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Long-Term Biodiversity Research Programme for Mindanao, Philippines

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ABSTRACT: The Long-Term Biodiversity Research Programme (LTBRP) for Mindanao is envisioned to be a collaborative programme of the Philippines. It will be a programmatic research on biodiversity - its status, threats, and conservation and management. The chosen research site is Mt. Malindang in Misamis Occidental of Mindanao. The BRP will support a set of research projects that will generate knowledge on biological and ecological, socio-economic, cultural and policy aspects of biodiversity conservation. It will also enable researchers to develop and try new methods for research on these aspects, separately or crossing boundaries of academic disciplines. Moreover, the BRP will implement support programmes which will provide the linkages of research activities to development issues and needs in the research site. The support programmes will also draw from the research projects, the knowledge that can be lent or immediately available to policy and programme formulation. The support programmes will comprise: human resource development or capability-building; information, education and communication; database; networking; community organizing; and development action. The BRP will be undertaken by a group of academic and research institutions from the Philippines, in partnership with their respective government entities and local government units in Mindanao. The Biodiversity Research Programme (BRP) will comprise a set of research projects to be undertaken by small research teams in the site. Researchable areas have been identified initially through the National Biodiversity Research Agenda, and later enriched in the Participatory Rural Appraisal (PRA) Analysis workshops by the Mindanao researchers and Philippine resource persons. Results of the PRA are presented in the paper.

Key Words: Biodiversity Research Programme, Mindanao, Mt. Malindang, Participatory Rural Appraisal.

INTRODUCTION

Among the 7,107 islands in the Philippines, Mindanao is considered to possess the highest level of biodiversity due to high mountain ranges. Of the ten highest mountains in the Philippines, six are found in Mindanao. With a total land area of about 95,587 km^2, Mindanao has many endangered, endemic, rare and economically important species of flora and fauna (Heaney and Peterson 1992, Kennedy 1995, Amoroso *et al.* 1996, Pipoly *et al.* 1996). However, the high and unique biodiversity resources of Mindanao have not been spared from wanton destruction due to human activities brought about by the lack of information and knowledge regarding biodiversity and conservation.

The Biodiversity Research Programme (BRP) is a collaborative research programme on biodiversity to be conducted in Mindanao, Philippines with five cornerstones, viz., partnerships, participatory and landscape approach, communitybased activities, and inter-disciplinary research.

The BRP was initiated to provide measures to prevent the eventual loss of the remaining biodiversity in Mindanao by developing and implementing a research programme that will (a) contribute to the conservation, management and sustainable use of biologiocal and genetic resources; (b) develop a comprehensive approach aimed at integrating support for collaborative research and support for building and strengthening capacity to conduct biodiversity research.

Through a series of consultation meetings, the Philippine Working Group (PWG) headed by Dr. Percy E. Sajise, Director of SEARCA, and Mindanao Researchers have agreed that Mt. Malindang Range in Misamis Occidental and its environs will be the research site and a participatory rural appraisal (PRA) had to be conducted in three ecosystems, viz., upland, lowland and aquatic ecosystems. Thus, this paper presents the results of the data gathered through PRA in the lowland ecosystem from 11 barangays of Misamis Occidental to identify problems, opportunities and researchable areas and to develop a biodiversity research program to conserve the biodiversity resources in Mt. Malindang.

METHODOLOGY

Site selection for the field reconnaissance and Participatory Rural Appraisal (PRA)

Using the map of Misamis Occidental, three transect lines were made starting from the coastal to the upland ecosystems based on the river and road systems. From these lines, 5 municipalities and 26 barangays were intercepted.

Eleven barangays were finally chosen for the PRA based on the following criteria: presence of IPs, economic, endemic or threatened biological resources, organizations, access to services and local government unit (LGU) participation. Four of these barangays interfaced with the coastal and three with the upland ecosystems.

Conduct of the Participatory Rural Appraisal

Two teams were formed composed of 4 or 5 members with biophysical, socio-economics and socio-cultural experts in each team. With the team leader, each team worked with 6 barangays.

In the conduct of the PRA data collection and analysis, general tools were used, namely: visualized analysis and sharing method, interview and direct observation method and group and team dynamics method. Through these methods and with the involvement of the stakeholders in the community, spot map, resource use map, transect, timeline, resource flow and network analyses were produced. The availability of the major informants has facilitated the collection of data. If needed, the team stayed overnight to immerse with them and to gather additional data in the community.

Information sharing between and among members of the team and between teams was done after the interview and even during night time. Mind mapping was also conducted to determine trending, relationships between barangays and identification of researchable areas in the 11 barangays. Collected data on biophysical, socio-economic and socio-cultural aspects were put in matrix form for analysis.

Community Validation Meeting (CVM)

Community validation meetings were organized to validate the results/data collected during the PRA. It was attended by the mayors, barangay captains, heads of government and nongovernment organizations. General presentation of the results and researchable areas was done in local dialect and simplified by the use of visual aids (illustrations, tables, graphs, photos, etc.). In the presence of the lowland team members, the invited stakeholders and major informants examined their outputs like the resource use map, spot map, time line and made some comments and suggestions.

RESULTS AND DISCUSSIONS

The 11 barangays chosen for the participatory rural appraisal (PRA) were grouped into three, based on the altitudinal range and interfacing with the coastal and upland ecosystems. The first group is composed of four barangays (Landing, Dioyo, Unidos, Tipolo) with altitude ranging from 25 to 65 m asl and interfacing with the coastal ecosystem as evidenced by the intrusion of salt water into the river. The second group of barangays (Lumipac, Calaran, Dapacan Alto and Mamalad) have altitudes ranging from 80~360 m asl, inland and without intrusion of salt water into the river. The third group is composed of three barangays (Sixto Velez, Siloy and Sinampongan) with altitudes ranging from 400~610 m asl, characterized by the presence of primary and secondary forests and interfacing with the upland ecosystem. The Langaran and Dioyo Rivers run through most of the barangays. Several creeks join these major rivers which eventually drain into the Murciellagus Bay.

Slope/topography

Group 1 barangays are generally flat to gently rolling. Inland barangays or group 2 tend to be relatively flat to rolling while the higher elevation barangays or group 3 are generally rolling: rising gently and steeply towards the hilly and rough rolