

¹ A version of this chapter is forthcoming in *Land Economics* (May 2001) as "How do national markets and price policies affect land use at the forest margin? Evidence from the Philippines."

policies and wage trends on elements of the upland agricultural decision set, such as soil conservation (Barbier 1990; Barrett 1991) and deforestation (Angelsen 1999). At the broadest level are general equilibrium papers in which intersectoral linkages, through factor markets, product markets and trade, are seen to influence upland decisions (Lopez and Niklitschek 1991; Deacon 1995; Coxhead and Jayasuriya 1994, 1995).

Looking across all the types of models one finds a wide array of assumptions about the economic links between upland economies and the national economies in which they are located (Angelsen 1999, in particular, explores many variations). The choice of market assumptions conditions the behavior of a model and thus the policy conclusions that are drawn from it. As an example, general equilibrium approaches to deforestation, by acknowledging labor mobility, conveys the idea that upland population “pressure” is a response to economic incentives, rather than an exogenous determinant of actions as in some of the other models.

Similarly, there is a great deal of variation in the assumptions commonly made about product markets. Given the importance to project and policy design of a correct understanding of market structure and pricing, there are surprisingly few studies that bring empirical evidence to bear on the market and policy aspects of upland agricultural resource use decisions. The goal of this paper is to encourage a move in that direction, as a complement to the existing body of household-level analyses.

It is our thesis that the design of upland projects directed at influencing smallholders’ land conversion and land use decisions in the direction of “sustainability” could be greatly improved by a better integration of information on market- and sector-level incentives with information on household-level decisions and constraints. Perhaps because of a lack of data and empirical analysis, project solutions to deforestation and agricultural land degradation in developing countries focus mainly on direct interventions through technology transfer, institutional innovations and other household-level actions. The role of policy, (and especially its less direct manifestations through intersectoral product and factor markets) is generally given little emphasis.² The obverse of this problem is a general neglect at the

² In the Philippine case, a recent set of national government guidelines for watershed management (PCARRD 1999) makes only incidental reference to markets as influences on farmer behavior, and none to policies other than those which have direct effects on land use— zoning, tenure laws, and similar.

policy level of the intersectoral and environmental impacts of trade and agricultural pricing policies.³ Both forms of myopia may have restricted the domain of possible project solutions to upland environmental problems, and indeed may have increased the probability that projects will fail because of conflicting messages contained in the direct and intersectoral signals from economic policies.

To illustrate this point, consider an upland economy producing two goods, one produced using a land-intensive technology and the other using a labor-intensive technology.⁴ Define the relative price of the latter to the former as P , and price of the lowland good relative to the upland land-intensive good by Q . There are thus three product markets; two for upland goods and one for an aggregate lowland good. Assume that upland production uses land and labor, and that in order to be brought into production, land must first be cleared of forest, an activity that uses labor. Profit-maximizing upland producers will thus allocate labor to forest clearing and farming, and to one crop or the other, in response to P . If there are links to the lowland economy, then Q will also play a role in these decisions.

Suppose first that all three goods are freely traded with the rest of the world at given world prices, and that the world price of Q increases. Whether this change has any effect in uplands, and if so in what manner, will depend on interregional labor markets. If labor is immobile between regions, the increase in Q will have no effect. If it is mobile, the increase will raise labor productivity in lowlands relative to uplands and induce out-migration. Since labor is needed for forest clearing as well as farming, deforestation must decline. However, now suppose that the labor-intensive good in uplands is not traded, so its price depends on domestic demand

³ The following passage from a former undersecretary for policy and planning in the Philippine Department of Agriculture illustrates:

Policymakers in the Philippines tend to examine economic problems from the perspective of individual consumers and firms, and thus, generate and propose actions and measures focused on directly supporting these entities. In no way have economic policies been evaluated on the basis of their environmental impacts. In rare cases, farmer interests are accounted for. For instance, price controls [on rice and corn] were defended on the basis of their effects on the consumers of staple commodities and the costs of raw materials to enterprises. Rarely were the adverse effects on supply responses as well as the welfare of producer— particularly of farmers and fishermen— considered. (Tolentino 1995).

⁴ For formal developments of the model in this section, see Lopez and Niklitschek (1991); Deacon (1995); and Coxhead and Jayasuriya (2000).

and supply; thus $P = P(Q, \dots)$. Now an increase in Q will have different effects on uplands depending on whether the goods are substitutes in consumption as well as supply side factors and income effects.

Similarly, imagine that Q is constant but that technical progress occurs in one upland crop. If products are freely traded at world prices, upland labor productivity will rise and both the share of land and the total area planted to the crop experiencing technical progress will increase; deforestation will rise in this case. On the other hand, if demand for the crop is downward-sloping (whether due to local or national non-tradability), then technical progress will alter P and the total area of upland, as well as the share planted to the labor-intensive crop, could rise or fall.

These simple illustrations highlight the sensitivity of deforestation and upland land use outcomes to market conditions. Under one set of assumptions, technical progress in an upland crop is predicted to increase deforestation; under another, deforestation could fall. Conversely, a national policy innovation that alters P or Q (or both) has the potential to induce changes in deforestation and land use even when the policy measure is not directly related to agriculture. This is so even when all goods' prices are exogenous, if labor is mobile between regions. Lastly, when upland farmers are risk-averse, the entire argument can be restated (with modifications as appropriate) using price variances as well as levels.

In the rest of the paper we focus on a case study from the SANREM study site in Lantapan, Bukidnon. We first provide a brief survey of major macroeconomic and policy trends in the Philippines and their possible effects on resource use decisions in an upland watershed like Lantapan. While we have information about macroeconomic and economy-wide phenomena, and about upland farmers' decision-making processes, we know little about the nature and strength of market links between the two. Accordingly, we then use econometric analysis to examine linkages between national and farm-gate prices on the basis of data collected in Lantapan over the period 1994-1999.

Growth, Policies, and Upland Resource Use in the Philippines

The pace of aggregate economic growth in the Philippines has accelerated in recent years, but the degree of dependence on agriculture and natural resources remains high by Southeast Asian regional standards. This is a function of earlier decades of slow growth and rapid population increase, which maintained a high level of dependence on agriculture. It

can thus be argued that the persistence of pressure on forest and upland agricultural land resources, is in part a consequence of poor macroeconomic performance.⁵

In the early postwar years migration to heavily forested frontier areas in the Philippines was officially encouraged as a means of alleviating economic and political pressures generated by increasing population and stagnating technology in the country's rice-growing heartlands. In subsequent decades, continued spontaneous internal migration has been fostered by low rates of non-agricultural labor absorption, as well as a series of labor-saving technical changes in lowland irrigated agriculture (Jayasuriya and Shand 1986), in the face of sustained high rates of overall labor force growth. The resulting increases in landlessness and unemployment stimulated searches for open-access resources from which incomes, however tenuous, could be earned (property rights to uncultivated lands in the Philippine uplands are poorly defined and difficult to enforce). The outcome was a trebling of upland population between 1950 and 1985, from 5.8 million to 17.5 million, and annual growth rates of upland cropped area of greater than 7% over the same period (M. Cruz *et al.* 1992). The evidence that macroeconomic instability and growth (or the lack of it) in non-agricultural sectors were major forces driving migration and upland land use decisions is compelling, if circumstantial (Cruz and Repetto 1992).

There is a strong suggestion that microeconomic and trade policies also promoted forest conversion and intensification in upland agriculture. In commercially-oriented upland agriculture – or even simply where labor is mobile into or out of upland areas— agricultural price policy can exert a significant, though not immediately observable, influence on natural resource management. In the Philippines there is evidence of a pervasive policy bias in favor of crops— such as corn and temperate vegetables— whose cultivation is most strongly associated with upland agricultural land degradation, soil erosion and related water pollution. This commodity bias emanates mainly from national-level economic policies, some of them unrelated to agriculture; it has been complemented in the past by the allocation of agricultural research resources; and it appears not to be offset by policy measures in favor of more environment-friendly cultivation techniques.

⁵ In Thailand, rapid economic growth and especially the expansion of labor-intensive manufacturing industries, was the major contributor to the stabilizing of agricultural land area during the “boom” years 1986-96, through outmigration from marginal upland and rural areas (Coxhead and Jiraporn 1999).

Throughout the postwar era successive Philippine governments have pursued self-sufficiency in grains, along with cheap consumer cereals prices, as key components of food security and income redistribution strategies. Philippine cereal yields are low by Asian standards, and with relatively little spending on agricultural infrastructure and technology, yields have not risen as quickly as in comparable countries. Consequently, grain output growth in uplands has been due primarily to area expansion. Given the political importance of self-sufficiency, grain imports are tightly circumscribed, and this in turn has maintained domestic producer prices at levels well above the domestic-currency equivalents of world prices.⁶

Vegetable production has also received substantial policy support. Import bans imposed in 1950 on fresh potato, cabbage and other horticultural crops (and reiterated in legislation as recently as 1993) were repealed and replaced by tariffs only in 1996 (see below). Demand for these non-traditional foods grows with per capita income and urbanization. Since supply growth is limited by trade restrictions and climatic constraints, their prices have tended to rise more rapidly than the general price level, and certainly more rapidly than prices of most exportable crops and staple grains. For potato, the ban raises Philippine *farm gate* prices to nearly double the imputed c.i.f. (landed) *wholesale* price of imports, if they were permitted (Coxhead 1997).

The Agricultural Tariffication Act of 1996 brought Philippine agricultural policy into compliance with the Uruguay Round of the GATT. Quantitative restrictions on corn and vegetables were replaced by tariffs, and minimum access volumes (MAVs) were specified for each product. The MAV is the volume of a product that is allowed to be imported at a lower rate of duty than the maximum bound rate under the GATT. For the period to 2004, in-quota corn tariffs (those applying to MAV imports, which themselves cover roughly 50% of annual imports) remain at 35%. Out-quota tariff rates for corn, set at 100% in 1996 are scheduled to fall to 65% in 2000 (similar changes apply to vegetables). These reforms, although they constitute important steps in the direction of more open trade, ensure that upland farmers will continue to benefit from protection

⁶ The nominal protective rate (NPR, a measure of the amount by which domestic prices exceed landed import prices) for corn has generally been much higher than for any other major agricultural product, especially after the mid-1970s when corn self-sufficiency was made a policy goal. The NPR averaged 18% in 1970-1974, but has since risen steadily to 60-100% (for details, see Coxhead *et al.* 2001).

at significantly higher rates than most other sectors for the foreseeable future.

Trade and price policy biases are also reflected in the allocation of agricultural research funds. Most important among these for uplands are corn programs. A number of provinces, including Bukidnon, have been designated as 'key production areas (KPAs)' for corn in the Philippine government's Grain Production Enhancement Program (GPEP). Farmers in KPA areas are eligible for subsidies and supports directed at increasing corn production, and are the first beneficiaries of research and development directed at increasing corn yields (Philippine Department of Agriculture 1994). Similarly, temperate climate vegetable crops are also the targets of disproportionate research resource allocations (Coxhead 1997).

This brief review of Philippine growth strategy and policies has indicated a number of channels through which decisions concerning use of upland forest and farm land are likely to be influenced. In the longer term, a successful development strategy would have raised lowland and non-farm labor productivity faster than in uplands and diminished the economy's susceptibility to destabilizing macroeconomic shocks; all these should have reduced net migration to uplands and by extension, pressures on forest and land resources. Trade policy liberalization would in general have promoted growth of export-oriented non-agricultural sectors and might have preserved the profitability of some upland perennial export crops, such as coffee, relative to annual crops, and this in turn might have caused some redirection of input subsidy schemes and R&D resources away from import-competing crops and towards more promising sectors. Moreover, this review makes it clear that there are many potential policy changes at the macroeconomic level or in trade and agriculture sector policy that could affect upland resource allocation. On the basis of this evidence any project directed at influencing upland resource allocation toward a "sustainable" path should at least be cognizant of this broader setting, if not actively involved in trying to alter it.

The evidence we have reviewed, however, is strictly circumstantial. Questions remain as to the strength and nature of linkages between uplands and the national economy, and it is in this field of inquiry, as previously noted, that specific data and evidence are lacking. The gap creates room for competing hypotheses about the upland economy, and these in turn imply different diagnoses of upland environmental problems and their solutions. In the next part of the paper we describe the site from which primary data have been drawn in an attempt to fill this gap.

Data

Data for this research have been collected through two sets of surveys conducted in Lantapan since 1994. One set of surveys gathered data on farmers' land use, technology, input costs and product sales, and a variety of other farm-related variables as well as detailed demographic information on household composition, age, ethnicity, and so on (for descriptions of these surveys see Coxhead 1995 and Rola and Coxhead 1997). The original sample size for the farm survey was 190 farms, from which information was gathered on more than 300 individual plots. Over time, the size of the sample has been reduced both deliberately and through attrition. There have been four major production and input surveys, and several shorter surveys covering mainly land use, production and sales.

The second set of surveys was a price monitoring effort, begun in the watershed in October 1994. Sanrem researchers identified a group of traders active at several points within the watershed and visited them four times each month to ask about prices offered for major crops. These data were linked with price quotes in wholesale markets in two provincial trading centers (the Malaybalay and Valencia markets) as well as in the Agora market in Cagayan de Oro, the major wholesale produce market for Region X. Much of the produce sold in the Agora market is shipped directly to Manila, the national capital and central market, either for processing or for sale; accordingly, Agora prices track the benchmark Manila prices. Wholesale price data were gathered by cooperators in the Bureau of Agricultural Statistics offices in Malaybalay and Cagayan de Oro. Together, the farm-gate and wholesale price series provide a picture of the evolution of prices of major commodities produced in Lantapan over the past five years: yellow and white corn, potato, cabbage and coffee.

Markets, Prices and Land Use Decisions

Our research focuses on factors influencing land use in the middle and upper watershed areas, on relatively steep and easily eroded valley sides and at the forest margin. The major crops grown are corn (both for feed and for human consumption) and vegetables— especially cabbage, beans and potato. In the analysis that follows we concentrate on corn, as by far the most important crop, in terms both of land use and of net farm incomes, within the study site. Nationally, too, the area planted to corn is second only to rice, and corn accounts for by far the greatest part of upland agricultural land use.

An initial survey of the Lantapan site had characterized agriculture in the upper watershed as 'subsistence' or 'semi-subsistence' (Bellows 1995). However, our data reveal clear commercial motivations for almost all farmers.⁷ More than 50% of corn production is destined for market, and vegetable crops such as cabbage, potato and beans strictly for sale, with home consumption accounting for less than 10% of production in each case (Coxhead 1995).

An econometric analysis of land use decisions by upland farmers in a comparable Philippine location indicates that their land allocations respond to relative prices, and to the prices variability, in statistically significant ways (Shively 1998). A similar exercise using Lantapan land use data (Coxhead *et al.* 1999) reveals that farmers' decisions on total land area farmed and its allocation to crops are influenced in statistically significant ways by household resource availability, physical and institutional constraints, and the variances of expected revenues, the latter indicating risk-averse behavior.⁸ The results with respect to planted area response to relative prices are somewhat weaker; although coefficients have the expected signs, they do not meet standard tests of statistical significance.

A question remains as to the relative importance of *markets*, as well as of national policies operating through them, as conditioning influences over farmers' decisions. If prices or their variability are important determinants of land use decisions, what are their determinants?

Market Integration and Price Causation

As argued earlier, understanding the nature of market links between uplands and the rest of the economy is critical to the efficiency of project and policy design. If markets within the study site were isolated from or only weakly associated with regional markets (the 'semi-subsistence' hypothesis), we would expect to see seasonal or even longer-term divergence between trends in local and regional prices. Further, we would be unable to see evidence that local prices are driven by national prices.

⁷ Data on production, input use, land use and sales for major crops, were collected annually from a sample of 120 farms in four rounds between 1994 to 1998 (for full details see Coxhead 1995 and Rola and Coxhead 1997).

⁸ In the Philippines, corn prices are stabilized through policy interventions, and the results of this exercise confirm that price stabilization encourages risk-averse farmers to increase corn area.

The tests of market integration and the direction of causation are important for both economic and environmental reasons. Under current production technologies corn, potato, cabbage and other intensive crops in Lantapan generate annual erosion and soil nutrient losses far in excess of natural regeneration rates. Remoteness and poor quality of infrastructure are frequently taken to indicate that market links to the rest of the economy are tenuous at best. This, if true, would have two important implications for policy and project design. It would mean that agricultural prices and trade policies—standard instruments for influencing agricultural resource allocation in lowlands—could be expected to have little or no effect in uplands. By extension, the most effective instruments for promoting sustainable agriculture in uplands would be direct interventions such as technology transfer, extension and education.

Alternatively, if markets are integrated but farm-gate prices are most significantly influenced by local production, then supply and price in upland agriculture will tend to move in opposite directions. If an increase in local supply drives prices down, then the profit-maximizing level of local output will be lower than if prices were unaffected. In this case the price-reducing effects of local adoption of supply-increasing innovations such as new technologies or more efficient management practices might be expected to act as a “natural brake” on the expansion of agriculture at the forest margin. However, these effects (even if they were observed) are likely to obtain only in the short run, since integration with the larger market will likely neutralize local effects in the longer run.

Theory tells us that if two markets are linked through trade, then under normal circumstances, differences in prices net of margins between the two markets create opportunities for arbitrage. Goods will flow between the two markets—trade will occur—until the price difference is eliminated.⁹ Although the properties of the data series prevent a formal test of long-run market integration,¹⁰ our observation confirms that trade between Lantapan and Agora is regular, seasonally consistent, and consists of high volumes. We can assert statistically

⁹ Statistically, if the prices in the tested markets are non-stationary (that is, that they are trending over time rather than merely following a random walk) then the markets are integrated if their price series are cointegrated, meaning that there is a (single) stationary long-run relationship between them.

¹⁰ The test for stationarity is conducted with a Dickey-Fuller test of the null hypothesis that each price exhibits a unit root. For example, under an AR(2) representation of yellow corn prices (including seasonal dummy variables), the ADF

that the markets are integrated in the short run (Coxhead, Rola and Kim 2001).

Examining the short-run dynamics of the price series permits tests of the hypotheses that upland farmers are price-takers and that national market and policy signals affect local prices. Our econometric method proceeds as follows. We fit the data to a set of regression equations, each of which has the price of a crop in one market as the dependent variable, and its own lagged values, as well as the current and lagged values of the prices of the same crop in other markets, as explanatory variables. Hypothesis tests on the coefficient estimates of these equations provide information about the direction of causation. As an example, for two markets A and B, when a price change in market A is shown to precede price changes in market B, we describe the price in A as “Granger-causing” that in B. In our study, confirmation that the local price Granger-causes the regional price would provide support for the “natural brake” idea referred to above, that expanded production of a crop within the watershed will cause its price to fall, at least in the short run. Conversely, confirmation that the regional price causes the Lantapan price would indicate a need to focus on agricultural price and trade policies as longer-run influences over farmers’ land use and crop production decisions.¹¹ The test of causation is also a test of a sufficient condition for short-run market integration, so long as at least one causal relationship is confirmed.

We apply these tests to weekly corn, potato and cabbage prices in Lantapan and the main regional market. In this analysis we concentrate on the Lantapan-Agora market relationship; the data series are summarized in Figures 3.1-3.3 (Appendix 3.1 reports the details of the

test statistics for this hypothesis are -4.818 for Agora and -5.307 for Lantapan. At the 5 percent significance level, the critical value for the test is -2.88 , so we reject the null hypothesis. We obtain similar results for the other products; these results are robust with respect to different lag specifications. We conclude that these price series are stationary; therefore no meaningful statistical test of cointegration can be conducted on these series. Given the proximity and volume of trade between the two markets, however, a statistical finding of no integration would be a very great surprise. Studies using aggregate data have indicated clearly that Philippine grain markets are integrated across regions and provinces (Mendoza and Rosegrant 1993; Silvapulle and Jayasuriya 1994). For details of the econometric procedure see Coxhead, Rola and Kim (2001).

¹¹ Both Granger-causality and the test of transmission of shocks (impulse response function) are founded on the vector autoregression (VAR) specification of a price series. See Greene (1993) or another econometrics text for details.

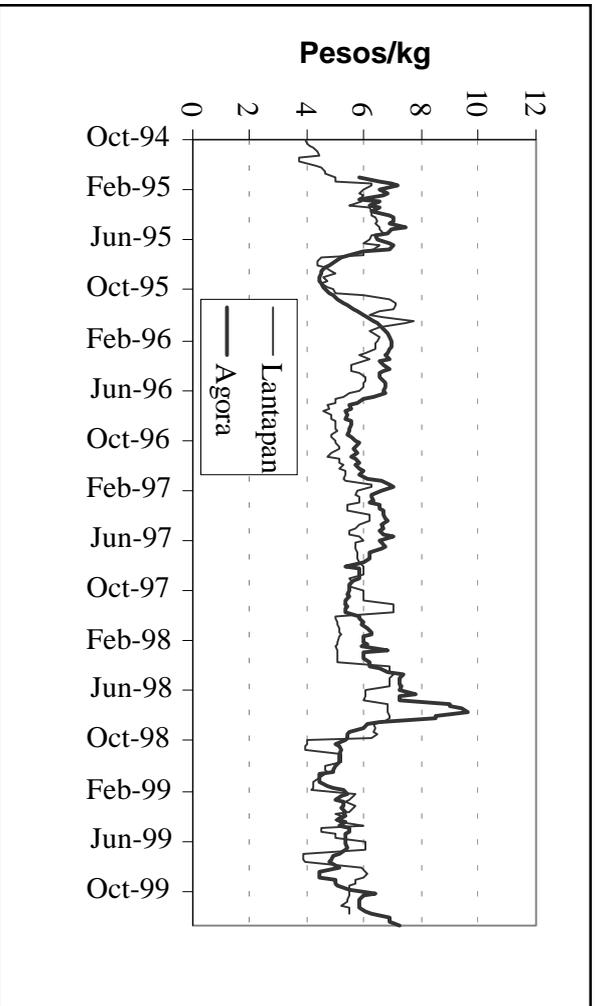


Fig. 3.1. Weekly price of yellow (feed) corn, October 1994-December 1999.

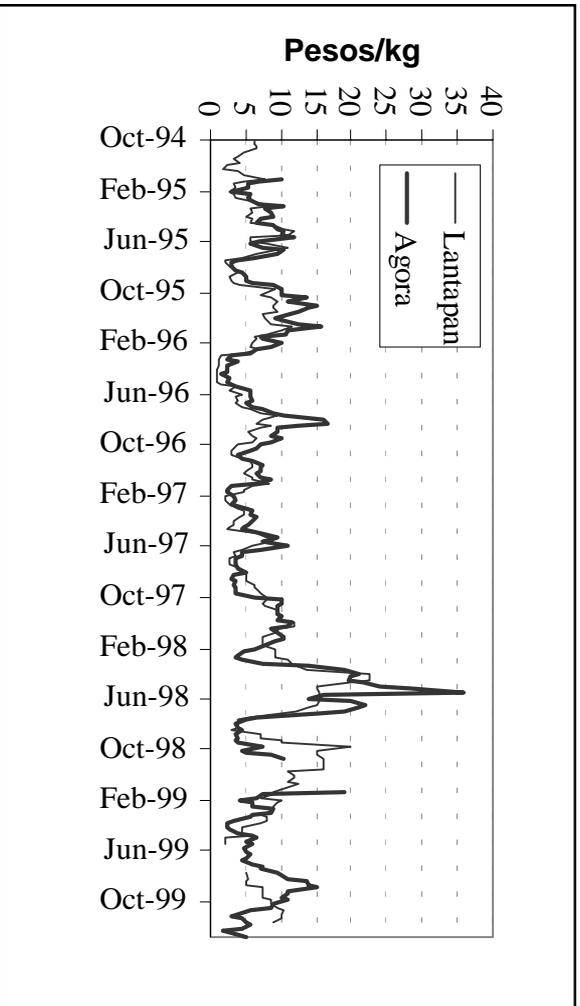


Fig. 3.2. Weekly price of cabbage, October 1994-December 1999.

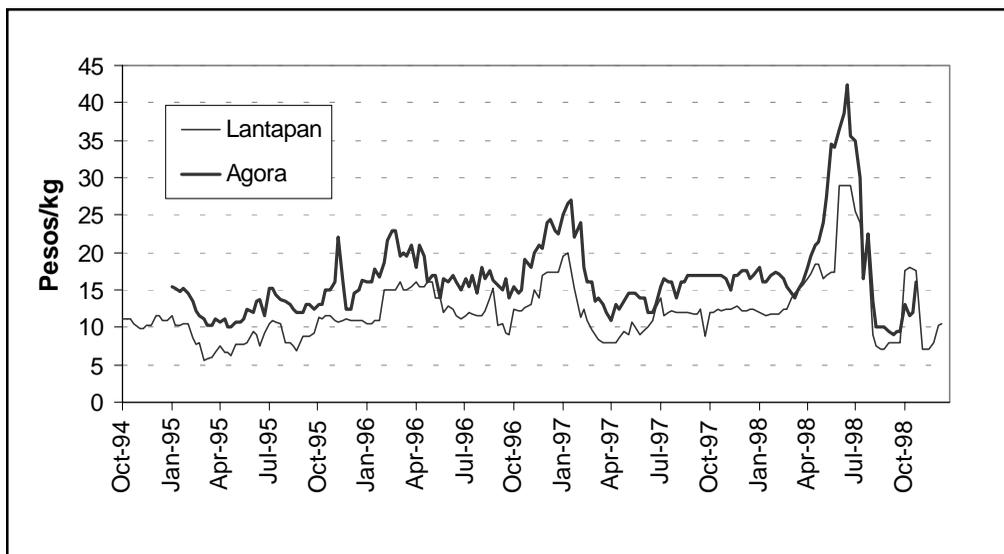


Fig. 3.3. Weekly price of potato, October 1994-December 1998.

econometric procedure). The results of these tests are summarized in Table 3.1. All markets display some form of causation, and so we conclude that local and regional markets are integrated for all crops in the study. For *yellow corn* and *white corn*, the direction of causation runs from wholesale market to farm gate. Corn prices in the watershed are driven entirely by prices in provincial and national markets. For *potato*, weekly data indicate two-way causation: farm gate prices are influenced by wholesale prices, but a local supply shock in Lantapan may also have a short-run effect in wholesale markets. Using biweekly data, however, we find a strong one-way relationship between Lantapan and Agora prices, with causality running from the latter to the former. For *cabbage*, the weekly data show a strong influence of Lantapan prices on wholesale prices, but monthly data show that when very short-term fluctuations are smoothed out, cabbage prices are determined in the regional market and not within the watershed.

To summarize, our results indicate that markets for the major crops grown in the watershed are integrated in the short run with broader regional markets. They also provide strong evidence for all crops that an expansion of supply within the watershed will have no measurable influence on its prices in wholesale markets, beyond a period of one or two weeks for vegetable crops. Rather, the evidence is that farmers in the watershed are price takers in regional and national markets.

Table 3.1. Summary of results of Granger causality tests for corn and vegetable prices.

Crop	Test ^a	R ²	DW ^b	F (N; d.f.)	P value ^c	Comments
Weekly Data						
Yellow Corn	Agora → Lantapan	0.75	1.97	3.22 (182;2,176)	0.042	One-way causation
	Lantapan → Agora	0.86	2.04	0.91 (182;2,176)	0.403	
White Corn	Agora → Lantapan	0.89	1.95	8.25 (162;2,156)	0.004	One-way causation
	Lantapan → Agora	0.95	1.96	0.39 (162;2,156)	0.680	
Avg. Potato	Agora → Lantapan	0.81	1.95	6.61 (157;2,151)	0.002	Two-way causation
	Lantapan → Agora	0.84	2.08	7.17 (157;2,151)	0.001	
Cabbage	Agora → Lantapan	0.86	1.97	2.88 (170;2,164)	0.005	Two-way causation
	Lantapan → Agora	0.68	1.96	5.60 (170;2,164)	0.004	
Monthly Data						
Avg. Potato ^d	Agora → Lantapan	0.75	2.05	13.8 (83;2,76)	0.001	One-way causation
	Lantapan → Agora	0.83	2.12	0.77 (83;2,76)	0.470	
Cabbage	Agora → Lantapan	0.61	1.90	3.36 (41;2,35)	0.046	One-way causation
	Lantapan → Agora	0.56	1.99	0.34 (41;2,35)	0.710	

^a Arrows indicate the direction of causation being tested, so for example “Agora → Lantapan” indicates a test that Agora price Granger causes Lantapan price.

^b Durbin-Watson statistic.

^c $P < 0.01$ indicates rejection of the null hypothesis (no causation) at 1% significance level; $0.01 < P < 0.05$ indicates rejection at 5%; $0.05 < P < 0.1$ indicates rejection at 10%.

^d Biweekly data for average prices of large and medium potatoes.

Market and Policy Linkages in Lantapan

If markets are integrated as we have argued, and given that short-run causality runs only from regional to local market, what can we conclude about the implications of national policies for upland land use in Lantapan?

For the reasons indicated earlier, we cannot as yet quantify the effects of changes in the trade policy regimes that underpin domestic market conditions for both corn and vegetables. For vegetables, import bans that prevailed until 1996 have been replaced with tariffs at prohibitive rates; in effect, there has been no trade policy change. For corn, in spite of the shift from quantitative restrictions to the MAV system with tariffs after 1996, announced trade policy changes are being introduced very gradually and are not scheduled to be completed before 2004. However, our finding that upland farmers are price-takers in regional markets makes it clear that any meaningful policy changes, were they to occur, would have direct effects on farm-gate prices in the uplands.

Of potentially greater interest is the observation that revenue instability, the phenomenon that risk-averse farmers strive to avoid, has intersectoral as well as local sources, even in a market (such as corn) which is subject to price stabilization. Our data span the recent economic crisis that engulfed Southeast Asian countries, beginning when the Thai currency collapsed in July 1997. While the crisis took different forms in each affected economy, there were three elements common to all. There was a sharp drop in overall economic growth, and there were sudden, unexpected and repeated re-evaluations of exchange rates that had previously been effectively pegged to the U.S. dollar. As a result there was a big increase in uncertainty among producers within the affected countries about final demand and prices, input prices, and even availability of key inputs such as credit. Since trade policy renders Philippine corn prices largely independent of world prices in the short run, were upland markets affected by the macroeconomic instability reflected in the exchange rate?

We used information about exchange rate variability to define the endpoints of the Philippine economic crisis.¹² During the period August 1997 to November 1998, the daily peso-dollar rate fluctuated wildly, whereas before and after this episode, the mean daily change was a fraction of one per cent (Fig. 3.4). We use this criterion to divide our data into “pre-crisis”, “crisis”, and “post-crisis” periods; as Table 3.2 shows, the price variance of yellow corn, the major crop in Lantapan, increased substantially during the crisis, even through the mean price did not. We are then able to make a preliminary identification of the effects of macroeconomic instability on the relationship between farm gate prices and those in national markets. We do this by calculating *impulse response functions*, which record the dynamic response of one data series to a one-time shock (“impulse”) in another (see Greene 1993). For example, the dynamic response of a shock in Agora on the Lantapan price can be captured by $\partial PL_{t+j} / \partial v_{PA_t}$.¹³ The impulse response measures are, thus, computed from the same VAR model used earlier to test market relationships, only with the data divided into sub-periods as noted.

¹² Although the values of the exchange rate are of direct interest in their own right, here we are using exchange rate fluctuations as a proxy for a more general set of macroeconomic conditions. In an open economy, exchange rate depreciation (as occurred during the early part of the crisis) serves as a proxy for (unobservable) inflationary expectations; exchange rate variability is then a proxy for general price instability.

¹³ This algebraic derivation involves successive substitution (Greene 1993).

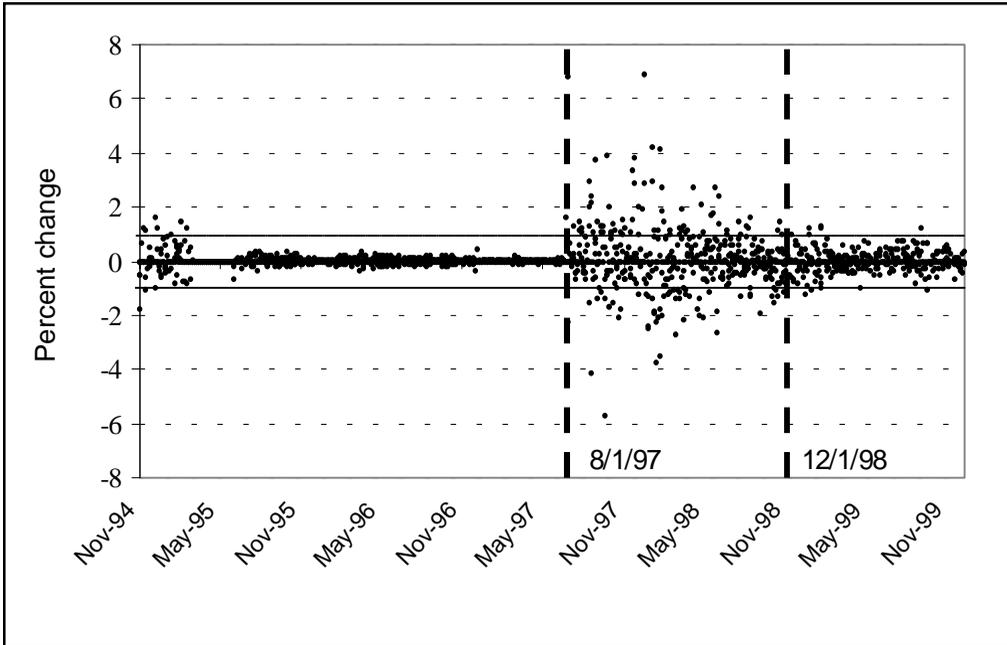


Fig. 3.4. Daily fluctuations of Philippine peso against US dollar.

Table 3.2. Moments of yellow corn prices before, during and after the exchange rate crisis.^a

Item	Pre-crisis	Crisis	Post-crisis
Lantapan mean price (Pesos/kg)	5.57	5.85	5.19
Agora mean price (Pesos/kg)	6.15	6.25	5.23
Lantapan price variance	0.627	0.774	0.462
Agora price variance	0.526	1.277	0.221
Exchange rate (Pesos/USD)	25.9	38.7	38.9
Exchange rate variance	0.468	16.892	0.817

^a Periods are as defined in text and illustrated in Figure 3.4.

The dynamic response of Lantapan corn prices to a shock in the Agora regional market price is shown for a two-period lag model in Fig. 3.4. The “impulse” is a one-peso per kilogram price shock, so the figures on the vertical axis of the graph are pesos per kilogram in the Lantapan market (the mean pre-shock corn price was about 6 pesos/kg, so this represents a shock of about 16%). In the pre-crisis and post-crisis periods, a shock in the Agora price yields a maximum rise in local prices of about 3% (0.2 pesos). The impulse response peaks three weeks after the shock and drops very sharply to a negligible amount by the 5th week after the shock. During the crisis, the peak is much larger (6%), and is sustained over several months. Comparing responses during the crisis period and in the earlier and later periods, we see that in the post-crisis era the signal from the leading Agora price to the Lantapan price is very much more “noisy” than in the prior period. The price dynamics indicate that during the crisis, a temporary disturbance in the Agora series induces a larger and longer-lived response in farm-gate prices.

While very preliminary in nature, the impulse response analysis suggests that the effects of macroeconomic instability find their way into the behavior of prices that guide farming decisions even in areas far from the main regions and sectors of economic activity.¹⁴ The economic signals upon which upland farmers make resource allocation decisions are not independent of conditions in national markets and in the macroeconomy. More rigorous investigations of these relationships, for corn and for other crops, will become feasible as more data from the post-crisis era become available.

Conclusions

Commodity market development, along with policy biases, has contributed to deforestation and the adoption and spread of relatively erosive crops, produced using relatively land-degrading technologies, in the upland Philippine watershed of our study. The environmental ill-

¹⁴ The exact effects of price instability on land use by Lantapan farmers cannot currently be determined with any greater precision than is provided in this statement. One reason is that land use response estimates such as in Coxhead, Shively and Shuai 2002 are based only on pre-crisis data and may not be stable once post-crisis data are incorporated. The analysis of the effects of the crisis in Philippine upland agriculture is the subject of ongoing research as new data become available.

effects of these crops could be minimized by adoption of appropriate technologies, for example to reduce erosion and preserve soil quality. However, only a few farmers in the study site have adopted effective soil conservation measures, and while this is clearly related to tenure insecurity, there is also evidence that among all farmers, the choice of annual commercial crops, and the failure to adopt soil-conserving technologies, has economic as well as institutional roots. If market-driven incentives dominate in farmers' decisions, there is a case for broadening the range of policy instruments brought to bear on the upland environmental problem; moreover, project design may be improved by a different balance of local action and national-level information dissemination and policy advocacy.

We have demonstrated that in spite of remoteness, the farmers in our study area produce for markets that are integrated in the national system. Supply shocks from the site have no effect on prices in broader markets: farmers are price-takers in these markets. National markets transmit both price information and the effects of macroeconomic instability.

While empirical tests of the effects of trade policies on prices await substantive policy changes, it is nevertheless clear that agricultural markets convey the effects of trade policies to the farm gate, even in upland agriculture. Trade liberalization can therefore be expected to reduce the farm-gate prices of corn and vegetables, the two most environmentally damaging crops currently grown in Lantapan and many similar Philippine watersheds.

Finally, anecdotal evidence of the importance of macroeconomic trends in driving upland migration and land use patterns is provided some additional contemporary support by our finding that the stability of market price relationships is a function of price stability in the overall Philippine economy. During the recent economic crisis, we find that instability at the macroeconomic level (as reflected in daily exchange rate movements) was associated with a noisier signal from wholesale to farm gate prices. Future research on the links between deforestation and agricultural expansion should benefit from this exposure of the importance of markets and prices in a typical frontier area of a tropical developing country. A combination of project-specific and more general policy measures is called for if the former are to succeed in changing farmers' actions, and if the latter are not to discourage environmentally sustainable strategies. At a policy level this research, if supported by counterpart studies from other sites, should provoke a reconsideration— and indeed a substantial broadening— of the set of policy instruments available to influence upland agricultural and forest land allocations.

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Appendix 3.1

Econometric Procedure

To account for the time series properties of the data we employ a vector auto-regression (VAR) model (Sims 1980).¹⁴ The structural equations of the VAR model (with 2-period lags, suppressing crop-specific subscripts) are:

$$\begin{aligned} PL_t &= \alpha_1 PA_t + \beta_{11} PL_{t-1} + \beta_{12} PA_{t-1} + \gamma_{11} PL_{t-2} + \gamma_{12} PA_{t-2} + v_{PLt} \\ PA_t &= \alpha_2 PL_t + \beta_{21} PL_{t-1} + \beta_{22} PA_{t-1} + \gamma_{21} PL_{t-2} + \gamma_{22} PA_{t-2} + v_{PA_t} \end{aligned}$$

where PL_t and PA_t are prices in Lantapan and in the Agora regional market respectively, and v_{PLt} and v_{PA_t} are error terms that we assumed are serially and mutually uncorrelated. Eliminating current-period variables from the right-hand sides of these equations yields a reduced form:

$$\begin{aligned} PL_t &= \phi_{11} PL_{t-1} + \phi_{12} PA_{t-1} + \phi_{13} PL_{t-2} + \phi_{14} PA_{t-2} + \varepsilon_{1t} \\ PA_t &= \phi_{21} PA_{t-1} + \phi_{22} PL_{t-1} + \phi_{23} PA_{t-2} + \phi_{24} PL_{t-2} + \varepsilon_{2t}, \end{aligned}$$

in which e_{1t} and e_{2t} are unobservable variables which are the serially uncorrelated innovations in the PL and PA processes.

Granger causality tests utilize test statistics computed from the VARs. A variable (m_t) is said to *fail to Granger-cause* another variable y_t relative to an information set consisting of past values of m_t and y_t if

$$\hat{E}[y_t | y_{t-1}, m_{t-1}, y_{t-2}, m_{t-2}, m_{t-2}, \dots] = \hat{E}[y_t | y_{t-1}, y_{t-2}, \dots]$$

¹⁵ The VAR approach to time series analysis is controversial. As Cooley and Leroy (1985) have pointed out, the VAR is “atheoretical” in the sense that it embodies no explicit economic theory. However, when restrictions in the VAR model, in terms of choices of variables and lag lengths, are weaker than the restrictions imposed on structural models, the VAR approach can provide a foundation for testing hypotheses based on *a priori* reasoning (Backus 1986). In our investigation of price relationships, we use both economic and econometric tools to choose variables and lag lengths. We thus view the VAR approach as a complement to the structural models implied by theory. Specifically in the case of Lantapan, the quality of transport infrastructure, high frequency of public and private travel, and the distance (130 km, or at most 5 hours) to the major market all suggest that price signals can be exchanged, and arbitrage occur, well within the two-week interval implied by a two-period lag structure.

where E denotes a linear projection of the dependent variable. In our example, this means that PA does not Granger-cause PL relative to an information set consisting of past values of PA and PL if (and only if) the estimates of f_{12} and f_{14} are equal to zero. In practice, an F-test can be used to test the null that one variable does not Granger-cause another. The results of these tests are summarized in Table 3.1.

Chapter 4: Soil Conservation Decisions and Non-Farm Economic Conditions: A Study of the Rural Labor Market in the Philippine Uplands of Bukidnon¹

Agnes C. Rola
Ian Coxhead

Introduction

Intensive agriculture in the fragile uplands is observed to cause environmental damage. In the long run, this might jeopardize the resource base and ultimately the capacity of upland households to maintain self-sufficiency in food supplies. There are, in general, two ways to influence farmers' use of natural resources: direct interventions aimed at altering behavior, and indirect interventions, such as through prices, aimed at altering factors that influence farm decisions. In the Philippines, the most common mitigating measure for seemingly unsustainable upland agricultural practices is the direct approach, especially the introduction of soil-conserving methods through extension and farmer education. For example, the Philippine Department of Agriculture (DA) introduced Sloping Agricultural Land Technology (SALT), which is a package of soil management measures for sloping lands, in the early 1980s to combat soil erosion and land degradation in uplands. However, while there is some adoption of conservation measures such as hedgerows in high-intensity extension projects, there is little evidence of widespread farmer interest in SALT (Garrity *et al.* 1993). Though no systematic evaluation is available, the general impression is one of low and slow adoption rates primarily because farmers do not perceive such very

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labor-intensive technologies to be economically profitable (Regmi 1997). Tenure insecurity is also cited as a constraining factor, as it is with any investment in fixed capital.

On the other hand, indirect policy options for soil conservation in the uplands are not widespread. This is arguably due to the perception among policy makers and their advisors that upland farmers are characteristically subsistence-oriented, existing somehow beyond the reach of market-based policies. However, the evidence shows that upland farmers respond to output price incentives (Coxhead *et al.* 2001). Commercial upland farmers in Bukidnon cultivate land intensively, producing crops mainly for the market (Coxhead, Rola and Kim, Chapter 3 this volume). When output price changes, so too does the mix of crops produced, and labor demand alters as a consequence. Moreover, in adoption decisions on land-clearing or soil-conserving actions, where long-term land productivity and sustainable resource management are issues of concern, the repercussions of a land use change due to external shocks such as market price or policy changes will also affect technology decisions and agricultural labor demand. One shock that would have a significant impact on labor allocation decisions in upland agriculture is the emergence of rural non-farm employment opportunities.

There is a need to explain the link between non-farm economic conditions and farmers' choice of crops and techniques. In general, the availability of farm household labor is an important determinant of production and land management decisions, including those affecting soil conservation. The capacity of a farm household to establish and maintain a hedgerow system, for example, depends in part on the availability of labor and management skills for the purpose. However, the number of household members available on-farm, and the amount of time they are willing to devote to farm labor and management, could be influenced by conditions in the non-farm labor market. In general, greater earning opportunities in non-farm employment cause the supply of family labor on-farm to diminish.

There have been few attempts to examine agricultural household labor supply in the context of the wider rural labor market (Sanchez 1991). One early work was of Lee Jr. (1965, as cited in Sanchez 1991), who provided a theoretical framework to explain the motivation behind decisions on the allocation of farm resources, particularly labor. The allocation decision between farm and non-farm activities is shown to be consistent with the objective of a household's welfare maximization and efficiency in the use of farm and household resources. His model suggests that the availability of non-farm employment opportunities,

coupled with the awareness of farmers of such opportunities, reduces labor input on family farms.

Experience suggests that some transfer of family labor to non-farm jobs might reduce the level of disguised unemployment and thus promote more efficient use of resources in agriculture, without significantly altering the level of farm output. This would be the case if some labor were initially underemployed on the farm. In the more usual case, however, the withdrawal of some family labor from the farm requires an adjustment in crops or technologies to reduce labor input.

In this paper we hypothesize that non-farm opportunities will reduce family labor input in farm operations even in a relatively remote upland area. This, we hypothesize, will occur because rising wages or earnings opportunities make farm work less remunerative relative to non-farm. Households will respond by cultivating less land, mechanizing some tasks, or shifting to crops or techniques that are less management and labor-intensive. In wealthy countries, rising non-farm wages have historically been associated with mechanization and the adoption of less labor-intensive cropping patterns (Hayami and Ruttan 1985; Binswanger and Ruttan 1978). In the uplands of a developing country like the Philippines, rising wages may under some circumstances signal a shift from relatively labor-intensive annual crops to perennial crops or to less intensive farming systems, including agroforestry. Depending on its exact nature, such a shift might be characterized as a move toward a more environment-friendly agricultural development.²

We use the case of the upland community of the SANREM project site in Lantapan to analyze farmer behavior in terms of crop choices and soil conservation technologies in the presence of an emerging rural non-farm labor market.³ The main question that we seek to address is whether changes in non-farm employment opportunities have measurable environmental effects either directly, through adoption of soil conservation practices, or indirectly, through changes in land use or technology.

² A number of studies conducted in the Philippines and elsewhere in the sloping uplands of the humid tropics identify the expansion and intensification of annual crop cultivation (primarily corn and upland rice) as the primary sources of agricultural land degradation, soil erosion, and (in areas where commercial forestry is no longer dominant) deforestation. Unit erosion rates are far higher under annual crops than under agroforestry and other perennial-based land use systems (David 1988), and the area covered by upland food crops is very large in relation to total upland agricultural area.

³ "Rural" here also includes surrounding towns in the province such as Malaybalay and Valencia, which are densely populated.

In the next section we discuss economic development and employment trends in the Philippines, and the Bukidnon and Lantapan labor markets, in particular. In the third section we analyze the link between non-farm employment and changes in agricultural techniques and activities, including practices with direct environmental implications. In section 4 we present a policy scenario for sustainable resource management. Section 5 contains a brief conclusion.

Our study makes use of both primary and secondary data. Secondary data are taken from published reports and municipal (Lantapan) and provincial (Bukidnon) statistics. Farm and household level data are from farm surveys conducted in the study site during the dry seasons 1996, 1998 and 1999, and in the wet season of 1998. The sampling and survey methodology are described in Coxhead (1995). Other demographic statistics and human capital data have been taken from earlier benchmark surveys (Rola *et al.* 1995). Data that characterize labor supply consist of the gender of labor market participants, educational attainment, place of residence, and nature of labor participation.

Economic Growth and Labor Market Trends Since the 1970s

Economic Growth and Employment Trends

A review of Philippine economic performance over recent decades reveals that as the economy grew, it experienced structural changes of the kind predicted by development theory, although at a rather low and fitful pace. The share of agriculture in Gross Domestic Product (GDP) has declined somewhat, from 28% in 1970 to 19% in 1998 (Table 4.1). The

Table 4.1. Shares in the real gross domestic product by major industry (in percent), Philippines, 1970-1998 (1985=100).

Major Industry Group	1970	1980	1990	1998
Agriculture, Fisheries and Forestry	28.18	23.50	22.38	19.42
Industrial Sector	33.70	40.52	35.59	35.42
Services Sector	38.12	35.98	42.03	45.16
Gross Domestic Product (in millions)	343,162	609,768	718,069	888,075

Source: Philippine Statistical Yearbook, 1999.

industrial sector share of GDP remained roughly steady at around 35%, while the services sector increased from 38.12% in 1970 to over 45% by 1998.

While economic performance was robust from the 1970s to the early 1980s, sluggish performance in the mid-80s was caused by unstable political conditions as well as the delayed effects of economic adjustments to the 1970s world oil price and interest rate shocks. The economic recovery, which began after the 1986 People Power Revolution, was cut short by a series of coups d'etat and natural disasters in the late 1980s and early 1990s. The economic turnaround of the mid-1990s was largely the result of economic and labor policy reforms, strong merchandise export growth, and a double-digit growth rate of net factor income from abroad, mainly in the form of foreign exchange remittances by overseas workers. The period was marked by a big improvement in productivity and output in the industrial and services sectors, led by electronics, garments and other manufactured exports which ballooned from barely 1% of exports in 1970 to more than 70% by the late 1990s. In stark contrast, agricultural exports fell from more than 90% of the total in 1970 to 28.17% in 1985, and to 15% by 1995 (ILS 1997).

The slow decline of agriculture in GDP is matched by the trend of its employment share, which declined from more than 50% in the late 1960s to about 40% by 1997 (Fig. 4.1). Most of the change in the structure of labor

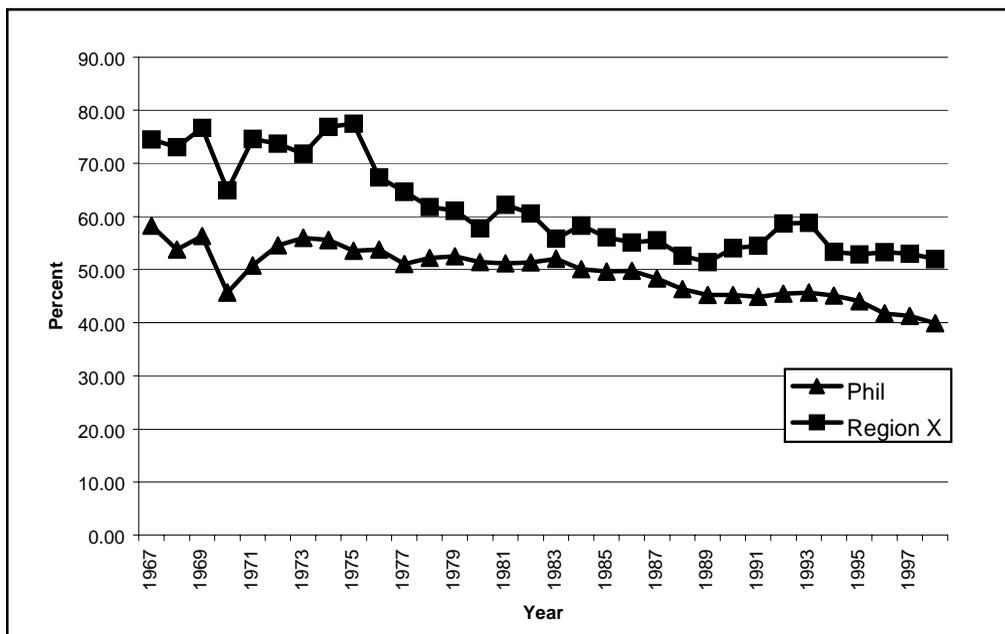


Fig. 4.1. Percent share of agricultural employment to total employment.

demand came from growth in the service sector, as industry employment remained quite stable over the past 25 years (Table 4.2).

The economic performance just described is also reflected in employment trends. Unemployment rates were much lower during the growth periods prior to and after the 1980s. Also, there has been a gradual structural shift in the composition of employment. While wage and salary workers have remained steady (as a fraction of the labor force) at around 42%, the proportion classed as unpaid family workers has fallen from 20.3% in 1980 to 14.9% in July 1996 (ILS 1997).

With relatively rapidly growing population and slow overall economic growth, real wages in the Philippines since 1980 present a rather depressing picture (Fig. 4.2). While nominal wages have for the most part risen steadily, real wages in both agricultural and non-agricultural sectors have barely changed since the major recession of the mid-1980s.⁴ Steeper increases in the agricultural wage after 1994—and a compression of the sectoral wage ratio—correspond to the decline in the agricultural sector share in total employment. This could reflect the effects of the structural change toward growth in more labor-intensive manufacturing sectors.

Table 4.2. Proportion of employed persons in major industry, Philippines, 1970-1998.

Major Industry Group	1970	1980	1990	1998 (October)
Agriculture, Fisheries and Forestry	53.80	51.44	45.20	39.89
Industrial Sector	20.80	20.00	20.07	25.22
Services Sector	23.67	28.53	34.66	34.90
Total (1,000)	11,775	16,434	22,532	28,262

Source: Philippine Statistical Yearbook, 1999.

⁴ Real wage increases in the late 1980s reflected recovery from this recession, and were reversed by the subsequent downturn of 1990-92. The agriculture-non-agriculture wage ratio remained roughly constant through the 1980s at about 1.4, indicating that the two labor markets were closely integrated in spite of a much lower participation rate by agricultural workers in *formal* labor markets. The gap widened as agricultural nominal wages stagnated (and the real agricultural wage fell sharply) in the early 1990s.

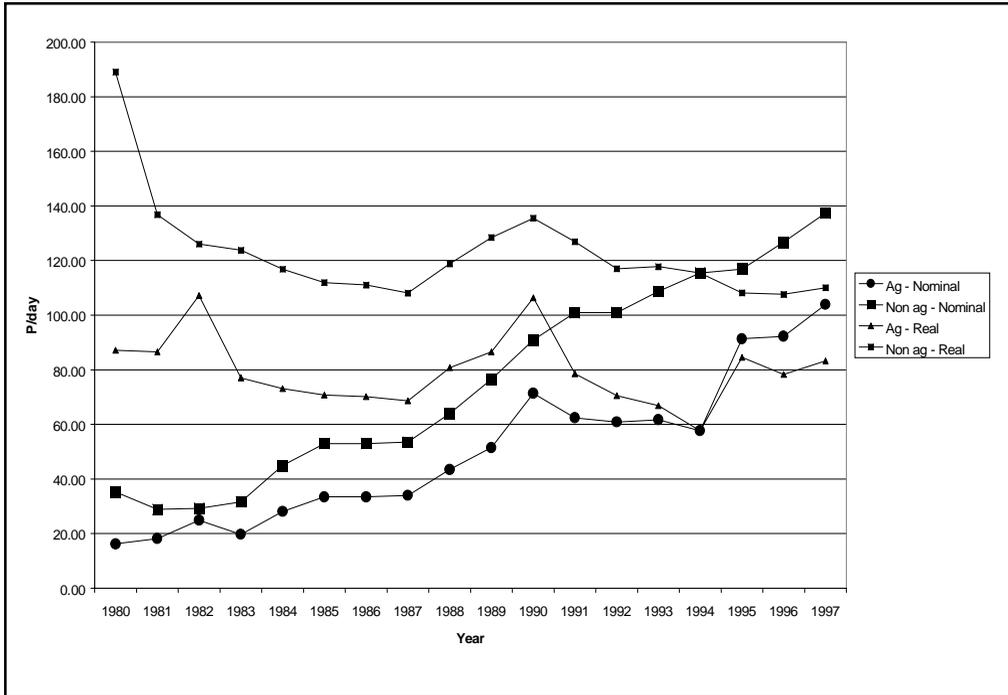


Fig. 4.2. Real and nominal wages by type of employment, Philippines, 1980-1997. (1994=100).

Migration and Agricultural Expansion in Upland and Forestlands

Migration to upland and frontier areas has been a prominent feature of modern economic development in the Philippines. In the early post-war years, government programs sponsored migrants to convert forestlands for agriculture. Subsequent migration, though spontaneous rather than sponsored, has retained the same motivation, i.e. the search for resources which, when combined with labor, can generate household income. The total population living in “forestlands” (officially defined as land of slope greater than 18%, whether forested or not) continued to grow rapidly through the second half of the twentieth century, trebling from 6 million in 1950 to nearly 18 million by 1985 (M.Cruz *et al.* 1992). The growth rate of the upland population has consistently exceeded that of the population as a whole. Accordingly, a very large fraction of Filipinos now resident in “forestlands” (*i.e.* engaged in upland agriculture) are at most second-generation descendants of in-migrants.

The motives for migration are not hard to intuit, and have been quantified in an excellent empirical study by Cruz and Francisco (1993). These authors used linear regression techniques on municipality-level

migration data together with economic, geographic and demographic data from censuses and other official sources to identify factors associated with migration into forestlands. Their results reveal per capita income and literacy in lowlands, and population density in uplands, were factors associated with low upland migration rates. Slope, upland urbanization, and the open access nature of uplands were all associated with higher migration rates. Upland incomes were not significantly associated with migration. Cruz and Francisco concluded that “migrants are motivated more by lack of other livelihood options than by the attractiveness of destination lands”(1993: 26); increases in lowland incomes, and better definition and enforcement of property rights over forest lands could both constitute major deterrents to migration.

Of course, the migration decision was undoubtedly driven in part by *changes* in expected income in uplands relative to that in the location of origin, and this feature of the economic calculus of migrants may not have been well captured in the census data on average household income used by Cruz and Francisco. In particular, changes in the relative profitability of lowland and upland agricultural production were likely to have influenced intra-rural migration decisions. The peak years of the Green Revolution, which enabled lowland irrigated rice farms to increase factor productivity by very large margins during the 1970s, were accompanied by down-slope migration from neighboring upland areas (Kikuchi and Hayami 1983). In subsequent decades, however, the rate of technical progress slowed, and the thrust of Philippine agricultural policy generally delivered relatively large profitability gains to crops grown in uplands rather than in irrigated lowlands. The implicit and effective protection rates on corn, the largest upland crop by area sown, increased dramatically from the 1970s to the end of the century, with the nominal protection coefficient (the ratio of domestic wholesale to world market prices) rising from near zero to 100% and more (David and Roumasset 2001). Similarly high protective rates prevailed throughout the period for other upland crops such as temperate climate vegetables (Coxhead 1997). The rise in price of these upland crops relative to rice, in a context of generally static real wages and slow growth in non-agricultural incomes, must also have been a factor in encouraging migration to uplands. We may therefore expect to observe that late twentieth century migration rates to areas in the Philippines that combined both open access to land and agronomic conditions suitable for corn and vegetable cultivation to be very high. This was indeed the case in the upland areas of Bukidnon province.

The Labor Market in Bukidnon, Philippines

Labor force growth in Bukidnon province is seen to be strongly influenced by in-migration. In the 1995 Philippine Census (National Statistics Office 1995) projections of inter-regional and inter-provincial migration patterns, Bukidnon was projected to have positive net migration rates (NMR), for both males and females (Table 4.3).⁵

Why has Bukidnon been such an attractive area for migrants? Surveys and local histories show that migrants came from other parts of the country to cultivate temperate crops in the cool highlands (Chapter 2, this volume), attracted by the opportunity to colonize or otherwise acquire land and convert it to intensive agricultural production. In recent years, the high migration rate also reflects strong job growth in the province, compared to the other provinces in Northern Mindanao (Table 4.4). Non-farm employment opportunities have increased rapidly in the urban areas of Malaybalay and Valencia, and province-wide data show nominal and real non-agricultural wages to be slightly higher than plantation wages, but significantly higher than the non-plantation (*i.e.* farm) wages since the mid-1990s. However, Bukidnon also had the highest visible underemployment rate, *i.e.* those employed were not necessarily fully employed. This may reflect in-migration by workers hoping to find full-time work, and willing to endure a period of unemployment or underemployment in the course of their search—a provincial version of the well-known Harris-Todaro migration model (Harris and Todaro 1970).

Rapid growth of the provincial economy also affected the labor supply decisions of long-term Bukidnon residents. For many farm families in the province, distances and travel times to urban areas was small enough to allow for daily (or at least weekly) commuting. Because of the proximity to alternative employment opportunities, rural household members can decide whether to seek farm, off-farm or non-farm jobs. Naturally, non-agricultural labor demand favors more educated workers, so the degree of intersectoral labor mobility is likely to be

⁵ The migration projection assumptions include the differentials in the levels of development of the provinces as well as the presence or absence of a growth center. The basic indicator of change in the level and direction of net migration was the percentage change over the two migration intervals (1975-1980 and 1985-1990). In both periods, the computed NMR for Bukidnon is positive. This is in contrast with other upland areas in the Philippines like Misamis Occidental and Mountain Province, which have negative NMRs, meaning, outmigration trends.

Table 4.3. Net migration rates (NMR), by gender, selected provinces, 1975-1990.

Province	Male			Female		
	1985-1990	1975-1980	2005-2010 ¹	1985-1990	1975-1980	2005-2010 ¹
Bukidnon	0.017	0.015	0.020	0.008	0.011	0.005
Misamis Occidental	-0.015	-0.023	-0.010	-0.018	-0.032	-0.010
Mountain Province	-0.028	-0.056	-0.014	-0.034	-0.064	-0.017
Cavite	0.057	0.061	0.118	0.059	0.059	0.075
Laguna	0.042	0.022	0.121	0.046	0.025	0.123
Nueva Ecija	-0.011	-0.019	-0.005	-0.015	-0.019	-0.003

Source: 1995 Census-based National Region and Provincial Population Projection, NSO, Manila.

¹ Projection by NSO

Table 4.4. Total population 15 years old and over and employment status, Region 10, selected provinces, 1996-1998.

Province/ City	Total 15 years old and over (1,000)		Labor Force Participation Rate (LFPR) ¹		Employment Rate ²		Visible Underemploy- ment Rate ³	
	1996	1998	1996	1998	1996	1998	1996	1998
Region 10- Northern								
Mindanao	2602	1709	69.8	73.0	92.7	94.1	15.4	16.1
Bukidnon	588	623	78.7	88.0	95.0	96.7	22.3	25.2
Camiguin	42	43	50.0	57.6	95.2	96.3	5.0	5.3
Misamis								
Occidental	323	340	64.1	64.2	94.2	91.5	3.1	5.5
Misamis Oriental	701	743	65.3	65.4	94.1	92.3	20.2	10.5
Cagayan de Oro	274	295	60.2	63.0	91.5	89.9	3.3	4.4

Source: Integrated survey of Households Bulletin, 1998.

¹ LFPR = % of people in the labor force over population 15 years old. People in the labor force are those who are working plus people who are looking for work during the reference period.

² Number of people employed/number of persons in the labor force.

³ Visible under employment rate – working for less than 8 hours a day.

influenced by factors on both the demand and supply sides of the market as well as the transactions costs of moving between markets.

Labor Market in Lantapan Municipality, Bukidnon, Philippines

Compared with other Philippine upland communities, Lantapan farmers practice highly commercialized agriculture, thus providing for year-round agricultural employment. A number of farm activities have remuneration on a daily wage rate basis.⁶

Are there other opportunities for employment in Lantapan aside from agriculture? From a 1996 survey of 120 households, 66% of all labor is mainly on own farm, 7% mainly in off-farm, and 27% mainly in non-farm activities. Eighty-six (86) percent of the non-farm workers are females.⁷ The results of a 1998 survey of the same set of households also suggest higher wage rates per day for non-farm incomes obtained by households than farm incomes (Table 4.5).

Several factors influence entry to non-farm work, including education and the willingness to pay for transport and transactions costs, and sometimes the cost of migration. Our data show that most farm workers reside on their own farm, while some non-farm workers reside outside Lantapan. The proportion of latter is increasing (Fig. 4.3). Empirical studies from comparable areas elsewhere in Asia suggest that these decisions are mostly irreversible, *i.e.* farm migrants are unlikely to move back to the farms, no matter what happens in the labor market (Coxhead and Jiraporn 1998).

⁶ Agricultural wage labor is usually called upon in times of plowing, planting, weeding, and harvesting. Farm labor remuneration in Lantapan includes both cash and non-cash payments. Cash payment may be daily per individual, or on a contractual basis, *i.e.* per hectare of land worked, per bag of fertilizer applied or per unit of crop harvested. Non-cash payments are observed in the harvesting of some crops, when harvesters get a share of output as payment. Exchange labor agreements (*hunglos*) among farmers are sometimes observed, specifically for planting and weeding. Daily wage rates vary depending on location, type of farm operation, sex and age of the laborer. Gender discrepancies are not distinct in corn areas, although some farmers have reported paying higher female wages in vegetable cultivation (Rola *et al.* 1995).
⁷ The reason for the high proportion of females engaged in non-farm work is that better-educated members of the population do more non-farm work, and more females than males complete high school and college degrees (Rola *et al.* 1995).

Table 4.5. Average non-farm and farm wages (P/day) by type of employment, in selected barangays, Lantapan, Bukidnon, 1998.

Type of Employment	SON	KIB	VIC	BAS	CAW	ALA	BAL	BAC
Office employment	77		78	47	364		159	137
Small-scale enterprise	95	136	68	23	150	32		
Construction work		150				150		200
Household help	45	120		32	23	57	68	
Sales lady		70				170	105	
Local midwife						18		
Farm work	64	55	60	63	55	50		49

Note: SON-Songco; KIB-Kibangay; VIC-Victory; BAS-Basal; CAW-Cawayan; ALA-Alanib; BAL-Balila; and BAC-Baclayon.

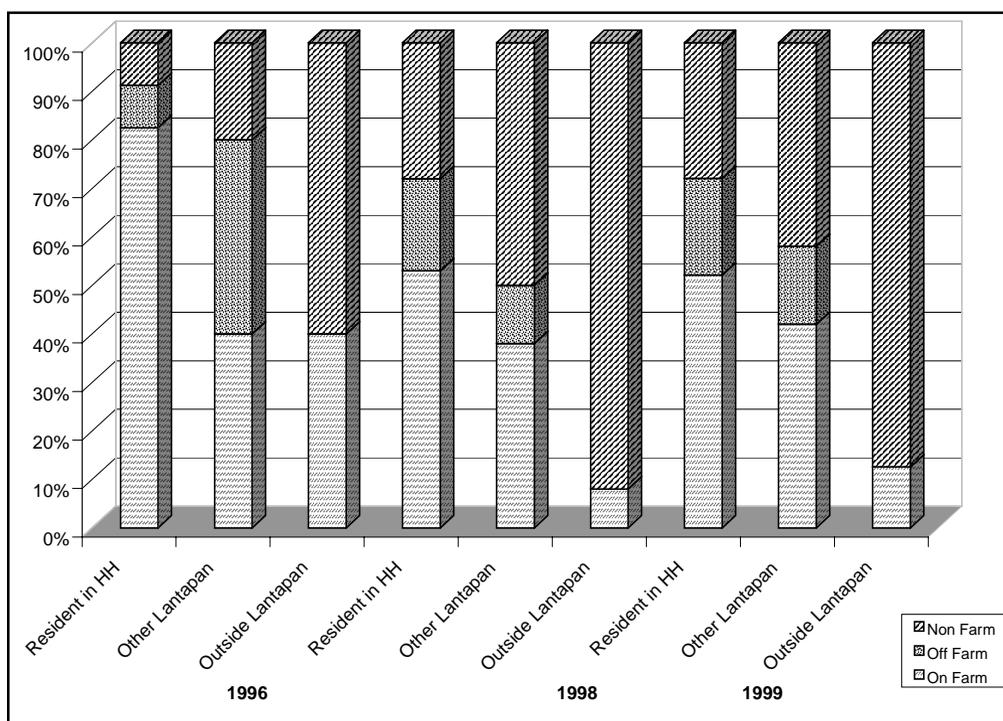


Fig. 4.3. Distribution of residence of household members over 15 years old, by type of employment, Lantapan, 1996, 1998 and 1999.

Non-farm Employment and Changes in Agricultural Techniques

Crop Choices and Soil Conservation Decisions

For given non-farm conditions, the level of farm employment in Lantapan is largely influenced by technology and crop choices. Farm labor intensity differs by crop. Hired (or paid) labor is high when external input use is high (Rola and Tagarino 1996); it is thus lowest in coffee and highest in vegetable systems. A shift from monocrop corn to vegetables would involve increased demand and management for both, as would the shift from perennials to annuals (*e.g.* coffee to corn) (Rola 1995; Coxhead *et al.* 2002). Less labor available for farm work should then shift crop choices to perennial (and more environment-friendly) crops such as coffee.

However, less labor on the farm would also discourage labor-using technologies, including soil conservation measures. Our data are consistent with this claim (Table 4.6). The percentage of sample plots with contours and hedgerows declined from 16% in 1996 to barely 5% in 1999. On the other hand, the proportion of plots with trees and fallow, or techniques with labor saving conservation measures, increased significantly, from 25% in 1996 to 68% in 1999.

Tables 4.7 and 4.8 provide information on crop-specific soil conservation measures. The number of cabbage plots with soil conservation measures was six in 1996, and fell to one in 1999 (Table 4.7). In the cabbage plots, contour plowing and hedgerows were more popular practices than trees and fallow. On the other hand, there was a smaller number of corn plots with soil conservation measures in the lower part of the Lantapan

Table 4.6. Number of plots with soil conservation measures, Lantapan, Bukidnon, 1996-1999.

Year	Total Plots (n=)	% of Plots with Contour/Hedgerows		% Plots with Trees/ Fallow	
		n	%	n	%
1996	224	37	16.52	56	25.00
1998-1	129	35	27.13	54	41.86
1998-2	135	33	24.44	60	44.44
1999-1	126	6	4.76	86	68.25

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

Table 4.7. Number of plots with soil conservation measures by crop, Lantapan, Bukidnon 1996-1999.

Year	# of Plots with Contour/Hedgerows	# of Cabbage Plots with Contour/Hedgerows	# of Corn Plots with Contour/Hedgerows		# of Other Crops with Contour/Hedgerows	# of Plots with Trees/Fallow	# of Cabbage Plots with Trees/Fallow	# of Corn Plots with Trees/Fallow		# of Other Crops with Trees/Fallow
			LW	UW				LW	UW	
1996	37	6	8	11	12	56	1	11	18	26
1998-1	35	1	4	11	19	54	1	12	5	36
1998-2	33	2	6	17	8	60	1	8	18	33
1999-1	6	1	0	4	1	86	1	20	18	47

LW (Lower watershed)- Alanib, Balila, Baclayon

UW (Upper watershed)- Songco, Cawayan, Kibangay, Victory, Basac

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

Table 4.8. Soil conservation measures of sample parcels, by crop type, Lantapan, Bukidnon, 1996-1999.

Year	Cabbage			Corn (Lower Watershed)			Corn (Upper Watershed)		
	% of Parcels with Soil Conservation Measures	% of Parcels Practicing Contours/Hedgerows	% of Parcels Practicing Trees/Fallow	% of Parcels with Soil Conservation Measures	% of Parcels Practicing Contours/Hedgerows	% of Parcels Practicing Trees/Fallow	% of Parcels with Soil Conservation Measures	% of Parcels Practicing Contours/Hedgerows	% of Parcels Conservation Trees/Fallow
1996	58.33	85.71	14.29	52.78	42.11	57.89	42.65	37.93	62.07
1998-1	50.00	50.00	50.00	55.17	25.00	75.00	50.00	68.75	31.25
1998-2	100.00	66.67	33.33	50.00	42.86	57.14	70.00	48.57	51.43
1999	100.00	50.00	50.00	76.92	0.00	100.00	53.66	18.18	81.82

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

sub-watershed than in the upper part. Trees and fallow were the more popular soil conserving practices in the corn areas (Table 4.8).

Non-farm Opportunities and Soil Conservation Practices in Lantapan

The previous analysis reveals that more corn farmers practiced soil conservation than vegetable farmers; and that labor-saving techniques were usually preferred among the former. Is labor the constraining factor? Do corn farmers' family members have access to jobs other than the farm jobs?

Our data show that farm household members in Lantapan are indeed participated in non-farm work (Fig. 4.4). In 1996, a higher proportion of non-farm employment in vegetable areas than in corn areas was observed. Interestingly, in 1998, households in corn areas had higher non-farm employment shares. Note that the data represent the dry seasons of 1996, 1998 and 1999.⁸ We also wanted to know the income composition of farm households practising soil conservation measures. In Figure 4.5 we note that those practicing contour plowing and hedgerows had a lower proportion of family members with non-farm incomes as compared to those practising trees and fallow. The positive growth of off-farm incomes in families practicing contour plowing and hedgerows was also evident. But in both types of soil conservation measures, there is an increasing trend of households with non-farm incomes (Table 4.9). The rate of increase was higher among households practising trees and fallow. The proportion of households with non-farm incomes practising this measure increased from 52% in 1996 to 79% in 1999.

Do Labor Market Trends Influence Adoption of Soil Conservation Measures?

The foregoing discussion suggests that labor market changes may influence farmers' choice of crop, technique and adoption of conservation measures. If so, what effect does the growth of non-farm jobs have on farm-level decisions that affect deforestation, soil erosion and other

⁸ The 1998 figures reflect the impact of El Niño on Lantapan agriculture. Because of the unfavorable weather conditions, some farmers did not plant corn in middle level areas, and had to look for non-farm jobs. However, the trend was maintained in 1999; as a conjecture, it may be that these family members have found a more permanent non-farm job, that despite the better farm environment, they were not willing to go back to the farm.

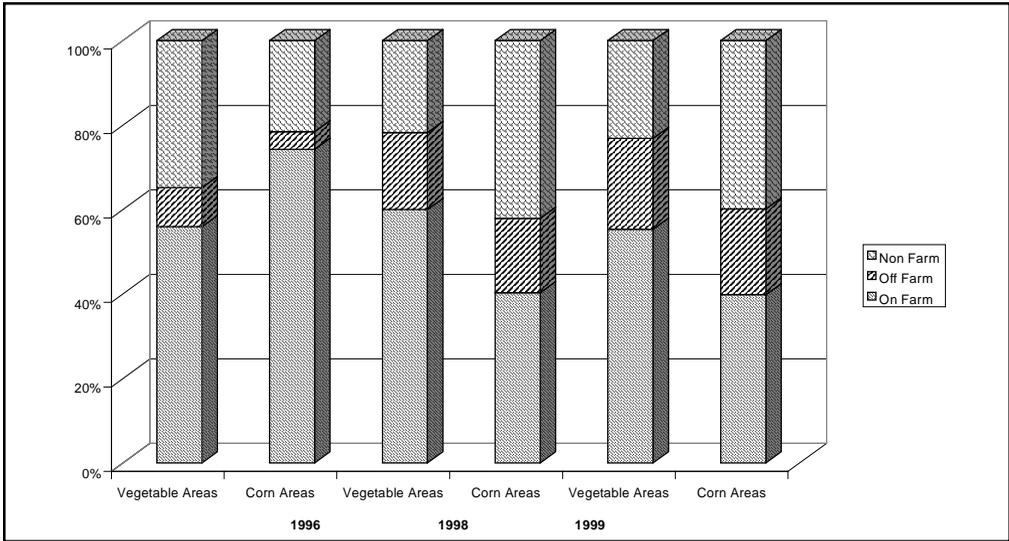


Fig. 4.4. Distribution of residence of household members over 15 years old, by type of employment, Lantapan, 1996, 1998 and 1999.

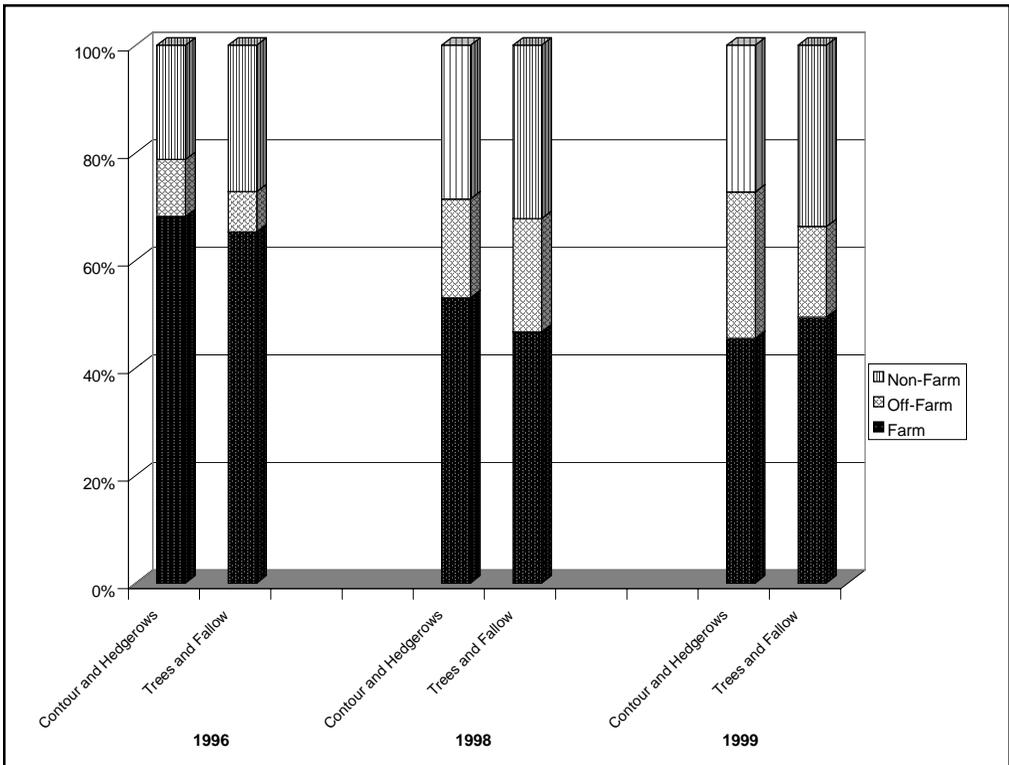


Fig. 4.5. Distribution of household members over 15 years old, by type of employment, practicing soil conservation measures.

Table 4.9. Percent of households practicing soil conservation with non-farm income, Lantapan Bukidnon, 1996-1999.

Year	% of Households Practicing Contour/Hedgerows with Non Farm Income		% of Households Practicing Trees/Fallow with Non-Farm Income	
	n	%	n	%
1996	19	51.35	29	51.79
1998 -1	22	62.86	35	64.81
1998 -2	22	66.67	32	53.33
1999 -1	4	66.67	68	79.07

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

environmental outcomes? As a first step toward an empirical answer to this question, we estimated a logit equation on farm-level survey data in which the binary dependent variable is defined as 1= practising conservation measures; and 0= not practicing conservation measures. Two equations were estimated to correspond to definition of two types of soil conservation practices as dependent variable: 1. Labor-using soil conserving technologies, such as contours, hedgerows and vegetative strips; and 2. Labor-saving soil conserving technologies such as trees and fallow, and planting of perennials. In addition, for each equation, two specifications were defined: Model 1. Pooled data of 1996, 1998 and 1999 dry seasons and 1998 wet season; and Model 2. A season dummy variable was included as independent variable, where 1= dry season for all years; and 0=wet season for 1998 only.

The unit of analysis is the parcel. In all estimated equations, the explanatory variables are slope of the parcel, tenure of the parcel, percent of non-farm employment to total number of employed adult members, and the average age of adult members.

The slope of the parcel affects farmers' soil conservation decisions; the higher the slope of the parcel, the higher is the probability of soil degradation due to intensive agriculture, and hence, the greater the benefits of soil conservation. Slope is measured by a discrete variable where 1 stands for flat land and 3 for the steepest slope. The proportion of parcels with flat land to total parcels is shown in Table 4.10. Note that mean slope of plots with contours and hedgerows is higher than with trees and fallow. This is especially true in wet season 1998, where more corn lands, (*i.e.* flatlands) were fallowed.

Table 4.10. Mean slope^a of sample parcels, Lantapan, Bukidnon, 1996-1999.

Year	Total Plots (n)	% of Parcels with Flat Slopes	Mean Slope of Plots Practicing Contour/ Hedgerows	Mean Slope of Plots with Trees/ Fallow
1996	224	29.90	2.40	2.18
1998-1	129	28.70	2.05	2.03
1998-2	135	31.10	2.27	1.89
1999-1	126	25.40	2.67	1.95

^a 1= flat slope; 2= medium slope; 3= steep slope

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

Tenure also determines farmers' soil conservation decisions in a positive way; farmers with more secure tenure have strong incentives to conserve soil resources (Table 4.11).

Average age of adult members is also deemed to be a determinant of soil conservation practices. It was observed that older persons knew more about soil conservation and that their indigenous knowledge leads to more sustainable practices. It could also be that younger farmers had more non-farm opportunities through higher educational attainment, and thus tended more readily to adopt labor-saving soil conservation technologies.⁹ Older farmers—especially in vegetable areas—practised contour and hedgerows; their opportunities for non-farm jobs may be more limited. We note that farmers practising contour and hedgerows were older, on average, than farmers who fallowed (Table 4.12).

Our main hypothesis is that available non-farm employment opportunities will entice farm household members to leave the farms. This will imply that labor-using soil conservation measures will have lower chances of adoption. On the other hand, labor-saving soil conservation technologies will be adopted more in the presence of non-farm employment opportunities.

⁹ Further work on the logit analysis should try to capture life cycle effects and possibly education as a way of better separating incentives for various types of soil conservation.

Table 4.11. Percent of plots with soil conservation having secured tenure, Lantapan, Bukidnon, 1996-1999.

Year	% with Secured Tenure		% of Plots Practicing Contour/ Hedgerows with Secured Tenure		% of Plots Practicing Trees/Fallow with Secured Tenure	
	n	%	n	%	n	%
1996	147	65.63	28	75.68	35	62.50
1998 -1	89	68.99	23	65.71	39	72.22
1998 -2	101	74.81	24	72.73	49	81.67
1999 -1	96	76.19	6	100.00	71	82.56

Note: 1998-1 and 1999-1 refers to dry season; 1998-2 refers to wet season.

Table 4.12. Mean age (in years) of adult household members practicing soil conservation measures, Lantapan, Bukidnon, 1996-1999.

Year	Mean Age of Sample Household	Mean Age of Farmers not Practicing any Conservation Measures	Mean Age of Farmers Practicing Contour/ Hedgerows	Mean Age of Farmers Practicing Trees/ Fallow
1996	32.79	32.44	34.10	32.41
1998 -1	34.48	34.24	34.00	33.45
1998 -2	34.75	33.49	35.32	33.01
1999 -1	35.04	33.57	37.00	34.96

Econometric Model and Results

The logit equation (Greene 1993) is modeled as follows:

- $Y = f(\text{slope, Tenure, NFE, Age})$, where
 $Y = 1$ if parcel has soil conservation practice; $= 0$ otherwise,
 Slope = 1 if plot is flat; = 2 if slightly rolling; = 3 if very steep,
 Tenure = 1 if private title, shared ownership, tax declared or other owner-like tenure; = 0 if share tenant or cash rental
 NFE = total adult members employed in non-farm work over total adult members of the household
 Age = average age of adult household members.

The SPSS for Windows package was used in the estimation. The results (Table 4.13) reveal that slope was the most important determinant of soil conservation practices in the study area. Farmers with very steep parcels almost always practiced soil conservation. Both tenure and age yielded positive coefficients.

Tenure was not statistically significant in the labor-using soil conserving technologies, but was statistically significant in labor-saving soil conserving technologies. We note that cabbage plots used more of the labor using technologies. It could be that these vegetable plots were rented out, and hence the tenure variable did not have a significant effect on the farmers' decision to conserve soil. On the other hand, tenure was significant in the labor-saving technology; maybe more of these were owners; or were participants of social forestry programs and thus had more incentive to manage soil resources.

Table 4.13. Propensity to adopt soil conserving measures, Lantapan, Bukidnon 1996-1999. (Dependent variable is 1= with conservation measures; 0= no conservation measures)

Independent Variable	Soil Conservation Measures			
	Labor Using		Labor Saving	
	Model I	Model II	Model I	Model II
Tenure	0.32 (0.29)	0.16 (0.21)	0.43** (0.21)	0.35** (.45)
Slope	1.01*** (.18)	0.87*** (0.13)	0.50*** (0.13)	0.50 *** (0.09)
Age	0.02 (0.02)	.03 ** (0.02)	0.03 ** (0.01)	0.03*** (0.01)
NFE	-0.01* (0.005)	-0.01* (0.004)	-0.004 (0.004)	-0.003 (0.003)
Season Dummy 1998 wet season = 0 1996-1999 Dry season = 1	-	-0.82** (0.26)	-	-0.40* (0.22)
Constant	-3.41*** (0.78)	-2.92*** (0.68)	-1.91*** (0.51)	-1.77*** (0.45)
Log Likelihood	367	682	640	1197

Note: Figures in parentheses are standard errors

*Significant at $\alpha= 0.10$

** Significant at $\alpha= 0.05$

*** Significant at $\alpha= 0.01$

The coefficient of the mean age of adult farm family members was significant in all model specifications but one. Older farm family members had a higher propensity to adopt soil conservation measures, whether they be labor-using or saving. This may reflect experience and knowledge, or wealth and/or demographics. Older farmers, typically with fewer dependents and a strong bequest motive, may find it preferable to conserve their natural resource assets, whereas younger farmers with more dependents may find it optimal to liquidate their natural resources in return for greater current period income.

The NFE variable was negative and significant for Model 1, as expected. These results reveal that indeed, greater access to nonfarm job opportunities can discourage labor-using soil conservation techniques. On the other hand, the results in Model 2 provide no support for the hypothesis of a positive link between non-farm jobs and adoption of labor-saving soil conservation measures.

The coefficients of the season dummy were negative and significant in all equations. In the dry season, the propensity to practice soil conservation was lower than in the wet season. This behavior could be driven by the fallow practices. A caveat that must be mentioned, however, is the abnormal condition during 1998, when both climatic and economic crises hit the country.¹⁰

A Policy Scenario for Sustainable Resource Management in the Commercial Highlands

In the short term, agricultural growth in the Philippine commercial uplands will be high and will mostly be due to intensive cultivation of the profitable annuals. This is in response to the prevailing economic and technology policies. For instance, there is a significant investment in corn and vegetable technologies as driven by the perception that these crops generate potentially high incomes for farmers. But much of this perception is due to the presence of price supports, particularly those reflecting trade policy interventions (Coxhead *et al.* 2002). A widespread replacement of

¹⁰ The impact of both these crises in the study site is ambiguous. Thus, for instance, farmers fallowed because of lack of rains, or they fallowed because credit cost was high, and there was no money for inputs. But the one thing that is quite clear is that more farm members especially in the corn areas (see also Rola and Tabien 1999) worked in non-farm activities during the crisis months because of the very limited farm opportunities.

coffee by corn in Lantapan can be attributed both to policy distortions and to the effects of yield-increasing research and development investments in corn, but not in coffee.

In the long term, continued growth and structural change in the Philippine economy can be expected to raise the opportunity cost of farm labor; and this is expected to diminish incentives to expand the agricultural area in spite of technical progress in agriculture. Price, trade and wage policies can be used as instruments in promoting sustainable resource management. The labor-using soil conservation technologies that the Philippine government has promoted do not seem feasible in general, as costs are high. How then can one reconcile the aim of achieving higher incomes in commercial upland agriculture and sustaining the productivity of the resource base?

At least two sets of policies could influence the behaviour of farm household members in promoting sustainable resource management in the uplands. One is a package of incentives from the local government units (LGUs) in terms of tenure security and other economic and non-market incentives. The other is to explore the incentive package that could attract investments by the private sector in the local areas on small village enterprises.

The LGUs can use both economic and non-economic policy instruments to promote sustainable resource management at the local level. One approach is to provide for tax credits for farmers practicing contours and hedgerows. The LGUs could also lobby to the banking sector to give interest discount on loans for farmers planting perennials or adopting agroforestry in their domain.

On the other hand, farm workers do not have to migrate to the urban centers for non-farm employment. Small or micro level village enterprises (SMEs), located in the rural areas could take out farm labor from intensive agriculture, while at the same time, preventing an exodus to the urban centers. In Lantapan, there are some small businesses, but mostly, input stores and small *sari-sari* stores that are not labor intensive. The perception by some that it is very expensive to put up a small business in the Philippines' municipalities reflects the magnitude of transaction costs that prevails and that constrains the growth of the SMEs.

Concluding Remarks

In the long run, upland agriculture should veer away from intensive cultivation without soil conservation techniques. But in the shorter run, policies are needed to influence farmer behaviour. Growth in non-farm

jobs could cause labor to be withdrawn from intensive agriculture without sacrificing household incomes. A desirable scenario is one in which there is growth of SMEs, together with higher non-farm wages, and accompanied by better remuneration for on-farm employment as the level of employed farm labor declines. This is expected to attract shifts to more labor saving crops; *i.e.* perennials and labor saving soil conserving technologies.

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Chapter 5: **Making a Living Out of Agriculture: Some Reflections on Vegetable Production Systems in the Manupali Watershed**

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Introduction

Sustainability of agricultural production systems must come at little or no cost to the primary producer. Such a maxim is particularly pertinent to farmers in the developing world, especially those close to subsistence, for whom the seasonal harvests determine marginal profit or loss.

Efforts to enhance sustainability of tropical upland agricultural systems, plagued by steep and unstable slopes, highly erosive rainfall, and precarious transport systems, must appreciate the non-separability of long-term development prospects of lowlands and highlands (Jodha, 1997), yet recognize the valuable contributions of uplands to biodiversity conservation, to clean water supply, to recreation and the like.

A trivial approach to the sustainability issue of tropical uplands would be to convert them into extensive national parks, but this does not recognize the rights of indigenous and migrant populations already in situ. Other government approaches to promote sustainability could include legislation that restricts cultivation of erosive species; whether directly through policy, or indirectly by removal of import barriers for lucrative temperate crops grown in tropical highlands.

Faced with dilemmas akin to the above, and with a brief to minimize the environmental impacts attributed to vegetable production systems in the northern uplands of Mindanao, Philippines, we implemented a research program under the umbrella of the USAID-SANREM over the period 1994-1998. The study area lies between 124° 47' to 125° 9' east and 7° 57' to 8° 8' north, and is characterized by steep lands in the upper foot slopes

above 800 m (our particular study area) over thick deposits of siliceous volcanic ejecta. Average annual rainfall is about 2300 mm, concentrated during May to November.

Some of the salient and comparative features from our research are presented herein, with full experimental details and discussions presented elsewhere (Midmore *et al.* 1997a, 1997b; Poudel *et al.* 1997, 1998, 1999a, 1999b, 1999c; Nissen and Midmore 1997a, 1997b, 1997c; 1999). In essence, we assessed the current vegetable production systems in terms of their financial integrity, their resource use and their perceived future, leading to a classification of farming types. Following this we, cooperatively with vegetable farmers, chose production technologies aimed at reducing environmental impact and enhancing income generation, and quantified their benefits and detractions.

Farm and Crop Level Analyses in Relation to Sustainability

Fifteen percent of vegetable farms were surveyed with a full previous-year recall, following extensive discussions with local *barangay* officials based upon local knowledge and with reference to a digitized 1986 land use map. Composite soil samples were collected from the main parcel of vegetable land on each surveyed farm, following quantification of natural and cultivation-imposed slope. Full details on data analyses are presented in Poudel *et al.* (1998).

Data collected illustrate the precarious nature of current production systems. One-half of farms were cultivated up-and-down the slope, for ease of operation and to enhance drainage. One third were farmed on slopes greater than 18%. This predisposed much of the land to soil erosion and runoff. Pesticides were applied on 26 occasions average during the tomato season, with only slightly lower figures for other vegetable crops (Table 5.1). Such prevalent spraying could lead to build-up in pesticide resistance, and almost one-half of producers recently changed

Table 5.1. Pesticide application frequency and rates, by crop per season.

	Tomato	Cabbage	Potato	Chinese Cabbage
Insecticides (kg/ha)	13.5	9.0	4.4	6.8
Fungicides (kg/ha)	20.5	9.8	14.6	3.7
Number applications	26.0	26.0	19.0	15.0

products to achieve more effective control. In spite of such copious applications, insect and disease reportedly led to close to 50% production losses. The control of late blight in potato with fungicides was essential for production, for potato yields were positively related to increased expenditure on fungicides ($r=0.630$ $P = 0.01$). There was a fair degree of correspondence between crop yields and fertilizer application rates across farms (*e.g.* between nitrogen rate and tomato ($r=0.752$ $P = 0.01$) or cabbage ($r = 0.630$ $P = 0.01$) yields), indicative of scope for yield improvement through fertilizer application on some farms. Possible spin-off benefits such as canopy-cover-induced reductions in soil erosion, could be had through objective use of nitrogenous fertilizer.

Taking the annual farm level data, it was apparent that intensification (*i.e.* expressed as number of crops grown per year, or as the inverse of proportionate area under the major vegetable crop) was associated with higher total rates of pesticide application per unit vegetable area. High fertilizer application rates were associated with a lowering of soil pH, a decrease in the Ca saturation of exchange sites, and a potential reduction in stable aggregates. Dolomitic limestone (for magnesium in the soil is also in short supply, as discussed later) must, therefore, accompany fertilizer application if soil acidification is not to become more prevalent in this watershed.

Classification of farming types among the sampled farms was undertaken using Principal Components and Factor Analyses and led to identification of seven factors (Table 5.2) from which two major distinct groups of farmers were identified. The factors reflected the following, in decreasing order of importance: 1 - the annual amounts of N, P, K applied per farm, 2 - the degree of non-dependence on vegetable crops, 3 - minimization of reliance on one or a few crops, 4 - a measure of soil acidity, 5 - opportunity costs for all farm family labor and rent, 6 - total input expenses per hectare arable land, and 7- an agro-ecological factor representing land use intensity and altitude.

The two major groups of farmers differed notably, and the major factor differentiating the groups was the quantity of N, P and K applied per hectare per year to vegetable crops (Table 5.3). Greater external nutrient applications offset the scope for fallowing, (which was limited by holding size, in the high external nutrient (HEN) group (Table 5.3). While the HEN system appears to commercialize vegetable production more than does the LEN (0.7 ha vegetable production per HEN farm per year vs. 0.4 ha per LEN farm), and yields were greater, the annual net returns from vegetable production were less under HEN (Table 5.3). The HEN system was also likely to achieve a net loss on the vegetable enterprise. Net return calculated this way can be interpreted as returns

Table 5.2. Factor loadings of maximum likelihood methods with varimax rotation with variables selected for farm level analysis.

	F1	F2	F3	F4	F5	F6	F7
NEVEGHA	0.9504						
PVEGHA	0.9654						
KVEGHA	0.8941						
ARANVEG		0.9721					
VEGCR			0.9426				
PH				0.9641			
SFUCULT1					0.9650		
INPUTEXP						0.8044	
CI							0.6596
ALTD							-0.4440
Proportion of standardized variance	0.15	0.26	0.35	0.4	0.49	0.56	0.62

Table 5.3. Some characteristics of the two types of vegetable production systems.

	Higher External Nutrient		Lower External Nutrient
Total land holding (ha)	3.2	<	3.7
Annual vegetable (ha)	0.7	>	0.4
Annual non-vegetable (ha)	0.5	<	2.8
Number of vegetable crops/yr	2.7	>	1.7
Vegetable fertilizer N:P:K (kg/ha)	231:68:155	>	142:43:105
Pesticide cost/ha (Peso)	6673	>	4476
Average tomato yield (t/ha)	16.9	>	11.0
Gross vegetable output	36,866(±7,848)	>	19,452(±5,141)
Vegetable net return	4,000(±5,546)	<	6,850(±3,840)
Gross non-vegetable output	6,513(±1,422)	<	18,475(±6,526)
Non-vegetable return	2,917(±1,266)	<	9,152(±4,045)

to labour (including management) and money left for payment for fixed costs including land improvement (Midmore *et al.* 1996). Optimizing input use through better management practices should be the primary strategy to improve the sustainability of the HEN system. This would also maximize financial returns over the short- and long-terms. Conservation of nutrients and soil fertility, and cost-effect integrated pest management are obvious options, as is objective rotation avoiding sequences of crops from the same botanical family.

Responses between both groups of farmers to questions relating to their perceptions of soil erosion rates, declining fertility status, declining crop yields and living standards did not vary. Deforestation and current farming practices were identified as responsible for soil erosion, and contour farming and cover cropping were believed to be the most suitable practices to stem soil erosion. Contour hedgerows utilizing leguminous shrubs/trees were not considered suitable for implementation, largely due to their labor requirements, encroachment into already limited space for vegetable crops, and the perceived lack of need for biologically-fixed N, since nitrogenous fertilizers are widely used and P is probably the limiting nutrient.

Digressions Into Fallowing

One-fifth of farmers had land in fallow of one or more years' duration when surveyed in 1994. This was less than the proportion of fallowed to cultivated land (16.7% vs. 50% of total Manupali watershed area in 1994 (Kanemasu *et al.* 1997)) estimated through satellite imagery. Setting aside land for fallow within production systems may lead to some restoration of soil fertility. The opportunity arose to quantify possible benefits of fallowing to vegetable farmers in the Manupali watershed, for extrapolation elsewhere.

In addition to the formal survey in 1994, one-day voluntary hands-on visits were made by one member of our team to farms identified as having fallow during the survey. These visits were made to understand fallow systems. Using soil collected during the survey, compared to cultivated land, fallow lands were more acidic (pH 4.4 vs 4.9) poor in organic matter (1.4 vs. 3.8%) and inexchangeable K and Ca (2.8 vs 5.9, and 0.12 vs 0.58 meq/100 g respectively for Ca and K) and high in aluminum (1.21 vs 0.58 meq/100 g). Profitable short-term conversion of these lands into crop production would require ample fertilizers and soil amendments. Most commonly corn preceded land fallowing, itself following tomato or potato once bacterial wilt (*Pseudomonas solanacearum*) rendered land unsuitable for those species. Corn received low fertilizer input and utilizes residual

nutrient resources after vegetable cultivation, but a downward spiral of productivity and fertility ensues as ground cover in successive crops was constrained.

Following an average period of 3.7 years, fallowed lands were recultivated. Land intended for recultivation often had wild sunflower (*Tithonia diversifolia*) stems and seeds spread over it, on the assumption that it would restore fertility (Van Noordwijk *et al.* 1997). Sunflower might enable mobilization of Ca, P and K from the soil, and might promote non-associative nitrogen fixation, but these possible benefits remain to be proven. Some land was fallowed not only due to poor fertility, but also due to lack of labor and/or lack of capital for cultivation. Higher levels of disposable farm income, favorable government policies, changes in farmer attitudes and appropriate market infrastructure might lead to a loosening up in use and improvement of fallow land. Potential systems involving timber trees are outlined later in this paper.

Notwithstanding these, farms with fallow on aggregate showed a higher annual net return compared to farms without fallow (22,246 ± 11836 pesos vs. 7066 ± 3639 pesos) but to some extent this might reflect the less intensive nature (*i.e.* the LEN group) of production if land on larger holdings were available for fallow. However, cluster analysis separated fallow farms into two groups (Table 5.4), both of which fell into the HEN grouping (*i.e.* well above the 242:43:105 kg ha⁻¹ average for LEN). Marked differences between the two groups were evident for annual net returns; the group with larger more-capitalized holdings achieved greater net returns. Among the group with smaller holdings, two-thirds planted potato in 1993 and achieved yields of only 3.5 t ha⁻¹, thus, was largely responsible for break-even or negative returns to vegetables in that year (Table 5.4).

When the idea of planting trees on fallow land (more specifically just prior to fallowing) was suggested to farmers, their acceptance depended upon the ability to generate income, and not necessarily because of perceived improvements to their degraded fallow. If fallow lands truly are the least fertile, and our soil data suggest so, and they are on steep slopes, then land fallowing may be considered as an important step towards environmental sustainability, especially if land is permanently taken out of production. If the ratio of aggrading to degrading land area is greater than unity in the watershed, progress is being made towards a sustainable system. Planting of trees, on holdings with land in excess of that manageable with current labor or capital limitations to vegetable production, may over the medium-term raise income and reduce pressure on, and indeed the financial attractiveness of, vegetable production. Such scenarios as may raise the aggrading: degrading ratio are explored later

Table 5.4. Some characteristics of the two groups of farms with fallow land.

	Group 1 (n=4)		Group 2 (n=17)
Total land holding (ha)	16.3	>	5.6
Annual vegetable (ha)	2.1	>	0.44
Annual non-vegetable (ha)	12.0	>	1.2
Vegetable fertilizer N:P:K (kg/ha)	529:201:400	>	278:88:215
Gross vegetable output	130,256(±67,575)	>	18,821(±3,385)
Vegetable net return	79,071(±43,595)	>	-2,861(±2,542)
Gross non-vegetable output	120,280(±74,957)	<	6,640(±1,216)
Non-vegetable net return	42,363(±53,209)	<	3,674(±1,226)

in this paper. For smaller farms with no opportunity for tree planting, conservation technologies that stem soil degradation are the only options to enhance sustainability. Outcomes from experimental approaches to test these two options are now discussed.

Conservation Practices Acceptable to Farmers

Field trials on a purpose-rented research site, and on 12 farmers' fields throughout the vegetable production zone, were set up in 1995. Conservation technologies and cropping sequences were established on replicated erosion plots (19 m x 8 m), on an average 42% slope, and managed for seven cropping seasons. All technologies trialed were endorsed by 30 of the one hundred plus farmers surveyed, following feedback to the farmers of the key highlights from analyses of survey data. In essence, the technologies comprised: 1) the current practice of planting up and down the slope 2) planting on the contour, 3) planting vegetables up and down the slope but with 5 m strips of bean across the slope at 5 m intervals and 4) as with number 1, but with four two-row strips at 4 m in intervals of high value hedgerow crops planted on the contour. The high value crops were (from top to bottom of the plots): asparagus, pineapple, pigeon peas and lemon grass (replacing tea after the first season). On each technology plot was super-imposed a sequence of three vegetable crops, such that each technology x vegetables species was represented during each growing season. Close to three crops were planted per year on each plot, the trial with a sequence of seven crops lasting 2.5 years. Eroded soil, runoff and nitrate were measured after each erosion event, and soil

chemical and physical characteristics were determined throughout the experiment, as were inputs, and crop yields. Sampling of soil and crop yields within plots was undertaken systematically to reflect spatial trends within each set of measurements. Full experimental details are presented by Poudel *et al.* (1999b).

Average soil loss with the farmers' up-and-down cultivation (Table 5.5) was 50% greater than in the conservation practices. Our values are similar to those reported by Presbitero *et al.* (1995) for Leyte, Philippines. As contour hedgerows became established, they were more effective in controlling erosion. Indeed, within the contour hedgerows 71% of total soil lost over the entire experiment was lost in the first three seasons and only 24% in the last three seasons compared to values of 46% and 47%, respectively, in the farmer's treatment. Among crops, tomato led to more soil erosion than any other species tested (Table 5.6). This difference between species in their propensity for erosion was related to differences between their canopy cover and tillage operations. Similar differences between treatments and crops, were evident for runoff, but for nitrate in runoff water no treatment/species effects were apparent (Tables 5.5 and 5.6).

Most soil loss through erosion occurred during only a few erosive rainfall events. Of all the rainfall events (> 1.0 mm) only 6.5% resulted in measurable soil erosion, and three events were responsible for almost 50% of total soil erosion over the seven seasons. Such losses were evident at planting time when bare, or almost bare, soil was exposed to rainfall. In Laguna, Philippines 25% of annual soil loss was due to one rainfall event (Paningbatan 1994) and similar dependency of soil erosion on one or a few rainfall events, even measured over decades (*e.g.* in the Cameron Highlands of Malaysia - Midmore *et al.* 1996), is not uncommon.

Table 5.5. Effects of erosion control measures on cumulative soil loss, runoff and nitrate loss through runoff, averages per cropping season.

	Soil loss t/ha	Runoff 1000 l/ha	Nitrate kg/ha
Up-and-down	23.3 a	254 a	4.6 a
Contouring	13.5 b	147 b	3.3 a
Strip cropping	15.6 b	205 ab	3.5 a
Hedgerows	16.2 b	171 b	2.5 a

Values with same letter within a column not statistically different at P < 0.05.

Table 5.6. Effects of crops on cumulative soil loss, runoff and nitrate loss through runoff, averages per cropping season.

	Soil loss t/ha	Runoff 1000 l/ha	Nitrate kg/ha
Tomato	21.3 a	245 a	4.8 a
Corn	15.1 b	161 b	2.8 a
Cabbage	15.0 b	177 b	2.8 a

Values with same letter within a column not statistically different at $P < 0.05$.

Average enrichment ratios (ER - ratio of nutrient content of eroded soil to that of the source soil) for organic matter, P, Ca, S, and N were 1.2, 4.7, 1.7 and 1.3, respectively, while for other nutrients, *e.g.* K and Mg, they were both 0.8. The high value for extractable P prompts particular concern both for its possible adverse effects on downstream aquatic habitats and due to the inherently low P availability in all but the fertilizer-rich Ap horizon. ERs for P increased over time, while those for K and Mg progressively declined. The former was most likely due to addition of phosphate fertilizer, while the latter reflected the much lower concentrations of K and Mg in soil eroded from deeper down the soil profile. Total amounts of nutrients per hectare removed in eroded soil over seven seasons totalled 320-637 kg N, 1.4-2.9 kg P, 23-39 kg K, 71-139 kg Ca, 14-31 kg Mg and 8000 to 13500 kg organic matter. *In situ* soil at the end of the experiment was particularly deficient in organic matter, Ca, Mg, K (*e.g.* Table 5.7) and had a lower pH, declining from pH 5.8 (± 0.05) to pH 3.8 (± 0.04) throughout the experiment. Application of dolomitic lime and potash can remedy this loss except for loss of organic matter, yet it is the loss of organic matter that contributes much to the exchangeable K, Mg and Ca. The close correlations between yields of some crops and Mg levels across treatments (*e.g.* tomato, $r = 0.63$ $P < 0.01$) although involving self correlation with other soil variables, strengthens the argument for application of dolomite.

Marked spatial trends in soil fertility and crop yields within plots were noted. Scouring of upper reaches, and depositions lower down, were responsible for much of this. An example of differences between tomato yields on upper and lower halves of each plot is presented in Table 5.8. On average over the experiment, yields on the lower half of plots were 36% greater for corn, 40% for tomato and 78% for cabbage compared to those of the upper half. The lower upper yields were associated with less organic matter, P, total N, Ca and Mg, four-fold reduction in infiltration, and

Table 5.7. Some soil quality parameters compared across original soil (0-15 cm), eroded soil (during 7th season), and remaining soil after the 7th season (0-15 cm).

Parameter	Treatment	Original	Eroded	Remaining
Organic Matter (%)	Up-and-down	7.35	7.02	6.06 ns ¹
	Contouring	8.16	7.61	6.06 ns
	Strip cropping	7.32	7.16	5.79 ns
	Hedgerows	7.00	7.28	5.58 ns
P (meq/100g)	Up-and-down	2.98	26.63	10.21 ***
	Contouring	4.09	29.95	14.51 ***
	Strip cropping	3.74	23.31	8.99 **
	Hedgerows	3.86	22.74	8.42 *
K Cmol _c /kg	Up-and-down	1.04	0.29	0.26 ***
	Contouring	0.87	0.28	0.27 ***
	Strip cropping	1.01	0.29	0.27 **
	Hedgerows	0.97	0.31	0.25 ***

¹Difference between original and remaining soil.

Table 5.8. Tomato yields (t/ha ± SE) according to slope position over five cropping seasons (1-5).

	1	2	3	4	5
Upslope	20.8(5.1)	7.7(1.4)	9.9(2.3)	3.7(1.8)	13.3(3.3)
Downslope	25.9(5.1)	11.1(1.7)	14.2(2.9)	4.3(1.4)	23.3(4.1)

greater soil acidity and exchangeable A1. These data suggest that the overall impacts of erosion could be large even if soil per se is not removed by erosion from the fields and landscape.

The movement of nutrients and organic matter down the slope on contour plantings was less than in other treatments, with little differential deposition down the slope in the former. A scouring effect, *i.e.* digging into the slope near the lower side of hedgerows, was observed after a couple of seasons of hedgerow contour planting. Data illustrating the scouring effect across the natural terraces formed between the high

value hedgerows are presented in Table 5.9. The greatest loss of organic matter occurred in the upper portion of the upper mid-terrace of each plot, with maximum accumulation in the lower portion of the lower mid-terrace. These differences were matched by differences in yields (Table 5.9) and have been shown to occur on similar soils planted on the contour with perennial leguminous hedgerows species (Angus *et al.* 1997). Clearly the poorer upper sections of each terrace require nutrient replenishment.

Most importantly, yields per unit planted area for vegetable and corn were greatest in the contour and strip treatments; reasons for this are currently being investigated.

Table 5.9. Scouring effect on soil and yield in terraces formed naturally between high-value hedgerows, four hedgerows in each plot.

	Organic Matter (%)		Calcium (Cmol kg ⁻¹)		Corn (t ha ⁻¹)	
	Upper- side	Lower- side	Upper- side	Lower- side	Upper- side	Lower- side
Top terrace ¹		7.4		1.5		-
Upper mid	4.4	10.3	0.82	0.93	0.94	1.50
Middle terrace	4.9	10.6	1.01	1.85	0.80	1.40
Lower mid	7.7	10.9	1.30	1.03	1.20	1.60
Bottom terrace ¹		9.9		1.97		-

¹ Top and bottom terraces only half-sized terraces.

Some Exercises with EPIC Modelling

The Erosion-Productivity Impact Calculator (EPIC) Model (Williams *et al.* 1984), as a process-based model, and the Modified Universal Soil Loss Equation, were calibrated to Manupali watershed conditions to compare crop sequence scenarios in relation to soil erosion. In the near future, the model will also be modified to simulate all of the conservation treatments. The model was initialized with data from research plots and validated for farmers' plots (Table 5.10). Under-estimations (*e.g.* on the 23% slope) were due to the model's inability to estimate gully or ephemeral gully erosion, but otherwise the model provided reasonably accurate prediction of erosion, suitable for estimation of watershed

Table 5.10. EPIC model validation of annual soil loss (t/ha) for contour hedgerow system.

	Crop Sequence	Slope %	Annual Soil Loss	
			Measured	Simulated
Researcher-managed	Tomato-corn-cabbage	42	44.1	42.1
	Corn-cabbage-tomato	42	53.5	54.9
Farmer-managed	Sweet pepper-fallow-cabbage	20	13.4	11.8
	Fallow-corn-cabbage	23	18.2	14.5
	Fallow-cabbage-potato	33	34.0	45.3
	Cabbage-corn-potato	40	26.6	33.9
	Fallow-fallow-potato	62	19.1	23.6
	Fallow-fallow-fallow	20	23.7	22.9

erosion (and runoff - data not presented). Model simulations highlighted both the need to carefully manage tomato if planted in September, and the soil conservation benefits of planting corn at that time. Annual actual and predicted soil losses for identical cropping sequences on slopes of 44% were from four to six times greater than on 20% slopes, indicative of the proportionally greater attention that must be turned to conservation practices as slope increases.

Based on EPIC simulation results, the cropping sequence of tomato-cabbage-tomato resulted (98.3 t/ha) in nearly three times more soil loss than that of cabbage-tomato-cabbage (28.1 t/ha), indicating that consideration must be given to the crops and planting seasons when designing a multiple cropping pattern to minimize erosion on steepplands. The reason for low annual soil loss from the cabbage-tomato-cabbage cropping sequence is attributed to a greater canopy cover by cabbage than tomato during erosive rainfall events. Erosion from the system where corn followed cabbage in the autumn was nearly double than that where corn followed tomato. Corn responded through better growth to the greater

residual nutrients following tomato than cabbage, hence canopy cover by corn was greater with consequent reduction in soil erosion.

Compatibility of Trees with Vegetables

Financial rewards are attracting interest in planting fast-growing timber species among vegetable (and other) farmers. On larger farms, with land in long fallow, trees provide the ideal opportunity to gain financial returns, especially since fallowing alone is unlikely to markedly enhance soil fertility. Intercropping small trees and high-input annuals save on management costs and make the association even more attractive. A shift of a vegetable enterprise towards trees also alleviates current and anticipated labor shortages, for the management of trees after the first year's growth is not labor intensive. From an environmental perspective the ability of trees to ensure constant canopy cover over (at least part of) the soil, and a possible safety net effect to reduce nutrient loss through leaching, add to the attractiveness of associating a high-input system (vegetables) with an otherwise poorly resourced commodity (timber). Our research aimed to quantify the benefits of vegetables on trees, of trees on erosion, of different tree-management options, and the overall financial attractiveness of agroforestry. Set on three major sites, two directly in cooperation with farmers and one on rented land, our experiments addressed local farmers' concerns with agroforestry and vegetables. We compared the performance of various tree species alone and intercropped with vegetables, their population and pruning practices, and supplementary fertilization to trees. These were conducted over a number of seasons. Growth and yield of trees and vegetables, spatially referenced, were quantified, as was N use by way of 15N.

Tree growth over the two years of data collection was considerably greater when intercropped (*e.g. c.* 58 m³/ha vs. *c.* 27 m³/ha for non-intercropped trees) and, as side-dressing of trees made no appreciable difference to current tree performance, it is believed that the extra growth represented nutrient uptake in excess of that for vegetables. The degree to which intercrop yield decline was due to above- or below-ground competition from nearby trees was investigated. Applications of 15N fertilizer to sole vegetables, and vegetables at varying distances from *Eucalyptus torrelliana*, showed no differential uptake of 15N (all between 18-21% of applied 15N). Intercropped trees however, intercepted N that had leached, or would soon leach, past the vegetable root zone (Table 5.11). This most likely happens quickly in a 200 mm monthly average rainfall regime. Although there was apparently no competition for N, or any other nutrient based on foliar sampling, vegetable yields were

Table 5.11. Analysis of harvested tree parts (\pm SE) of *Eucalyptus torelliana* intercropped with cabbage.

	Dry Weight (kg)	N (%)	NDFFF* (%)
Leaves	0.86 (0.24)	1.99 (0.09)	10.05 (3.23)
Green branches	0.35 (0.76)	0.66 (0.11)	8.37 (1.94)
Woody branches	0.08 (0.04)	0.42 (0.07)	7.84 (2.27)
Stem	0.57 (0.14)	0.36 (0.06)	8.72 (1.65)

*Nitrogen derived from fertilizer.

reduced in the rows closer to the tree (by 25%). In part this was due to competition for light, for the canopy of *E. torelliana* is dense around the trunk. In addition, since rainfall was well-distributed over the sampling period, and competition for soil moisture was unlikely, it is possible that allelopathic compounds from eucalyptus root exudates were present. This possibility requires further investigation because of its potential impact on site quality.

Intercropped with the sparse shading tree species *Paraserianthes falcataria*, crop yields were constant across the 5-m wide alley, adding weight to the thesis that below-ground competition was minimal. That unfertilized trees did not reduce yield more than did fertilized trees further supports this viewpoint. In this system, intercropped yields did not differ from monocropped yields until the third season, when they were reduced by 18%. This coincided with the onset of enhanced growth in the intercropped trees. Until intercrop yields began to decline, the intensive nutrient and weeding management of the intercrops significantly reduced the costs of managing trees.

Data on intercrop performance from the various tree population trials all conform to the pattern illustrated in Fig. 5.1, for *E. deglupta*. Intercrop yields declined as stand basal area increased. The stand basal area (*i.e.* $\text{II}/4000 * \text{mean diameter breast height} * \text{No trees ha}^{-1}$) is commonly used to describe forest stand growth, and is easy to measure, correlating well before complete tree canopy closure with crown area and shading. Such data provide information on the anticipated loss in terms of vegetable yield as the tree grows, a set of values that can be compared with the percent of control yield that is still economic based on returns to vegetable production over the short-term. While we as researchers struggle with this, farmers may have an instinctive feeling for the balance. However, once the balance involves prediction of net profit over the duration of the tree rotation, farmers would be unlikely to correctly

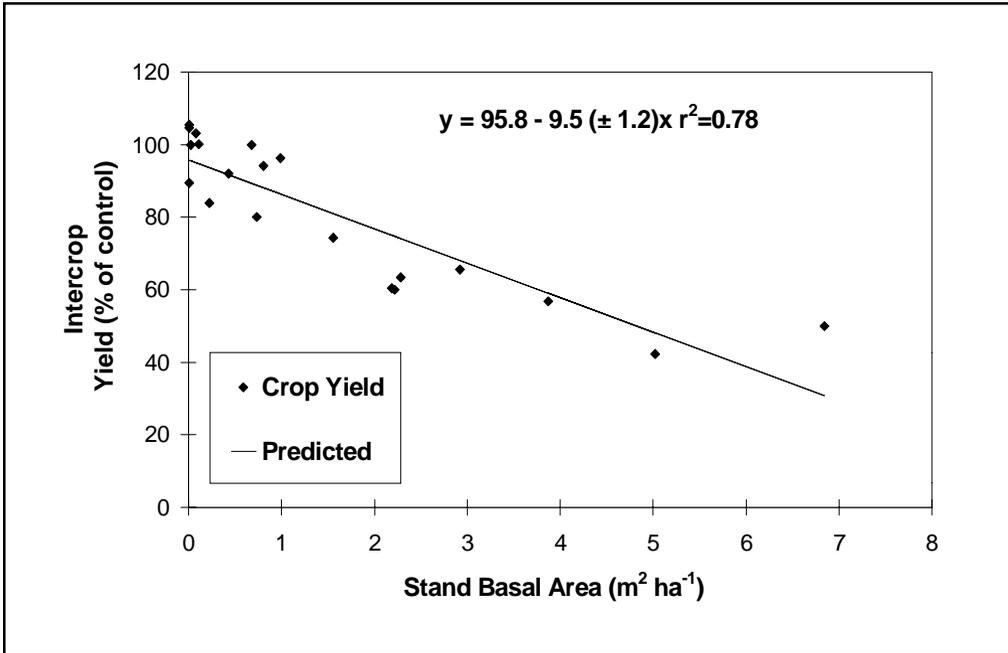


Fig. 5.1. Intercrop yields decline as stand basal area of *Eucalyptus deglupta* increases.

predict outcomes. Indeed, our data suggest that timber intercropping is not as profitable on a per area basis as high-yielding vegetables if one assumes that vegetable yields with continuous cropping do not decline (Table 5.12). As our data show that vegetable productivity does decline, and if labor availability follows current trends, then timber intercropping becomes increasingly attractive (Table 5.12). Added advantages of carbon sequestration and sale of carbon credits, conservation of soil resources and risk diversification to offset the possible opening of markets to import vegetables, also weigh in favor of timber intercropping.

Farmers interested in minimizing competition between trees and vegetables will need to confront both the above- and below-ground sources. Periodic pruning and increased fertilization (for P) near the tree are options. However, our data show that intensive pruning will slow growth of the tree, which is unacceptable for farmers with a priority to grow trees quickly. Similarly, moving the first intercrop row away from the tree limits the tree in accessing non-limiting nutrients, especially if the nutrient is leached before tree roots reach that far. These trade-offs are real, and need to be addressed experimentally to enhance efficient, and reduce competitive, use of resources.

Table 5.12. Projected effects of a four year rotation of (a) food crops only, (b) *Paraserianthes falcataria* (leguminous timber tree) only, and (c) intercropping of both for the first two years, on net present value of agricultural revenue (in Philippine Pesos), when unconstrained or constrained by fertility.

Rotation	Unconstrained	Constrained
Food crops alone	156356	80982
Forestry alone	17176	17176
Agroforestry	91766	81776

Conclusions

The magnitude of soil and nutrient losses, and their relationships with conservation practices, have been quantified in this study. Smaller, more intensively-farmed operations do not result in higher net profit for farmers, although they may, due to higher nutrient use, have better canopy cover and, therefore, less erosion per unit cultivated area. Higher input use may, however, be in response to soil degradation and cumulative losses of nutrients through erosion. Conservation practices reduced soil erosion by approximately one-half, and, though effective during the major erosion events, the level of soil conservation was less than hoped for. Scouring effects down the slope, even across naturally formed terraces behind the contour hedgerows, still require attention. Our data suggest that differential applications of dolomite and chicken dung (as a proxy for organic matter) may be called for. Crop yields were not disadvantaged by adoption of soil conservation practices, but full economic comparisons await final scrutiny.

For tree-vegetable intercrops we have quantified some of the interspecific interactions. Trees did not out-compete vegetables for below-ground resources in the first year. Indeed, they benefited from excess nutrients in the vegetable systems. The degree of competition for light can be managed by the farmer through varying planting density of trees, their planting geometry, and pruning. These results are of direct relevance to farmer cooperators, for the research upon which they were based focused on farmer needs.

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Chapter 6: Innovations in Participatory Watershed Resource Management to Conserve Tropical Biodiversity

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Introduction

Two decades ago it was commonly thought that protecting the environment in the tropics would entail a significant drag on economic development in developing countries. But in recent years the global consensus has shifted toward the view that environmental conservation is not in conflict with development, but rather is a crucial element of sustainable development. The conservation of biodiversity has now become a widely shared goal among nations, leading to the implementation of many projects to attempt to save natural areas from degradation or destruction (Keating 1993).

The classical method of preserving a natural area has always been to declare it off-limits and enforce exclusion. Boundaries are set and guards patrol. This often results in conflict and hostility between the enforcement agency and the local communities. Enforcement seldom worked because population pressure on the land was too great, or the costs of enforcement were too high. The modern approach of integrating conservation and development suggests that enforcement ought to be linked with some form of compensation to the communities that are directly affected by the presence of the natural area. This would enable them to recover some benefits from foregoing their use of the protected area (Wells and Brandon 1992). Conservation would only be assured if the management of protected areas is reconciled with the social and economic needs of local people. During the past decade there has been a rapid expansion in participatory watershed resource management projects and integrated conservation-development projects (ICDPs). However, the participatory mode is novel

and complex, and the implementers of such projects have little theory or experience to draw upon (Rhoades 1998).

In the Philippines, the passage of the National Integrated Protected Areas System (NIPAS) Act in 1992 was heralded as one of the most progressive attempts in the tropics to embody into law scientifically-advanced principles of establishing protected areas. But implementation has presented complex challenges. The Philippines' biodiversity heritage is globally valued because of the very high species endemism. The country's species inventory includes about 13,000 species of vascular plants (8,500 species of flowering plants, 3,800 trees), which is about 10% of the world total; 556 birds (6% of the world total), and 210 mammals (4% of the world total). However, 60% of the endemic Philippine flora are already extinct, and a great many other species are endangered. Despite a logging ban in virgin forests, and the presence of 64 national parks and 19 wildlife sanctuaries, the on-the-ground protection for these areas is nominal at best. The NIPAS Act aimed to remedy past deficiencies by focusing on scientific development of resource management plans for 100 priority sites, and mobilizing action at the local level to implement them. Resource profiles and resource management plans are to be developed for each protected area. The first stage is focused at 10 sites distributed across the country: The Mt. Kitanglad Range Nature Park in Bukidnon is one of the 10.

The Sustainable Agriculture and Natural Resource Management (SANREM) Program is a global research effort that aims to develop a new paradigm for research on sustainable agriculture and natural resources management (Hargrove *et al.* 1999). It is a paradigm that includes people, communities, and local government bodies as reviewers, partners, and implementers of research. It is a paradigm that takes the whole landscape and lifescape of a watershed as the basis for formulating and resolving major management issues. The approach seems well suited to tackling some key methodological issues in protecting the natural habitats of unique tropical biodiversity that are encountering human pressure.

One of the three global sites where SANREM has been working is the Manupali watershed on the southern border of the Mt. Kitanglad Range Nature Park in Central Mindanao, Philippines.

The Biodiversity Consortium at the Philippine site was a component of SANREM during its first phase (1993-98). It was composed of collaborating organizations including a university (Central Mindanao University), NGOs (including the Network for Environmental Concerns and Green Mindanao), and government agencies (including the Department of Environment and Natural Resources). The consortium was lead by the International Centre for Research in Agroforestry (ICRAF). Its objective

was to conduct research to develop tools and approaches to improve biodiversity conservation with the active involvement of the communities that live near the Mt. Kitanglad Range Nature Park. This paper reviews that experience. The following section discusses the global setting of Integrated Conservation Development Projects (ICDP) , highlights some of the key lessons learned so far, and proposes a theoretical framework. The subsequent sections review the SANREM experience in developing methods for achieving conservation with development in the Manupali watershed. The conclusion summarizes the progress observed and remaining limitations. It discusses future directions for integrated conservation-development in this location, and more.

The Global Experience

The SANREM Biodiversity Consortium began its work by drawing on the lessons learned from the global experience with ICDPs, particularly from the comprehensive review by Wells and Brandon (1992). That review examined the experiences of 23 ICDPs from around the world. All of the projects were attempts to reconcile the management of protected areas with the social and economic needs of local people. Some of the key lessons that emerged from these experiences are summarized in the succeeding paragraphs.

Cooperation and support of local people is the key. It has been frequently observed that communities near protected areas bear substantial costs in foregone use or extraction from the protected area, yet gain little in return. Local residents are usually poor and remote to normal government services. They perceive that the protected area restricts their ability to earn a living. They often see encroachment as a means to rectify this. International recognition of these realities gradually intensified through the Man and Biosphere Program of UNESCO in the 1970s, the World Conservation Strategy (1980), the World Commission on Environment and Development (1987), and was vigorously affirmed by the Rio Conference on Environment and Development in 1992. It is no longer considered politically feasible or ethically justifiable to exclude the poor from reserves without providing them alternative means of livelihood.

There must be explicit linkages between project components. Practitioners of ICDPs often assume that people made better off by a development project will refrain from illegal exploitation of a reserve

area, even if no enforcement is practiced. But there is no evidence to support this (Brandon and Wells, 1992; Kramer *et al.* 1997). An integrated approach with balanced attention to both enforcement and development is necessary. However, there are few examples so far of effective linkages between enforcement and compensation. This omission is seen as a serious weakness in most projects. In order to achieve the goals of protecting biological diversity and helping to improve the welfare of the people living near the protected area, it is necessary to pay very explicit attention to how the rural development activities directly support the objective of protection.

This linkage is often missing or obscure because, at project initiation there is a clear imperative to build trust and confidence between the implementation staff and the local people. Sometimes this must be done in light of an environment of significant prior mistrust. In such situations, there are obvious advantages in implementing confidence-building activities in which the village community senses a clear positive gain. Negotiated linkages with park protection regulations are deferred until later. In other projects it appears that the institutions involved (being oriented toward development) are uncomfortable with, or unaware of, how to link enforcement with development. This process involves negotiation, and some form of agreement between outside institutions and local institutions about rights and responsibilities. This issue of linkages in the circumstances of Kitanglad poses a major challenge.

Another difficulty is that some types of development initiatives can themselves increase the pressure on the reserve, rather than decrease it. Construction of a road, or growth in agricultural productivity, may have this outcome under some circumstances. Introduction of technologies that raise agricultural productivity will elevate land values, and may make it more attractive to encroach on to reserve land. Implementation of such 'double-edged' changes must be assessed carefully, and must be linked with clear and effective enforcement mechanisms. The lesson is that the development orientation of the ICDP approach does not mean that direct enforcement is no longer needed. Rather, it justifies making traditional enforcement mechanisms more effective. Enforcement from within the community may take a number of avenues. Our initial concept was that conservation agreements on a village-by-village basis appeared most likely to succeed. This was later supplemented by a much more comprehensive framework involving the natural resource management at the municipal, natural park, and ancestral domain levels.

Alternatives in promoting local development. Compensation to communities may take many forms. The ICDPs that were reviewed by

Wells and Brandon employed a diverse range of such mechanisms including agroforestry practices, crop intensification and irrigation, conservation farming practices, community forestry and others. Most projects attempted to encourage improved natural resource management practices in the areas outside the reserve. The objectives were to increase people's incomes, and to intensify their production systems away from the more extensive systems currently practiced. Agroforestry alternatives were emphasized in many projects. There is growing interest in the development of more intensive land-use systems on the margins of protected forests and the identification of policy and technology directions to underpin these efforts.

Migration and off-farm employment. In addition to boundary enforcement mechanisms through local participation, and technical innovations to increase land-use intensity, there are two other important factors impinging upon protection of natural biodiversity areas. These are: controlling in-migration and off-farm employment influences. If in-migration is occurring, the accelerated population pressure will destabilize the balance between intensification and enforcement. Migration must be controlled in the communities on the boundary. In some areas this has been successfully achieved in mature communities through local land tenure systems (see Cairns (1994), for an example in Minangkabau communities on the boundary of the Kerinci-Seblat National Park in Sumatra, Indonesia). But in most pioneer communities, local control of migration is problematic. Conditions in the wider economy play a major role in affecting migration. Off-farm employment for residents living in the buffer zone may be increased or decreased. The park protection problem may thus be seen as a function of four factors:

$$\text{Protection (P)} = f(\text{E, I, M, OFE})$$

where E is boundary enforcement, I is intensity of land use, M is migration, and OFE is off-farm employment. ICDP or watershed management programs must consider the implications of all of these factors and their interactions.

Integrating Conservation and Development in the Manupali Watershed

Biodiversity Value

The Manupali Watershed in Bukidnon, Philippines, is a microcosm of farm families and communities whose diverse vocations exert pressures on both the natural and managed ecosystems, particularly on the remaining protected forest of the Mt. Kitanglad Range Nature Park. The Park is acknowledged as one of the most important biodiversity reserves in the Philippines. It supports the richest known vertebrate fauna (mammals and birds) in the country (Amoroso *et al.* 1996; Heaney, 1992, 1993). 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*.

The Park is a relatively small ecosystem of approximately 50,000 ha, but is also of exceptionally high conservation value in terms of high endemism of the vascular flora (Amoroso *et al.* 1996; Pipoly and Masdulid, 1995). This includes the endangered rootless vascular plant (*Tmesipteris lanceolata* Dang.) (Amoroso *et al.* 1996). The Park has been found to have the highest tree density ever reported in a tropical forest (Pipoly and Masdulid 1995). This combination of a small, manageable size, and a rich, singular biodiversity, conforms to the type of protected ecosystem that Sayer (1995) proposes ought to receive the most determined attention in tropical biodiversity protection. Amoroso (1997) has, however, noted the alarming rate of habitat destruction due to human activities including illegal cutting of trees, over-harvesting of minor products, shifting cultivation, and conversion of forest lands to agricultural production.

The Watershed

The present landscape of the upper reaches of the Manupali watershed consists of essentially three belts of land:

- 1) *The national park*, consisting mostly of pristine forested land existing at high altitudes (>1200 masl) with few current household land claims and National Park status,
- 2) A zone of land surrounding the Park that is managed by the Department of Environment and Natural Resources (DENR) as

production forest: *this is the external buffer zone* of the Park. This is land on the fringe of the forest and has now been mainly converted to agricultural fields interspersed with *imperata*-dominated grassland. Encroachment here has been partly sanctioned through the expectation of social forestry stewardship contracts, with eviction no longer a tenable management option, and

- 3) *Privately-owned agricultural land* that is further downslope from the public DENR lands. These landholdings comprise a mosaic of agroforest, crop, and fallowed fields, with remnant forest existing in the steep ravines which border the streams that drain the national Park.

The Farm Communities

The Participatory Learning/Lifescape Appraisal (PLLA), and our research during the initial years (1993-96), documented the land use practices in the forest margins of Mt. Kitanglad Range Nature Park, and the high rate of slash-and-burn farming in the remaining forest (COPARD 1996; Banaynal 1996). This work highlighted the urgent need to develop an integrated sustainable buffer zone management program. It is commonly assumed that the interests of local communities living in the environs of protected ecosystems are diametrically opposed to those of outside stakeholders concerned with global biodiversity (Wells and Brandon 1992). Our research, however, provided evidence that this is an overly pessimistic assumption, at least in the context of Manupali (Cairns 1996). There is, in fact, significant self-perception among communities on the boundary of Mt. Kitanglad Range Nature Park that the protection of the natural biodiversity is in their own self-interest, particularly among the *Talaandig* indigenous people, who regard the public lands as their ancestral domain. These values are articulated by local people as protection of the hydrological resources of the upper watershed for their water supplies, and of the spiritual and cultural values of the forest, among others. The current failure to protect these resources appears to be due in large part to the lack of institutional mechanisms that provide a framework for management of these systems. Such mechanisms must explicitly include local interests, and address practical local needs for alternative livelihood directions. Lack of secure land tenure by the households residing in the buffer zone outside the park boundaries is a critical limitation to generating among them a perceived stake in park protection.

The Project Framework

The project goal was to elucidate a more fundamental understanding of the people-ecosystem interactions that would lead directly toward development of practicable natural resource management plans and processes. The research aimed to develop the necessary elements of a workable *social contract* between buffer zone communities and the non-local stakeholders at the national and international levels concerned with resource protection. We asked: “What is a practicable social contract? And, what are the processes leading to its successful implementation?” We sought a model of buffer zone management that works, and that could be extrapolated to other protected forest situations.

We hypothesized that there are two essential conditions for sustainable buffer zone management and biodiversity conservation in the Mt. Kitanglad Range Nature Park, and other protected areas in the tropics:

- 1) Agricultural/agroforestry intensification in the buffer zone that enhances income growth on static land resources, complemented by other forms of off-farm employment generation in the local and national economy, and
- 2) Community-supported enforcement of the boundaries of the natural forest ecosystem.

Our work focused on both aspects. The first investigated appropriate technical innovations suited to the biophysical and socio-economic conditions of the buffer zone. The second studied how to induce institutional development based on local and national realities. The social contract underlying the model links the provision of assistance in intensifying agriculture to local responsibility for park boundary protection. The following section reviews some key aspects of the characterization of the watershed, after which we review the work on technical innovations. Subsequently, we examine the institutional innovations for participatory resource management.

Enhancing Agrodiversity

Agriculture is the dominant livelihood of people living in the villages near the park, as is the case with most other protected areas in the tropics. Intensification of the agricultural systems in the vicinity of the park is crucial to providing alternative livelihood means to alleviate encroach-

ment pressure. There is growing interest in the development of more intensive land use systems for forest margins all over the world. ICRAF is coordinating a global research program on Alternatives to Slash and Burn that seeks to identify policy and technology directions to guide national efforts (van Noordwijk *et al.* 1995).

Agroforestry systems have frequently been cited as a path toward appropriate intensification in the buffer zones of protected areas (Wells and Brandon 1992; Garrity 1995). The planting of useful tree species is often a highly desired intervention by recipient communities near protected areas. Provision of tree germplasm through nursery programs has therefore been one of the most popular ICDP development interventions. Farm families can increase their nutrition and economic welfare through a greater quantity and diversity of fruit and timber trees on their farms (Garrity and Mercado 1994).

Where there has been a history of tree crop cultivation in the vicinity of a protected area, the environment of the farming zone outside the boundary develops ecologically favorable characteristics for protection, and even extension, of the biological diversity of the park itself. The *damar* agroforest systems on the boundaries of the Barisan National Park in Lampung, Indonesia, harbor a major proportion of the natural rainforest flora and fauna species (Michon *et al.* 1995) and effectively act as a continuation of the biodiversity of the park into the agricultural landscape. Rubber agroforests on the boundary of Kerinci-Seblat National Park in Jambi Province of Sumatra play a similar role (van Noordwijk *et al.* 1995). Even in areas where smallholder agroforestry systems do not yield such striking levels of protection or extension for natural biodiversity, the benefits of increased tree cover on the watershed functions of the landscape may be important.

The boundary area of Mt. Kitanglad Range Nature Park is located at an elevation (600-1700 m), where temperate vegetable crops (including potatoes, cabbages, and tomatoes) are quite productive. Vegetable production is expected to further expand dramatically in the future. Our analysis indicated that the most likely future trajectory for farming systems in the buffer zone is toward continuous vegetable production on a portion of the farm (0.1-1.0 ha), with perennials (timber or fruit trees) grown on the remaining farm area, particularly on the steeper parts. A farm planning exercise with 67 families in three buffer zone villages (COPARD 1996) found that their greatest interest was in establishing contour hedgerows on the annual crop areas of the farm, and increasing the area of fruit and timber tree crops on the

remainder. The farmer-participatory research effort backstopped this self-perceived vision. The consortium focused on three technology-related initiatives:

- the enabling environment for smallholder tree production;
- participatory contour hedgerows initiative; and
- intensifying indigenous fallow management.

These research activities were implemented to develop sustainable agricultural systems in the upper watershed. They were seen as key components of the evolving social contract. The following sections briefly review the progress in these initiatives.

Enhancing Smallholder Tree Production Systems

Prior attempts to reforest the buffer zones of protected forests in the Philippines tended to focus on the public sector (DENR) and the planting of large blocks of trees with local wage labor. These tree plantations were then guarded against fire and encroachment. Such a project was implemented in the Manupali watershed during the late 1980s before SANREM began. Like many other such top-down attempts, it was a failure. The plantations were burned out, often by local smallholders, across whose land the trees were planted. Only a few small remnant stands now remain in the 'reforested' area. Meanwhile, there is overwhelming evidence that smallholders will enthusiastically plant trees on their own farms if they have some semblance of tenurial security. There is increasing acceptance of the idea that smallholders are the key to future reforestation efforts in the tropics (Pasicolan 1996; Garrity 1994). Research in Northern Mindanao (including Lantapan) has documented a major transformation toward smallholder timber tree production in this region in response to market development (Garrity and Mercado 1994).

The approach we are testing is to ensure that the demand for trees and tree products is strong, that market infrastructure is adequate to keep marketing costs low, that price information is widely available, that improved germplasm is available of a variety of species to enhance yield and reduce risk, and that best management practices suited to local farm circumstances are in place. Our initial work focused on determining an appropriate mix of species of interest to farmers, and testing diffusion strategies to incorporate them into farming systems rapidly and cost-effectively. A farming systems survey (COPARD 1996) and our previous training exercises (Koffa and Garrity 1996) indicated that farmers in the buffer zone and on private lands were very interested to expand the area

of timber trees on their farms. The constraints to accelerating the process were the lack of low cost and convenient seedling supply, knowledge of which species were most profitable, appropriate tree management, and availability of a wider range of tree germplasm to diversify risk.

Farmers currently have a very limited repertoire of potential timber species. We conducted a farm survey that resulted in a comprehensive database on multipurpose tree species performance by elevational belt in the upper watershed, based on participatory rural appraisal methods (Glynn 1996). The most common timber species planted in the upper watershed were *Pereserianthes falcatera*, *Gmelina arborea*, and *Eucalyptus camaldensis*. Farmers observed that *Eucalyptus* species performed particularly well at the buffer zone elevation levels (Glynn 1996). We introduced germplasm of a range of other fast-growing timber species, with emphasis on new accessions of *Eucalyptus deglupta* and others. This was followed by the development of a series of trials to evaluate available commercial species for performance by elevation. This work is being complemented by investigations to domesticate a number of local species identified and used by farmers for timber (Palis 1997).

What is the best approach to getting tree seedlings to farmers? We are experimenting with three types of smallholder nursery systems and how they may be mutually reinforcing: private small-scale nurseries, neighborhood or *hugpong* nurseries, and village-level nurseries. By implementing nurseries with enthusiastic partners at all three scales we are developing case study experience and general guidelines to inform the private and public sector about more effective nursery development (Koffa and Garrity Chapter 10, this volume).

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 *Talaandig* 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. When introduced by seed or stem cuttings into recently abandoned dryland or burned *Imperata*/fern areas, these *Compositae* species formed dense thickets within one year. They are aggressive, pioneer colonizers that will dominate fallowed fields with minimal farmer intervention if conditions are favorable for their growth. Farmer management of wild sunflower, *Tithonia diversifolia*, as a green manure crop was widespread among the Igorots in Northern Luzon (Maslan 1989; Bawang 1995; Ferrer 1996). Igorot migrants brought this technology with them to Lantapan. Awareness of its agronomic potential has helped gradually spread information among the wider area of the farming community. Farmers are manipulating wild sunflower as a biological tool to eradicate *Imperata* and rehabilitate degraded grasslands. They claim that at the end of the first year, the *Imperata* was almost completely controlled and displaced by sunflower; by year two, the sunflower fallow could already be re-opened and grown without fertilizer inputs. We are validating this practice as a prelude to dissemination of this practice in the watershed and elsewhere (Cairns and Garrity 1999).

Getting Conservation Farming on the Land

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 buff strips reduces these losses by 50-99% and creates natural terraces that stabilize the landscape and facilitate further management intensification. These advantages have led to wide promotion of contour hedgerow systems by the DENR and the Department of Agriculture (DA). But adoption has been poor, and installed hedgerows are usually abandoned. This is because the increased labor demands in managing tree hedgerows were 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 were exceptionally effective in soil conservation. They required minimal maintenance and required 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 have observed that almost 300 farmers have adopted the technique in the upper watershed. NVS technology seems particularly well-suited to vegetable farming systems because there is a little possibility of competition between the NVS and the crops.

In summary, we observed that there have been advances in all three technical areas we've been investigating (tree farming, improved fallows, and contour buffer strips). They have immediate potential to help farmers in the buffer zone intensify land use and increase profitability, while reducing resource degradation. These practices are now backstopping the institutional innovations by providing pragmatic alternatives to encroachment in the national park. We now turn to the process of evolving participatory institutional innovations.

Assembling the Elements of a Social Contract

The foremost policy issue impinging on local natural resource management systems in the area is the reality of overlapping land rights and management priorities. There are three sets of overlapping management claims and systems in the case of the Kitanglad Range Natural Park. These are the jurisdictions of the six municipalities that surround the Park, the Park and production forest land administration of the state (DENR), and the ancestral domain claim of the *Talaandig* people (see Fig. 6.1.) The conflicting claims must be reconciled, and effective management plans developed and implemented by each of the three types of entities.

Each municipality surrounding the Park includes a portion of the Park area, and a portion of the buffer zone, that is legally a part of its land area. As the seat of local government, the municipalities play very important roles in influencing the ultimate fate of land use within their borders. The Park itself was gazetted only a few years ago (1996), and a Protected Area Management Board (PAMB) was instituted to guide its administration. The PAMB is composed of the Park administrators from the DENR, the mayors of the six municipalities, and representatives from a range of other agencies and stakeholder interests, including an NGO

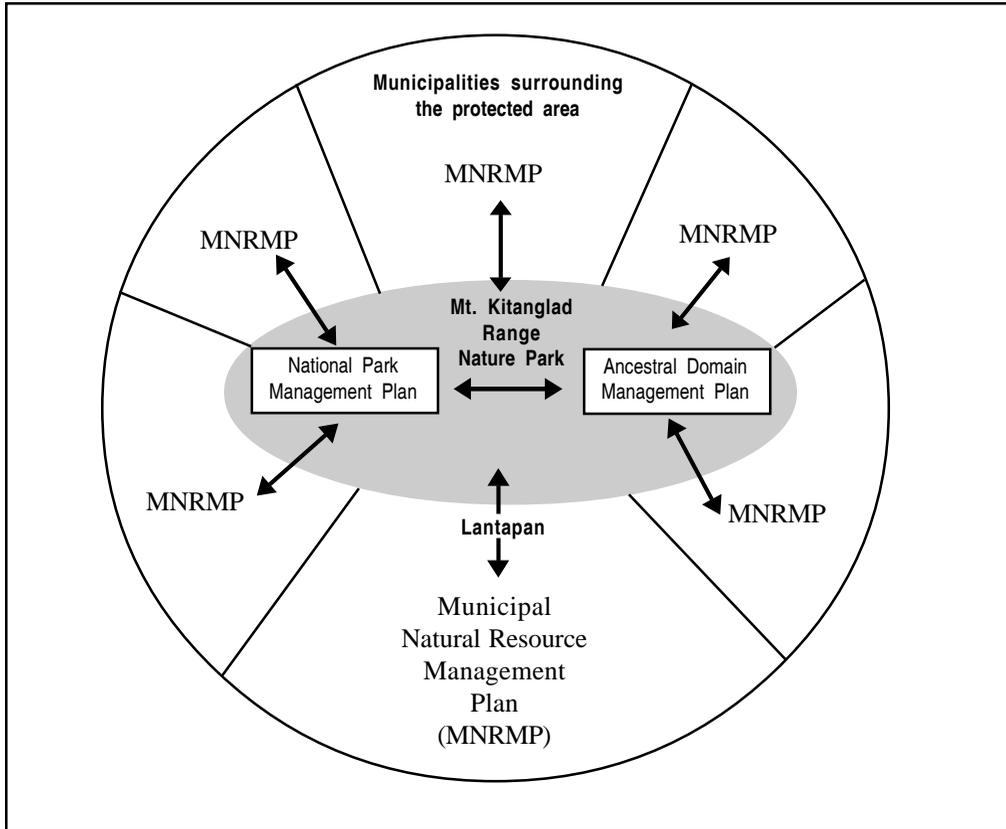


Fig. 6.1. Diagrammatic representation of the linkages between three types of natural resources management plans.

specially created to facilitate park management, the Kitanglad Integrated NGO (KIN). Much of the area of the Park and buffer zone also falls within the constitutionally protected indigenous rights of *Talaandig* communities. Tension between *Talaandig* control over the management of ancestral areas, and the conservation priorities expressed by local government and park management, is a critical consideration to promote sustainable resource management.

SANREM research has focused on understanding ways in which the three overlapping jurisdictions can be reconciled, and in developing a scientific basis for management plans by the three sets of entities. The first five-year phase of work concentrated on two components. The first focused on assembling the information needed to guide the development and implementation of a natural resource management plan for the Municipality of Lantapan. The second aimed to analyze the ancestral domain claim of the *Talaandig* people in relation to the natural resource

management issues of the natural park and the surrounding municipalities. It became clear that the interactions between the three domains (the Park, the ancestral domain claim, and the municipalities) must be resolved. The work aimed to provide options leading to a consensus that would meet the various stakeholders' concerns.

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. It will be coordinated with an ancestral domain management plan, that in turn is consistent with individual municipal-level conservation plans. This will be backed up by conservation plans developed at the village level. The following sections review the current status of that work.

The Ancestral Domain Claim

The Philippine community forestry program is designed to address the needs of the nation as a whole as well as those of local communities that depend upon and have clear rights to forest resources. Central to this approach is the development of a package of options government now offers local communities, a package that in many ways is not unlike what is offered forest industry. Foremost is the right to exploit forest resources in selected secondary forests. But unlike the forest industry, many local communities have long-term traditional rights over their land classified by the state as forest — rights that must be considered during the development of tenurial instruments for local people.

Villagers, universities and NGOs in Indonesia and the Philippines have developed a two-stage approach to promoting secure tenure for communities that hold ancestral rights. The first entails work within the state regulatory framework and promotes the granting of limited use and management rights to local individuals or communities. This responds to the immediate need for halting the conversion of ancestral lands to large-scale forest concessions while at the same time supports sound management of these areas. The second stage is a long-term legal and political struggle by local people to gain legal recognition that their lands have been misclassified as state forest zone and that in fact private rights are attached to these areas.

The community forestry program also includes opportunities for local people to be central players in the management of protected areas, particularly national parks. The National Integrated Protected Areas System (NIPAS) enabling legislation explicitly supports the rights of Indigenous Cultural Communities (ICCs) who are living within NIPAS

sites. While this law has opened the door for ICCs to participate in the development and implementation of conservation areas within their ancestral areas, many questions, such as the processes that will lead to complementary management approaches remain unanswered (Dagondon *et al.* 1997).

In 1994, a group of *Talaandig Datus* (community leaders) prepared and submitted a *Talaandig* ancestral domain claim covering more than 40,000 ha. The claim includes the entire Kitanglad Park and surrounding buffer zone. In May of 1996, the Provincial Special Task Force on Ancestral Domain, chaired by the DENR and responsible for the recognition of ancestral domain claims and the awarding of Certificates of Ancestral Domain Claims (CADC), delayed action on the *Talaandig* claim. It requested an endorsement of the claim by the Kitanglad Park Area Management Board (PAMB), a group made up of local government officials, community leaders, government line agencies, and non-governmental organizations. After considerable deliberation, the PAMB opted not to take action, sending the claim back to the PSTFAD without an endorsement. As this process unfolded, several mayors of municipalities bordering the Park began to promote a process that would lead to ancestral domain claims that are based upon municipal boundaries, as opposed to the one unified claim. The PAMB, organized a consultative process aimed at determining the best way for the *Talaandig* to proceed with their ancestral claim. Some *Talaandig* leaders assert that PAMB and local DENR used consultation formats that have favored efforts to promote municipal-based claims. As organizing on both sides of this issue continues, no aspect of SANREM community-based research and the IPAS community organizing work is unaffected. There is a need for clear guidelines for how consultations with local communities are conducted. It is possible that such guidelines could draw from similar work that is being done on how best to determine when “informed consent” of local communities has been genuinely gained.

Native belief that nature is controlled by a hierarchy of spirits whose wrath must be avoided, guides the tribes in a respectful attitude to the environment (Cairns 1996). Indigenous practices such as safe havens for wildlife, preservation of keystone tree species, and restricting swidden size indicate a conservation approach to resource management. The tribes reacted to the degradation of their ancestral lands in 1993 by organizing and creating a network of ‘tribal guardians’ to maintain vigilance on the forest margins. Some seizures of poached lumber have been made and the initiative appears to be gaining momentum. The community-based park protection (CBPP) that is evolving spontaneously in these forest margin villages is internally-driven and has been enabled by reviving and

strengthening existing tribal institutions. This determined and highly organized surveillance of the forest warrants recognition by DENR, and argues for further empowerment of these communities by formally decentralizing forest protection to their control.

The tribes' demonstrated commitment to conservation suggests that granting them ancestral domain would not be antagonistic to National Park objectives. Rather, it could form the basis of a contractual agreement in which the tribes would guarantee protection of the forest margins in exchange for commensurate development programs. The cultural diversity of the tribes has contributed to maintenance of the Park's biodiversity, suggesting that cultural conservation should be an integral goal in National Park protection. Our findings indicate that while both *Talaandig* and migrant settlers are guilty of park and watershed encroachment, the *Talaandig* communities represent the best bet for implementing sustainable land use systems that protect the integrity of the park. Research among a number of *Talaandig* communities has revealed indigenous traditions and experience in implementing land use systems that aim at maintaining a balance between natural resource extraction and forest conservation. Consensus has emerged that the policy question that now needs the greatest attention is: "How does the *Talaandig* ancestral domain claim and the management of lands under the claim relate to the conservation objectives of the Mt. Kitanglad Range Nature Park?"

As the SANREM Biodiversity Consortium pursues its work to develop methods for buffer zone management, it was judged opportune to hold a national meeting through which the Consortium could help synthesize the current status of such work elsewhere in the country, and share its experiences with others facing common concerns. The workshop, held in 1995, reviewed the principles and national experiences in buffer zone management and agroforestry. It identified lessons that could be applied in current and future buffer zone management programs, fostered closer linkages, and planned follow-up action that will accelerate the successful implementation of buffer zone programs in the Philippines (Garrity 1996).

A Model for Municipal Natural Resource Management Planning

SANREM research in the early years evolved a knowledge base to contribute to the development of a scientifically-based natural resource management process. In late 1995, discussions on this led the Mayor of Lantapan to commit human and financial resources to the development and implementation of such a plan, for which there was no precedent in the Philippines (Catacutan *et al.* 1999). Authority was derived from the Local

Government Code of 1991, which had devolved numerous functions and responsibilities to the local governments from the state. In 1996 a Memorandum confirmed SANREM's commitment to provide technical assistance using the research outputs in the development of the municipality's Natural Resource Management and Development Plan (NRMDP).

The Lantapan municipal government created a multi-sectoral Natural Resources Management Council, and a local planning team. The planning program involved an iterative learning process. That experience identified a number of innovative features and important lessons for participatory and local NRM planning. The draft plan was circulated and subjected to public hearings, and enacted by the Municipal Council in early 1998. The municipal government has currently allocated 5% of the municipal budget for plan implementation. Ten villages within the municipality have also allocated an average of 10% of their budgets for activities related to the plan. The initial impact of the plan may be seen in terms of a number of new policies and regulations related to resource conservation, and a number of activities that were implemented to conserve land, water, and biodiversity.

In 1998, as the plan was being finalized, the DENR recognized the Lantapan experience as a national model for natural resource management planning that is based on local demand and voluntary action, in the *Philippines Strategy for Improved Watershed Resources Management* (DENR 1998). The plan is now being implemented based on public-private partnerships. All stakeholders involved in the planning process were called upon to participate in the implementation of the plan. A formal partnership was forged by the local government and various stakeholders in implementing the plan through a Memorandum of Understanding signed by all concerned parties.

ICRAF's technical contributions to the plan stemmed from its research on agroforestry, conservation farming, and biodiversity conservation. For example, numerous steep ravines emanate from the Kitanglad range out into the agricultural landscape. These valleys are the least disturbed part of the agricultural landscape, 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 (1996) developed a methodology to survey and map the vegetative communities of major ravines of the Alanib River. She 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 was 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.

ICRAF is currently doing an assessment of the planning process, and publishing a 'how-to-do-it' booklet on the process for other municipalities around the country. The Lantapan experience is a significant advancement in municipality-led and participatory local NRM planning. We are now seeing the model implemented in other municipalities in Bukidnon and in other provinces. It is a significant step in the decentralization of planning and management to the local level and a shift from traditional top-down planning approaches towards participatory multi-sectoral planning and research-based decision making.

Landcare Movement Mobilizes Grassroots Conservation

The villages immediately surrounding the protected area are on the conservation interface. They are embedded physically in the competing jurisdictions of the local municipality, the state (their farms often occupy land claimed by DENR), and the ancestral domain claim. In terms of on-the-ground enforcement of the park boundaries, we observed that the villages tended to occupy one or more interfluves (land between two streams). They occupied the areas between the ravines of respective streams emanating from the mountains. 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.

Ultimately, the success of natural resource conservation depends on the support of the villagers. This is dependent upon a strengthening of a conservation ethic at the community level, the successful adaptation and adoption of conservation-oriented and more productive farming practices, and ultimately, the development of conservation agreements at the village level (Garrity 1995). Our hypothesis was that village-level landcare organizations may be a key to knowledge-sharing, and to building community approaches to natural resource management problems.

ICRAF had facilitated a farmer-led approach to technology development and dissemination in Claveria, Northern Mindanao that began in 1996. It resulted in an unexpected boost in farmer adoption of soil conservation technologies and agroforestry (Mercado *et al.* 2000). The institutional innovation that drove the process was the Landcare movement: a federation

of community organizations developed and led by farmers. The movement attracted strong support from local government and technical support from NGOs. Landcare started as a method to rapidly and inexpensively diffuse agroforestry practices among upland farmers, based on the farmer's innate interest in learning and sharing knowledge about new technologies that earn money and conserve natural resources (Garrity and Mercado 1998). The movement is composed of self-governing groups of people concerned about land degradation problems, and interested in working together to do something positive for the long-term health of the land. Today, there are more than 5,000 farmers in Claveria, Misamis Oriental, and in 14 other municipalities in five provinces who are members of the Landcare Associations. These farmers are maintaining hundreds of voluntary fruit and timber tree nurseries and are actively doing extension work to disseminate conservation farming technologies to fellow farmers.

The core of the Landcare model is effective local community groups and partnership with government (Mercado *et al*, 2000). Groups respond to the issues that they see as locally important, solving problems in their own way. In other words, Landcare depends on self-motivated communities responding to community issues, not issues imposed by any external agency.

The Landcare approach was introduced in Lantapan in 1998, through networking with the local government and the extension agents based there. Farmer training and assistance in the organization of Landcare chapters was provided by ICRAF. There are currently 60 Landcare groups with a total of over 1,000 members, most living in the villages near the Park boundary. The groups have formed a federation in order to share information and plan larger-scale activities. The municipal and village governments actively and financially support the Landcare groups through annual budgetary allocations. The chapters have stimulated the development of over scores of nurseries for timber and fruit trees, and fostered the adoption of contour buffer strips on nearly 300 farms (see previous section). They have begun community-wide environmental protection by assisting in the planting of thousands of trees to develop the riparian buffer zone along the Kulasihan River, which is suffering the most severe pollution problems in the municipality. The movement is continuing to expand rapidly, and a major review is underway to assess its experience. During the current phase of the project the potential for Landcare to be a means to evolve community support for national park protection will be tested.

In Australia, the Landcare movement, which began in the late 1980s, is now composed of over 4500 groups, with strong support from the local,

state and federal governments. About one in three Australian farmers are members. Consciousness and support for Landcare is also ubiquitous in the urban population. Increasingly, the focus is shifting to catchment management through the participation of Landcare groups. This is a direction that is becoming evident in Landcare in Mindanao as well.

Conclusion: Putting the Pieces Together

Significant progress has been made in assembling the elements for an effective social contract to protect the natural biodiversity of Mt. Kitanglad Range Nature Park. As a result of the dramatic increase in environmental awareness in the communities surrounding the Park, due to the Landcare movement and the implementation of the municipal plan for natural resource management, there has been a dramatic decline in the incidence of encroachment into the Park. But constraints remain to be overcome. These constraints mainly involved institutional limitations, rather than the technical ones. Key among these are continuing confusion over government lines of responsibility and authority, and overlapping and potentially contradictory land use processes. Processes for resolving these conflicts have not yet been developed. This is one of the major areas on which we are now concentrating further research efforts. The Lantapan Natural Resource Management Plan, for example, in spite of its very impressive technical detail, does not address the issue of the ancestral domain claim within the municipality. Rhoades' (1998) has pointed out the unwieldiness of decision-making bodies that are composed of a wide array of stakeholders are evident in the limited effectiveness of the Protected Area Management Board. These issues need to be addressed.

It was mentioned earlier that there were few examples so far of effective linkages between enforcement and compensation, and that this omission is seen as a serious weakness in most projects. Our work has not yet succeeded in overcoming this weakness. Experience indicates that a gradual progression toward this linkage may often be necessary. There is clear evidence however, through the strong support for natural resource management planning and implementation, the grassroots Landcare movement, and other evidence, that a conservation ethic is evolving rapidly within the community. Biodiversity protection is gradually being viewed as a responsibility but with pride.

These developments point to the evolution of a demand-driven and community-based approach to the management and sustainable utilization of local resources for multiple purposes; and the extension of responsibility

for national park management beyond the limited area of jurisdiction of the Park out into the agricultural landscape of the surrounding communities. It is increasingly accepted that in the future local government units will assume more responsibility for planning, implementation and evaluation of these activities within their areas with the guidance and support of national institutions. Many methodological challenges are still evident in fostering these processes.

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 continue to try to provide useful guidance to the IPAS program. The Bukidnon Watershed Management and Protection Council, and the Bukidnon 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.

We are currently working with these bodies 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.

Part of our efforts are directed to scaling-up to the global level. Our work is linked 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. 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 are sobering. Their conclusion is that such approaches must be reinforced and expanded simply because there are so few viable alternatives. This makes the issue of improving their performance such an important one.

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Chapter 7: **Community-based Water Quality Monitoring: From Data Collection to Sustainable Management of Water Resources¹**

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Introduction

The following is an account of how a rural community in the Philippines worked side by side with researchers, nongovernmental and governmental workers over a five-year period to develop science-based indicators of water quality that proved relevant for developing environmental policy. The case primarily focused on the early stages of implementing a municipal-level, natural resource management plan in Lantapan. The setting and background of the project are briefly described, followed by the nature of specific indicators and how they were chosen and refined. Next, the process by which these indicators

¹ The water quality project described in this chapter was implemented through the International Center for Aquaculture and Aquatic Environments, Auburn University. Work plan collaborators included Heifer Project International/Philippines (co-principal investigator of the project), Central Mindanao University, the San Herminigildo Agro-Industrial School, Inc., the National Power Corporation and the Provincial Planning and Development Office of Bukidnon, and the University of the Philippines Los Baños. Most of the field work was conducted by the Tigbantay Wahig, Inc. people's organization of Lantapan, Bukidnon, Philippines. Honorable Mayors Teddy Pajaro and Narciso Rubio and the Municipal Council of Lantapan are acknowledged for their partnership in this work and for beginning to apply the pertinent findings of the project.

influenced policy are documented, concluding with lessons learned throughout the process.

Materials for this chapter are based on a paper presented at a SANREM Annual Meeting and Conference, held in Malaybalay, Bukidnon, Philippines in May 1997. This paper was later modified for inclusion as a chapter in a book entitled *Environmental Indicators and Public Policy* (Mary Durfee, ed.), which is currently under review for publication by the University of Akron Press. The scientific information presented here has been considerably expanded from these previous works, however, with the addition of nearly two years of community-based research data. This chapter emphasized the methods, results and applications of the biophysical data collected by the citizen monitors. The process of how the community members became involved in water quality monitoring, and their current and future work as a nongovernmental organization, is presented in Chapter 9.

The Community-based, Water Quality Monitoring Project

Several interdisciplinary research projects on soil, water and biodiversity were designed within the larger SANREM/Philippines program, based on information gained during several weeks of reconnaissance and the interests of collaborative research teams. Among them was a project on local water quality assessment and management. The overall goal of the project was to foster the development of community-based water monitoring groups, and to collect credible water quality and quantity data that lead to environmental and policy improvements. This was primarily accomplished by conducting a series of workshops and field exercises to train interested community groups in the evaluation of water quality using portable test kits and other, basic analytical tools.

Many of the methods used were modeled after those developed in Alabama Water Watch, a citizen volunteer, water quality monitoring program that is now underway in the U.S. (Deutsch *et al.* 1998). Filipino partners on the SANREM work plan who were educators and community developers helped customize the workshops and sampling techniques to the local situation. Community participants primarily included farmers, teachers, members of certain women's organizations and some members of the local government unit. The project researchers and volunteer, water monitors selected 16 sampling sites in four main tributaries of the Manupali River (Fig. 7. 1). Sites chosen were those generally accessible and representative of the diverse portions of the overall landscape, including subwatersheds of varying degrees of forest cover, agricultural land and population. A "menu" of possible water quality indicators was

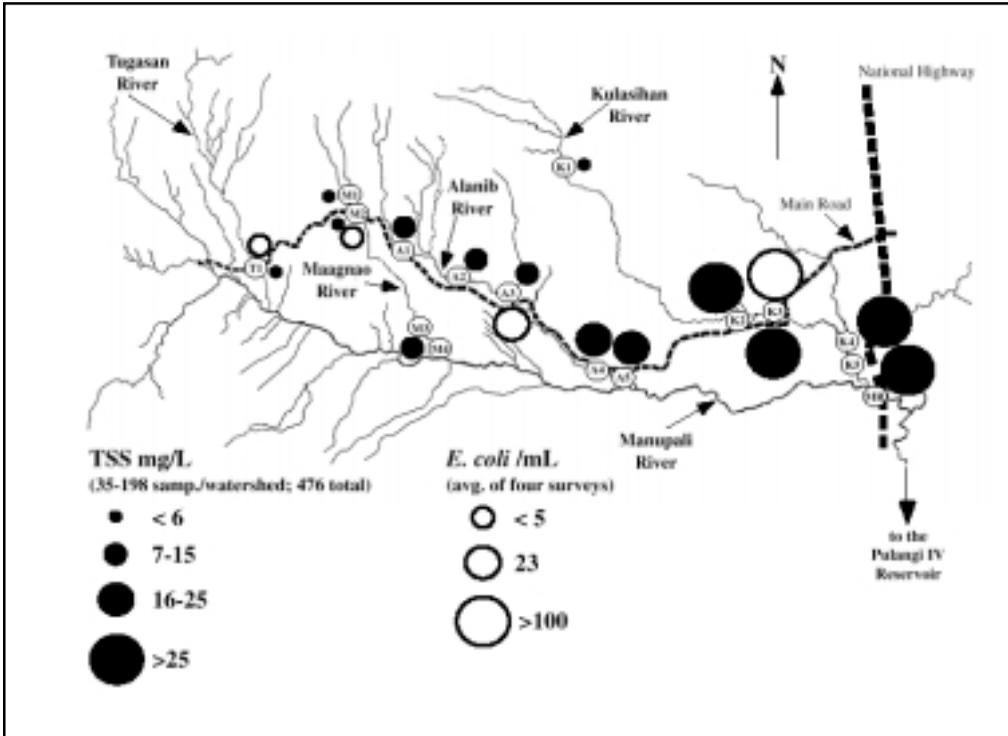


Fig. 7.1. The Manupali River watershed, with total suspended solids (TSS) and *E. coli* bacteria concentrations in four subwatersheds, August 1995 - July 1996.

made available to the monitors in the workshops. These included the physicochemical parameters of temperature, pH, alkalinity, hardness, nitrates, phosphates, dissolved oxygen, turbidity and total suspended solids. Biological parameters included biotic indices of stream macroinvertebrates and measurements of *E. coli* and other coliform bacteria concentrations.

Community-based Water Quality Indicators

Many international development agencies are actively pursuing research on environmental indicators to better manage and evaluate their programs and improve efficiency and extension. They are basically trying to determine which of the thousands of biophysical and social indicators are best for determining environmental trends, reducing unsustainable practices and implementing restoration activities. Attempts to understand and define these environmental and agricultural indicators have led

researchers to develop elaborate typologies that include dimensions of time, space, form and worldview (Madden 1995).

The approach of this project was to develop and test specific water quality indicators that were appropriate for natural resource management by community volunteers and the local government unit. In that regard, the following criteria were established for each indicator:

1. scientifically valid methods, for credible qualitative and quantitative information;
2. relevant to the community, for their endorsement and participation in data collection; and
3. practical and relatively inexpensive, for sustainable use and applications using locally available materials.

After several months of testing water for the 8-10 parameters presented in the training workshops, the data began to suggest that the relatively few parameters related to soil erosion, disrupted stream flows and bacterial contamination were the most productive to pursue as indicators. Both the citizen monitors and researchers concurred and there followed more in-depth study and application of these indicators. The following is a summary of the rationale and methodology behind each of the key indicators, starting with the qualitative indicator of community perception, memory and experience before the science-based project began.

Indicator #1: Community Perceptions, Memories and Experience

For the SANREM/Philippines program, several sectors of the local community were involved with researchers and community organizers in an initial, watershed-scale evaluation of the site, called a Participatory Landscape/Lifescape Appraisal or PLLA (Bellows *et al.* 1995). During this time, scientists, development workers and some local residents worked as a team to interview people of the Lantapan community and become aware of perceptions and environmental concerns. This appraisal was vital to the development of the framework plan, which led to the water indicators research.

The first dialogues between community members and researchers regarding potential environmental indicators revealed that residents were commonly concerned with water contaminants, such as pesticides and pathogens, in addition to soil erosion and sedimentation of streams and irrigation canals. Some farmers did not water their livestock in streams during rainfall events, citing loss or illness of animals from

pesticide runoff. Public health records, although scanty, indicated a higher than average infant mortality and morbidity rate in the community, and many common ailments were caused by waterborne pathogens.

Besides water quality concerns, some residents questioned or lamented the fact that some streams were no longer maintaining regular flows, but were cycling through seasonal flood and drought. Memories of stable stream flow and clean water were within the last few decades. Flash floods were increasingly common in the eastern part of the Manupali watershed, resulting in severe soil erosion, crop loss and occasional loss of livestock or human life. Overall, the pattern of watershed degradation experienced by the community was typical of that in upland landscapes of the Philippines and in many other parts of the world.

Indicator #2: Eroded Soils in Streams

Because the community of Lantapan is primarily agrarian, measurements of soil loss and sedimentation were particularly relevant to volunteer monitors. Farmers generally understood that soil loss usually meant a reduction in the fertility of their fields, with accompanying reduction of crop production. Farmers of lowland rice clearly realized the negative impacts of upland soil erosion because the irrigation canals had become heavily silted and, as a system of water conveyance, were only about 25% efficient.

Further downstream, the Manupali River flows into the Pulangi River, which is impounded to create a series of hydroelectric generating stations. Interviews and information gathering activities of the PLLA revealed that the Pulangi IV reservoir was silting in at an alarming rate of nearly one meter per year at the dam, and that the reservoir capacity had been drastically reduced from sedimentation. This also contributed to premature wear of hydropower turbines and frequent power outages or “brown outs.”

One indicator of soil erosion and sedimentation was the measurement of total suspended solids, or TSS. A relatively simple and inexpensive technique was adapted in which a known volume (usually one liter) of stream water was filtered for calculation of mg/L suspended solids. The plastic filtering system apparatus was lightweight and easily portable, with a hand pump, in a small back pack. The glass fiber filters (6 micron pore size) were prepared and weighed before and after sampling according to standard methods at a nearby university. Labeled, preweighed filters were brought to the watershed in batches for monitors to sample TSS, and

sampled filters were returned to the university for processing and data recording.

After the community collected several hundred TSS samples throughout the subwatersheds of the Manupali River valley, this indicator of soil erosion began to reveal patterns of degradation that went far beyond the simple observations of “clear” and “muddy” water in various streams. Even within the first two years of monitoring (1995-96), data strongly suggested differences in erosion rates at the subwatershed level, with sharp increases in TSS concentrations from the western to eastern subwatersheds (Figs. 7.1 and 7.2). When correlated with rainfall data collected from local weather stations (three stations in the Manupali watershed), it became clear that seasonal difference in TSS occurred in each subwatershed (Fig. 7.2). These differences were probably caused by natural factors, such as changing rainfall frequency and intensity in rainy and dry seasons, as well as cropping patterns. Sometimes, a combination of these natural and human induced changes greatly increased TSS in streams, such as when farmers plowed and exposed large areas of bare soil for planting just prior to heavy spring (May-June) rains.

Most of the TSS monitoring by the community was done once or twice monthly at four main sites (bridge crossings of the four major tributaries of the Manupali River) in daytime, base flow conditions. By using the TSS indicator in this way, monitors seemed to determine important trends and patterns occurring in the river valley. Nevertheless, their overall measurements were an underestimate of the greatly increased erosion rates during strong storms. Recognizing this fact, the monitors offered to measure TSS more frequently, just before and during selected rainfall events in each subwatershed. Results were sometimes dramatic, and in one case, TSS increased by 1,000-fold within a two-hour period of a heavy rain, to reach about 18 kg of soil in each cubic meter of water. To better communicate this to farmers and other community members, such a rate of erosion was likened to the weight of a sack of seed corn in each unit volume of water that approximated the size of a small desk. The TSS indicator became an increasingly important way for the Lantapan residents to quantify environmental change and lay the foundation for local action and policy changes.

Indicator #3: Altered Stream Flows and Soil Export

TSS is only a relative indicator of erosion and watershed degradation (a concentration value) which does not provide important estimates of soil loss in water past a given point. Because the streams of the four subwatersheds in Lantapan were similar in size, TSS trends were generally

comparable, however, stream discharge measurements were required to use TSS to its full potential and calculate soil export. Moreover, the patterns of stream discharge provide important clues to watershed stability and the effects of land use change.

Typically, stream discharge measurements are made by researchers using expensive and fixed structures and instruments, such as concrete and metal wires, flumes and elaborate gauging stations. Such methods are usually impractical for rural communities using their own resources, so low-tech methods were developed and adapted for use by the volunteer water monitors in Lantapan.

Stream velocity and discharge measurements were made with locally available materials, including rope, measuring sticks and a float. A cross-

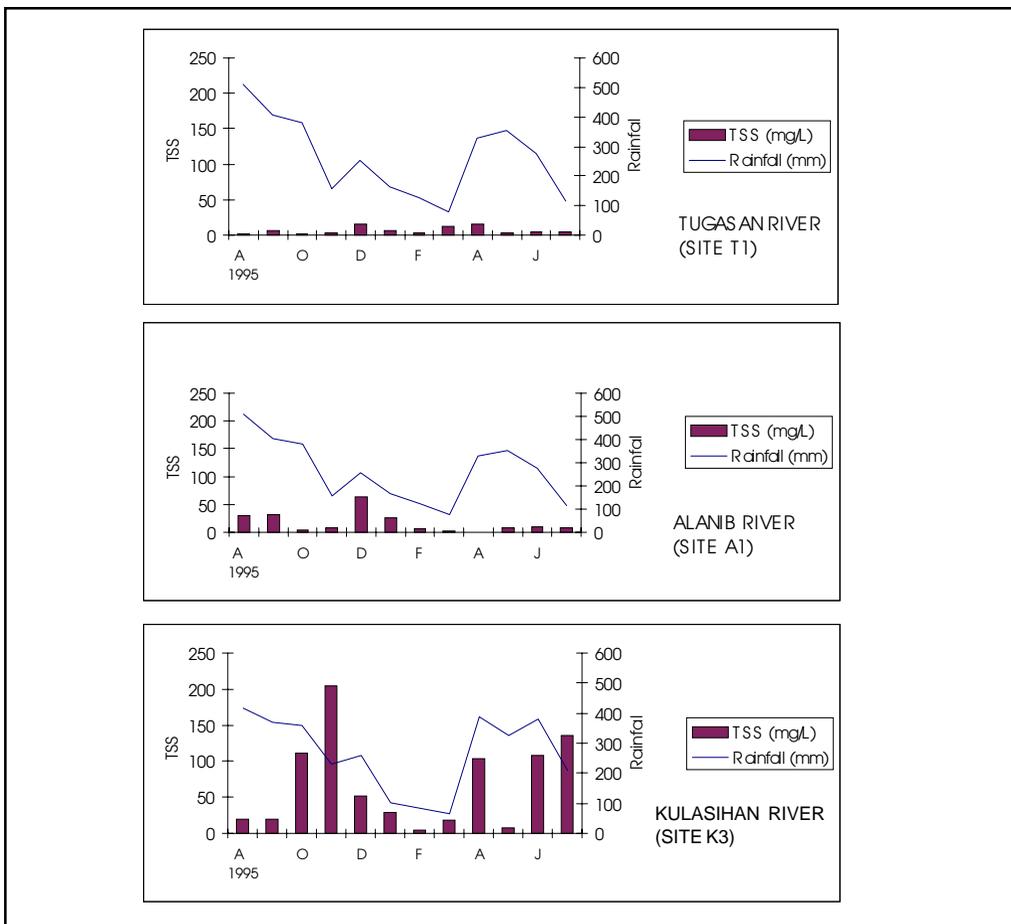


Fig. 7.2. Total monthly rainfall and average monthly total suspended solids (TSS) in three subwatersheds of the Manupali River, August 1995 - July 1996.

sectional map of each of the four streams was made at the main bridges, using the regular, concrete sides of the revetment wall under the bridge as boundaries when possible. A rope was stretched perpendicularly across the stream between two fixed points and stream depth was determined at one-meter intervals along the rope. Measurements of stream width and depth were used to draft cross-sectional maps and calculate area.

Another rope of known length was stretched parallel with the stream bank to mark the distance that a floating orange (or other tropical fruit) would travel while being timed. Multiple measurements of the time required to float a known distance in different parts of the stream were used to determine average current velocity. Together, the cross-sectional area of the stream (square meters) and its current velocity (meters per second) were used to estimate stream discharge (cubic meters per second).

The measurements of stream discharge provided an excellent indicator of the hydrologic cycle. Monthly discharge measurements taken in each of the four streams on the same day from 1997-99 were used to produce graphs of seasonal stream flow (hydrographs) that indicated distinct subwatershed differences. For example, the easternmost Kulasihan River had a much greater range of flow during an annual cycle than that of the Tugasan and Maagnao Rivers in the western part of the watershed, in spite of similar average discharges and rainfall patterns (Table 7.1, Fig. 7.3). The coefficient of variation in monthly flows ranged from 32% (Maagnao River) to 140% (Kulasihan River) among the subwatersheds, and seemed to provide a simple yet valuable indicator of watershed stability that followed the same pattern as the soil erosion indicator of TSS.

Hydrographs of the Maagnao and Kulasihan Rivers were compared with total monthly rainfall data that was collected at a weather station between the two subwatersheds (Fig. 7.3). This revealed that the Kulasihan River is much more dependent upon seasonal rainfall patterns for surface flow than the Maagnao River. Such instability or "flashiness" of the Kulasihan River, indicated by its abrupt flooding and drought cycle, is intensifying and becoming a serious problem for the local municipality. A new culvert needed to be constructed in the Kulasihan subwatershed following the July 1997 flood (Fig. 7.3) in which three additional concrete tubes were installed to convey floodwaters and prevent washout and blockage of the main access road. Such an expense for local government, along with the property damage and loss of crops and soil from flooding that preceded the construction project, underscore the importance of the stream discharge indicator as an early alert to watershed disruptions.

Table 7.1. Average discharge, range and coefficient of variation (CV as %) of four tributaries of the Manupali River (measured monthly on the same day), February 1997-October 1999.

Stream	Average Discharge and Range (cu. m/s)	CV
Tugasan	1.78 (0.26- 3.84)	51
Maagnao	1.92 (0.77- 3.40)	32
Alanib	1.29 (0.13- 2.93)	60
Kulasihan	1.84 (0.00-10.26)	140

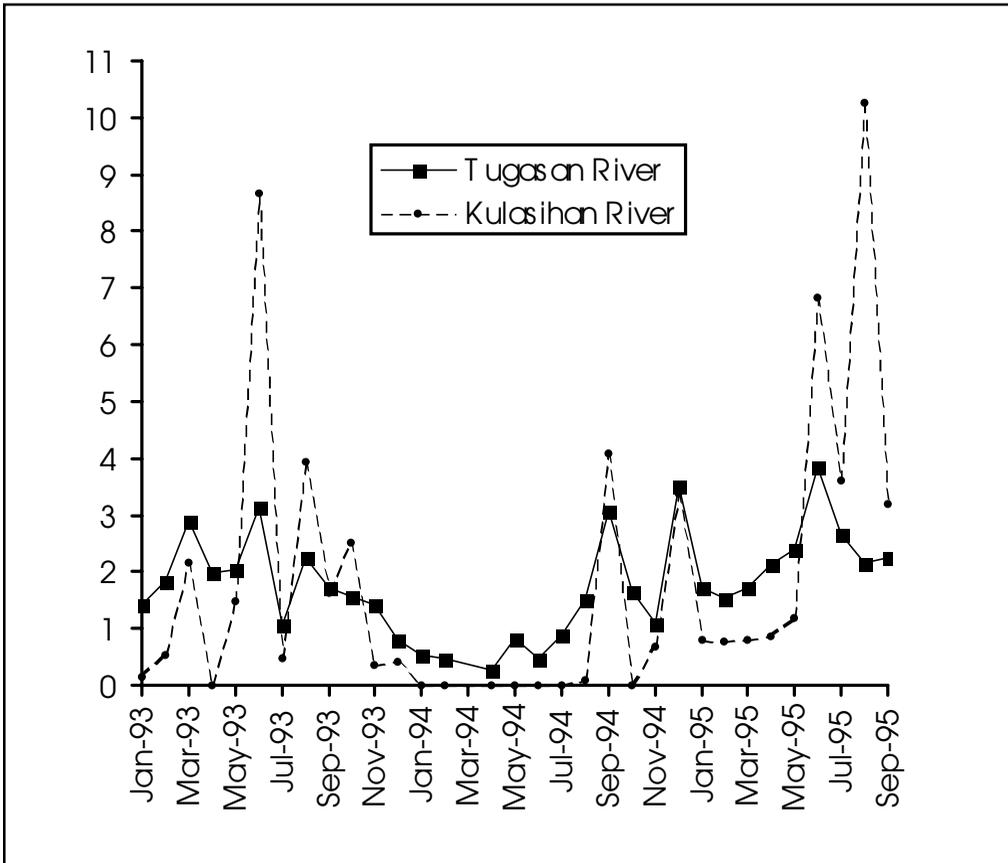


Fig. 7.3. Stream discharge of the Tugasan and Kulasihan Rivers (measured monthly on the same day), February 1997 – October 1999.

The database of stream discharge and soil export data documented some of the effects of the El Niño event in Lantapan. A severe drought occurred in Lantapan as a result of the El Niño, beginning in November 1997. For the subsequent nine months, the Kulasihan River had greatly reduced flows, and was completely dry for most of February-September 1998. In addition to disruptions of the natural environment, this caused hardships on local people who depended upon the river for bathing, washing clothes, watering livestock and other activities. During this same period, the flow of the Maagnao River was only slightly less than its typical amount (Fig. 7.3). Whereas the flow of the Maagnao River remained relatively stable through 1999, the Kulasihan again began to periodically flood, and its discharge of September 1999 exceeded that of the July 1997 flood.

Concurrent TSS and stream discharge measurements resulted in practical and valuable estimates of soil export. As might be expected from TSS and discharge data, soil export data varied significantly among watersheds and revealed the severe soil loss problems within the Kulasihan subwatershed. From February 1997 through September 1999, soil export estimates in the Maagnao River subwatershed ranged from less than 10 kg/h to about 125 kg/h and was generally correlated with total monthly rainfall values (Fig. 7.4). During this same period, soil export in the Kulasihan River was much more variable. For several months of the El Niño drought, soil export in the Kulasihan River was zero because of no surface flow. However, during the rainy periods of September 1997 and July 1999, soil export in the Kulasihan was measured as 1,300 and 3,400 kg/h, respectively, and exceeded the maximum measured in the Maagnao River by 10-25 times. Clearly, this indicator is a relatively simple and inexpensive, yet important, tool for local watershed management.

Indicator #4: Bacterial Contamination of Water

Levels of potentially harmful bacteria in streams, wells and piped drinking water were of primary concern to many citizens of Lantapan because of obvious public health risks and personal experiences of illness. As with related memories of community members regarding stream degradation from pesticides and silt, older adults recounted how they freely drank from streams in the past at places where they knew they would become ill.

Evaluation of water for bacteria in the community had been infrequent, and the tests that were occasionally done by the Department of Health or the *Barangay* Health Workers only detected the presence or absence of fecal coliforms without determining a concentration value. As with all

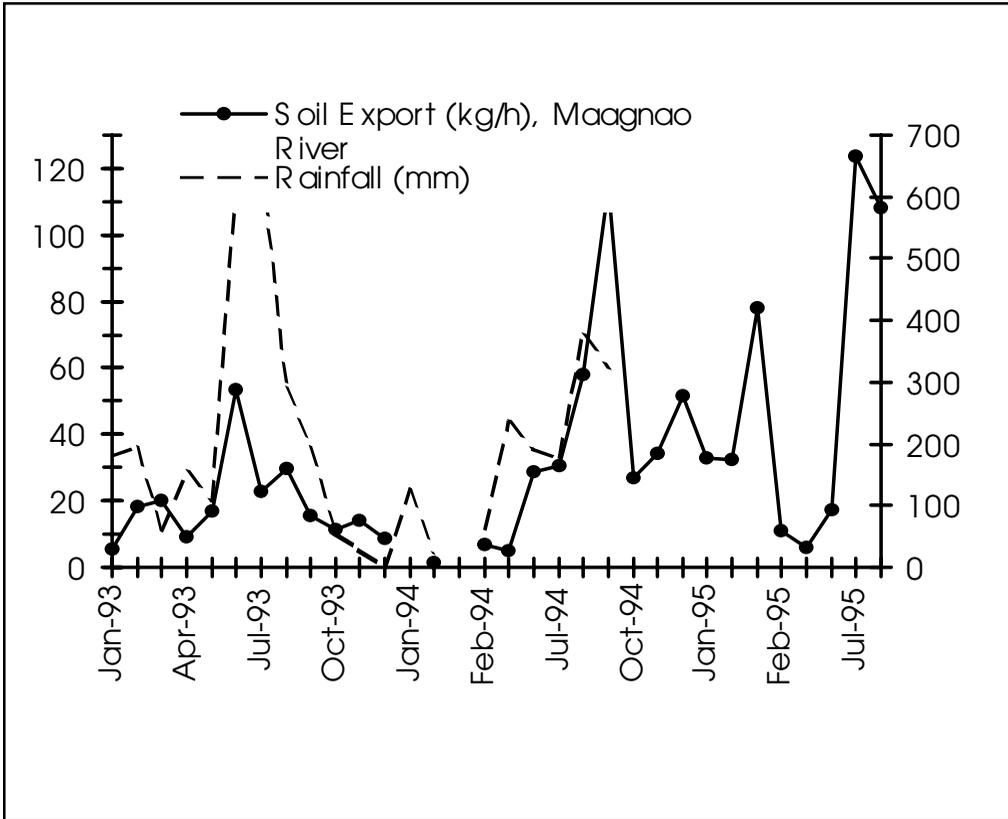


Fig. 7.4. Soil export (kg/h) in the Maagnao River, February 1997-September 1999, with total monthly rainfall, February 1997-September 1998.

other techniques and indicators to be developed for practical use, bacteriological monitoring methods were chosen and adapted based on simplicity, accuracy and low expense.

A relatively new technique of measuring concentration of *E. coli* and other coliform bacteria was used for the monitoring. With this method, a one milliliter sample of water is collected using a sterile, plastic pipette and squirted into a 10 mL bottle of sterile, liquid medium. The medium (with color indicators for coliforms) containing the water sample is poured onto a sterile, plastic dish which is designed to induce the liquid to solidify. Incubation of sample plates at ambient tropical temperature was sufficient to grow the bacterial colonies for enumeration in about 30-36 hours. No incubators, sterilizers or glassware were needed for this technique and necessary supplies (which cost about \$1 US per sample) could be easily transported to remote areas for sampling scores of sites per day. Following the incubation period, bacterial colonies of *E. coli* and other coliforms

were enumerated and reported for feedback to the community. The procedures used to monitor coliform bacteria in Lantapan were approved by the U.S. Environmental Protection Agency for the Alabama Water Watch Program in January 2000 (Deutsch and Busby 1999).

Four bacteriological surveys of the four major tributaries of the Manupali River were conducted in different seasons throughout 1995-96. Bacteriological results were surprisingly similar to the pattern observed for TSS at these same locations, and reinforced the erosion and stream discharge indicators that degradation was occurring in a west-to-east gradient across the landscape (Fig. 7.5). According to World Health Organization and U.S. Environmental Protection Agency standards, bacterial concentrations in the Tugasan and Maagnao Rivers are generally safe for human “whole body contact,” whereas those in the Alanib and Kulasihan Rivers typically exceed the safety standard by 10- to 50-fold.

Bacteriological surveys were also made of the community drinking water faucets which were distributed throughout each of the 16 *barangays* of the municipality. Virtually all drinking water is gravity fed through a plastic piping system from one of several mountain springs, and is untreated with filters or chemical sterilizers. Surveys revealed several faucets which had become contaminated with *E. coli* because of breaks in the pipes and seepage into them from contaminated soils and water.

Whereas the initial participants in water quality training workshops and monitoring were predominantly young men, bacteriological monitoring generated much interest among women and girls. It is believed that this parameter was of particular interest to women because of its direct tie to family health, especially that of infants and children. It also may have been more relevant than other parameters because the measurement was made from community faucets and public springs that had a close connection to household affairs and daily chores. Strong involvement from the Federation of Lantapan Women’s Organization and other women of the community added a new dimension to community-based water quality indicators and their applications. Overall, the concentration of coliform bacteria has become an important indicator of water quality, used by diverse sectors of the community.

Indicator #5: Demographics and Land Use

The community-based indicators of TSS, stream discharge, soil export, and *E. coli* bacteria concentrations within the four subwatersheds were compared with both demographic and land cover patterns determined from government census and remote sensing data to better understand

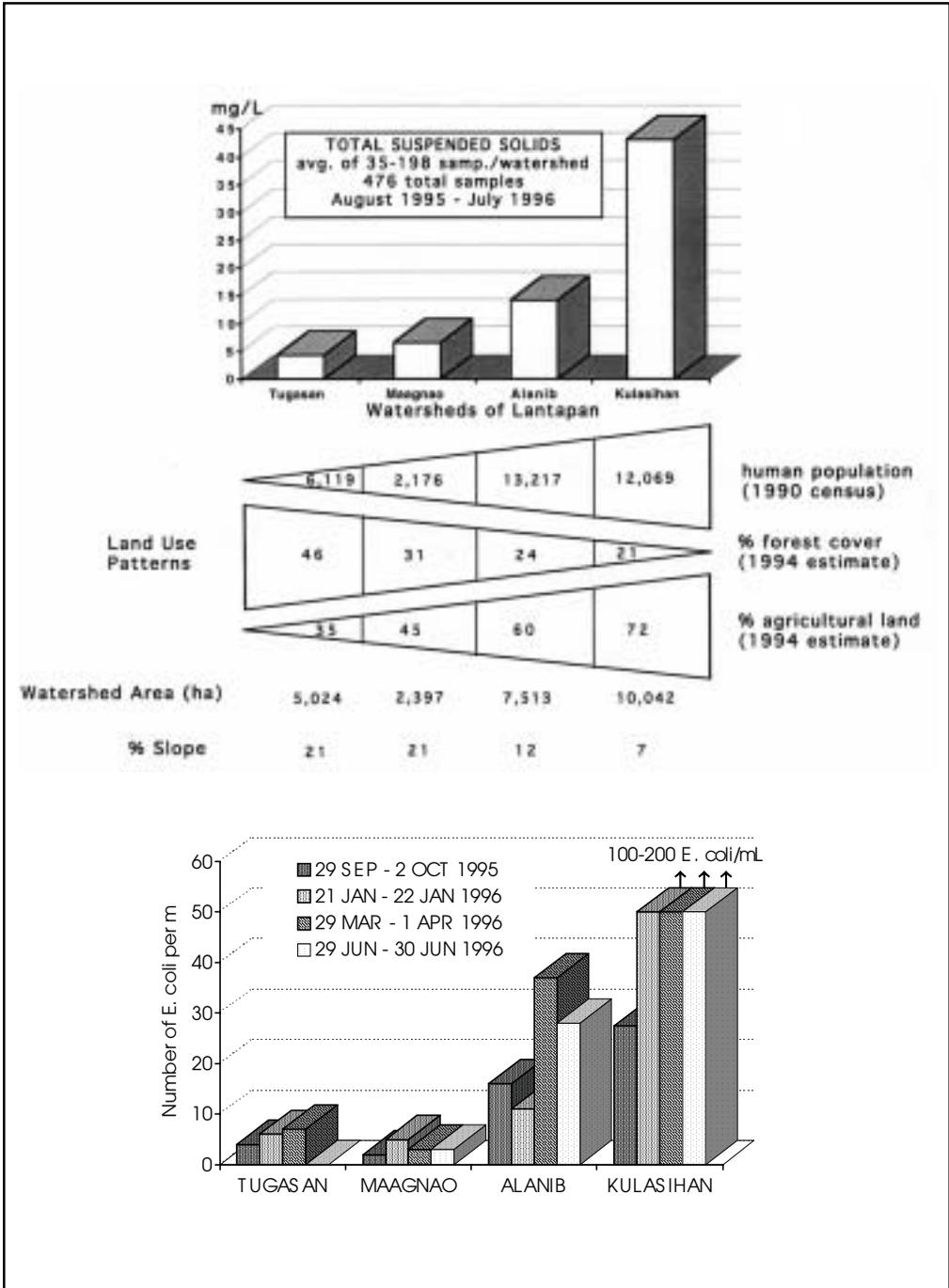


Fig. 7.5. Total suspended solids, land use patterns and concentrations of *E.coli* bacteria in four subwatersheds of the Manupali River, August 1995 - July 1996.

the linkages between land use and environmental quality. This comparison revealed a clear yet disturbing pattern. The progressive decrease in forest cover and increase in cleared land from west to east across the Manupali River valley were closely correlated with the patterns of water quality degradation that the community monitors had detected (Fig. 7.5).

The results of study indicate that the community-based indicators might be very important for describing landscape-scale trends. For example, abrupt increases in TSS occurred when subwatershed forest cover dropped below 30% and agricultural land made up more than 50%. Knowing such threshold levels of unsustainable soil erosion by using an indicator like TSS could be of immense value to natural resource managers and policy makers. In the case of Lantapan, the western two subwatersheds may be even more vulnerable to severe erosion with deforestation than the eastern two subwatersheds because their average slope of about 20% is much greater (Fig. 7.5). It is also noteworthy that about 75% of the population of Lantapan live in the two eastern subwatersheds (although human density in all subwatersheds is similar, ranging from 0.9-1.2 person per hectare). Much larger populations in the Alanib and Kulasihan subwatersheds, including many more houses and roads, certainly contributed to the sharply elevated levels of soil erosion, *E. coli* concentrations and other measures of water-related problems.

From Indicators to Policy

As the water quality information increased through greater community involvement and monitoring activity, the environmental indicators helped to explain and communicate the changes in land and water that were occurring. It seemed clear that the “price of development” in Lantapan under current technologies and land use strategies included streams that were silt laden, contaminated with bacteria and unstable in their seasonal flow.

What made the emerging scenarios of development and degradation more stark was that this rather extreme environmental gradient occurred in one, medium-sized river valley, and the changes were well within human memory. Community members did not have to envision a hypothetical, pristine or highly degraded watershed or a centuries-long process. They had seen for themselves by monitoring the dynamic ecosystems of the Manupali River valley in which they lived, and many were beginning to understand the consequences of land use decisions on a landscape scale.

To increase public understanding and action, the watershed information was popularized as a “Walk Through Time,” *i.e.* subwatersheds of the west, including the Tugasan and Maagnao Rivers, represented relatively natural conditions of the past whereas the Alanib and Kulasihan watersheds of the east illustrated the environmental costs of using traditional technologies to clear land for agriculture, homes and roads over the last few decades (Fig. 7.4). Put simply, a person in the middle of the watershed could “look west” to see where their environment had come from, and “look east” to see where it was going. This basic way to use indicators to describe environmental change and suggest human causes and responses contributed to policy debates and decisions.

A Municipal Natural Resource Management Plan

The environmental information collected in the water monitoring project was provided to representatives of the local government unit in a variety of forms. At the invitation of the Mayor of Lantapan, a summary of the research findings was orally presented with visual aids to the municipal council. This prompted the local government to incorporate community-based water testing and some of the research findings and recommendations into their Natural Resource Management Plan (NRMDP, 1998). The plan is well underway, and begins with the following statement:

The Natural Resource Management and Development Plan (NRMDP) of Lantapan is a practical, not wishful action plan that presents practical intervention to the critical conditions of the natural resources. This has led to the identification of “hot spots” or fragile areas that need immediate attention before it will be totally degraded over the next few years. The NRMDP evolved from a strong, participatory planning and collaboration of various sector groups in the community and the local legislators that composed the Municipal Natural Resource Management Council (MNRC), together with different stakeholders from concerned government agencies at the provincial level...The plan will likely become a development model or template for natural resource management and environmental planning to other municipalities in the province of Bukidnon.

Among the many “implementable actions” of the plan is a strategy to improve water quality, quantity and distribution. Key activities within this strategy involve continuous water quality monitoring and the expansion of membership of the Tigbantay Wahig group through the organization of

community chapters (see Part II, Chapter 9). Such a strategy represents a major step toward the practical application of community-based water quality indicators by a local government unit of the Philippines.

Of extra significance was the recent mayoral appointment of the president of the Tigbantay Wahig to the newly formed Natural Resource Management Council of the municipality. This created a direct link between the water monitors and government policy makers, and was in accord with the trend toward greater citizen participation in governance, provided for in the new Local Government Code.

Other Effects on Policy

In addition to the actions taken by the municipal government, the water quality project has affected decisions and policies of certain *barangays* and the local school system. In one recent case, a *barangay* leader in Lantapan was interested in tapping some mountain springs to convey drinking water to several household of the *barangay*. She requested the services of the water monitors to determine the bacterial level of the water prior to making the final decision of installing the pipes. The tests revealed that some of the springs had unsafe levels of coliform bacteria, and this type of information was obviously useful in choosing alternative water sources, saving government funds and minimizing the risk of waterborne disease.

Through presentations to schools and involvement of teachers and their students in the water monitoring activities, young people are becoming more aware of environmental indicators and their meaning. Some of the elementary students of Lantapan are now being taught which of the rivers of their municipality are clean and which are polluted (Mrs. Natividad Durias, Head Teacher, Alanib Elementary School, personal communication, July 1997). Beyond awareness of the environmental problems, some of the school students and their teachers have begun restoration activities including tree plantings on riverbanks to prevent soil erosion and sedimentation.

The initially informal way of extending the information of water quality indicators to schools has become more systematized through discussions with representatives of the school district and the Philippine Department of Education, Culture and Sports (DECS). The Secretary of DECS has endorsed the overall SANREM program and has requested that additional steps be taken to enhance outreach and environmental education in schools. Additionally, the water research findings are being used in various courses of the local university, through a faculty partner in the project.

Conclusion

Largely through the practical development and application of water quality indicators, the local government and community have increasingly acknowledged the advantages of having an ongoing, citizen water quality monitoring program. Regular dissemination of the water information in a variety of forms and to different audiences has done much to convince policy makers and the public of the value of water assessment using simple indicators.

The NRMDP of Lantapan is still in a formative stage, and much remains to be done to have clear policy that results in specific conservation measures. National elections of May 1998 resulted in changes of leadership from president to mayor that might have profound effects on the way NRM planning is conducted. In the meantime, citizen participation in monitoring and restoration activities is increasing and will, hopefully, ensure that elected officials continue to implement their much-needed plan.

Factors for Successful Use of Indicators in Policy

An evaluation of the project suggests that two key factors combined to create a strong potential for water quality indicators to have lasting policy impacts.

1. Perceived Need and Receptivity of the Community and Local Government Unit

The landscape of Lantapan shows obvious signs of degradation that have resulted in a general concern among local residents. As in most rural settings, daily life and well-being depends upon reliable sources of clean water and productive soil without the luxury of expensive inputs and treatments. Lawrence *et al.* (1996) found that farmers of the upland Philippines were “more articulate” about environmental problems than those in the lowlands, and that this pattern also occurred in Bangladesh and India. They attributed this to the fact that farmers are most aware of issues that affect them directly, and that soil erosion and increasingly unreliable or scarce water supplies (often attributed to deforestation) are upland farmers’ principal agricultural problems over recent decades. As a result, there is a strong consensus among academics, development workers and farmers on the problems. The Lantapan project supports this observation, and found that many in the community have an interest in environmental integrity that carries a sense of urgency and goes far beyond academic interests.

As authority in natural resource management is decentralized and “people power” flourishes in the Philippines, municipal and provincial planning and policy is increasingly focused on a long-term, sustainable course. The status of NGOs is probably higher in the Philippines than in most Asian countries, and they often interact well with government (Lawrence *et al.* 1996). The ability of Lantapan citizens to enter the political process as accepted stakeholders will be vital, and the formation of the Tigbantay group, with the mentoring and backstopping by an established, Filipino NGO partner in the project will sustain the development and practical application of environmental indicators in the Manupali watershed.

2. Participatory Research with Focus on Indicators and Policy

The SANREM program in general and the water quality project in particular provided financial resources and expertise that synergized with the community interests and political climate of the Philippines. A natural resource research program that stressed intersectoral collaboration, community participation and a landscape scale approach fit well with the predisposition of the local residents and the new Local Government Code.

An added emphasis on environmental indicators (Bellows *et al.* 1995), and on-site coordination of the program and water project enhanced this synergy.

Development of a “menu” of practical, low-tech water indicators (Table 7.2) gave the community options for exploring their local environment and identifying areas needing conservation and restoration. This process was facilitated in Lantapan by adapting techniques that were previously developed in other contexts of citizen monitoring (Deutsch *et al.* 1998). The Philippine experience, in turn, led to further refinement of methods and indicators for applications in other places, including improvements to U.S. programs. The physical features of water make it conducive to measuring a variety of important parameters using simple tests with color-changing chemical indicators (colorimetric methods) and inexpensive equipment. Additionally, the hands-on activities of environmental monitoring are a tremendous motivation for community participation, awareness and action.

Table 7.2. Summary of community-based, water quality indicators.

Issue/Problem	Indicator	Unit of Measure
General Environmental Degradation	Community Perceptions, Memories, Experiences	Anecdotal, or Questionnaires/Surveys
Soil Erosion	Suspended Soils in Water	mg/L TSS
	Soil Loss in Water	kg/h soil export
Disrupted Stream Flow	Stream Discharge	cu. meters/second flow (monthly measurement)
	Flow Variability	coefficient of variation (comparisons: time, space)
Bacterial Contamination	Coliform Concentration	no. colonies/mL of water (<i>E. coli</i> and other coliforms)

Future Needs and Applications of Indicators

As the process of affecting public policy using community-based water quality indicators has progressed over the last few years, three major needs for further research and applications of findings have emerged.

1. Test and Compare Community-based Indicators with those of Researchers

Much more needs to be learned about the value of community-based water indicators, and their application to scientific knowledge and natural resource management. It is conceded that these indicators lack the precision of more sophisticated tests that are commonly used by researchers. Moreover, the typical sampling times, locations and frequencies of citizen monitors often miss rare but significant events affecting water quality, such as strong storms or pollution spills. In the case of the Lantapan project, TSS values collected near the stream surface may be lower than those near the stream substrate, and stream discharge and *E.coli* concentration measurements probably did not capture the extremes of an annual cycle (as would be detected by continuous monitoring equipment).

The lack of precision, and possible bias that may stem from community-based monitoring techniques must be weighed against the

advantages of simplicity, mobility, cost-effectiveness and local relevance. An underlying question is how useful such measurements and derived indicators are *for environmental managers and policy makers* (such as the local government unit of Lantapan). What are the limits and constraints of the community-based approach, and does it capture enough information to be consistently valuable for environmental assessment and policy recommendations? Specific answers to these questions are important to pursue and would require side-by-side studies using different levels of analyses.

Some of the community-based indicators were similar to indicators developed by research organizations, and raise intriguing questions of comparability. For example, the Lantapan water monitoring study found that abrupt increases in TSS occurred when forest cover dropped below 30% (Fig. 7.5). A threshold of 30% minimum cover before severe environmental degradation was also recently determined for upland tropical forests by the International Centre for Research in Agroforestry (Dr. Dennis Garrity, ICRAF Forest Research and Development Center, personal communication, January 1997).

2. Apply Indicators to Restoration Activities

After five years of research in Lantapan, the community and local government unit is ready to incorporate environmental indicators into specific action plans to restore degraded areas or “hot spots” within the landscape. The water quality indicators have the potential to not only identify these areas more quickly, but to be a useful tool for evaluating the effectiveness of restoration activities.

Intended applications include the use of the TSS indicator to identify specific streamside areas that have disproportionate amounts of soil erosion and stream sedimentation. Concentrations of *E. coli* in piped water may be used to identify specific areas of the public drinking water system needing repair, and to make a stronger case in municipal grant proposals for federal aid to do extensive pipe replacements. This indicator of water safety may also be used to quickly evaluate the existing mountain spring sources of public water, as was already begun by one barangay leader of Lantapan. Such strategies are in accordance with national policies which “are likely to underemphasize new water supply projects and focus instead on changes leading to more efficient utilization and management of water resources” (Rola 1997).

Environmental protection policies in Lantapan will probably also include recommendations on soil, water and biodiversity conservation measures such as the establishment of streamside (riparian) zones, selected

reforestation, ravine restoration and contour farming. A variety of simple indicators could help guide this process.

3. Extend Development and Use of Indicators Beyond Lantapan

Several initiatives are in progress to extend the methodology and significant findings of the research program, including environmental indicators, beyond Lantapan. The Provincial Planning and Development Office (PPDO) of Bukidnon has facilitated a forum in which the water project and key indicators have been presented to policy makers and planners in the 15 other municipalities of the province. The PPDO also maintains records of how municipalities use the internal revenue allotment from the federal government, and they plan to work with and encourage them to apply portions of the allotment to natural resource management (Mr. Antonio Sumbalan, PPDO of Bukidnon, personal communication, January 1997).

Additional outreach activities have included presentations regarding community-based water monitoring and indicators to scores of college and university faculty at a national seminar and workshop on environmental education and management at Central Mindanao University. The level of response and enthusiasm toward the water quality indicators suggested that significant impacts on water management could be promoted throughout the country via university researchers.

Because of strong program partnerships within the Philippine national government, the approach of local environmental management that has begun in Lantapan can be formally extended throughout the country. Already, the establishment of indicators of sustainability from research in Lantapan has contributed to the implementation of the Philippine Agenda 21 (Dr. William Dar, Executive Director, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, personal communication, July 1997). The strategy of the SANREM program in coming years is to continue this process of extension throughout southeast Asia and in other regions of the world.

Lessons Learned

A major strength of collaboration in participatory, environmental indicator research is that development and extension of information and community action are occurring simultaneously. Instead of a traditional model of conducting the research in isolation from the local community, then trying to extend the significant findings to them through such things as technology transfer and the media, the citizens, community organizers

and scientists have learned together. The startup of this collaborative, indicators research project was relatively slow and expensive, but initial results indicate that the potential for lasting benefits and project sustainability are much higher than if attempted by a community, NGO, university or government agency in isolation.

Most scientists are aware that excellent and important research findings often go underutilized because they do not enter the political process. Instead, the data remain in professional journals and away from meaningful action. The type of information needed by policy makers for natural resource management planning should be science-based, but need not necessarily meet all the requirements of the scientific community with regard to precision and rigor. This is especially true in watersheds that are degrading rapidly, with irreversible consequences. In these situations, application of partly understood conservation practices, with full community involvement, may be far better than waiting for a "complete" scientific understanding.

Glover (1995) noted that rigorous research requires a clear definition of a problem and the variables to be measured, but the objectives of government policies and programs tend to be loosely defined and sometimes contradictory. He added that, "In the research domain, there is no single recipe for policy impact. Luck and persistence, along with good science, are vital ingredients." The case study of Lantapan suggests that when science and persistence directed toward natural resource management comes from within the community, there is a much greater probability of policy impact.

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Chapter 8: Implementing a Participatory Natural Resources Research Program

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Implementing a participatory natural resources research program proved to be a great challenge for the SANREM CRSP. At the time the program was initiated, no established model existed that researchers could use to successfully carry out an integrated, interdisciplinary research in agriculture and natural resource management. “This was the beauty and challenge of implementing SANREM,” the program administrators confidently declared. SANREM had the flexibility to be self-correcting and to consistently tune in to the processes developed in the field.

In the absence of a model, SANREM adopted a set of cornerstones or guiding principles, which elucidated and established the approach that would be taken to conduct research on sustainable agriculture and natural resource management at a landscape scale (SANREM CRSP n.d.: 3).

In the first section of this chapter, we show that these cornerstones provided the practical approach for guiding SANREM’s research in the Southeast Asian region during Phase I. In the second section, we present a brief discussion of the other issues that further shaped research activities and direction. We will address the following questions: How did the cornerstones shape the research process? Did these cornerstones lead to the generation of methodologies to better understand landscape interactions?

Foundations: Defining and Implementing the Cornerstones

As mentioned in Chapter 1, the SANREM program is built on principles of participation, inter-institutional collaboration, landscape/lifescape focus, and interdisciplinary research. The initiation of SANREM research and other activities was preceded by efforts to define these cornerstones

in ways that had meaning in the Philippine context. Discussions on this point helped to define SANREM's overall approach as well as to generate a broad set of guidelines for the design and implementation of research. In the rest of this chapter, we summarize the product of those discussions. Rather than presenting a comprehensive review we focus on areas in which insights with potential value to other projects emerge.

Participation

Participation has become a key concept in developing country research and development programs. Although participation is sometimes dismissed as merely a buzzword to legitimize programs involving local communities, when it provides meaningful partnerships in research, it is a very valuable concept. In agriculture, farmer participation is perceived as the key to improved research effectiveness in the developing world (Okali *et al.* 1994). The implementation of farming systems research (FSR) projects in the 1970s popularized participatory on-farm research. Despite numerous reports and anecdotal success stories, the early FSR approach was criticized for being technology-focused and commodity-oriented, for its lack of attention to policy issues and socioeconomic differentiation within communities, and extractive and disempowering (Farrington and Martin 1988; Biggs and Farrington 1991; Jiggins 1984; Okali *et al.* 1994; Chambers 1992). Dissatisfaction with the level of farmer participation in farming systems research inspired the creation of alternative approaches such as “farmer participatory research” (Okali *et al.* 1994), “farmer-back-to-farmer model” (Rhoades and Booth 1982), “farmer first and last” (Chambers and Ghildyal 1985), and “beyond farmer first” (Scoones and Thompson 1992). All of these approaches promised a deeper involvement of farmers and other participants in the research process, transforming them from information providers to collegial partners.

Participatory Research in Action

SANREM designers appropriated the idea of a participatory research approach that places the farmer at the center of the research process. The program's original proposal to USAID acknowledged the challenge posed by Chambers (1983) to put the people who are traditionally last first (SANREM n.d.). SANREM adopted the “farmer-back-to-farmer” model (Rhoades and Booth 1982) as the template for implementing a participatory research program. To accommodate a diverse range of participants, “farmer” was replaced by a more inclusive term, “end-users”. This

semantic shift acknowledged that other actors from the project site and beyond would be involved in research directly or indirectly as users of information and other outputs generated by scientific investigation. Such inclusive definition of participation also recognized that participants have different capacities and strategic roles critical in specific stages of implementation, from diagnosis to design of potential solutions, evaluation of the appropriateness of a technology and the application of research information within and outside the boundaries of the research site. The enormity of the task demanded building partnership with institutions that possess extensive experience in community organizing and facilitating participatory research.

Whose view of participation?

SANREM designers sought collaborative partnerships with universities, international agricultural research centers and, particularly, with private voluntary organizations (PVOs) and non-government organizations (NGOs), widely known for their expertise in grassroots mobilization. These partnerships greatly influenced the manner by which participatory research was realized at the field level. While researchers from academic and research institutions and representatives from development NGOs generally agreed on the principle of involving community members in the research process, they diverged in their definitions of participatory research. Debate centered on the question: *should participatory research seek to address a broader development agenda or should it strictly focus on addressing a defined research question?* The NGOs were committed to community organizing, empowerment, and building strong community-based institutions as the foundation for participatory research. However, the level of commitment regarded as appropriate by the NGOs was perceived by some scientists to come with high transaction costs and to be potentially counter-productive in a scientific exercise. These differences in perspective became apparent in the research activities conducted in the Manupali Watershed. We now turn to analyzing the characteristics of participation in SANREM research projects.

How participatory were SANREM research projects?

Analytical frameworks have been developed to examine the content of participation in research and development (Pretty 1995; Biggs 1989; Deshler and Sock 1985; White 1996; Cohen and Uphoff 1980; Farrington and Bebbington 1993; MacAllister and Vernooy 1999). A representative

analysis distinguishes the different levels of participation in a project such as the framework developed by Pretty (1995:1252), which identified seven scales of participation in a development project (Table 8.1).

We adapted these frameworks to analyze the types of participation in a natural resource management research project (Table 8.2). While we use a similar set of typologies, the current framework explicitly differentiates participation by level and perception. The *level* of participation can be differentiated into two categories: passive inclusion and active inclusion. In passive inclusion, the end-users are not effectively given the opportunity to participate in research or to influence its outcome. Participation is functional, serving to achieve mainly the researchers' goals. Active inclusion, on the other hand, allows for some degree of end-user participation in the decision-making process and the attainment of both researchers' and end-users' goals. Participation is viewed as a mechanism to empower end-users. *Perceptions* of participation describe the participants' interests for participating in research. These include their motivation, roles, responsibilities and expected benefits.

The six levels of participation presented in Table 8.2 are not mutually exclusive. We introduce the category, "devolved", to stand for the highest level of participation, characterized as being group or community-based. Devolved participation involves local groups mobilizing to attain locally defined goals. This is distinctively different from contractual participation, which is focused on the individual participant or group of participants who receive remuneration in exchange for the resources that they provide to the project. As the level of participation graduates from contractual to devolved, the nature of involvement moves from being individualistic to group-oriented or community-based. Benefits from participating in a research project also shifts from one that is enjoyed individually to one that is shared by group members or across the community.

When we used this framework to analyze participation in SANREM research activities, we found that classifying projects solely by level of participation limited the depth of our analysis. For a program as complex as SANREM, one would expect to find diverse research projects led by individuals with divergent appreciation for participatory research. Some research methodologies may encourage participation while others may be restrictive. Taking these into consideration, we identified four types of research that represented our projects in the Manupali watershed. These are developmental,

Table 8.1. A typology of participation; how people participate in development programs and projects.

Typology	Characteristics of Each Type
Manipulative participation	Participation is simply a pretence, with “people’s” representatives on official boards but are not elected and have no power.
Passive participation	People participate by being told what has been decided or has already happened. It involves unilateral announcements by an administration by project management without any listening to people’s reponses. The information being shared belongs only to external professionals.
Participation by consultation	People participate by being consulted or by answering questions. External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to consider people’s views.
Participation for material incentives	People participate by contributing resources, for example, labor, in return for food, cash or other material incentives. Farmers may provide the fields and labor, but are involved in neither experimentation nor the process of learning. It is very common to see this called participation, yet people have no stake in prolonging technologies or practices when the incentives end.
Functional participation	Participation seen by external agencies as a means to achieve project goals, especially reduced costs. People may participate by forming groups to meet predetermined objectives related to the project. Such involvement may be interactive and involve shared decision-making, but tends to arise only after major decisions have already been made by external agents. At worst, local people may still only be co-opted to serve external goals.
Interactive participation	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systematic and structured learning processes. As groups take control over local decisions and determine how available resources are used, they have a stake in maintaining structures or practices.
Self mobilization	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for the resources and technical advice they need, but retain control over how resources are used. Self-mobilization can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilization may or may not challenge existing distributions of wealth and power.

Source: Adapted from Pretty (1994), Satterthwaite *et al.* (1995), Adnan *et al.* 1992, and Hart (1992).

Table 8.2. Typologies of participation in natural resource management research.

	Levels	Perception of Participation	
		End-Users	Researchers
P a s s i v e I n c l u s i o n	<i>Contractual</i>	End-users have no stake in the research process and output. Provide resources such as labor or land in exchange for cash or other forms of remuneration. Participation ends when their services or resources are no longer needed by the project. Example: participant rents out land to be used in research.	View research as purely technical. Obtain right to conduct research by renting resources owned by the end-users or by hiring their labor.
	<i>Nominal</i>	Participation is characterized by simple appearance in public meetings. Individual participants do not have a stake in the research process and output. They have no specific role and are not given the basic opportunity to participate. Expected benefits are immediate resulting from being present in meetings.	Use people's presence to legitimize the project. Research is mainly researcher-driven and perceived as technical. Researchers are the experts. They involve the people at the beginning of the project to gain passage to the community. Research output is much more important than impact.
	<i>Resource</i>	Individual participation. They provide information with or without receiving compensation for the time. No stake in research process and output. Example: surveys	Define research process. They treat participants as sources of information or to get free access to local knowledge systems and other resources. Information they generate may or may not be useful to the research participants.

Table 8.2. (Continued).

	Levels	Perceptions of Participation	
		End-Users	Researchers
A c t i v e I n c l u s i o n	<i>Consultative</i>	Individual or group-based participation. End users provide information or contribute other resources as their ticket to participation. Although they take part in implementing and monitoring research activities, they do not fully participate in the decision-making process. They benefit from participating in the research process. Benefits are enjoyed by individual or shared by group members.	Setting of research priorities, planning, and analysis are done by the researchers in consultation with the end users. Researchers view participation as a means to achieve research goals while providing some benefits to the research participants.
	<i>Interactive</i>	Group-focused. People participate in defining the problem, setting research priorities, designing solutions, implementation of activities, monitoring progress and analyzing data, and in reviewing results. They view their participation as a way to ensure that they have a stake in the research process and outputs. Group members and other members of the community share benefits.	Researchers recognize the important role of community-based groups in the research process and in sustaining the activities. They facilitate activities leading to the empowerment of local partners. Generally, researchers develop the research methodology with input from end-users. They facilitate the research process.
	<i>Devolved</i>	Group-focused or community-based. Presence of strong locally led organization. Research is driven by end-users' goals. They assume responsibility in conducting informal research and recognize its value in the generation of knowledge and improving community well-being. Participation is a means to empower the group members. The community benefits from the research process.	Recognize and support informal research by capacity building or providing technical assistance. Actively integrate formal agricultural research and informal research led by end-users. They serve as resource persons in the research process.

Source: Adapted from Pretty (1995), Biggs (1989), White (1996), and McAllister and Vernooy (1999).

descriptive, analytic, and resource- focused.¹ We then grouped the projects by type of research and level of participation (Table 8.3).

Our analysis reveals that despite the emphasis on end-user participation or “putting the last first” in early SANREM documents, there were differing levels of participation in the actual implementation of the research projects. Activities displaying low levels of participation involved conventional data gathering and analysis. As we moved to higher levels of participation, in other words from consultative to devolved, we observed a mix of NGO-led development-oriented projects and a few projects with strong research orientation. Projects led by the NGOs embodied a strong community-organizing component that included activities such as awareness raising, empowerment, and institutionalization, similar to the strategy that they employed in the Priming Program (Orprecio *et al.* n.d.; Network for Environmental Concerns, Inc. *et al.* 1994). The NGOs worked with existing sub-community household social networks, which they called “hugpong” or “pundok”, to identify and address farm-related problems — commonly through capacity building (*e.g.* training) and technology transfer.

The only project that seemed to have the potential for attaining the highest level of participation, devolved, is the local government-led natural resource management and development planning project. The local government mobilized human resources as well as forming a multi-sectoral natural resource management council, which undertook the responsibility of developing the municipality’s natural resource management and development plan. The planning process also involved all the villages in the municipality.

The local government also invited other institutions, outside of the municipality, which had a stake on the conservation and management of the natural resources in the Manupali and the Mt. Kitanglad Range Nature Park, to take part in the council. Because of the project’s inclusiveness and potential for widespread impacts, the scale of participation surpassed that of the other SANREM-funded research

¹ Developmental activities aimed to promote broad social and political development in the community. Such activities have a strong organizational development component. Descriptive activities consisted of research activities conducted to provide a detailed characterization of the Manupali watershed’s landscape and lifescape. Analytic research activities sought to explain the biophysical and social interactions within the landscape as well as establish connections between endogenous factors and local decisions. Resource-focused research aimed at providing solutions (usually in the form of intervention) to resource-related problems such as soil erosion and loss of biodiversity.

Table 8.3. Analysis of level of participation by type of research project.

		Types of SANREM Research Projects Implemented at the Manupali Watershed			
		Developmental	Descriptive	Analytic	Resource Problem-focused
Levels of End-User Participation	Contractual		Weather monitoring		
	Nominal		Soil characterization GIS Forest resources		
	Resource		Development of sustainable production systems Gender Demographic characterization Flora & fauna characterization	Water quality & quantity modeling Economics of sustainability	Farming systems interactions (maize)
	Consultative	Environmental Education Priming Program	Ethnoecology		Enhancing biodiversity conservation Sustaining vegetable production systems
	Interactive	Environmental awareness & local empowerment Users-first research			Bufferzone resource management Water resource management & education
	Devolved	Natural resource management & development planning			

activities. It offered a new dimension to facilitating participatory natural resource management research in which sustainability does not depend much on the adaptability of technologies, but on building partnerships and resilience to political transitions.

We now turn our attention on the resource-focused projects that displayed high levels of participation. Among these projects, only the water resource management and education project and the buffer zone resource management project used continuous NGO facilitation and coordination. The other resource-focused projects did not include active NGO facilitation as part of the research process. Other than this difference, the projects share common attributes. First, they intimately involved the participation of individuals, households, and groups in action-oriented activities such as monitoring resource conditions and designing technological and institutional innovations to better manage the natural resource base. Second, these projects invested in capacity building activities for the participants, which provided new skills or enhancement of existing skills in natural resource management. Third, repeated interaction and building of social capital among participants facilitated the formation of community-based organizations or peoples' organizations that then took active roles in implementing the research projects (see Garrity *et al.*, Chapter 6; Deutsch *et al.*, Chapter 9 and Koffa and Garrity, Chapter 10 in this volume).

Constraints to Participation

Several constraints hindered end-users' participation in research. These included conflicting responsibilities within and outside of the household that made it difficult for some participants to participate in project-sponsored activities such as workshops, training activities and on-farm experiments. Another constraint to participation was related to lack of project funds. The downsizing of the weather monitoring research project's budget forced its implementers to terminate an activity involving villagers who were paid to record data from rainfall gauges across the watershed. Lack of access to and control over resources, land in particular, hindered farmers from fully participating in on-farm experiments. Some farmers anticipated the risks involved in trying out introduced technologies and, therefore, did not participate in the on-farm trials. Finally, miscommunication between the participants and researchers also hindered meaningful participation.

Participation is dynamic. It constantly evolves as a project progresses. A project may begin with a low level of participation, but as it progresses the level may shift from low to high. A high level of participation may not

be sustained if leadership and local support is absent. People participate in projects that are relevant to their goals as well as needs (Garrity *et al.* Chapter 6 in this volume). They may start as individual participants and later graduate into formal or informal groups. Group formation and the active involvement of groups in research indicate a high level of participation.

Inter-institutional/Inter-sectoral Collaboration

Sustainable agriculture and natural resource management deals with multiple crosscutting issues related to human well-being, agricultural productivity, environmental concerns, and development strategies. These make broad-based inter-institutional collaboration in research not merely possible, but highly desirable (NRC 1991: 59). The NRC panel explicitly instructed SANREM to

build on, work with, and work through established research institutions, which can provide, and in many cases have long provided, the professional, educational, and scientific leadership that meeting the challenge of sustainable agriculture will require.... [and] *organizations and institutions beyond those that have traditionally undertaken agricultural research* (NRC 1991: .48, italics added).

Instead of prescribing a procedure to facilitate collaborative research, the panel recommended a set of general strategies.

For the current SANREM program, the motivation for embracing inter-institutional collaboration was not only to comply with the NRC panel's recommendation. It arose from the program's commitment to depart from the traditional mode of diagnosis and intervention. SANREM advocated the creation of "unconventional" research partnerships among representatives from community-based groups, NGOs, and the local government with scientists from national and international research and academic institutions. Although there was some ambiguity about how the partnerships would be formed, this general approach resonated with all partners in the program as a means to avoid "top-down" research. To conventional minds, this approach mixed science with outreach and even activism, and thus placed undue stress on partnerships whose members neither shared a common paradigm of scientific method, nor a common set of criteria for

formulating and choosing research questions. From the scientists' point of view, adherence to the ideas of participation and inter-institutional partnership in the research design threatened to compromise the quality of the research as well as delay on-site activities because of the number of players and agendas involved. To the community, NGOs and other development-oriented partners, insistence on scientific method diminished the immediacy of the project, threatened its relevance, and even risked alienating many end-users, including community members hosting the research.

The SANREM management made inter-institutional collaboration a requirement for proposed projects in Phase I, in addition to being participatory, interdisciplinary and landscape-based. Research project proposals had to show partnerships among international, national, and local institutions, which included organizations and agencies based in Mindanao. In practice, this was a demanding requirement, since the program was not building on a long history of collaboration among its partners. It presented a major challenge to partner institutions because inter-institutional collaboration in natural resource management research involves a great intensity of linkages and prior networking. It is established based on shared vision, sharing of power and resources, and joint responsibility among collaborating institutions. It also demands an integrative approach to attaining research goals – one that recognizes and utilizes institutional capacities and ensures that benefits are shared by partner institutions.

We recognize that all of the above attributes could be used as indicators in conducting an in-depth analysis of inter-institutional collaboration. Our present analysis falls short of integrating these indicators. Instead we focus on examining institutional diversity within each type of research. By institutional diversity we mean the presence of NGOs, academic and research institutions, community-based organizations, and government agencies in a particular type of research. As shown in Table 8.4, we differentiate institutions based on four categories: (1) role as project leader or partner, (2) hierarchy, *i.e.* local, provincial/regional or international, (3) type, *i.e.* whether institutional partner is an NGO, university or research institution, government agency and so on, and (4) scale of research, *i.e.* whether research covers community, regional and national levels.

As observed earlier, NGOs were the natural leaders of development-oriented projects while research-oriented projects were led by

Table 8.4. Inter-institutional collaboration in SANREM/Philippines, Phase I.

	Developmental	Descriptive	Analytic	Resource-Focused
Lead Institutions				
Local	NGO Municipal gov't, ²	University		University
Provincial/ Regional		NGO		
National		University		
International	NGO University	University IARC ³	University	IARC University
Partner Institutions				
Local	Municipal gov't. University Community schools	Tribal association University	University	Community-based organizations University
Provincial/ Regional	Provincial gov't. Gov't. agency	University/ NGO	Gov't. agency	NGO Gov't. agency
National		Gov't. agency	University	University
International	University			NGO
Scale of Research	Community	Community	Community Regional National	Community

² All SANREM projects collaborated with the local government to develop the municipal natural resource management and development plan. The current table does not specify all the institutions involved.

³ IARC stands for International Agricultural Research Center.

university or research-based institutions⁴. There was a notable lack of national government agency involvement either as lead or partner institution.

Roadblocks to Collaboration

Inter-institutional collaboration in SANREM involves a diverse group of institutions. If inter-institutional partnerships succeed, it has the capacity to transform participating groups in ways leading to lasting outcomes and impacts. However reflecting on the SANREM experience, we identify some roadblocks in developing collaborative research partnerships. First, collaboration is bound to fail if roles of participating institutions are not clearly defined and if there is no regular interaction and equitable relationship among partners. The second roadblock is what we call episodic collaboration, a situation wherein collaboration focuses on the individual level rather than institutional. This means that the project is not recognized as a legitimate partner by a host institution. Such situation could stall strategies for long-term institutionalization of project processes, methodologies and outputs. The third roadblock is transition. Collaborative partnerships and institutions are constantly changing. Transitions within institutions could affect an existing collaboration. Local government units, for example, are strongly affected by change in political leadership, especially after elections. A change in political leadership could alter earlier collaborative agreements. In deciding to work closely with the local government, the project placed itself at some risk from the political cycle. Third, collaborative research involves high transaction costs. Opening the program to a variety of institutions meant dealing with various and sometimes divergent institutional agendas. Conflicting agendas among partner institutions could strain or break partnerships. Balancing institutional agendas with those of the program demanded scheduling activities to facilitate regular interactions among partners.

⁴ The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), which is the Philippines' national agricultural research system (NARS), was not included in this analysis because it did not undertake any research project. PCARRD's primary responsibility in Phase I was research management although it was also responsible for linking SANREM in national level dialogues.

Landscape Approach

Implementing a research program using a landscape approach distinguishes SANREM from other CRSPs and agricultural research and development projects, which mainly have a commodity orientation. The landscape approach provides an integrative framework for analyzing complex agroecological processes and properties. This includes showing how human activities and non-human factors directly or indirectly affect the way resources are managed and how systems function. By taking a landscape approach to research, SANREM places itself in the mainstream of sustainable development thinking, which focuses on analyzing issues or the various components of a system in an integrated fashion rather than in isolation. This is, therefore, a major departure from the classic reductionist analytical approach.

The Manupali watershed offered the ideal location to conduct research on a landscape scale. The Manupali site is comprised of diverse agroecosystems and provided SANREM researchers with the opportunity to study the factors that influence long-term productivity and sustainability of the system as a whole. The first on-site activity, the participatory landscape/lifescape appraisal (PLLA), laid the foundation for pursuing a landscape approach to natural resource management research (Bellows *et al.* 1995). Subsequent activities led to the assignment of research projects across the landscape. In Phase II, the SANREM Southeast Asia program has embarked on developing an integrated watershed model.

Interdisciplinary Research

In Phase I, SANREM attempted to promote interdisciplinary research by organizing the research agenda into three “biophysical” focal groups: soils, water, and biodiversity. Each focal group contained several research projects. Each project encouraged scientists from the natural, agricultural, and social sciences to work together. This strategy, however, succeeded only in constructing tentative bridges (in the form of consultations) across disciplines. The conduct of activities within research projects was generally multi-disciplinary, *i.e.* groups of researchers with each member working within his or her own discipline. This was understandable when in-depth characterization of the properties and processes of the landscape were perceived to be more efficient when conducted within disciplinary boundaries.

It is clear from the design and procedure of Phase II that the rather tentative bridges across disciplines constructed during Phase I will form

important links among researchers in a more confident, more focused Phase II effort. Moreover, site research activities are beginning to yield results that are of great value to other projects. As Phase II progresses, a demand for cross-disciplinary projects has taken place with the development of analytical tools that are able to integrate disciplinary explanations of how various components within and outside the watershed interact. SANREM's research project on integrated watershed modeling, which is implemented in Phase II, provides a mechanism for integrating these disciplinary explanations. Unlike most watershed models, it incorporates socio-economic and political dimensions as well as biophysical data to explain how watersheds function.

Other Issues

The previous sections laid out the guiding principles of SANREM research. While knowledge of these is essential to obtain a broad appreciation of SANREM's approach, other issues emerged that shaped the program's direction. These were decentralization in Philippine governance, and scaling-up natural resource management research.

Conducting Natural Resource Management Research in the Context of Government Decentralization

As mentioned in Chapter 1, the implementation of SANREM in the Philippines took place just as significant reforms were introduced in Philippine governance, *i.e.* the selective decentralization of authority and resources from central to local government. Among the basic services devolved to the local governments were services that affected the environment and agriculture sectors. While decentralization was underway, on-site research activities focused on developing a comprehensive description of the landscape and lifescape as well as analyzing the impact of agricultural production systems on the environment. Other research activities attempted to generate field-tested methodologies and technologies to manage a fragile natural resource base for long-term agricultural production. The initial perception within the program (and even among related programs in the country) was that SANREM's research strategy was appropriate and relevant. Linking natural resources management research and sustainable agriculture made sense, because both depend on each other.

However, as the process of decentralization gained momentum in the municipalities, it became evident that public policy, now partially entrusted

to local governments, was an area that demanded attention. Under the 1991 Local Government Code, Philippine local governments are to exercise authority as comprehensive land use managements, lead in policy formulation in addition to promoting economic growth. (PCARRD-DOST-DENR-DA-UPLB-CFNR/ENFOR 1999; Brillantes 1997). Sustainable agriculture and natural resource management, thus, depend on sound government policies that provide incentives to farmers and/or natural resource managers to adopt technologies that reduce environmental degradation and opportunity for local organizations to participate in the decision-making process. Yet a majority of the local government units were inadequately prepared to carry out this role nor did SANREM initially articulate a strategy as to how gains in research with obvious policy application would be translated at the local level. Thus, it became necessary, with some pressure from the local government, for SANREM and the local government to come up with a thrust that not only would enhance the program's overall research strategy but also support the local government in carrying out its devolved responsibilities. The search for a mutually beneficial strategy culminated with the formal agreement between the Lantapan municipal government and SANREM to collaborate in developing the municipality's natural resource management and development plan (NRMDP). The process mirrored SANREM's cornerstones, particularly inter-institutional collaboration and participation. In the spirit of decentralization, the local government organized a natural resource management council, which was comprised of sectoral representatives from the community and the province, to lead in the formulation of the natural resource management plan. The council members received training in participatory planning. The plan's formulation facilitated the integration of SANREM's research results into the local government's agriculture and natural resource management research and development agenda. It laid out the municipality's five-year research and development agenda on agriculture and natural resource management (NRMDP 1998). It also partially served as the local government's compliance with the national mandate requiring municipalities to formulate a municipal comprehensive development plan. The plan was a tangible output that cemented local government and SANREM collaboration while providing a base to anchor research activities in the first and second phase of program implementation.

SANREM's experience in reorienting research within the context of decentralization suggests the following lessons. First, it enabled SANREM to bridge natural resource management research and public policy, which would have been less possible in commodity-oriented research. However, though we remain optimistic, this bridge could be best described as

incipient because of its dependence on political structures whose resilience over the electoral cycle is as yet unproven. The full implementation of the plan and the continuity of the council remain subject to the vagaries of Philippine politics. Only when the plan becomes institutionalized within the local government with strong commitment from the community will it be able to withstand political transitions. Second, the research and decentralization link legitimizes the importance of multi-stakeholder or multi-sectoral participation and the need for a clear articulation of roles as well as interests in the planning and research processes. Third, there is a need for experts in policy analysis and governance who can assist local policy-makers use research results and other outputs to formulate sound policies. Fourth, multi-stakeholder support for research and decentralization will sustain if gains are not only translated through conservation and management of the natural resource base but also through improved quality of life, strengthened social capital, and increased household incomes and local government revenues. Finally, successful decentralized natural resource management and planning techniques could be used as models for scaling-up outcomes, outputs, and impacts outside the Manupali watershed.

Scaling- up Natural Resource Management Research and Planning

Numerous definitions and typologies of scaling-up have been used in research and development (Korten 1990; Clark, 1991; Fisher 1993; Uvin 1995; Gaventa 1998; Blackburn and Holland 1998; Pretty and Chambers 1994). A number have evolved from the desire to multiply the impacts made by non-governmental organizations working in communities in the developing countries. We will borrow key elements from existing definitions to define scaling-up in natural resource management research and planning as a set of activities intended to increase community level impacts to other similar communities or to higher levels of policy making. There are four strategies to scaling-up. The first is information dissemination. This strategy could potentially cover a wide geographic area compared to the other strategies. It assumes that impact is made when recipients apply information generated by the core program. The second strategy involves replicating activities from a specific study community to other communities facing similar NRM-related issues. Capacity building is an important component in replicating activities to other sites. The third strategy is policy advocacy. Institutions engaged in natural resource management research and planning in a core community move towards influencing higher levels of decision making, for example

from community to provincial/regional and national level. The fourth strategy contains a strong research orientation. It involves increasing the scale of analysis and impact by starting, for example, at a watershed scale and going up to an eco-regional scale, using sophisticated analytical tools.

Among the strategies described above, the Philippine program undertook information dissemination and (to some extent) policy advocacy in Phase I through informal and formal channels. SANREM co-organized with the municipal and provincial governments a series of *Kapihans* (literally means coffee meetings) to share research results with policy makers, development practitioners, planning officers, and students. Project researchers also gave presentations at national and international meetings. PCARRD undertook policy advocacy at the national level by providing assistance in drafting a congressional bill to promote sustainable sloping agricultural land technologies. It introduced some of the research results and approaches generated from SANREM's work in the Manupali Watershed into the bill.

In Phase II, replication activities are under way. These activities include capacity building for water quality monitoring, agroforestry, and natural resource management planning. Local organizations, namely the Tigbantay Wahig and the Agroforestry Trees Seeds Association of Lantapan, play a key role in providing hands on training to participants from municipalities/provinces in Mindanao and neighboring islands. Capitalizing on local organizations legitimizes SANREM's commitment to participatory research and strengthens community organizations, which is consistent with the goals of decentralization.

Scoones and Thompson (1992: 8) raised the questions, "How can local-level insights derived from participatory investigations articulate larger-scale policy formulation and planning approaches at regional or even national levels? What methodological approaches are needed to allow the range of interest groups to be heard in the process?" Answers to these questions could guide SANREM managers in developing a strategic approach to scaling-up at the national level. The lack of diverse institutional partners involved in SANREM research poses a challenge to expand impacts at the national level. Intermediary organizations such as PCARRD and NGOs could play an important role in policy advocacy. Local organizations, too, could be part of the process.

The SANREM program in the Philippines gained valuable insights as it encountered the realities of implementing an ambitious program of participatory research and outreach in the Manupali watershed. First, it was not enough to ensure that there is a semblance of each cornerstone in the research activities. Some cornerstones required a lot more time to cultivate than others. Obviously, during the first two years of

implementation, SANREM focused on process in the hope that the benefits would be long lasting. The program invested substantial time and resources to ensure community awareness, acceptance, and participation and to facilitate smooth inter-institutional relationships. However, the process-oriented cornerstones required a high transaction cost, and the value of participatory process may not be immediately appreciated in a program that is focused solely on research. Second, the complexity involved in ensuring that the cornerstones are integrated into the research process requires flexibility in all levels of project management. Flexibility, however, should not sacrifice efficiency and effectiveness. Third, the cornerstones could not be treated individually. They were in various ways interrelated. Establishing a balance between the cornerstones, achieving scientific rigor, and producing long-term impacts within a five-year time frame was unrealistic. In assessing the SANREM experience in Phase I, the extent to which the commitment to the cornerstones assisted or hindered the project remains an important question.

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Chapter 9: Community-based Water Quality Monitoring: The *Tigbantay Wahig*¹ Experience¹

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Introduction and Objectives

This chapter will document the exciting development of a people's organization in Lantapan that is committed to protecting and restoring the water resources of their municipality. It will briefly place this development in the historical context of Philippine decentralization and the rise of environmentally-related nongovernmental groups, as well as the goals and cornerstones of the SANREM CRSP program. The groups' technical and social formation will be outlined, with a description of milestones, success stories and future directions. The

¹ TIGBANTAY WAHIG is a term that in the Binukid dialect means "Water Watchers," the citizen volunteer, water quality monitors of Lantapan, Bukidnon, the Philippines.

This chapter is an expansion of a paper presented at the International Farming Systems Association Conference, SANREM CRSP Panel Presentation, Santiago, Chile (November 28, 2000) entitled, *Formation, Potential and Challenges of a Citizen Volunteer Water Quality Monitoring Group in Mindanao, Philippines*, by W. Deutsch and J. Orprecio. The water quality project described in this chapter was implemented through the International Center for Aquaculture and Aquatic Environments, Auburn University. Work plan partners included Heifer Project International/Philippines (co-principal investigator of the project), Central Mindanao University, the San Herminigildo Agro-Industrial School, Inc., the National Power Corporation and the Provincial Planning and Development Office of Bukidnon, and the University of the Philippines Los Baños. Most of the field work which led to the results presented was conducted by the Tigbantay Wahig, Inc. people's organization of Lantapan, Bukidnon, Philippines.

watershed-level research findings and applications of this project are featured in Part I, Chapter 7.

Historical Background: Public Participation in Philippine Water Issues

In spite of the fact that the Philippines is water rich, with nearly 5,000 cubic meters per capita of renewable water resources, there is a national crisis regarding conservation of a dwindling supply of high quality water. This has led to recent presidential decrees and other legislative action at the federal level, including Senate Bill No. 1082 which is designed to institute “a comprehensive water development act thereby revising and consolidating all the laws governing the appropriation, utilization, exploitation, conservation, development and management of water resources, creating the National Water Commission” (Policy Forum 1997).

Water quality of both coastal marine and inland freshwater environments of the Philippines is threatened by soil erosion and sedimentation, excess nutrient runoff and bacterial contamination. These types of pollutants often come from broad areas of both rural and urban land (usually classified as polluted runoff or nonpoint source pollution). Although polluted runoff is the most common source of water degradation in the Philippines and worldwide, it is much more difficult to control than pollution from specific sources.

As in most parts of the developing world, there is a limit to what government can do to protect and conserve water because of a lack of personnel, equipment and finances. This is especially true in remote, rural areas, where rates of natural resource loss generally exceed local governments’ attempts to remedy environmental problems. In particular, specific information of water conditions needed to establish management strategies is generally lacking.

Regardless of governmental resources, many of the current environmental problems are not solvable by government regulation alone. Citizens need to become aware of the issues and take an active part in finding solutions. They have the greatest vested interest in conserving local water supplies and a greater capacity than that of the government to measure conditions, identify specific problems and decide upon a proper course of action. Of pressing need are practical, environmental indicators that local communities can use to determine trends of their natural resources and evaluate the appropriateness of their collective actions.

Decentralization and Potential for Local Environmental Management and Policy

A more complete description of Philippine decentralization and devolution of authority is presented in Part I of this monograph, however, a brief summation of the elements of that process that most apply to the development of environmentally-related people's organizations is presented here.

Since the era of President Ferdinand Marcos and the 1986 revolution, the Philippines has moved squarely in the direction of decentralized authority, including decentralized natural resource management. The "people power" democratization process saw the flourishing of nongovernmental organizations (NGOs) eager to play an active role in the country's development, and the Philippines now has one of the highest numbers of NGOs in the world. A recent evaluation of this transition (Jutkowitz *et al.* 1997) indicated that "...the Philippines has made significant progress in establishing legal guidelines for greater local government autonomy, for more responsive and accountable local government, and for broader participation by civil society at the local level."

The government reversed the centralized political power and governance primarily through the enactment of the Local Government Code in 1991. The code includes the following provisions (Jutkowitz *et al.* 1997):

1. devolves power and authority to deliver services to local government units and calls for health, agriculture, environment, infrastructure, and social welfare services to be run by *barangays* (municipal subunits),
2. provides for quarterly distribution of internal revenue allotments to local government units from national revenue collected, using a formula based on government level and population (such allotments may be used for natural resource management and protection),
3. mandates participation of government-accredited NGOs (nonprofit organizations) and peoples' organizations (community-based membership organizations) in local government council deliberations, and
4. authorizes local initiatives and referenda to allow registered voters to propose, enact, repeal, or amend ordinances directly at the local government level.

Continued decentralization of authority over the last 8-10 years has provided a foundation for community-based environmental management and policy. At the local level, municipal mayors are being mandated by federal and provincial governments to develop natural resource management plans that often need to address water issues. Although not always the case, many mayors and local government units are becoming more receptive to cost-effective ways they may obtain information to formulate municipal policies of environmental protection and restoration.

The Community-based, Water Quality Monitoring Project, 1994-2000

A community-based environmental assessment of the Manupali River watershed in Central Mindanao, Philippines (Bukidnon Province) was begun in 1994. The objectives of this project were to facilitate the development of water quality and watershed assessments by local communities, and provide physicochemical data that would be used to improve water quality and policy. Such a participatory approach to natural resource management on a landscape scale, that involved researchers from various disciplines and partners from various governmental and nongovernmental sectors, was the goal of the greater SANREM Program.

The project had two research questions related to the above objectives:

- 1) What is the general physical, chemical and biological condition of water in the streams of the Municipality of Lantapan?
- 2) Can the local community of Lantapan form citizen monitoring teams to measure water conditions and conserve the aquatic resource?
 - a. Is there community-wide interest in becoming more aware of water issues and in forming monitoring teams?
 - b. What is the best way to train and equip citizens to collect meaningful data?
 - c. What is the most efficient way to sample and implement quality control measures so that the information is most usable for community education and problem-solving?
 - d. Would citizen water monitoring receive government support and become established or institutionalized in such a way that it makes a lasting impact?

Approach and Methods

The participatory methods used were modelled after those developed in Alabama Water Watch, a citizen volunteer, water quality monitoring program that is now underway in the U.S. (Deutsch *et al.* 1998). Filipino partners on the SANREM work plan who were educators and community developers helped customize the workshops and sampling techniques to the local situation (Deutsch *et al.* 2000). Community participants primarily included farmers, teachers, members of certain women's organizations and some members of the local government unit.

Formation of a Community-based, Water Monitoring Team

“Priming activities” led by NGO partners helped the community to understand and feel comfortable working with researchers. For example, a study tour was organized and led by a local educator and project partner to enable several local farmers to travel from their upland communities, through various portions of a large river valley, to the sea (some for the first time). This helped the farmers more clearly understand certain biophysical and social linkages between their land and downstream areas that researchers intended to study.

The indigenous people of the *Talaandig* tribe in Lantapan had distinct perceptions of environmental problems that were important to consider. The overarching worldview of the tribe was that spirits of water, air, forests and other natural and human phenomena were to be respected, and that lack of respect led to natural disasters. For example, one *Talaandig* man explained that a recent flash flood that killed a young girl of the tribe resulted from outsiders who came to the forest and were loud and irreverent. The view was that water came suddenly from the ground, independent of rainfall, as a judgment.

To help reconcile differing cultural views of environment, and raise awareness of the tribal way of life, the *Talaandig* leadership invited researchers and development workers to a several-hour “ritual of understanding” in the tribal center. Subsequently, researchers and community members interested in studying water quality and quantity obtained the permission of the tribe to enter and sample the water of the streams. Modern testing methods for determining water quality merged with an ancient, tribal spirituality of water and in one instance, a rice offering in a banana leaf was left to the water spirit by a *Talaandig* man who had just measured various chemical and biological parameters of a stream as part of the *Tigbantay Wahig* monitoring group.

Local citizens, including *Talaandig* and immigrant farmers, volunteered to receive training in water quality monitoring and principles of watershed management. The first workshop was conducted on July 4-7, 1994 and included techniques for simple physicochemical and biological tests of water. In the field portion of the workshop, volunteers and researchers began a systematic monitoring program of four subwatersheds, which included collecting data on water chemistry, bacteria, total suspended solids, stream discharge and soil export. Several other training workshops were conducted over the next six years, to introduce new parameters for monitoring, interpret results, and help new volunteers to begin monitoring.

The project researchers and volunteer water monitors selected 16 (later reduced to four) sampling sites on four main tributaries of the Manupali River. Sites were chosen that were generally accessible and representative of the diverse portions of the overall landscape, including subwatersheds of varying degrees of forest cover, agricultural land and population. The area of the subwatersheds ranged from about 2,400 to 10,000 ha.

A “menu” of possible water quality indicators was made available to the monitors in the workshops. These included the physicochemical parameters of temperature, pH, alkalinity, hardness, nitrates, phosphates, dissolved oxygen, turbidity and total suspended solids. Biological parameters included biotic indices of stream macro-invertebrates and measurements of *E. coli* and other coliform bacteria concentrations.

After several months of working together, the monitoring teams made suggestions for improving the project, including sampling site selection and use of the data collected in community outreach. Monitoring results were disseminated to community members, educators and local policy makers through oral presentations and written reports. After several months of involvement in the project, the core group of water monitors proceeded, in Filipino fashion, to form a people’s organization (the Tigbantay Wahig, Inc.) and incorporate as an officially recognized NGO in 1995.

Results and Discussion

Monitoring has continued from 1994 to the present, with the analyses of thousands of samples and a general description of the physicochemical and biological features of the watershed. The primary indicators of watershed health and ecological sustainability derived from the research were described in Deutsch *et al.* (2000) and are summarized in Table 9.1.

Table 9.1. Summary of community-based, water quality indicators.

Issue/Problem	Indicator	Unit of Measure
General Memories, Experiences	Community Perceptions, Questionnaires/Surveys	Anecdotal, or Environmental Degradation
Soil Erosion	Suspended Soils in Water Soil Loss in Water	mg/l TSS; kg/ha soil export
Disrupted Stream Flow	Stream Discharge (monthly measurement); Flow Variability (comparisons: time, space)	cu. meters/second flow; coefficient of variation
Bacterial Contamination	Coliform Concentration	no. colonies/ml of water (<i>E. coli</i> and other coliforms)

Research results have begun to have several applications, including:

- 1) Establishing a baseline of water quality conditions across the SANREM CRSP/Philippines study site that may be used to assess change over time and evaluate research goals of implementing sustainable practices for agriculture and environment.
- 2) Providing the Lantapan local government unit and citizens of Bukidnon with the techniques and information to establish and perpetuate a community-based water monitoring program. This information may pertain to public health (potable water supply and waterborne disease), sustainable agriculture (pesticide and soil loss from land to water) and economic development (multiple use of the aquatic resource).
- 3) Providing a model for other parts of the Philippines and other countries (including the U.S.) so that community-based environmental monitoring may be efficiently expanded and coordinated on local, national and global scales. This application of research results could greatly expand the audience/beneficiaries of the information.

The equipment and techniques used in this project provide the potential for collecting data that is adequate for describing and managing the aquatic resource. Although tests may not be sufficiently accurate for

certified laboratories or research chemists, the ranges of bias and precision are narrow enough to determine valid trends in water quality for several important parameters. This assumes that 1) the monitors are properly trained and are committed to maintaining quality, and 2) the equipment and reagents are properly cared for and regularly maintained according to established protocols.

After collecting and analyzing thousands of water samples, the citizen teams have developed a monitoring program that is beginning to increase public awareness and concern about water issues. Beyond the necessary awareness that a community and policy-makers need to undergo before lasting environmental protection takes place, specific information that monitors collect has direct relevancy to end-user problems.

For example, by sampling hourly through a rainfall event, citizen data on total suspended solids detected about a 1000-fold increase in eroded soil in a stream of Lantapan. With the skills to measure this dramatic rate and magnitude of soil loss, the monitors can now identify “hot spots” of soil erosion throughout the landscape. The community (possibly through SANREM work plans or the local government unit involvement) can then work toward remediation measures and continue monitoring streams to evaluate their effectiveness and success.

Key Training Activities and Group Milestones

In addition to monitoring water quality and quantity on the major tributaries of the Manupali River in Lantapan, the *Tigbantay Wahig* has been involved with many other aspects of community development and environmentalism. A sample of such training workshops, meetings and field activities are listed below:

1. September 12-13, 1995: Leadership and Group Facilitating Skills, HPI Field Office, Lantapan, Bukidnon (18 participants). To increase participant’s understanding of the different roles people play in facilitating meetings and to highlight the importance of consensus building in directing and/or achieving the group’s goals and objectives.
2. April 11-12, 1996: Organizational Management and Effective Decision Making, Central Mindanao University, Musuan, Bukidnon (16 participants). To strengthen the group members’ capabilities in managing their own organization, in project planning and implementation. This training was facilitated by Mr. Ben Ramiso of the Muslim-Christian Agency for Rural Development or MuCARD.

3. July 1, 1996: Bookkeeping and Financial Management (Level 1), HPI Field Office, Lantapan Bukidnon (3 participants). To capacitate the group in managing their own funds.
4. September 24-25, 1996: Community Organizing Training, Balila Barangay Hall, Balila, Lantapan, Bukidnon (20 participants). To further enhance the group's capabilities in organizational management and project planning/implementation.
5. October 24-25, 1996: Pre-Membership Education & Basic Human Relations, Balila *Barangay* Hall, Balila, Lantapan, Bukidnon (26 participants). To accommodate expanded membership in the TW, especially participation of women, the training included group workshops such as: the 3 Good Qualities, Old/Young Lady, Communication, Conflict Resolution and Team Building.
6. May 6, 1997: 7S + R Training, Central Mindanao University, Musuan, Bukidnon, and the Balila *Barangay* Hall, Balila, Lantapan, Bukidnon (20 participants). To give the group the opportunity to develop their Vision, Mission and Objectives. The group's vision is "to build a strong and sustainable organization serving as a model for the benefit of the larger Lantapan community. Among the objectives they set were: 1) to raise awareness about the state of the Pulangi River and its tributaries, and conduct activities aimed at preserving its natural resources; 2) to continue the goals and objectives of the SANREM CRSP program towards sustainable agriculture. Also, a workshop objective was to form the Tigbantay Wahig structure which included the following committees: Project Committee, Outreach/Education Committee, Water Sampling Committee and Information Committee.
7. June 3, 1997: Aquaculture Exposure Trip, Mindanao State University/Naawan, Municipality of Naawan, Misamis Oriental and the Balila *Barangay* Hall, Balila, Lantapan, Bukidnon (30 participants). To learn more about fishpond management.
8. August 14-15, 1997: Stream Discharge Training (8 participants). To enable the members to learn the methods of calculating stream discharge for determining trends in water quantity and soil erosion.
9. January 12-14, 1999: Goat Production and Management Training (13 participants). To equip the members with knowledge in goat management, including animal health, breeding, stock selection and nutrition. HPI/Philippines Technical Officer, Ms. Jusa T. Banda, facilitated the training.
10. August 11-12, 1999: Cornerstone Value-based Planning and Management Training (5 participants; TW officers). To increase

the capacity for organizational management, planning and evaluation.

11. August 23-24, 1999: Aquaculture Management Training and Exposure, Lantapan, Bukidnon (26 participants). To increase the capacity to produce fish in farm ponds. The training was conducted by Prof. Danilo Vicente, Dean of the Aquaculture Department of Mindanao State University and Mr. Eugene Moleño (Aquaculture Technician).
12. September 1-3, 1999: Bukidnon Watershed Summit, Valencia, Bukidnon. A poster on Community-based Water Quality Monitoring was presented by Mr. Jun Magsacay (TW President), Janeth B. Labis and Mr. Jim L. Orprecio.
13. September 6-8, 1999: Tree Planting Activity. A total of 1,200 seedlings were planted along the Kulasihan River for stream bank restoration, erosion reduction and improvement of water quality.

Conclusions and Lessons Learned

In spite of initial skepticism that rural communities would be unwilling or unable to consistently participate in an environmental monitoring project, the water monitoring team has collected a valuable data set. The water information was gathered prior to, during and after the El Niño phenomenon and is, therefore, an important and unique data set for upland tropical watersheds.

One of the main strengths in collaboration is that participatory research, extension of information and community action are occurring simultaneously. Instead of a traditional model of conducting the research in isolation from the local community, then trying to extend the significant findings to them through such things as technology transfer and the media, the citizens, community organizers and scientists learn together.

It has been difficult to translate the significant research findings of the project to policy and environmental improvements because of a variety of factors:

- a. The local government unit has undergone changes in key leadership and agendas.
- b. The “critical mass” of interested citizens and policy makers is still low, and there is considerable apathy in addressing environmental problems among the government and citizenry.

- c. Economic development, such as building new roads and bridges and attracting plantation-style agro-business has taken precedence over conservation, sustainable agriculture and natural resource management.
- d. There is a relatively small presence of the SANREM program in the community, and the program thus has reduced recognition as an important part of community development (compared with initial stages of the program). This relates, in part, to changing agendas of the U.S. Agency for International Development (primary funder of the SANREM CRSP), and the SANREM Management Entity.

Expansion of the *Tigbantay Wahig* Scope

Although the impacts of the *Tigbantay Wahig*'s work is yet to find its full potential in Lantapan, it continues to grow and has attracted considerable interest among other municipalities in the Philippines. Study tours of local government representatives from Sarangani Province (Southern Mindanao) led to the start of a similar, community-based water monitoring effort there. Importantly, this was done with the Sarangani government's initiative and financial resources. A similar program, requested by the Governor of Bohol, is scheduled to begin in early 2001.

The self-identified, future directions of the *Tigbantay Wahig* include:

1. group strengthening through organizational development trainings;
2. group expansion to accommodate interested community members;
3. tree planting activities along the four main rivers of Lantapan;
4. development of an Agro-Aqua-Forestry Project by fully establishing their current demonstration farm with the fish and goat project;
5. establishment of a *Tigbantay Wahig* Multi-Purpose Cooperative;
6. collaboration with other government agencies such as the Department of Environment and Natural Resources; and
7. continued water quality and quantity data collection.

Important Lessons

1. Many citizens of the Philippines and the world have a keen interest in being part of environmental assessment as it pertains to their daily lives. Awareness of environmental issues is relatively high, even in remote rural areas.

2. The hands-on activities of environmental monitoring using simple equipment and techniques are a tremendous motivation for participation. Once the mystique of “only the professionals can do this” is removed in a workshop, citizens are usually eager to become involved. They take pride in knowing that the information they gather is really important and can improve the management of their land and water.
3. The type of information needed by policy makers for natural resource management planning should be science-based, but need not necessarily meet all the requirements of the scientific community with regard to precision and rigor. This is especially true in watersheds that are degrading rapidly, with irreversible consequences. In these situations, application of partly understood conservation practices, with full community involvement, may be far better than waiting for a “complete” scientific understanding.
4. The startup of a collaborative process in these projects was relatively slow and expensive, but initial results indicate that the potential for lasting benefits and project sustainability are much higher than if attempted by a community, NGO, university or government agency in isolation.

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Chapter 10: Grassroots Empowerment and Sustainability in the Management of Critical Natural Resources: The Agroforestry Tree Seed Association of Lantapan¹

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Introduction

Quality germplasm, in this case seed, is the most significant input in farming systems, including agroforestry systems. Quality seed determines the upper limit of yield, the ultimate productivity of other inputs, transference of genetic information from one generation of crops to another, the basis of economic yield of the majority of crops and makes substantial contribution to productivity independent of other inputs (Sperling *et al.* 1996; Simons 1996; Cromwell *et al.* 1993; Cromwell 1990; Thomas 1990). It is, therefore, an important source of innovation and intervention, particularly for farmers with small holdings of marginal lands, who have low capacity to absorb high losses and less resources for alternative inputs (Simons *et al.* 1994; Cromwell *et al.* 1993).

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The lack of quality seed has not only been identified as an impediment to the adoption of agroforestry technologies (Koffa and Garrity 1996), which the International Centre for Research in Agroforestry (ICRAF) is successfully disseminating through the Landcare Approach (Garrity and Mercado 1998; Campbell 1994) and participatory tree domestication initiatives (Weber *et al.* 2000) in Lantapan and elsewhere in the Philippines. It is also a major problem in the national quest to reforest millions of hectares of idle lands and problem soils in the Philippines for the protection of critical ecosystems such as nature reserves and watersheds. For instance, it costs just as much to establish tree plantations from poor (genetically inferior) seed as it does from seed of the highest genetic potential, but the difference in material and economic returns can be substantial. Poor quality seed has: (a) reduced storage capacity; (b) poor and non-uniform emergence when sown; (c) high incidence of abnormal planting stock, with high susceptibility to pest and disease attacks; and (d) often develops into plants of poor quality in terms of yield, form and growth rate.

In high-rainfall areas with steep slopes and nutrient-poor soils, as is true for the Manupali watershed and the buffer zone of the Mt. Kitanglad Range Nature Park (MKRNP), tree crops and tree-dominated agroforestry systems are the most stable forms of land use other than natural forests (Sayer 1991). The introduction of such agroforestry systems and component technologies in buffer-zones around protected areas has therefore been suggested as a credible technology option which may not only reduce pressure on forest resources, but may also improve the living standards of the rural population whose lives are almost exclusively dependent on such protected landscapes (Sayer 1991, van Orsdol 1987).

In nearly five decades of development work in the third world, U.S. (United States) institutions have developed and field-tested many approaches towards improved living standards for the poor but with varying degrees of recognized success. Outstanding among the lessons learned in these attempts is that development efforts, through participatory practices, must incorporate an appreciation and understanding of the priorities and constraints that shape the farmers' experience (SANREM-CRSP 1999). SANREM CRSP has embodied and employed this lesson in its work in Lantapan through the programme's four cornerstones of participatory research, inter-disciplinary teams, inter-institutional collaboration and a landscape scale of analysis of resource use challenges and opportunities.

This case study draws heavily on and employs the principles of participatory research and development and the building, and use of interdisciplinary teams of farmers and scientists to define problems and

identify and test potential solutions as partners in the management of a critical natural resource base. This paper discusses a strategy that attempts to give farmers the capacity to collect/produce, process and develop seeds of a variety of agroforestry tree species both as viable enterprises and for biodiversity conservation through the development of agroforestry systems and component technologies to manage the bufferzone of the MKRNP. Around the world, farmers currently depend upon more than 2500 tree species for construction materials, fence posts, firewood, charcoal, fibers, resins, waxes, fruits, medicines, fodder, poles and service functions such as soil conservation, boundary delineation and shade (Salim *et al.* 1999, Simons 1996). With these benefits the collection/production, development and marketing of quality tree seeds are potential alternative ways to promote local development so as to encourage improved natural resource management practices outside protected areas.

The Strategy

The strategy that was implemented involved continuous interaction between researchers and farmers during the identification, testing and extension of agroforestry technologies. This enabled us to establish a strong partnership with farmer partners, understand their practices and find ways to improve and enhance such practices. Our strategy also included assisting a grassroots organization through capacity building to support the project's research and extension activities and build a mechanism for the organization to sustain and extend its activities within the Manupali watershed and beyond. To follow is a detailed description of the strategy.

Creating an Interactive Participatory Research Process

In about a year of research and extension work with farmers in nurseries and on farms to improve the management of tree-based production systems, we learned that seed was collected by and exchanged among relatively few farmers, while others sold seed for cash in Lantapan and nearby municipalities. However, nothing was known about the appropriateness of the seed collection and the processing (extraction, cleaning, drying, storing, packaging) methods used, the quality of the seed exchanged or sold and the attendant constraints farmers were facing. A case study (Koffa and Roshetko 1999) was undertaken to address these and related issues and concerns.

The case study mainly focused on assessing the seed collection, processing and diffusion practices and systems of smallholders, so as to understand these systems and to improve and use them to serve as channels for producing and disseminating quality tree seed. The study indicated, among other findings, that while farmers showed commitment and had an entrepreneurial spirit in seed collection and processing, serious knowledge gaps existed as to standardized methods for seed collection. Most farmers, for example, collected seeds from only 1-5 trees. Collecting seeds from such a limited number of trees often result into the production of seeds of limited genetic base. Seed with a limited genetic base develops into trees that are highly likely to suffer from inbreeding depression. Inbred trees grow very slowly, develop poor form (*i.e.* branchy, shrubby and crooked stem) and are susceptible to pest/ disease attacks. Farmers, by and large, are quite familiar with cereal crops, which are generally self-pollinating and therefore breed true. Cereal crops differ greatly from tree crops, which are preferentially outcrossing (Dawson and Were 1997; Simons *et al.* 1994). Tree seeds must be collected to maintain a broad genetic base, and this is accomplished by collecting seeds from the minimum of 30 trees, which are about 50/m apart. The seeds are then bulked and mixed properly (FAO 1995). The requirement to maintain a broad genetic base is especially important if inbreeding depression in future populations of trees (in this case, on-farm) is to be prevented, and if an adaptive capacity in this genetic resource is to be provided to meet the ever changing and increasing needs of smallholders and the diverse micro-environmental and socio-economic conditions under which they must operate. Assessing and understanding farmers' seed collection/ production and diffusion practices and systems was a prerequisite to improving them.

In a workshop arranged to share these findings with farmers in 1997, the 15 seed collectors who attended said they were not aware their methods were inappropriate and welcomed the findings. At the end of the workshop, this group of farmers decided, with ICRAF's facilitation, to organize themselves into a seed collector/producer association that is now known as the Agroforestry Tree Seed Association of Lantapan (ATSAL) (Fig. 10.1).

Institutionalization of Farmer-managed Seed Production Systems

Germplasm supply systems can either be formal or non-formal and the two often co-exist in the tropical developing world (Simons 1996). The formal seed system has recognized or licensed seed programmes. In



Fig. 10.1. A lunch break of farmers who attended the "feedback" workshop during which ATSAL's formation was decided.

sharp contrast, the non-formal system is composed of unaccredited seed collectors or unlicensed seed traders who, generally, are not concerned about the quality of their products and services. This is the major source of seeds in developing countries. The formal system sustains its overall activities and assures the quality of its products and services. However, due to high production and distribution costs it delivers an insignificant proportion of the seed requirement of small, scattered, diverse and risky markets such as those found under smallholder conditions in developing countries (Cromwell *et al.* 1993; Cromwell 1990; Garay 1990). Our working experience indicates that smallholders, in Lantapan, in particular, and in the Philippines, as a whole, largely depend on the non-formal system for agroforestry tree seed.

An alternative system of an intermediate nature between the formal and non-formal systems is critical if farmers' needs for seed are to be met cost-effectively and sustainably. One means to address this concern is to involve farmers directly as more than mere recipients of seed but as active participants in an entire spectrum of activities, ranging from seed collection or production to seed processing and marketing. This requires building the capacity of smallholders to collect/produce their own seed on-

farm, adhering to standardized methods developed for this purpose and to exercise some degree of control over their production systems. Self-managed seed production systems are extremely important because these poor farmers cannot afford the cost of quality seed produced by the formal system or may not accept such seeds on account of the questions they usually raise about their quality .

Upland farmers have limited access, either directly or through extension services, to information and technologies generated to improve their lot. Their limited capacity to tolerate risks reduces their willingness to experiment and to adapt technologies to their own circumstances. Most importantly, perhaps they are rarely well-organized or powerful enough to pressure research systems to understand and meet their demands. If relevant technology is to be developed and adopted, farmers must be given a voice in the research process. In Lantapan, ATSAAL has provided that voice because it enables farmers to pool their talents and limited resources together in a working relationship with researchers to serve their interests. As a strategy towards empowering farmers, the process of institutionalization consists of the following elements:

Building Capacity for Grassroots Associations in Agroforestry Management.

In workshops and village-wide assemblies organized to identify training needs, farmers were advised to signal their interest by listing their names, addresses and the themes/areas each would wish to learn more about as far as seed collection, processing and development in nurseries and management on farms. Those who provided this information attended a planning meeting to discuss their availability for training and training mechanics and schedules. Our training activities combined informal interactions and hands-on exercises. In the series of hands-on training exercises, the participants collected and processed seeds of varying sizes (small, medium, large) from a variety of agroforestry tree species, administered treatments to enhance germination of seeds of selected species in nurseries and undertook tree planting and management work on their farms.

The training activities lasted a little over three months, which spread over two years, as interested farmers could afford to put in only three days of training in each of the three months. Because farmers could not find the time to undergo training in three continuous months, this arrangement of training time was thought necessary and enough for them to have acquired adequate knowledge about and participate in every aspect of the activities involved in the management of tree crops. These

activities ranged from seed collection and processing to nursery and plantation establishment and management. Ten carefully selected members of ATSAAL attended these training activities. Hundreds of other farmers also participated, but they did not put in as much time as the selected ATSAAL members. The ten farmers were chosen on the basis of their demonstrated interest to learn more, their ability to teach others and their willingness to put in more time in practical work with researchers.

Some training sessions were rotated among villages as requested by the trainees. This was particularly done for seed collection and processing exercises, as well as for tree planting and plantation maintenance (fertilizing, pruning, replanting, thinning, weeding) in farmers' fields.

The goal of training was to strengthen the capability of ATSAAL members and to create the environment for changing the state-driven approach to forest management away from a narrow focus on farmers as passive adopters ("beneficiaries", in government parlance) of imposed forest management schemes and practices, to a broad focus that accepts, respects and works with farmers as partners in the management of forests and other critical natural resources.

The specific objectives of the training, therefore, were to: (a) initiate or foster self-reliance and self-determination in resident smallholders within the buffer-zone to make informed and practical tree-planting and management plans and decisions; and (b) help scientists to develop, nurture and expand strategic alliance with smallholders as a means by which to strengthen private initiative in the management of forest and other critical natural resources within the buffer zone and beyond, thus protecting the MKRNP and similar landscapes throughout the Philippines. Through training we have developed and are working with a pool of talented farmers. On several occasions, this team of trained farmers was requested to train fellow farmers in other municipalities of Bukidnon on nursery management and tree planting activities.

The association, by the contacts it has established through the training it provided for other farmers, has broadened its markets and has sold seeds and seedlings to managers of various reforestation and community forestry projects in some provinces in Mindanao and the Visayas. In 1998, for example, ATSAAL supplied seeds to the European Union-Agrarian Reform Support Programme's farm forestry projects in the Philippines, the Community-based Forest Management Programme of the Philippine Department of Environment and Natural Resources and exported seeds to Kenya.

ATSAAL's current membership is comprised of 63 smallholders (as households and individuals). These members are residents of 10 out of the

14 villages of Lantapan, located across the landscape at upper elevations (Alanib, Cawayan, Songco, Victory) and relatively lower elevations (Baclayon, Balila, Bantuanon, Bugcaon, Kulasihan, Poblacion).

ATSAL serves as a unifying body that brings to bear farmers' collective will, skills, talents and efforts in meeting six key objectives relating to sustainability. These are: (a) to collect and process quality tree seed to meet household tree planting needs and for the markets; (b) to establish, develop and manage tree nurseries and tree planting activities efficiently and cost-effectively; (c) to harvest, process and market trees and tree products and to produce wood for home consumption; (d) to train other farmers in the collection and processing of tree seeds, and the establishment and management of nurseries and plantations; (e) to serve as a channel for disseminating and diffusing quality germplasm of promising agroforestry tree species from other countries; and (f) to conserve steeply-sloped areas of farmlands by undertaking low cost, efficient soil erosion control measures, employing the independent or combined effects of grasses, shrubs and trees on contours to stabilize soils and check erosion. ATSAL is a chapter of the Landcare movement in Lantapan, active in the collection, processing, diffusion and marketing of tree seeds, which are important inputs of agroforestry systems and component technologies (Fig. 10.2).

Developing Management Efficiency

The production, development and management of quality seed and the income accrued as a result are in themselves significant achievements. However, these are only a part of the whole picture of tree resources management. Unless quality seed is developed in nurseries and introduced and managed on-farm, it cannot become a component of an agroforestry system or an agroforestry technology from a practical standpoint. Working with ATSAL, efforts are made to get farmers to engage not only in the establishment and management of nurseries and plantations, but to perform these tasks efficiently.

Nurseries are managed to raise uniform and healthy planting materials for the highest plantation output(s) at the least possible cost in terms of cash, labor, space and time. Our participatory research and development efforts are contributing to learning from and with farmers, particularly in the work in decentralized nurseries (those managed by individuals or group of individuals). Management of decentralized nurseries, a continuing effort, implies a situation in which rural people themselves, as individuals, households or group of households, raise seedlings of species they prefer, primarily for their own needs and the



Fig. 10.2. A seed processing session of the workshop that followed a series of seed collection activities (in the field). Note the arrangement of seeds of four tree species with respect to size (large, medium, small:L-R)

local market. The various plant materials involved in AT SAL's work in nurseries include landraces, exotics and indigenous tree species.

Decentralized nurseries are more appropriate for the smallholders than centralized types (those run by corporations, cooperatives, etc) for the following reasons:

- a) **Distribution and management efficiency.** Because smallholders in Lantapan generally live in villages isolated by distance and rugged terrain, production and transport of seedlings is convenient, safe and made easier only by establishing and managing small-scale nurseries in or close to these villages;
- b) **User sensitivity.** Better provision of seedlings for a range of farmer-preferred tree species is made possible in decentralized

nurseries, where farmers can and do engage in production for and by themselves at any time convenient to them;

- c) **Equity.** Decentralized nurseries provide a wider distribution of the economic and related benefits from raising seedlings. Because these types of nurseries require relatively low inputs and can be established on small plots of land around homesteads, they are an enterprise in which socially isolated and economically disadvantaged people can participate to improve their lot; and
- d) **Sustainability.** The management of decentralized nurseries is a credible approach to sustainability in developing forest resources, as this means transferring the means of production to end-users. When this happens, sustainability is highly likely to be a reality.

There are now 28 nurseries managed by ATSAL members across Lantapan. These include one central nursery where farmers work together to produce seedlings of various species (including native and exotic timber and fruit trees) to meet their marketing and on-farm tree planting needs. About 56 small-scale woodlots (0.15-0.5 ha) planted in blocks, boundaries, *etc.*, have been established on-farm with seedlings propagated by the smallholders, with technical assistance from ICRAF.

While there are standard procedures for tree propagation that can be applied with minor adjustments at different levels of production, creating a management system that could be conducive to sustainable production on the smallholder level is more problematic and remains a challenge. Such a system answers a host of methodological questions and, hence, contributes to fostering wide-scale adoption of agroforestry technologies and sustainability in production. Our work with farmers in decentralized nurseries is a step towards building such a management system, because this approach enables researchers to identify areas for improvement in farmer-managed nurseries, which cannot be diagnosed by conventional data collection methods such as interviews and surveys (Fig. 10.3).

Encouraging Product Diversification

Because of the multiple needs of farmers and the vagaries of markets and the physical environment, product diversification to avert risks is very important. ATSAL members are not only collecting seeds of timber trees to meet their tree planting requirements and for cash, they have



Fig. 10.3. Transplantation of young plants from seedboxes to plastic bags. This is an extremely important activity in seedling production. Participants in this training exercise also include farmers who are not members of ATSAL.

also been trained to produce seedlings of fruit trees for their own use and for the market. The association is also in the process of establishing silvopastoral systems in backyards where fodder trees and animals (rabbits and goats in particular) are to be integrated and managed. This, of course, will require cash for each household to buy at least a pair of these animals.

In the past, research focused on producing broadly uniform technologies, which were widely applicable across a range of conditions. The Green Revolution is a concrete example. With resource-poor farming systems, research must produce multiple products tailored to the identified needs of diverse client groups and production systems (Merrill-Sands *et al.* 1991). Thus, when research addresses the needs of resource-poor and risk-averse farmers, it must generate a number of different technologies, enhance their adoption in a wide range of conditions and evaluate them according to the broader range of criteria that farmers use. Product diversification contributes substantially to the generation of

different technological options. It also contributes significantly to meeting the changing and specific needs of small, poor farmers.

Linking Farmers to Markets

There is evidence worldwide that agroforestry systems and component technologies have raised productivity of smallholders, whose production has largely been subsistence. Chief among the problems farmers face in Lantapan in this regard is the lack of adequate market and marketing information to sell their products or to profitably dispose of any excess that must have been produced as a result of improved agroforestry systems and technologies. A study was conducted to assess the market and marketing channels for smallholder-produced trees and tree products in Lantapan (Koffa and Garrity 1999). Information has been gathered on potential markets for ATSAL's seeds, seedlings, timber, poles and lumber. ATSAL's representation in national tree farmers' congresses and workshops has also been facilitated. This has helped the association identify more markets for its seeds, seedlings, timber, poles and lumber.

Tree seeds generate income and employment faster and probably to a greater extent than wood, particularly for tree management systems like those in Lantapan where timber production is the primary objective. Tree seed production affects soil stabilization because it reduces the frequency with which trees must have been harvested within the buffer zone, on steeply-sloped lands where intensive farming of cereal crops and vegetables is ongoing. This also means more wood can be produced and hence more income generated, since more wood is expected to be harvested with the longer rotation age made possible by seed harvesting and marketing. What the latter statement assumes is that as farmers earn from seed sales, they are likely to be able to afford to wait a little longer before harvesting their trees for cash.

As of November 2000, ATSAL had earned \$29,591.00 from the sale of tree seeds and seedlings. The processing and marketing of these forms of germplasm is managed by the association's germplasm collection, handling, development and marketing committee. Figure 10.4 shows a group of ATSAL members visiting one of the lumberyards and sawmills where lumber is sold.



Fig. 10.4. A group of ATSA members visiting a lumberyard and a small-scale sawmill. There are three of these in Lantapan and dozens in the municipalities of Malaybalay and Valencia. These establishments are markets for smallholder-produced wood (sold here mainly as sawn timber)

Discussion

Advantages of farmer-managed seed production systems

There have been a large number of seed projects and programmes in many third world countries; the actual successes of these, as they affect the smallholder, appear relatively limited and the processes by which the seed reaches the farming community are not documented (Garay 1990). In working directly with farmers we realize that opportunities exist to increase the impact of tree domestication efforts and, hence, to improve agroforestry systems and component technologies, by elucidating effective diffusion mechanisms at the farmer level through the capacitating of self-seed production systems.

The smallholder-managed scheme has several positive features: (a) farmers do the work themselves; (b) the seed is available where the investment required is minimal; and (c) farmers have good knowledge of the potential of the seed; and (d) the seed can be tested by farmers themselves, under the diverse micro-environmental conditions under which they operate. This user-driven approach to seed supply and diffusion is efficient and cost-effective as farmers become extensionists and researchers at the same time. ATSAAL members collect seed mostly from exotic plantations established about two decades ago and patches of natural forests that are not necessarily owned by the association. As such, these are not sustainable seed sources. On-farm trials of indigenous and mostly exotic tree species, established three years ago to select the best species mix on varying elevations, are being transformed into seed production areas to respond to farmers' demand. Seed have already been collected from three of these trials (Fig. 10.5).

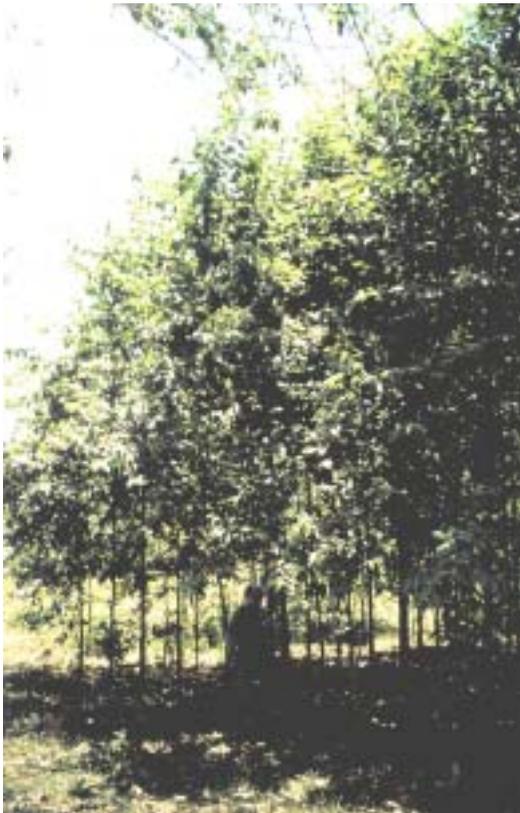


Fig. 10.5. A portion of one of the 15 on-farm trials involving 14 tree species, established on 10 sites of varying elevations. The trials (including this plot) are three years old.

Buffer-zone Agroforestry and Biodiversity Conservation

Buffer zone agroforestry has been ICRAF's principal approach to conserving biodiversity of the MKRNP. Genetic diversity is a critical component of biodiversity. The sources of genetic diversity in the gene pool of a given crop, including trees, include (a) wild relatives (natural processes unaided by humans); (b) landraces (crop evolution, selection and adaptation in farming systems of highly heterogeneous and often marginal environments); and (c) formal breeding (to create new genetic combinations on the basis of predetermined criteria) (Eyzaguirre and Iwanaga 1995).

While new technologies employed in mutation breeding programmes and some engineered genes (of those with enhanced herbicidal resistance) may introduce new variations, isozyme and molecular data on diversity in wild relatives, landraces and modern cultivars indicate that wild relatives and landraces remain the major sources of genetic diversity in crop gene pools (Miller and Tanksley 1990). The approaches to maintaining these principal sources of diversity in farming systems, while providing development options that support the continuity of populations of wild relatives and landraces, are to: (a) work directly with genetic resources which smallholders value and conserve; (b) create and conserve protected areas; and (c) provide smallholders with genetic diversity in the form of landrace germplasm from a range of sources (Ezaguirre and Iwanaga 1995; Maurya *et al.* 1988; Altieri and Merrick 1987).

ATSAL and Biodiversity Conservation

Our work with ATSAL and the rest of the farming community in Lantapan addresses the key elements for maintaining the three major sources of diversity, as discussed above, while paying attention to meeting the socio-economic and related needs of bufferzone residents. Complex agroforestry systems are being developed and are contributing to diversified and sedentary farming practices within the buffer-zone. This will not only curb further encroachment on the remaining forest of the park, but will also increase productivity and generate income and employment for marginalized buffer-zone farmers. These activities clearly link conservation with development.

Linking conservation to development, as a growing body of literature indicates, creates a situation in which local communities see themselves as genuine stakeholders in resource management and park protection (Colchester 1996; Wells and Brandon 1992; Maurya *et al.* 1988). For example, the cash benefits from the marketing of seeds and seedlings by

farmers themselves, in addition to enabling farmers to establish their own woodlots to meet their needs, create a social contract that links the welfare of these local resource users to park protection. This, in essence, gives birth to a viable enterprise that links development to conservation as well as sustained, decentralized management of Lantapan's critical natural resource base.

ATSAL and Grassroots Participation

Despite the recognized and established significance of grassroots participation in attempts to manage the critical natural resource base (see Gakou and Force 1996; Fisher 1994; Clarke 1991; Raintree 1991; Cernea 1989; Postel and Heise 1988; Rao 1985), in practice there has been limited improvement in the contribution of natural resource management projects and programmes to local development. The essential argument is that participation has largely been seen in terms of merely seeking involvement of local people in projects exclusively conceived and largely designed by outsiders, rather than creating an enabling environment for local control of resource management through the participatory development of the required skills on the grassroots level.

In the Philippines, the entirely outsider-driven approach to resource management has clearly manifested itself in the establishment of new organizations instigated by outsiders in a given rural community or beyond, or hastily organized by insiders, rather than carefully identifying and supporting local grassroots institutions. The underlying problem is that outsiders often ignore the existence of local institutions, either because they do not believe in their effectiveness or simply because they do not recognize them as institutions (Fisher 1994). Identification and recognition of grassroots organizations are key requisites to genuine participation. Interactive participation of farmers has been the central tenet of our work with them, including those who are not members of ATSAL.

The Future

ATSAL is barely two years old. Its members need more training in entrepreneurial skills, the management of small-scale wood processing and related industries, livestock husbandry and the propagation and husbandry of a host of indigenous tree species and non-timber forest products (abaca, bamboo, bee keeping, fodder, fuelwood, fruit trees). The association, with time, is expected to graduate into a tree-farmer cooperative that spearheads collection and production of quality tree seed

as well as its distribution and diffusion. ATSAL may also serve as a channel through which quality germplasm from sources in other countries may be introduced to a host of farmers and tested on-farm in the Philippines and other Southeast Asian countries. Training is also needed to develop skills for the collection of market and marketing information and to operate and maintain harvesting and processing equipment.

Conclusion

Biodiversity conservation and management has been one of the programme components of the SANREM-CRSP. Its goal is to evolve community-based approaches/strategies to the conservation, management and utilization of existing biodiversity (fauna, flora) in selected regions in the tropics. In our bottom-line world, results tend to be equated with an immediate, tangible product, something that can be captured with a dollar sign or a snapshot. However, in a community-based approach to biodiversity conservation and management, today's successful product can become tomorrow's white elephant (in the form of abandoned hedgerow systems or abandoned community-based nurseries) if it is not a fruit of a genuine and broader participatory process. This is not, in the least, to suggest that the emphasis on results is misplaced. It is particularly vital today in the world of growing demand and dwindling resources.

The challenge on our hands, therefore, is to identify a community-based development strategy that will take into account both success in the short run and sustainability over time, in attempts to conserve critical ecosystems upon which the lives of smallholders directly depend. Improved agroforestry systems and component technologies, if developed through a credible participatory process, offer a lasting solution in these respects. In about two decades, agroforestry has re-emerged as a means to produce traditionally important goods and services, listed earlier in the body of this paper. As such, agroforestry can be viewed as an intervention to break the downward spiral of land degradation and rural poverty.

The forest and non-wood forest-based products whose simultaneous production agroforestry systems provide, can be used by smallholders in Lantapan to either generate cash with which to buy fertilizers to improve the yields of staple crops or as a profit-motivating incentive to promote the establishment of more trees on-farm. This, ultimately, will ameliorate soil depletion and land degradation across the landscape of the Manupali watershed and the forest margins of the MKRNP. Thus the vision now is of agroforestry as an integrated land use system that combines

productivity and income generation with environmental rehabilitation and diversification of agroecosystems. Central to the development of improved and efficient agroforestry systems are quality seeds and the processes involved in their appropriate collection/production, processing, development, dissemination and marketing.

ATSAL is a product of a farmer-oriented research and development process that encourages grassroots participation in conservation. This process initially identified seed collection and marketing activities which farmers themselves undertake towards improved living standards. Working with farmers, these activities are being improved and formation of a grassroots institution facilitated. This process creates and strengthens links between farmers and researchers in three basic ways that also promote interactive participation. First, it emphasizes feedback, and this helps to ensure that research is driven more by demand (responding to the needs of farmers) than by supply (reflecting mostly the interest of scientists). Farmers will actively participate in a process if they know that it genuinely takes their interest seriously. This attitude is highly likely to develop when “external” assistance identifies “internal” initiatives and interest with which to work and improve (if need be), rather than re-inventing the proverbial wheel. This approach is not only cost-effective; it also enhances interactive participation and ensures sustainability.

Second, the process performs three basic tasks that are critical to technology generation and adoption. These are diagnosis of real problems, design of relevant solutions and evaluation of technologies. Third, this client-oriented participatory research and development process enables researchers to monitor changing problems in farmers’ situations, thus enabling research to take corrective action or respond more quickly to farmers’ evolving needs. Evolving strategies for community-based resource management must be sensitive to farmers’ evolving needs. About four years ago, the Manupali watershed was dominated by a single tree species, *Gmelina arborea*, planted mostly along boundaries. To date, a variety of other tree species has been introduced through the numerous woodlots farmers have established on their farms. There is therefore a greater tree cover within the watershed than it was four years ago. This increase of tree species in diversity and space is a living testament of increased experience and self-reliance of farmers, engendered by the research and training this project provides. What must be remembered here, however, is that research and training efforts were directed to strengthening technologies which farmers themselves genuinely felt could improve their standards of living.

Our ultimate partners, smallholders, are more concerned about the health and continuing productivity of their land than any salaried employee;

their survival depends on this. Concerned farmers, if properly trained and organized, will therefore react positively to technologies, which would improve their management efficiency, produce economic benefits and conserve the natural resource base upon which their lives directly depend. The collection/production of quality tree seed and its processing, development and marketing, integrate conservation with development. The ATSAL experience demonstrates that even in the most remote and apparently resource-scarce situations, it is possible to develop a viable production system that draws its strength from interactive participation.

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Chapter 11: Conservation and Management of Watershed and Natural Resources: Issues in the Philippines, the Bukidnon Experience

Antonio Sumbalan

Introduction

There has been a continuing shift in the management of watershed and natural resources in the Philippines. Stakeholders such as local communities, LGUs, indigenous people, and the civil society reflect this in changes in government policies from being top down, driven by the central government to one that is built on local participation. The Forest Management Program demonstrated this gradual shift in the 1970s. This was implemented by selectively devolving rights to utilize individual land parcel with responsibilities to conserve adjacent forestlands. Such efforts were pursued through the application of agroforestry, tree farming, and soil conservation technologies.

In the 1980s, the upland development direction focused on the social forestry agenda brought into the fore not only technical concerns in forest resource management but also issues pertaining to social and economic development in forest areas. This was carried out under the Integrated Social Forestry (ISF) Program that placed great emphasis on providing land tenure to forest occupants.

The 1990s saw the passage and implementation of the 1991 Local Government Code, which created a tremendous impact on the delivery of basic services at the local level. The environment and natural resources sector were among those sectors affected by the devolution. The policy content of the Code stipulates the devolution to local government units the implementation of social forestry and reforestation initiatives, the management of communal forests not exceeding 5000 ha, the protection of the small watersheds, and the enforcement of forest laws. In Bukidnon, these developments have offered the local government

units numerous opportunities and challenges to effectively carry out these new mandates.

Brief Profile

Biophysical

Bukidnon is a landlocked province and occupies a wide plateau in the North Central part of Mindanao Island. It has a total land area of 829,378 ha accounting for 2.7% of the Philippines' total land area. Being relatively elevated and centrally located, Bukidnon is in itself a "watershed" for most of North-Central Mindanao, comprising the headwaters and substantial portion of seven major river catchments originating in the Province. These are the Pulangi River watershed, Tagoloan River watershed, Cagayan River watershed, Muleta River watershed, Maradugao River watershed, Salug River watershed, and the Cugman-Agusan River watershed.

Bukidnon is the country's eighth largest province, lying between the latitudes 7°22 to 8°35 north, and longitudes 124°33 to 125°26" east. About 49% of its total land area consists of rugged hills and mountains. Mts. Kitanglad and Kalatungan are the second and the third highest mountains in the country, rising to 2,938 m and 2,836 m, respectively.

The province's land classification shows that 336,412 ha (40.56%) are classified as alienable and disposable while 492,966 ha are forestland. The vegetative covers of the forestland reveal that only 227,062 ha are forested while the remaining 265,904 ha are brush lands and open or cultivated areas. Furthermore, analysis of the forestland shows that 213,330 ha are utilized as production forests.

Socio-economic

The last three official population surveys of the National Statistics Office showed that the province had a reported population of 631,634 (1980); 843,891 (1990); and 1,060,415 (2000). This suggests an average population growth rate of 3.46 % (1975-1980) to 2.94 % (1980-1990) and 2.31% (1990-2000).

Bukidnon is basically an agricultural province. The major economic activities include farming and livestock production. Principal crops cultivated are corn and rice. Commercial crops include sugarcane, pineapple, banana, coffee, rubber and other high value vegetable crops grown extensively in the upland areas.

Political and Administrative

Bukidnon is a first class province, based on income classification. It was formally created under Republic Act 2711 on March 10, 1917. As a province, it has autonomous functions, organization, responsibilities and accountabilities. It is mandated to exercise corporate powers and to implement the delivery of basic services to the people.

A duly elected governor administers the day-to-day affairs of the provincial government and head the Executive Branch. Within the provincial government, there are three offices that are responsible in the conservation and management of watershed and natural resources. These are the Office of the Provincial Administrator, which handles the division of the devolved DENR personnel; the Office of the Provincial Agriculture, which provides devolved functions on extension services on sustainable agriculture; and the Office of the Provincial Planning and Development Coordinator, which leads the planning and coordination of programs/projects related to sustainable development (Province of Bukidnon 1999).

The legislative branch, headed by the vice-governor, supports the executive department of the province. It is also responsible for the formulation of policies, including measures to promote conservation and management of watershed and natural resources through the Committee on Environment and Natural Resources.

Issues and Concerns in Watershed Conservation and Management

The province faces numerous issues and concerns related to promoting watershed conservation and management. These are:

1. Rapid Population Growth

The rapid increase of population in the province (observed population growth of 1.90%), attributed mainly to in-migration, has put pressure to upland land use. The natural population growth and the lack of access to economic opportunities in the lowland have contributed to the uncontrolled in-migration of non indigenous peoples into the upland areas. This had led to the declaration of forestlands into settlement areas. Further, the indiscriminate disposal of solid waste and sewer by households to ridges, dumpsites, and other bodies of water contributing to sanitary problems and environmental degradation which have been observed to be on the rise as the population of the province continues to increase.

2. Demands for Raw Materials

Construction of buildings and installation of other infrastructure projects need large quantities of raw materials such as sand, gravel, and wood. These require the use of a considerable amount of the province's natural resources, most of which are from forest reserves and protected areas.

3. Conversion from Forest Land Use to Agricultural and Other Land Uses

Development brings about a lot of changes not only on the social and economic side but also more on the physical view of the environment. Development of upland areas for high value crops and the attractiveness of the province's low lands for plantation crops such as pineapples and bananas, and the establishment of poultry and piggery farms have further pushed the local population to the uplands.

4. Unsustainable Agricultural Practices

Modern farming involves the extensive use of inorganic fertilizers and chemical pesticides, some of which have been proven to pollute land and water resources and hazardous to people's health. As farmers apply more and more chemicals to their crops, the higher the soil acidity becomes, and the lesser the soil's potential to produce abundant harvests. Further, since the great majority (about 84%) of present agricultural areas are in the uplands, the inappropriate farming technologies have contributed to the degradation of upland areas.

5. Inconsistencies of Government Policies

Though the LGUs at the lower level strive hard to put into realization the environmental policies and orders, the upper ranks are hesitant to put it into full implementation, considering that a lot of the officials themselves become "protectors" of big capitalists of chemical fertilizer and pesticide companies. Also, the conflicting national policies in mining and forestry are problems that local governments and communities have to grapple with. This situation is partly attributed to vague and undefined mandates of some government organizations that often overlap with each other. This is compounded by the absence of clear guidance on laws and policies affecting protected areas such as forests and watersheds. Further, the weak enforcement of laws give wrong signals to the people and have

encouraged them to take up residence in critical slopes, important watersheds and even in identified national parks.

6. Difficult Terrain

The difficult terrain of the watersheds resulted in the dearth of government services reaching these areas. The provision of extension services on appropriate natural resource management practices and the monitoring of illegal resource extraction such as the indiscriminate cutting down of trees by forest occupants, some of whom have encroached into these areas due to population pressure in the lowlands, could not be carried out as desired.

The Changing Role of Government Units in Watershed Conservation and Management

The country's decentralization policy through the implementation of the Local Government Code of 1991 and selection of the province, specifically the Municipality of Lantapan as the site for the SANREM Project in the Philippines, have assisted the local government in carrying out its responsibilities in watershed conservation and management.

Shift from Central to Local Governments

Prior to the implementation of the 1991 Local Government Code, the national government supervised four reforestation projects with a total area of 66,794 ha. These are the Cinchona (1,994 ha), Impalutao (1,700 ha), Malaybalay (1,600 ha) and the Muleta-Manupali (61,500 ha). From 1982 to 1993, the Department of Environment and Natural Resources (DENR) pursued a soil conservation component of the Muleta-Manupali Rehabilitation Project. These are considered priority critical watershed areas by the national government.

Another special project was initiated in 1989 covering an area of 21,000 ha, a portion of which included the Malaybalay Reforestation Project. This is the Bukidnon Industrial Plantation Project. In 1990, this New Zealand Government-funded project was converted into the Bukidnon Forests Incorporated (BFI) under the management of a board headed by the provincial governor. The goal of this project was to manage and implement industrial forest plantation development to help address issues related to environmental rehabilitation and the development of

alternative wood resource, thereby mitigating the pressures on the country's remaining forests.

Some local officials viewed the DENR-managed Muleta-Manupali Rehabilitation project was unsuccessful due to DENR's failure to identify market for harvested wood and the unstable price of coffee, which was promoted in the privately titled areas within the watershed, and the lack of involvement of local governments and other community stakeholders in the planning processes. On the other hand, the BFI plantation venture that was operating independently from the DENR, was considered successful for it has involved the local officials in its decision-making processes as well as facilitated community participation. This assessment foretells the critical role of local governments and community participation in watershed conservation and management. These, in fact, are among the vital components in devolving powers and resources in environmental management from central to local governments.

The Local Government Code of 1991

The Local Government Code of 1991 provides for the autonomy of local government units at provincial, municipal and *barangay* levels and mandates them to play leading roles in promoting sustainable development within their areas of jurisdiction. The Code provides guidelines on the responsibilities of national line agencies and the local government units and their local offices in relation to the promotion of ecological balance. It sets up the policy framework in which services and environmental concerns are devolved to local governments. It states that:

It is the policy of the State to require all national agencies and offices to conduct periodic consultation with appropriate local government units before any project or program is implemented in their respective jurisdiction.

The services devolved to the municipal level include the following:

- water and soil resource utilization and conservation projects;
- implementation of community-based forestry projects;
- management and control of communal forests with an area not exceeding 50 square kilometers; and
- establishment of tree parks, greenbelts, and similar forest development projects pursuant to national policies and subject to supervision and review of the DENR.

The province is responsible for the following, pursuant to national policies and subject to supervision, control and review of the DENR:

- the enforcement of forestry laws limited to community-based forestry projects;
- pollution control law, small-scale mining law, and other laws on the protection of the environment; and
- mini-hydro-electric projects for local purposes.

In the area of inter-governmental relations the national government agencies are specifically mandated under Section 26 of the Code to consult with the LGUs in their effort to maintain ecological balance. Furthermore, under Section 27, the Code specifies the requirement for national line agencies to conduct prior consultations.

The Code paved the way for the devolution of 126 Integrated Social Forestry Projects previously managed by the DENR to the province. This covers an aggregate area of 24,148 ha with 9,471 beneficiaries. The transfer of direct supervision of these ISF projects to the province, together with the 26 personnel from the DENR, made the province evaluate its current thrusts and priorities with regard to conservation and management of watersheds and natural resources. This led to the creation of unified vision on development and the creation of framework and implementing guidelines to put this vision into practice.

Development Vision of the Provincial Government

The development of the province is guided by its vision to make Bukidnon a “province of self-reliant people enjoying a full life in an atmosphere of justice and harmony, and as an agricultural-based industrial center with an optimally developed agricultural economy and ecologically balanced environment” (RDC 1999: 2). Specific to conservation and management of watersheds and other natural resources of the province, the approved Provincial Physical Framework Plan (PPFP) and the Bukidnon Watershed Development and Protection Plan provide guidance as to how the vision statement is to be implemented

The PPFP translates provincial policies and development goals and objectives into a general land use plan indicating the manner in which land shall be put into use within the planning period (in this case from 1993 to 2002). Further, it delineates the direction and extent of expansion of urban and other built-up areas of cities and municipalities in the province, the alignment of transportation networks, the location of major

infrastructure projects and facilities and all major land development proposals that have provincial, regional, or national impact and significance. The provincial legislative body officially adopted this plan in 1996.

The Bukidnon Watershed Management Framework Plan (1996) provides the provincial government with the basis to coordinate and supervise all programs and projects relating to water management in Bukidnon. The plan aims to document the common understanding reached by the range of institutions and interest groups concerning the current environmental and socio-economic situation in the province. It also outlined the general principles and approaches that the province believes should be followed to most effectively address the situation, and to have a commonly agreed framework for coordination and supervision of subsequent programs, projects and activities on behalf of the Provincial Government.

Local Government Initiatives

The specific responses of the local government units of Bukidnon with their mandates under the Local Government Code of 1991 include the following:

1. *Creation of the Bukidnon Environment and Natural Resource Division under the Office of the Provincial Administrator and the BEST Farm Project*

Administrative Order No. 44, which was issued in 1993, provided the basic guidelines on how the devolved Integrated Social Forestry (ISF) Program and personnel of the DENR will be carried out in Bukidnon under the direct supervision of the Provincial Administrator. The ISF Program was redirected to ensure that the forest occupants participating in the program would feel the economic value of reforestation. This resulted to the implementation of the Bukidnon Environment Small-scale Tree (BEST) Farm Project.

The ISF program requires the ISF holders to plant at least 20% of their land to permanent forest cover or trees. The province developed a scheme to reverse the requirement to 80%. The farmers are allotted 6,000 Philippine pesos (approximately US\$ 133.33) as direct cost plus an additional 1,500 Philippine pesos (US\$ 33.33) as supervision cost per hectare of land committed to the BEST Farm Project. The project was designed to ensure partnership between the tree planters and the province,

recovery of cost investment, and sustainable land use practices in the uplands.

The steps involved in the process include the conduct of information drive emphasizing that tree planting is an economic endeavor and that the farmer-cooperator shall pay for only 15 trees for the loan extended. The program was successful that it was able to establish 2,101 ha of tree farms and covered 75% of the ISF sites turned over to the province in 1992. Further, requests for funding assistance and inclusion of Alienable and Disposable Lands flooded the Provincial Government and this demonstrated the wide acceptance of tree planting as a truly economic endeavor.

2. Provincial Watershed Protection and Development Plan

The province likewise initiated efforts to establish a mechanism for coordination and complementation of efforts among LGUs and national line agencies and the non-government organizations in watershed development and protection. This was given a boost with the issuance of Presidential Memorandum No. 270 in 1995, creating the Bukidnon Watershed Protection and Development Council whose responsibility is to develop guidelines to protect and preserve the remaining forests found in the watersheds of Bukidnon and to rehabilitate open areas within their headwaters.

The council grew out of the Bukidnon Watershed and Environment Management Council formed by Governor Carlos O. Fortich in 1993 to “exercise general guidance and oversight functions relative to watershed and environment management and to facilitate inter-agency coordination” as mandated under the Code.

The presidential memorandum also enjoined all national and local agencies to fully cooperate and support the council in implementing its mandate. One of the most important outputs of the council was a properly documented consensus on the current situation of the watersheds of the province and the proposed intervention contained in the Bukidnon Watershed Management Framework Plan developed in 1996.

The formulation of the watershed management framework plan was facilitated with full support from the various researchers involved with the SANREM project. SANREM provided technical inputs in the preparation of the plan.

Below are some of the lessons that the provincial government learned in the process of developing and implementing the plan:

- 1 Local governments have to play a proactive role to link with national line agencies and to assist these agencies in working with upland communities.
- 1 Local governments have to immediately establish a good track record to gain support from foreign donors. Having an established track record makes it easier to approach funding agencies for support.
- 1 Sustaining local initiatives require sensitivity and recognition of cultural tradition and local knowledge as well as flexibility to negotiate.

3. Forest Land Use Planning

Responding to the Local Government Code, which stipulates that the LGUs share with the DENR the responsibility in the sustainable management and development of the forest resources within their territorial jurisdiction (MC No. 98-01 of DENR and DILG), the province and the DENR initiated forest land use planning in 1998. The output of this activity is the Provincial Forest Framework Plan, which delineates the watersheds of the province. The technical inputs of the Technical Advisory Group of the Bukidnon Watershed Protection and Development Council (BWPDC), which includes SANREM, enhanced the preparation of the various comprehensive land use plans of the different municipal governments that give equal emphasis to watershed development and protection. Through forest land use planning, the current efforts of the different municipalities has given equal importance to detailed planning of the forestland areas, thus, complementing the primary concern of the BWPDC to ensure the protection of the watersheds through effective planning.

4. Advocacy work for the declaration of Mt. Kitanglad as a Natural Park

Eight municipal governments, with full support from the province, assisted in developing a local legislative action towards the proclamation of Mt. Kitanglad Range into a national park to protect its socio-economic and ecological importance. This became a reality when former President Aquino declared Mt. Kitanglad as a protected area in December 1990 under Presidential Proclamation No. 677. Various SANREM workplan investigators also provided technical assistance to the Protected Area Management Board (PAMB) of the Mt. Kitanglad Range Nature Park. Thus, on 24 October 1996, Mt. Kitanglad became a protected area under the category of Natural Park under Presidential

Proclamation No. 896. And finally, last November 9, 2000 President Estrada signed the Mt. Kitanglad Range Protected Area Bill into law as Republic Act No. 8978.

Emerging lessons from the experience the LGUs on the management of Mt. Kitanglad Range Nature Park include the following:

- 1 First, park management can be implemented successfully by changing the locus of decision-making from the national agencies to local governments.
- 1 Second, decentralization of park area management is not mainly the domain of local governments but should provide participation of stakeholders and implementation of complementary projects.
- 1 Third, devolving responsibilities is accompanied by the devolution of decision-making authorities.
- 1 Lastly, there is no ready-made template in park area management.

We have also learned that natural resource management cannot be undertaken by a single agency such as the local government or the DENR. Collaboration, if done right, could have a positive impact on various stakeholders. This continues to be demonstrated in the local governments' collaboration with the SANREM project in the Manupali watershed.

5. Municipal-led Natural Resource Management Plan

The Municipal Government of Lantapan boasts of its natural resource management plan. This plan was not conceived as an initial objective of SANREM but rather was the result of the intent of the Lantapan local government to ensure that all the scientific outputs of the research project will be incorporated into a plan that will benefit the locality. It was launched in 1996 with the formation of the multi-sectoral Natural Resource Management Council, with participation of individuals representing various economic, social, and religious sectors of Lantapan. The SANREM Site Coordination Office played a pivotal role in working with the municipal government and the council. They incorporated the range of research outputs of the consortium to come up with a natural resource management plan to address the problem of the declining rich natural resource base. The formulation of this municipal-led plan is considered a milestone in the decentralization of planning and management to the local level. A shift was made from traditional top-down planning approach to a participatory, multi-sectoral planning and research-based decision-making approach.

6. Environmental Planning through Linkage with Funding Agencies

The Bukidnon Watershed Protection and Development Council (BWPDC), with technical assistance from the USAID's Governance and Local Democracy (GOLD) Project and SANREM inputs, facilitated a planning approach using a watershed rather than a political area as a planning unit. This brought together five municipalities (the Maradugao Watershed Cluster) to formulate their locally adapted municipal watershed management plans geared towards soil and water conservation measures, and agroforestry activities. The Watershed Cluster pooled their resources in the management of the Maradugao Watershed and was able to generate financial support from the Southern Philippines Development Authority, which is a national government agency, and from the province to finance identified activities. The planning activities are implemented at the *barangay* level.

The council was able to generate support from various agencies for technical and financial assistance. In September 1999, the province held its first Bukidnon Watershed Summit with support from USAID, SANREM, GOLD, and the Growth with Equity for Mindanao (GEM) and AusAID. This locally initiated advocacy on watershed has inspired other donor organizations to link up with the province to encourage other LGUs for Mindanao-wide activities on watershed advocacy.

The International Council for Research in Agroforestry has likewise linked up with the province for the scaling up of the natural resource management methodology to the different municipalities of the province. This is based on their current SANREM work plan. This is being pursued with the introduction of the Landcare movement.

Likewise, the Canadian International Development Agency (CIDA)-supported Local Government Support Program has taken cognizance of the province's effort for alliance and capacity building among stakeholders in the field of natural resource management.

7. Environmental Management Planning and Development Policy Analysis Using a Watershed Model

This project, a collaboration between the Bukidnon provincial government and Lantapan local government in partnership with SANREM work plans, was implemented from June 2000 to May 2001. Its objectives are to 1) develop a monitoring and evaluation system for the NRMP impacts, and other national policy impacts on households and the communities' natural resource endowments; 2) strengthen policy analysis and policy advocacy skills through development of mechanism

and linkages with other involved agencies that will ensure continuity of programs and policies contained in the plan; and 3) to make the Natural Resource Management Plan of Lantapan more understandable to the farmers and other stakeholders through an advocacy plan. The project has released several policy briefs that are very useful to the local decision makers and even to the national line agencies operating in the province in relation to the implementation of their programs and projects.

Opportunities and Challenges to Local Government Units

The Bukidnon experience points that devolution brought new challenges to local governments. It also inspired the local government to go out and build linkages and alliances with organizations and agencies that share their goal of promoting sustainable management of the natural resource base and recognizing the importance of strengthening local capacity development. Devolution works best when the vision comes from the local government and the people. The people are the centerpiece of the process of development.

The presence of the SANREM and the other research groups in the province offered an opportunity for the local government units of Bukidnon to link research with development. Technical support from SANREM has enabled the LGUs to better address the challenges of ensuring the conservation and effective management of our watersheds. These include:

1. improving the database on the state of the province's natural resources. This is to establish a firmer basis for decision-making such as the allocation of resources for environmental conservation and appropriate land use planning for agricultural development and other development uses.
2. enhancing awareness and participation of various stakeholders such as the indigenous communities and the tenured migrants in the uplands, the "users" of the upland resources (investors, government agencies engaged in the provisions of potable water, irrigation water, hydro electricity, *etc.*) on water management;

3. developing and sustaining participatory mechanisms such as the localization of watershed planning and management, institutionalization of water watch, and Landcare movements; and,
4. ensuring real participation of various stakeholders including grassroots organizations in the existing mechanisms established for watershed conservation and management. Presently the indigenous people and the village elected leaders are recognized members of the Mt. Kitanglad Natural Range Park's Protected Area Management Board.

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Chapter 12: Assessing the Impact of a Participatory, Research-oriented Project: Results of a Survey

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Background and Aims of the Study

In this paper we report our attempts to evaluate the achievements of a project whose main purpose is, through applied research and participatory information exchange, to influence the environmental awareness, attitudes and practices of a group of mainly farm households in a Philippine watershed. Part of the project involves scientists engaging in applied research on water quality, soil management, and forest management by community members. The methods used to disseminate and acquire feedback on this research are mainly very informal. The output of the information exchange is hard to quantify, and moreover, attribution to the project is problematic when similar information may emanate from several sources and find its way to individuals by numerous paths. We report on a survey in which we attempted to minimize these difficulties.

The Project

The SANREM CRSP-Southeast Asia (SSEA) is an international project undertaken by a consortium of US-based universities in partnership with individuals, community groups, universities, NGOs, and government agencies in developing countries. The project aims to promote environmental protection and the sustainable use of natural resources in agricultural development through research, outreach and participatory activities. This landscape-based project is multidisciplinary and intersectoral—in the sense of bringing together participants

from a range of educational, governmental, non-profit, and business institutions.¹

SANREM-SE Asia (SSEA) is one component of a larger global project with several regional sites. SSEA was inaugurated in the Philippines 1993 by a site selection process accompanied by a rapid rural appraisal (Bellows *et al.* 1995). The site chosen was the upper Manupali watershed, in the area covered by Lantapan municipality, Bukidnon Province, in Northern Mindanao. Since 1994 a number of different research, outreach and training activities have been conducted at the site by SANREM-funded consortia. These activities have included soil quality and soil erosion measurement on experimental plots and in farmer-managed fields, biodiversity assessments and agroforestry initiatives, water quality monitoring by a local NGO established with SANREM support; survey-based collection and analysis of economic, ethnographic and agronomic data from households; policy briefings and analysis at local and provincial levels, to name just the most prominent (Appendix A presents a complete list of SANREM-funded activities from 1994-1997).

In 1997 the global SANREM project completed its first five-year funding cycle. In preparation for a second cycle, participants in SSEA agreed to undertake a synthesis of research findings (see Chapter 8, this volume), and a survey-based study of the project's impacts to date. The impact assessment aims to measure and evaluate the extent to which SSEA activities have influenced processes leading towards the promotion of sustainable agriculture and natural resource management in and around the project site.

Assessing program impact poses a challenge in the selection of appropriate measures (indicators) as well as methods to measure change. In particular, SSEA is not a conventional development project in the sense of building physical structures, transferring technologies, or undertaking other activities with easily defined boundaries and readily measurable impacts. Rather, its major activities have been in the collection and analysis of data and dissemination of results, in the facilitation of communication among groups with common environmental or resource management interests, and in the provision of scientific and (to a lesser extent) organizational support for local non-government and governmental groups interested or involved in resource and environmental management. While research findings may be readily documented, and numbers of interactions among SANREM staff or researchers and local counterparts readily enumerated, measuring the actual impact of these

¹ More detail on the overall project can be obtained from <http://www.sanrem/uga/edu>

diffuse activities is highly problematic. In essence, SSEA has attempted to promote *awareness* of natural resource issues and environmental linkages; to influence the *attitudes* of natural resource managers and those making environmental policy decisions; and to encourage *actions* likely to have beneficial effects on natural resource use and environmental quality—such as the adoption of alternative farming techniques. The impact study reported in this paper has focused on measures of the project's influence over awareness, attitudes and actions (A³).

Definition and Classification of Impacts

SANREM is a multi-faceted program and uses a wide variety of methods to pursue a range of goals. As such its impacts are inherently difficult to measure. This difficulty is compounded by the subject matter of the project, since the environmental and economic variables that are the targets for any project attempting to promote sustainability evolve very slowly and are subject to myriad influences. Impacts, however real, may be felt indirectly, or not all during the life of the project. *A Landscape Approach to Sustainability in the Tropics (LAST)*, the global SANREM CRSP plan, highlighted this point:

Through the farmer-participatory approach to designing, testing and demonstrating suitable interventions that will lead to sustainability, we expect that farmer adoption of improved strategies will be enhanced. Through improved understanding of the interactive mechanisms that contribute to complex processes like desertification, for example, we anticipate changes within our 'sphere of influence' over a 10- to 20-year period (SANREM CRSP n.d.: 6).

The same paragraph continued with a partial listing of anticipated changes over this period:

- 1) reduced soil erosion and soil nutrient depletion, 2) reductions in the rate of deforestation and/or desertification, 3) reductions in the rates of loss of biological and genetic diversity, 4) improved food availability and/or quality, 5) improvements in the socio-economic status of women agricultural producers, 6) improvements in effective information exchange, 7) improved research capabilities in host countries, and a result of training and collaborative research, 8) improved ability to monitor and evaluate changes in the natural

resource base, and 9) increased governmental and nongovernmental capacity to support and promote sustainable agriculture and natural resource management (SANREM CRSP n.d.: 6).

Clearly, some of the items on this list—most especially the first five—are likely to be observed only in the very long run. Even then, it is highly unlikely that a causal link to SANREM activities could ever be established with certainty. Items 6-9 are intermediate goals having indirect environmental effects; they are more likely to be amenable to change by a project with the resources and capabilities of the SANREM CRSP, and causal links from the project to these types of change should be more easily established. These are the most appropriate targets for an impact analysis after five years of a “ten- to twenty-year” agenda.

In the Philippines, the SANREM project defined more specific goals in keeping with the circumstances of the project. An early SANREM-Philippines document defined “impact” as “a change in the behavior of [project] participants that results in an enhanced quality of life or improvement in environmental conditions such as the quality or quantity of natural resources” (SANREM CRSP 1996: G2-1). The document went on to define a process of progress towards impacts as illustrated in Figure 1 and defined as follows:

This hierarchical classification scheme ... begins as changes in peoples’ involvement in or reaction to sustainable resource management activities or issues. As these first-order changes crystallize, they form a foundation for changes in peoples’ knowledge, attitudes, skills or aspirations regarding sustainable resource use. To produce an impact with long-term significance these second-order changes must ultimately bring about changes in behavior regarding sustainable agriculture and natural resource management (SANREM CRSP 1996: G2-1).

This hierarchical classification of impacts provides a useful initial framework for an evaluation of the project’s achievements. In addition to seeking evidence of changes in behavior, the evaluation should also seek evidence of changes referred to above as ‘first-order’ and ‘second-order’ effects, *i.e.* awareness and predisposition to adoption of more sustainable resource use strategies. Documentation of these intermediate impacts—what we have described above as *awareness* and *attitude*— is especially important when, as noted above, the more tangible impacts may be indirect, or may occur only long after the completion of the project.

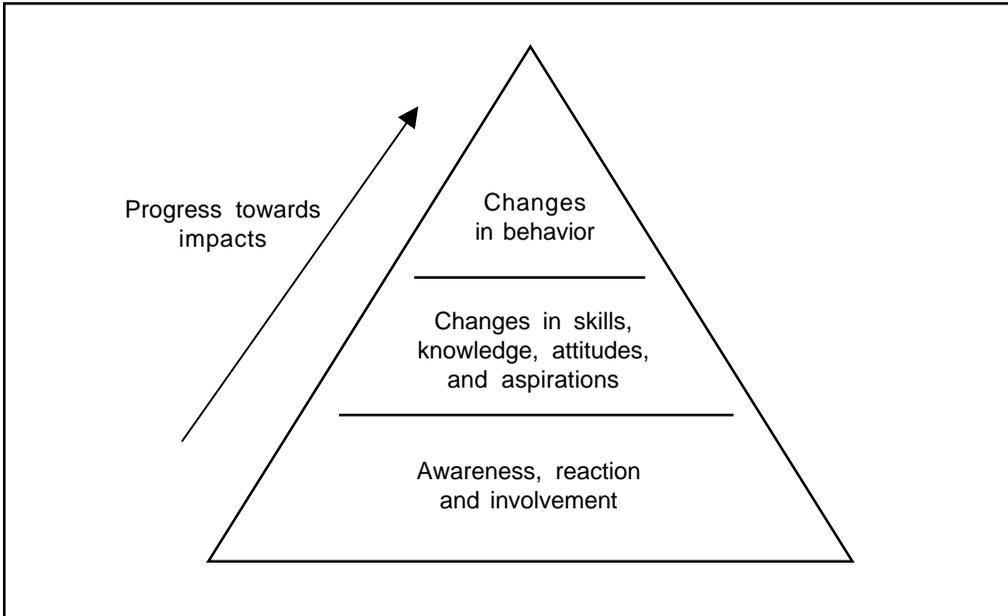


Fig. 12.1. Classification of impacts and progress towards impacts.

Our assessment cannot simply count changes in A^3 , however. It is essential to attempt to identify the source of information upon which changes in A^3 are based. There are many such sources, including radio and television, extension agencies of national and local government, other foreign-funded projects, schools, and so on. Moreover, to be really useful the impact assessment must endeavor to differentiate the extent and nature of its impact by meaningful classifications within the population. We want to know what kinds of people are more receptive to ideas and more likely to act upon them in order that future projects with similar goals and methodologies may benefit.

Goals of SANREM-Philippines and Its Component Workplans

In keeping with the overall goals of the SANREM project, individual workplans developed for the Philippine site adopted the following four broad measures of impacts relating to resource management and sustainability.

- Changes in perceptions, awareness, involvement
- Changes in knowledge, skills, attitudes and aspirations
- Changes in individual behavior
- Changes in institutional policy and action.

These fit neatly with the categories of progress towards impacts defined above, with the refinement that we now distinguish individual behavior from that of institutions, such as local government. Within these generic goals before them, individual workplans undertook specific research, outreach and educational initiatives, some of which are capable of being evaluated in terms of impacts and/or progress towards impacts. In addition, the overall project, by its presence and activities in the Manupali site, presumably had some overall impacts not traceable to the activities of any one workplan or activity.

Some of the major activities that are candidates for evaluation include:

- Increase in resource managers' awareness of causal linkages in the environment, especially those between agricultural production and environmental change;
- Indications of willingness to make sacrifices to conserve scarce natural resources or maintain environmental quality;
- Adoption of more sustainable land management techniques or agricultural production technologies;
- Awareness and policy action on environmentally sustainable development by communities, local, provincial and national government, and external agencies involved in the promotion of economic development and human welfare.

Impact Assessment Methodology

Impact assessment can and should take a variety of forms. These may include direct measurement of impacts (*e.g.* water quality changes, reforestation rates); comparisons of before/after or with/without project conditions and changes; testimony from key individuals and groups, including those outside the study site and unassociated with the project; and if possible, projections of likely future changes given progress towards impacts as of the present. The survey reported in this paper takes the form of "testimony" (although not in the usual sense, since we obtain it from a random sample of respondents); however, the other forms of impact are important and we will speculate on these toward the end of this paper.

Baseline Data and "Distance" Measures

The conduct of an effective quantitative assessment of the project's impacts is hampered by some weaknesses in the potential data set. First, baseline data on environmental awareness, attitudes and even practices

is incomplete. This is a weakness attributable in part to excessive reliance on the rapid rural appraisal (or “Participatory landscape-lifescape appraisal”) performed at the outset of the project, over more conventional and quantitative baselining methods. The lack of baseline data on A³ make measuring the impacts of the project or of any of its component workplans difficult, although not impossible. Second, the more tangible impacts of the project may only begin to appear long after it has officially finished. These may include measurable impacts such as changes in water quality, soil erosion rates, and even cropping practices, as well as some much more evanescent phenomena such as changes in social rewards or sanctions for the generation of environmental externalities.

Our survey methodology allows us to address the first of these issues, and to make some progress towards the resolving the second. We draw our sample of respondents from a population displaying variation in several types of ‘distance’ from the project.² Variation over ‘distance’ should provide an effective substitute for the absence of baseline data and time depth, as long as the measures of distance used capture the generation and spread of ideas and information in ways that are analogous with their diffusion through time. Thus, for example, respondents who reside far from the project in a geographic sense (even outside the site) may display attitudes and aspirations regarding soil conservation that differ from those in close geographic proximity. More tellingly, respondents whose exposure to and involvement with the project has been greater (*e.g.* those who have attended seminars or field days, or hosted crop trials) may display characteristics analogous to those of ‘older’ samples in a time series. In order to capture this form of distance, we will need to control for other characteristics that may influence individuals’ decisions and attitudes to the project. To summarize, we collect data that permit, for each respondent, the quantification of three types of distance:

- Geographical distance (D1), as measured by (a) distance by most frequently used form of transport from residence to nearest point on the National Road and to the barangay (village) center; and (b) distance from residence to furthest farm field.

² “Social distance” is a sociological concept with a long tradition, beginning with Park (1924), who conceptualized it as “a mechanism for reducing to measurable terms the amount of understanding and intimacy which characterizes personal and social relations” (Brein and Ryback 1971:81). In this study we adopt a multivariate concept of distance, taking in geography, education, wealth, participation in organized activities and markets, and (most importantly) proximity to the project.

- Social/organizational distance (D2), as measured by the frequency and intensity of structured interactions with other members of the community. For example, each respondent was asked how many monthly barangay meetings he/she attended in the past year, how many organizations he/she belonged to, and the frequency of visits to provincial market centers (Malaybalay and Valencia).
- Project distance (D3), described in more detail below: level, frequency and intensity of exposure to SANREM activities and ideas.

With adequate data on D3, and using D1 and D2 to control for other characteristics, we are able to construct a sample that spans respondents “near” and “far” from the SANREM project. The advantage of this approach relative to usual “with project” and “without project” comparison, is that by choosing respondents from within the same geographical area we avoid the problem of cross-site heterogeneity in physical, social or economic conditions. In addition, since our data are based on a random sample within the project area, they are less likely to be hampered by selectivity bias: D3 should provide a gradient of proximity to the project, from close involvement to complete lack of awareness.

Other Social and Economic Characteristics

As mentioned above, we are interested not only in the project’s impact in an aggregate sense, but in distinguishing who among the population is more likely to respond to environmental information. For this purpose the survey gathered information on age, gender, wealth, educational attainment, ethnicity, major sources of income, and other key variables that differentiate individuals.

The Site

In Lantapan, recent expansion of sugar and corn cultivation at low altitudes, and of vegetable and corn at higher altitudes, has occurred substantially at the expense of perennial crops, whether pasture/grassland, forest/bush fallow, or coffee. Other things equal, the replacement of perennial land uses with short-season and annual crops on sloping lands is associated with rapid increases in soil erosion and land degradation. Field measurements in Lantapan confirm rapid soil erosion rates and depletion rates of soil nutrient and organic matter content in soils that are generally of poor initial quality. In spite of these negative effects of the spread of annual crops, land fallowing and crop rotation are rare and are

usually undertaken only when yields of commercial crops decline to the point of economic losses in the current season. Although soil erosion and land degradation problems appear to be widespread, few farmers report significant investments in soil-conserving structures or technologies (Coxhead 1995; Midmore *et al.* 1997).

Agricultural intensification without adequate management of soils has deleterious effects both on-site and off-site. Intensive cultivation of annual crops in general, and the increased use of fertilizer, pesticides and other chemicals on vegetable crops in particular, are likely to degrade water quality and may create health problems for farm families and those living downstream. Lantapan-based water quality monitoring reported in Deutsch *et al.* (1998) reveals both qualitative and quantitative evidence of water quality degradation. Perceptions of pesticide residues have made some residents reluctant to water animals in streams during or after rainfall events. Measures of total suspended solids (TSS) in streams across several sub-watersheds were considerably higher in those where agricultural cultivation was more widespread, in spite of much lower average slope, and seasonal TSS peaks appeared to coincide with months of intensive land preparation activity. Deutsch *et al.* report that many of the more noticeable changes in water quality and seasonal flows have occurred “well within human memory” (p.12).

Finally, the unchecked expansion of agricultural production at the margins of the remaining forest systems poses a potential threat to the integrity of those systems, with possibly serious consequences. These include reductions in water retention capacity of the upper watershed and thus changes in the quantity and seasonal distribution of water flow in springs and rivers, and possibly irreversible changes in biodiversity. In the past decade or two the primary impetus for forest encroachment has been the profitability of commercial vegetable cultivation, with decisive contributions from road development and the lack of well-defined and enforced property rights in land (Cairns 1995). Concerns about the loss and degradation of forest resources include such specific phenomena as watershed degradation (especially with logging in the headwaters of creeks) and the loss of wildlife habitat and sources of forest-based foods and raw materials, as well as more general, and less easily quantified, phenomena such as the reduction in measures of biodiversity.

In summary, evidence gathered by SANREM researchers provides emphatic support for two arguments. First, the natural resource base of the Manupali watershed is undergoing degradation of a nature and at a rate without modern precedent. Second, much if not most of the degradation can be attributed directly or indirectly to the spread of intensive agricultural systems based on corn and vegetables. Much of the research

effort in SANREM Phase I was dedicated to building an understanding of the reasons for and consequences of agricultural expansion and intensification, and to the identification of alternative, more sustainable, practices. What impact, if any, did these activities have on the farmers, other resource managers, and influence-makers of Lantapan?

Sampling Methodology and the Survey

We hypothesize that SANREM may have had two kinds of influence on environmental awareness, attitudes and actions. The first is a direct demonstration effect: through participatory research, on-farm trials, farmer field days, seminars and other less formal contacts, farmers may have acquired new information. We expect this to be measurable among those who have taken part in SANREM activities. The second is indirect, through acquisition of information by key community members such as *barangay* officials and teachers who then communicate with the rest of the community. Accordingly, in constructing our sample we chose two groups of respondents. The first group was randomly chosen from *barangay* lists. The second group was chosen at random from a list of “key informants”—*barangay* leaders, municipal officials, teachers, and others holding public office or positions of responsibility within the community (we will refer to these as the “random” and “purposive” samples respectively). The random group consists of 120 respondents, stratified by *barangay* (*i.e.* chosen to reflect *barangay* shares in total population). The purposive group contains 31 respondents. The survey instrument was translated to Cebuano and back-translated to English; it was then pre-tested and revised. The final survey was administered during July and August 1998 by a team of trained enumerators from Central Mindanao University under the guidance of professors Liberty Josue and Consuelo del Castillo.

The survey sought to elicit respondents’ awareness of environmental concerns, their attitudes towards them, and (if farmers) their own practices. Respondents were also asked a number of questions to elicit their “distance” in various dimensions, as described above. Total interview time averaged about 20 minutes per respondent (however, travel times sometimes exceeded this by a factor of five or more). Returned surveys were checked daily and in many cases returned—sometimes more than once—for clarification. The completed surveys were coded in Madison and each set of coded responses was keyed twice. The keyed files were compared and corrected and form the database for the following preliminary report of results.

Preliminary Results and Analysis

Project Distance and Other Distance Measures

Information from each respondent enables us to construct several distance measures. Geographic distance was captured by distances from the house to the national road, the *barangay* hall, and the farmer's furthest field. In each case we asked the type of road used and the usual mode of transport. Social distance was captured by asking respondents how many times in a year they attended monthly *barangay* meetings, visited the provincial market centers of Malaybalay or Valencia, and how many organizations they belonged to. Respondents were also asked about their educational attainment and wealth (proxied by the construction materials of their houses) as well as about a range of economic and demographic variables including ethnicity, gender, tenure, age, number of children and so on. Finally, a measure of project distance was elicited by asking about their knowledge of and involvement with SANREM. The survey asked "Do you know about the SANREM project?" Those responding positively were then asked to state the nature and intensity of their involvement with the project. Responses were sorted into the following categories (with ranks in parentheses):

Relationship to Project	Rank
Employed by SANREM	1
Hosted SANREM-sponsored activities such as crop trials	2
Attended SANREM seminars, workshops, or farmers field schools	3
Attended <i>barangay</i> or other meetings at which SANREM was discussed	4
Have been surveyed by SANREM staff	5
Discussed the project with family, friends or neighbors	6
Know of the project but have no involvement or information	7
Don't know about the project	8

The first row of Table 12.1 shows the frequency of respondents in each of these categories, and the distribution of respondents ranked in this way across several other distance measures. Of the 120 respondents, half were involved with the project through their participation in *barangay* or other meetings at which the project was presented or discussed. One fourth of respondents (31) were more closely involved through a variety of activities, and the final fourth (28) were involved either peripherally, or not at all. Of these, ten respondents (8%)

Table 12.1. Distance measures and respondent characteristics by proximity to project (random sample).

	Hosted Trials	FFS/ Training/ Seminar/ Field Trip	Barangay Meeting	Conversation/ Seminar/ Others	Know/ Not Involved	Don't Know	Total
Frequency	17	14	61	12	6	10	120
Distance geographic: meters home to national road	941	750	975	583	833	1200	917
Distance geographic: meters home to barangay hall	1147	1000	1025	1250	1167	900	1058
Distance geographic: meters home to furthest plot	1471	1250	1541	1833	1500	2150	1575
Distance social: number of barangay meetings attended per year	3.24	3.71	3.51	3.25	3.83	2.70	3.42
Number of meetings, seminars attended past 12 months.	1.24	1.57	0.72	1.58	0.67	0.60	1.00
Past 5 years held public office: barangay captain/council(1/0)	0.24	0.07	0.03	0.00	0.33	0.00	0.08
Past 5 years held public office: hugpong/organizations (1/0)	0.18	0.00	0.10	0.00	0.00	0.00	0.08
Past 5 years held public office: others (1/0)	0.41	0.57	0.10	0.17	0.00	0.10	0.2
Number of times traveled to Malaybalay/Valencia past 12 months.	3.18	3.14	2.83	3.17	2.67	2.40	2.91
Main house construction materials*	2.18	2.00	1.69	1.92	1.33	1.10	1.75
Years of education	8.59	9.71	7.21	6.83	7.33	5.60	7.5

Scale of 1-4, with 1=Timber, bamboo; 2=Milled wood; 3=Wood/cement; 4=Cement/iron grills/wood

reported that they had not heard of the project. Other rows of Table 12.1 report respondent characteristics and other measures of distance. An inspection of these rows indicates that while there is no clear correlation between geographic distance and project distance, those closer to the project are generally more likely to have attended meetings, traveled to market centers, and held public office than those further from the project. Education and wealth are also significantly higher among respondents closer to the project. The latter correlations beg the important question of whether SANREM in Lantapan has merely “preached to the converted”, if wealth and education are preconditions for concern with the environment. We return to this question later in the report. In the following paragraphs we use the ranked project distance measure to identify associations between project distance and respondents’ awareness, attitudes, and adoption of sustainable agriculture practices. At this early stage in the analysis we do not present formal hypothesis tests; rather, we observe correlations among variables in the data set and draw some tentative interpretations based on these. Unless otherwise noted, the results we report below are based only on the random sample of respondents.

Awareness of Environmental Concepts

As discussed above, the first stage of a project like SANREM is to attempt to increase awareness of environmental relationships and concerns. The survey asked respondents to respond to several assertions about relationships between agricultural or natural resource management practices and the environment, for example “Agricultural expansion in upland areas is a major cause of deforestation”. The possible responses were: usually true, usually not true, unable to judge, what is it? For each question, respondents were also asked to nominate the year in which they first became aware of the issue, and to identify and rank all their sources of information.

Levels of awareness were generally high for all respondents; a large majority answered “usually true” to most if not all questions. Since there is little variation in these data we do not report them. However, rankings of the sources of information differed in very marked fashion. Respondents were asked to rank these from 1 to 8, with 1 being the most important source, and 8 being equivalent to “no information from this source”. Figure 12.2 shows rankings assigned to the SANREM project, with respondents sorted by proximity to the project. A strikingly clear pattern emerges. Among those ‘close’ to the project, SANREM is ranked approximately 3rd as an information source, after mass media and family/

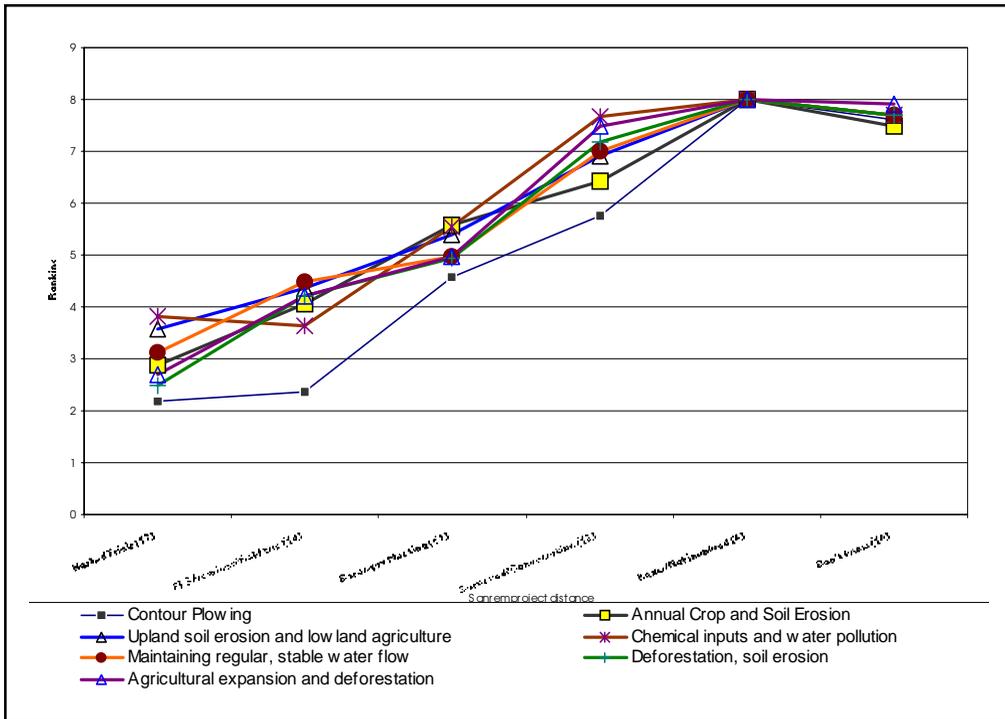


Fig. 12.2. SANREM as source of information, by project distance (random sample). Note: Information sources are ranked 1-8 with 1=primary source, ..., 8=no information from source (): Frequency.

friends/neighbors. As proximity to the project diminishes, so too does its rank as an information source. Across all respondents in the random sample, SANREM’s rank averaged between 4 and 5 (Fig.12.3).

Barangay, municipal and other government officials (excluding municipal agricultural extension officers) were usually ranked just ahead of the project as the third most important information source. However, these officials are the respondents in our purposive sample. Figure 12.4 shows that this group rank SANREM far more highly as a source of information on environmental and natural resource issues than do the randomly chosen respondents. Although we lack firm evidence, it is reasonable to argue that by influencing local officials and key community members, the project also indirectly contributed to a broader environmental awareness. It is especially notable that respondents in the purposive survey placed the project clearly first as an information source in several areas of concentrated SANREM activity—those relating to soil erosion, water quality and deforestation due to agricultural expansion.

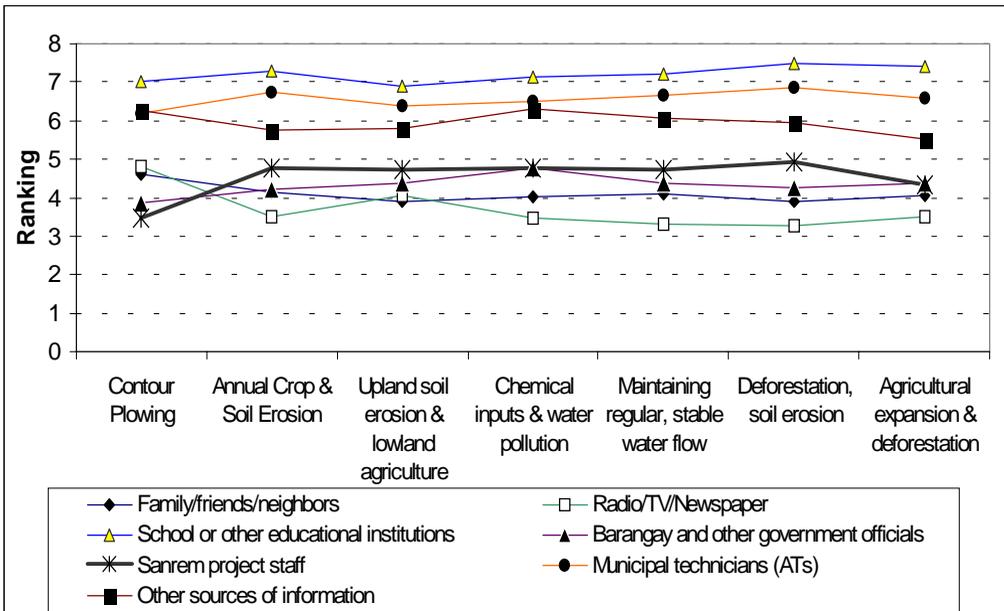


Fig. 12.3. Sources of information on environmental consequences of agricultural practices after 1993 (random sample).

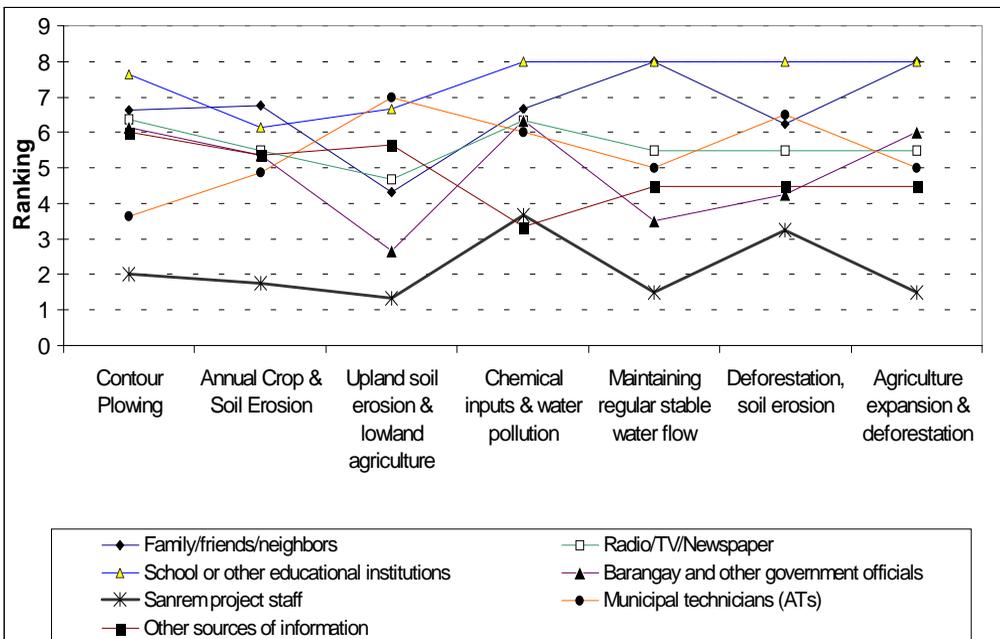


Fig. 12.4. Sources of information on environmental consequences of agricultural practices after 1993 (purposive sample).

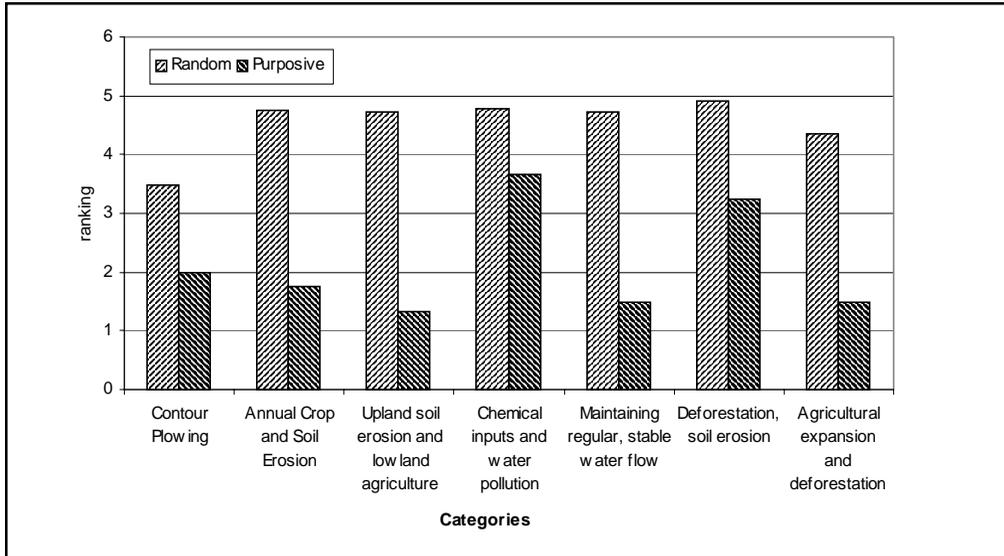


Fig. 12.5. SANREM project staff as a source of information after 1993 (random vs. purposive samples).

Attitudes Towards Environmental Issues

Eliciting and evaluating information about attitudes is a very difficult task. In the survey we posed three questions, each asking respondents to agree or disagree (on a scale of 1-9, with 1= "strongly disagree", 5= "unable to judge" and 9= "strongly agree") with statements asserting that certain steps should be taken to protect the environment. However, it is widely recognized that in face-to-face interviews, respondents have a tendency to offer the answer they believe the interviewer most wants to hear. One solution sometimes attempted is to ask additional questions about respondents' perceptions of the attitudes held by others in the population from which the sample has been drawn. The latter response may be regarded as less prone to bias than the former.³

³ A recent example of this technique was reported in the New York Times in early 1998. A random sample of Americans was asked whether they were following media reports of developments in the Clinton-Lewinsky scandal closely. A majority answered in the negative. However, asked whether they thought *other people* followed these reports closely, a majority answered in the affirmative. In view of high ratings reported for television broadcasts dealing with the scandal, the report suggested that the latter response more accurately reflected the respondents' own behavior. In honor of this report we refer to our check questions as the "Monica Lewinsky questions".

In our sample, nearly every respondent chose “strongly agree” for each of the three questions about their own environmental attitudes. However, answers to the check questions about their perceptions of others’ attitudes were much more varied. Moreover the latter—summarized in Table 12.2— vary systematically by proximity to the SANREM project. For each question, those closer to the project perceive others as holding attitudes more like their own (correlation coefficients of the response against project distance are significant). The table makes clear that if responses about attitudes held by *others* really do indicate more accurately the *respondents’* own attitudes, then the association between proximity to SANREM and a willingness to make sacrifices to maintain environmental quality is very strong.

Adoption of “Sustainable Agriculture” Practices

Our final category of impacts of the project upon individuals is the adoption of agricultural practices thought to be associated with improved management of natural resources. SANREM field activities did not begin in earnest in Lantapan until late 1993 and moreover, the area has been host to several earlier projects with some degree of environmental concern—most notably the Muleta-Manupali Watershed Development Program, funded by the Asian Development Bank, in the

Table 12.2. Response to questions about attitudes towards environmental quality.

	Attitudes (1:strongly disagree, 9:strongly agree)						Corr. Coef.
	Hosted Trials	FFS/ Training/ Seminar/ Field Trip	Barangay Meeting	Conversation/ Seminar/ Others	Know/ Not Involved	Don't Know	
1. Prevent soil erosion	8.12	8.07	7.39	6.75	7.17	6.80	-0.189 (0.038)
2. Protect forests	7.76	7.57	7.50	6.91	7.5	6.1	-0.169 (0.066)
3. Preserve the quality of water	8.29	7.36	7.85	6.83	8.33	6.90	-0.127 (0.167)

The questions asked were:

1. As far as I can judge, other people around here also think it is very important to take steps to prevent soil erosion on sloping lands, even if this means lower incomes for some farmers.
2. As far as I can judge, other people around here also think it is very important to take steps to protect forests, even if this means lower incomes for some farmers.
3. As far as I can judge, other people around here also think it is very important to preserve the quality of water in our rivers and streams, even if the community must pay to accomplish this.

early 1980s. Given these predecessors and the short duration of SANREM's presence at the site, we did not expect to find strong evidence for SANREM influence over adoption of conservation practices.

The survey elicited adoption rates of several agricultural practices. These ranged from simple, easy, cheap and not especially effective (contour plowing and planting trees or grasses on the borders of fields), to practices requiring some knowledge and skills, and some sacrifice of current income (fallowing and crop rotation), to relatively complex, skill-intensive and risky investments (IPM and hedgerows or other vegetative strips). We also asked respondents to name the years since adoption, as well as their reasons for adopting or not adopting a given practice. A 1994 survey of Lantapan farmers had indicated fairly widespread adoption for the first category of practices, lower rates for the second group, and very low rates for the third (Coxhead 1995).

The data on adoption are summarized in Tables 12.3 and 12.4. Table 12.3 shows average adoption rates and frequencies; Table 12.4 shows average years since adoption. In Table 12.3, adoption rates are calculated only across those respondents for whom adoption was a feasible choice.⁴ For the relatively easy practices (contour plowing and planting trees), there is no discernible difference between SANREM participants and non-participants. Adoption rates are uniformly high (Table 12.3), and most categories of respondent report having adopted these practices a decade or more before the present (Table 12.4).

The second group of practices, fallowing and crop rotation, reveal more heterogeneity. Although overall adoption rates are high and fairly uniform, respondents "close" to SANREM appear to have adopted these practices significantly earlier than those further from the project. SANREM, in other words, has attracted participants who had already made some non-trivial investments in soil-conserving technologies, before the start of the project.

The third group of practices involve considerable risk as well as potential or actual losses of current income. For hedgerows, some land must be taken out of production, thus reducing current income. For IPM, the subjective risk of crop failure is initially high, and considerable skill is required for its effective implementation. Adoption rates for IPM are

⁴ For example, farmers with only flat land were not counted among non-adopters of contour plowing. For some questions, the choice of whom to exclude involved a judgement. For example, many farmers who did not adopt fallowing or crop rotation explained that they "always plant corn", or "must plant corn". We interpreted these responses as indicating a subsistence or safety-first motive that prevented farmers from taking land out of production, or planting more risky crops, or non-food crops.

Table 12.3. Adoption rates and frequencies (in parentheses) of selected agricultural practices, by proximity to Sanrem project (random sample).

	Attitudes (1:strongly disagree, 9:strongly agree)						
	Adoption (%) [*]	Hosted Trials	FFS/ Training/ Seminar/ Field Trip	Barangay Meeting	Conversation/ Seminar/ Others	Know/ Not Involved	Don't Know
Contour plowing	85.7 (72)	100.0 (15)	88.9 (8)	80.0 (32)	75.0 (6)	100.0 (4)	87.5 (7)
Integrated Pest Mgt (IPM)	22.3 (23)	68.8 (11)	23.0 (3)	9.8 (5)	30.0 (3)	25.0 (1)	0.0 (0)
Contour strips/ hedgerows	68.4 (52)	92.9 (13)	57.1 (4)	58.3 (21)	42.9 (3)	100.0 (3)	88.9 (8)
Plant trees or grasses on border	95.2 (100)	100.0 (17)	100.0 (13)	94.3 (50)	100.0 (8)	100.0 (5)	77.8 (7)
Regular fallowing	56.9 (62)	58.8 (10)	50.0 (7)	57.4 (31)	60.0 (6)	80.0 (4)	44.4 (4)
Regular crop rotation	67.0 (71)	80.0 (12)	57.1 (8)	71.2 (37)	54.6 (6)	100.0 (4)	40.0 (4)

* Denominator = adoption + non-adopters who have the option to adopt (e.g., denominator for contour plowing excludes farmers with only flat land, do not own land or have planted trees; denominator for IPM excludes farmers who do not grow vegetables and those who reported “no pests”; all denominators exclude tenants reporting that landlords forbade adoption.)

Table 12.4. Average years since adoption of selected agricultural practices, by proximity to SANREM project (random sample).

	Years Since Adoption							
	Adoption (%) [*]	Hosted Trials	FFS/ Training/ Seminar/ Field Trip	Attended Barangay Meetings	Conversation/ Seminar/ Others	Know/ Not Involved	Don't Know	Corr. Coef.
Contour plowing	85.7	10.8	6.6	13.5	8.7	20.8	8.6	0.033 (0.783)
Integrated Pest Mgt (IPM)	22.3	6.6	3.3	6.5	36.3	10.0		0.441 (0.04)
Contour strips/ hedgerows	68.4	5.7	4.8	7.1	2.7	16.3	10.9	0.038 (0.04)
Plant trees or grasses on border	95.2	14.5	7.7	8.0	25.4	9.0	11.3	0.054 (0.592)
Regular fallowing	56.9	19.0	6.0	7.8	1.8	5.3	4.0	-0.362 (0.003)
Regular crop rotation	67.0	12.5	8.3	10.8	2.7	6.5	3.0	-0.208 (0.081)

* Denominator = adoption + non-adopters who have the option to adopt (see note to Table 12.3).
Note: for frequencies see Table 12.3.

generally low, and for both technologies, adoption is highly correlated with proximity to the project. From Table 12.4, we see that years since adoption are low for almost all respondents.⁵ These findings are capable of multiple interpretations and merit closer examination

Since we know that those close to the project also tend to score more highly on measures of wealth, education social distance, one possible interpretation of the adoption results is that SANREM is merely preaching to the converted, *i.e.* that those drawn to participation in the project are farmers who were already investing in soil-conserving technologies and other environmentally beneficial practices. However, there are alternative interpretations. In particular, it is known that investments in the maintenance of soil fertility and the reduction of erosion have positive long-term effects on yields and the stability of production, and through these links have positive effects on income. Thus part of the *current* wealth of respondents close to the project could conceivably be attributed to their having adopted fallowing and crop rotations earlier than the average. This group, by virtue of their greater wealth (security) and education, were then better prepared both economically and psychologically to consider adoption of the more expensive, more risky technologies like IPM, that have been demonstrated and promoted in SANREM research, seminars, training sessions and field trials.

If the data summarized in Tables 12.3 and 12.4 really do indicate that SANREM has been influential in farmers' decisions to adopt more challenging conservation decisions after a relatively short period in the watershed, this result is as unexpected as it is gratifying. As anticipated in the SANREM concept and proposal documents cited earlier in this report, the adoption of conservation measures is an impact that we would expect to become observable only after a much longer period of project activity.

Perceptions of Project Goals

In addition to the A³ questions, the survey asked respondents, in open-ended fashion, "What do you think are the main goals of the SANREM project?" Needless to say, we obtained a very wide range of

⁵ Some cells in the IPM row show very high numbers, indicating many years since adoption. These appear to reflect a definition of IPM based on traditional techniques, or "indigenous knowledge" rather than the modern package of techniques and skills normally referred to as IPM. In any case, the numbers or respondents in these anomalous cells are very low.

responses. Examination of these responses from the purposive and random samples reveal great variation in knowledge and perception of SANREM activities related to soil conservation, agroforestry, and water monitoring—areas in which project outputs and activities are very visible in the field. The answers ranged from “do not know”, a notably small percentage (9%) of the entire sample, to the specific articulation that SANREM does research on soil, crops and water and promotes sustainable agriculture in sloping areas and natural resource management. Between these answers, we note many “development-oriented” responses such as “they teach”, “they assist”, “they promote”, and “they educate” and those which explicitly state “promoting sustainable livelihood”. Responses that began with “they protect”, “they preserve”, “they restore”, or “they conserve” revealed personal perceptions of SANREM’s stewardship role in the community. Personal assessments that SANREM mainly does research were revealed in few responses such as “always doing research on soil, crops and water”, “they do surveys”, “collect data not so much for local development”, “monitor soil erosion”, and “research on environment”. Table 12.5 summarizes these responses into several broad categories. Respondents in the random sample tended to perceive the project as having mainly development or stewardship goals, whereas those in the purposive sample placed much greater emphasis on the project as a research venture. These differences undoubtedly reflect variation in the ways in which the project has presented itself. In continuing research we will consider the implications of these differences for our evaluation of the impacts of the project.

Table 12.5. Perceptions of SANREM goals (percentage of respondents).

Goals	Random Sample (N=120)	Purposive Sample (N=30)
Development	30.8	6.5
Stewardship	12.5	22.6
Research	7.5	25.8
Development & stewardship	16.7	12.9
Development & research	8.3	3.2
Stewardship & research	2.5	12.9
Development, stewardship & research	4.2	12.9
Don't know/other	17.5	3.2
Total	100.0	100.0

Other Measures of Project Impacts

In Phase I, most, though by no means all, of the project's activities were directed at the residents of the Lantapan community. Needless to say, the project aspires to a much broader impact, both through horizontal transmission (to other watersheds or municipalities) and vertical transmission, to higher levels of government, research projects, and NGOs. Our survey made no attempt to evaluate success in these endeavors. However, there is considerable accumulated evidence that the Lantapan experience has affected the views and in some cases the behavior of those 'outsiders' who have become involved with the project, or who have observed it closely. As the direct result of its interaction with the project, the Lantapan local government was the first in Bukidnon province (and possibly the first in Mindanao) to adopt a Natural Resources Management Plan, as mandated by the Philippine Local Government Code of 1991. This action in turn has stimulated considerable interest among other municipalities and at the level of the provincial planning and development office. At the national level, several documents have recorded the influence of SANREM activities on agricultural policy evaluation and resource allocation within the national agricultural research system (Dar and Serrano 1998). Most notably, the recently-approved 'Philippines Watershed Management Strategy and Implementation Program', developed by the Forest Management Bureau of the Philippine Department of Environment and Natural Resources, proposes a profoundly greater emphasis on the devolution of natural resource management planning to the local level. This document proposes the natural resource management planning processes developed by the municipality of Lantapan in collaboration with SANREM as a model for this thrust toward municipal NRM planning and implementation. The team that developed the national watershed management strategy visited Lantapan twice in the nine months prior to the finalization of the plan.

Finally, within Southeast Asian regional agricultural research networks, SANREM has been cited as "one of several key projects implementing and demonstrating a new approach to agricultural research that avoids the pitfalls of both the traditional engineering treatment of soil erosion and deforestation and of non-technical development activities (Garrity 1998).

The Project in Economic and Social Context

The Philippines, like many developing countries, is changing rapidly. Part of this change is driven by economic growth, which resumed in the 1990s after a “lost decade” during which internal migration, deforestation and upland land degradation provided last-resort opportunities for poor and displaced Filipinos of both urban and rural origin. Another part of the change is due to the implementation of a wide-ranging administrative decentralization, largely to municipalities, since 1991. Decentralization shifted responsibility for a range of functions, including natural resource management and land use planning, to the local level. Along with this has come a degree of devolution of powers to make fiscal and natural resource policy. Philippine decentralization is regarded as having created an administrative and political system more power at the local level than almost any other functioning developing country system (references). As the local government reforms are consolidated, local officials and ‘opinion leaders’ of the kind included in our key informant survey are likely to acquire steadily greater prominence in political, fiscal and policy decisions affecting natural resource management. Our results show the project as a leading influence in the environmental thinking of such key figures; if this is true, then the goals of the project may be realized with increasing momentum as the devolution process continues.

Devolution has another important implication: it shifts the center of natural resource management decision-making much closer to those affected. In the project site the municipal government has become increasingly closely (if somewhat reluctantly) involved with resource management debates (including arguments over cutting of specific stands of trees, for example) at the demand of its constituents, who increasingly see the municipality, rather than a national ministry headquartered in Manila, as the first line of recourse. Because of this, environmental awareness among opinion leaders and the general population is likely to become mutually self-reinforcing.

Conclusions

Post-project appraisal is a generally unpopular and underfunded activity. This is paradoxical, given its potential not only as a tool for evaluation of past activities, but for the planning of future projects. This value is especially great for ongoing projects such as the SANREM CRSP-Southeast Asia, since the project will not only continue to engage in

research and development at the Lantapan site, but will also begin to attempt to extrapolate its findings to other regional sites.

Our motivation in undertaking this survey was to attempt to obtain quantitative information of the impact of SANREM on environmental awareness and attitudes, and adoption of sustainable agriculture practices, by the residents of Lantapan, the municipality enclosing the SANREM study site. The project is primarily focused on research and policy, and its thrust is long-term, with a projected life of between 10 and 20 years. Moreover, most of the first phase has been devoted to characterization and initial analyses rather than the development and dissemination of new or improved techniques. Accordingly, we did not expect to find substantial evidence of progress in adoption of new practices.

We have reported preliminary explorations of the survey data which show—admittedly without rigorously establishing causality—that there are significant associations between proximity to the project and the propensity to be aware, hold attitudes and even adopt practices that are generally consistent with the goals of the project. These early results appear to vindicate the project's approach, and in particular, the strategy of engaging in explicitly participatory research design and implementation. The participatory nature of SANREM seems to have had an important influence on the spread of ideas and information through its target community. There appear also to have been significant indirect effects, through SANREM's influence on thinking about environmental and natural resource management issues by local officials, *barangay* office-holders and other influential community members.

While the conclusions we reach in this report are very preliminary and thus by necessity rather tentative, it seems clear from the unexpectedly strong associations between the project and the adoption of new technologies that there is a continuum between research and development. People have to anticipate or see the “development benefits” to be able to appreciate the conduct research or, more importantly, to gain confidence in the value of research at the personal and community level (Coxhead and Buenavista Chapter 8, this volume). This is not to suggest that SANREM must engage only in development activities. Information exchange and feedback from participatory research which enables farmers or policy makers to apply the utility of information generated from that research are in themselves valuable tools to support development activities.

Beyond this preliminary report, the continuing analysis of data we have examined in this paper can profitably be pursued in several ways. One extension of the present approach is statistical analysis using simple Probit models in which the probability of awareness, or of holding a certain attitude, or of adopting certain agricultural practices is a

function of the project distance measure and other variables including wealth, education, and tenure status. This multivariate model could allow us to investigate relationships between A³ and proximity to SANREM more deeply than in the simple tabular analysis presented so far. A more sophisticated statistical approach will make use of Heckman's two-stage method for correcting for self-selection bias. Finally, our results will provide a valuable baseline for future evaluations of the impact of this project; moreover, we suspect that our methodology may even contribute to the improvement of project impact evaluations elsewhere within and beyond the SANREM CRSP.

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Chapter 13:

Impact of SANREM CRSP/ Southeast Asia on PCARRD and the Philippine NARRS

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Introduction

The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), one of the five councils of the Department of Science and Technology (DOST), was created through Presidential Decree No. 48 on November 10, 1972. It serves as the country's main arm in planning, coordinating, evaluating and monitoring the national agricultural research program. It started as the Philippine Council for Agricultural Research (PCAR) whose mandate gradually broadened to cover natural resources (PCARR) and eventually the development function (PCARRD). PCARRD carries out five major mandates, namely: 1) formulating policies, plans, strategies programs and projects for science and technology development; 2) monitoring research and development projects; 3) programming and allocating government and external funds and generating funds for research and development (R&D); 4) developing the capability of institutions/organizations involved in R&D; and 5) promotion and commercialization of technologies.

PCARRD has established the National Agriculture and Resources Research and Development Network (NARRDN) comprising of national multi- and single-commodity and regional R&D centers, cooperating stations and specialized agencies.

Research activities are done by the member agencies of the regional consortia. The network and the consortia promote mutual sharing of resources and minimize duplication of activities. The two are separate but closely linked systems. Their interrelated management functions effect decentralized decision making at the regional level. At present, there are 14 regional consortia established nationwide.

Overall, PCARRD, the NARRDN and the regional R&D consortia compose the National Agriculture and Resources Research System or NARRS.

In its 28 years of existence, PCARRD has evolved as a major institution fostering excellence, relevance, cooperation and sense of urgency in the management of research and in generating technologies to promote national development and global competitiveness. PCARRD has been instrumental in the packaging and implementation of integrated R&D programs, which on the other hand, by their contribution and impact have also helped shape PCARRD and the NARRS. One such program is the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP/Southeast Asia). It is a comprehensive farmer participatory, interdisciplinary, research, training and information exchange program that aims to elucidate and establish the principles of sustainable agriculture and natural resource management at a landscape scale.

SANREM CRSP/Southeast Asia had its Phase I implementation from 1993 to 1997 and is currently in its five-year Phase II implementation. The program is funded by the United States Agency for International Development (USAID).

This paper reports on the lessons learned and impacts of SANREM CRSP/Philippines to PCARRD and the NARRS.

Lessons Learned and Impacts

PCARRD's experience in SANREM has provided rich insights for infusing constructive improvements in the Philippine NARRS. Learnings from Phase I implementation of the program have been incorporated in PCARRD operations. These learnings and impacts are presented and discussed below.

Balancing Commodity Approach with Ecosystem Approach

For over two decades, PCARRD has been accustomed to the commodity approach in conducting research and development. That is, researches are planned and implemented focusing on narrow commodity-based categories such as vegetables, plantation crops, and wood production forest. The unsustainability of this system has led to the incorporation of the ecosystem approach to R&D. SANREM CRSP has provided practical basis and mechanisms in pushing this approach through its comprehensive agroecosystem and landscape lifescape-

based approach to R&D. The program has provided a helpful framework in harmoniously interrelating a commodity with the various components of the ecosystem including offsite effects of development interventions.

Rationalized Review of R&D Proposals

SANREM's participatory approach to project development and evaluation has helped provide impetus to PCARRD in improving further its proposal evaluation mechanism. Aside from holistic and interdisciplinary considerations, PCARRD has increased membership of farmers and private sector practitioners in its R&D Commodity Teams, Technical Advisory Committee (TAC) and Governing Council (GC). PCARRD handles 22 R&D commodities each being managed by a 6-member Technical Team composed of a farmer, private entrepreneur or representative from non-government organization. The PCARRD TAC and GC, on the other hand, now have three farmers and a private sector representative each. These bodies screen, evaluate and approve R&D project proposals at different levels. This move is meant to ensure that the actual needs and welfare of the farmers and the industry are addressed by the projects under implementation.

Strengthening of Integrated Research and Development Program (IRDP)

Our experience on landscape-lifescape approach in SANREM CRSP has enriched our packaging of IRDP to comprehensively include all aspects of a particular program area including environment and human or socio-cultural components. We now have a total of 14 integrated R&D programs on agriculture and natural resources implemented and managed by our regional R&D consortia.

Institutionalization of Sustainable Development Concerns in Research

PCARRD's experience with SANREM has taught us practical approaches in incorporating sustainable development concerns in our research agenda, programs and thrusts. Our exposure with SANREM CRSP's landscape-lifescape approach has enhanced our capacity to balance economics, socio-cultural and ecological concerns in agriculture and natural resources research. To effect this, PCARRD has

promulgated a policy for compliance by the NARRS to address socio-cultural and environmental concerns as early as the conceptualization of projects up to technology packaging and commercialization stages.

Input to the Localization of PA 21

The Philippine Agenda 21 (PA 21) is a comprehensive framework for the country's pursuit of sustainable development in keeping with our commitments in the 1992 Rio Summit. Through Presidential Memorandum Order No. 399 dated September 26, 1996, all sectors have been mandated to incorporate Sustainable Development in their programs and thrusts. Responding to the call of PA 21, the R&D sector stepped up the formulation and implementation of projects that promote sustainable development (SD). Specifically, SANREM CRSP has addressed interrelated PA 21 SD principles namely holistic science and appropriate technology, cultural sensitivity, self determination, local capacity building, gender sensitivity, intergenerational and spatial equity, ecological soundness and global cooperation. The localization process has been particularly guided by key concepts of integration, multistakeholdership and consensus building. Research results from SANREM CRSP continue to be valuable scientific inputs to environmental policy initiatives both at the local and national levels. During Phase I of SANREM, a total of 1250 local stakeholders were trained on landscape-lifescape development methodologies enabling them to participate actively in the program. The formulation and implementation of the Lantapan Natural Resources Management Development Plan (NRMDP) has helped institutionalize localization of PA 21 in Bukidnon.

Contribution to the Development of PCARRD as a Model in Research Management

Along with other parallel programs, SANREM CRSP had helped in the development of PCARRD as a model institution in research management. PCARRD's system for competitive research grants and research management for both local and foreign funded projects has been presented and commended as a model in a World Bank organized conference of National Agricultural Research Systems in Washington D.C. USA in June 1997. The presentation also highlighted partnership and collaboration between local and international institutions and capability building as is happening in the SANREM CRSP.

Fine-tuning Partnership between Scientists and Farmers

PCARRD is mandated to work for and partner with farmers and the private sector in the generation and transfer of technologies in agriculture and natural resources. The SANREM CRSP program has helped evolve effective approaches in working with farmers in the development of agroforestry and upland farming technologies and in the development of a comprehensive natural resource management and development plan, linking with indigenous systems for cooperation such as the *hugpong* and the local *barangay* (village). Development Councils have been found to be effective. So were the practices of leveling off with the grassroot partners and identifying researchable areas with them. These approaches are now adopted by PCARRD in its other programs.

Stronger Partnership with the CGIAR System

In recent years, there has been an expressed policy of the Consultative Group for International Agricultural Research (CGIAR) to work with and help strengthen the National Agricultural Research Systems (NARS) of developing countries. In addition, they have adopted natural resources management as a program thrust in line with their emphasis on sustainable development. Along these thrusts, the SANREM CRSP has provided opportunity for stronger collaboration between the Philippine NARRS and selected CGIAR Centers. These centers are the International Council for Research in Agroforestry (ICRAF) and the International Rice Research Institute (IRRI). Local institutions that have worked closely with these CGIAR Centers through the SANREM Program include the Central Mindanao University (CMU), Department of Environment and Natural Resources (DENR), Department of Agriculture (DA), Ecosystem Research and Development Bureau (ERDB) and PCARRD. The partnership resulted in the sharing of knowledge and expertise and joint efforts in the development of approaches for sustainable agriculture and natural resources management. These approaches benefited from the high standard skills of international scientists balanced by the expertise and knowledge of Filipino scientists and local farmers. PCARRD, for its part, disseminated and shared this mechanism and its impact to the membership of the Asia Pacific Association of Agricultural Research Institutions (APAARI).

Replication of SANREM CRSP Approach in other Areas

The SANREM CRSP/Philippines has served both as an inspiration and a model for other evolving agriculture and natural resource management-related programs. These include the University of the Philippines Los Baños program on “Landscape Approach to Sustainable Agriculture and Rural Development for Mt. Banahaw”, the DOST program on “Basin-wide Approach to Rehabilitation and Conservation of Laguna Lake and Surrounding Watersheds” and the Isabela State University’s “Cagayan Valley Program on Environment and Development”. The Department of Environment and Natural Resources has also recognized SANREM CRSP as a model in pursuing improved strategy for watershed management in the Philippines.

Looking Forward

Phase I implementation of SANREM CRSP/Southeast Asia has left a dent in PCARRD and the NARRS in terms of improved research management and strengthened program for sustainable development. Bringing these gains into the Phase II implementation of the program, we look forward to significant contributions of SANREM CRSP research for enhanced agroforestry and upland technology adoption, established decision support system for farmers and development workers and contribution to improved local and national policies for sustainable agriculture and natural resource management. PCARRD and the NARRS look up to SANREM CRSP as a forerunner program in tracking the path to sustainable development particularly in balancing food production and environmental protection. This is expected to benefit not only the Philippines but also the rest of Southeast Asia.

Chapter 14:

Conclusions

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In developing societies, the relationship between development and the environmental and natural resource base has many influences. These include not only population growth and demographic change, but also expansion of urban markets, development of markets for new products, and changing roles of institutions and governments. For upland areas in relatively remote regions, continued dependence on the natural resource base presents a major challenge to the design of research and development projects promoting sustainable agriculture and natural resource management.

The mission of the SANREM-SEA project is to conduct research on the linkages between environment and development in the context of upland agriculture, and where appropriate, to formulate proposals for locally as well as nationally based initiatives for change. This volume has reported on the first five years of the project. In this conclusion we highlight some key lessons, both from the research and from the processes by which research was designed and implemented, and briefly recap the accomplishments of the project after five years.

Process is a critical aspect in the design and implementation, in developing countries, of natural resource management research oriented toward sustainable development. There is no prescribed model or “blueprint” for the design of such research. This is both because of the relative novelty of the idea of research that jointly addresses economic and environmental goals, and because of the high degree of heterogeneity in the geographical, cultural, political and economic circumstances of rural communities. The lack of a blueprint does not, however, imply that the design of the project was haphazard or lacking in structure. Rather, the project embraced a set of principles that stressed breadth, inclusion and completeness in the choice of activities and evaluation of outcomes—as discussed in Chapter 8. Adherence to these principles, when it worked well, provided a realistic perspective on the complex and intersecting

factors affecting resource management decisions by individuals and communities in the project site.

Of the four “cornerstones” or guiding principles adopted by the project, participation and inter-institutional collaboration played key roles in defining process. The challenge of promoting sustainable natural resource management in a developing economy cannot be met merely by adopting participatory data collection methods and setting up on-farm experiments. It requires outreach activities, with the meaningful engagement of institutional partners, which build local capacity and empower communities to analyze and resolve their own problems. In Lantapan, the project worked with NGOs, community groups, and local government. All groups of these types have comparative advantage over researchers in activities such as community organizing, outreach and even capacity-building. This did not mean, however, that a division of labor in which all outreach was assigned to non-research partners while control over research was retained by academic and research-based institutions would be the best means to proceed. The commitment to participation and inter-institutional collaboration—linking researchers and “action-oriented” local institutions—helped ensure that research was relevant, sensitive to local conditions, and oriented towards the solution of specific local problems. At the same time, the involvement of researchers in outreach-oriented partnerships created new opportunities by bringing science to bear on complex issues. The formal impact analysis of the project (Chapter 12) reveals influences at work in both directions.

Over and above locally based partnerships at the activity level, an important element of our experience is that the project itself, by displaying its long-term commitment through a strong and continuous on-site presence, became part of a web of local and national institutions dealing with resource management in Lantapan. This willingness to engage and work creatively with networks of village groups and local and national institutions helped reduce the project’s vulnerability to the vicissitudes of local politics and the electoral cycle.

Among the lessons that emerge from the project, two stand out above all others. The first is that while that *participation* is a term with multiple shades of meaning (Chapter 8), the probability of a project achieving lasting success depends heavily on the extent to which its objectives and methods are aligned with community interests and institutions. This lesson has been learned in a number of ways, both positive and negative, in the course of the activities reported in the chapters of the book. Research activities that made considered and deliberate commitments to participatory research, such as those documented in chapters 9 and 10, have resulted in the establishment of formal locally-based organizations

as well as strengthening existing ones. Their presence gives credibility to the claim that a project's influence may persist after its funding has ceased. Similarly, the remarkable convergence of interests between the project and the Lantapan municipal government, resulting in the creation of a municipal Natural Resource Management and Development Plan, indicates the kinds of opportunities that are created when project design is responsive to local political and institutional processes. To be sure, not all of the project's attempts at participatory engagement have been as successful as these, but there can be no doubt that long-term institutionalization of SANREM-sponsored ideas and approaches to development has profited both from early success and by learning from setbacks.

The second outstanding lesson is that it is not safe to assume that solutions to environmental degradation or unsustainable use of natural resources depend entirely, or even predominantly, on efforts to alter behavior of the residents of the affected area. So long as farmers and others are connected to a broader economy through markets for labor, credit and agricultural products, there is scope for market signals or economic policies to drive local resource allocation decisions. Admittedly, the farmers of Lantapan municipality are for the most part engaged in highly commercialized production, but even those who do not produce for the market are clearly strongly influenced by market prices. Two illustrations of particular relevance are those of Philippine corn and vegetable pricing policy, and the local labor market and wage effects of growth in the national and regional economies. As seen in Chapters 3 and 4, national policies that raised corn and vegetable prices have been major forces behind land expansion in Lantapan. Similarly, growth of non-agricultural labor demand could in the long run cause cultivated area to diminish—and perhaps influence adoption of soil and forest-conserving technologies as well. Thus market-related events beyond the control of the affected community can have major effects on incomes and on resource use decisions. We conclude from this that efforts to alter resource use patterns that do not acknowledge markets and the influence they play are unlikely to achieve lasting success, no matter how carefully they attend to the process of becoming embedded in local development institutions.

It might be observed that the two lessons just cited appear to embody a contradiction. On the one hand, we have made the case for *local* involvement as a precondition for the success of a project of this kind. On the other, we argue that project design must pay careful attention to policy constraints and market signals from *outside* the project site as (possibly dominant) influences over major resource use and environmental decisions. How are these consistent? The answer is that both are important, but in

different ways. Even if external stimuli dominate in farmers' land use decisions, there is substantial and increasing local administrative influence over land use zoning and taxes relating to resource use. Philippine decentralization since the early 1990s has shifted considerable and increasing power over resource use to local jurisdictions; this move has coincided with economic reforms that have greatly strengthened the power and reach of markets. Moreover, the acknowledgment of overlapping claims to ownership and control over land and forests in Philippine uplands has greatly increased the importance of village and cultural institutions as arbiters of actions affecting natural resources and the environment. This has occurred even as (in many respects) the *economic* importance of such resources has diminished with urbanization and the growth of non-agricultural, non-rural income and employment. One thing that is clear is that inconsistency between local approaches and the resource use incentives "received" from a broader economic and policy setting will most likely result in failure to move toward sustainable development. A project aiming to promote sustainable use of local environmental and natural resources must therefore be cognizant that the *primary* managers of resources are farmers and others whose actions are constrained by specific local cultural, economic and political institutions, but must not lose sight of the influence of external economic opportunities and policies on individual actions. Researchers can document, analyze and disseminate findings in which local processes, broader influences and technological and institutional opportunities are identified and their interactions made clear. Ultimately, though, responsibility for sustainable development of Southeast Asia's upland areas is shared between farmers, communities and community groups, and political jurisdictions from local all the way to national level.

Can agricultural development be consistent with the sustainable use of natural resources and the maintenance of environmental quality? *Seeking Sustainability* reports on research in the SANREM CRSP/Southeast Asia, a collaborative project directed at answering this and related questions. Contributing authors draw on experience in an upland Philippine watershed to derive lessons not only about environmental change and resource management, but also about an approach to project design that stresses community participation and a landscape perspective. Local initiatives and technology transfer are both important, but plans for sustainable development must also consider changing market and policy influences on the actions of farmers and resource managers, and involve policy makers at all levels of government.

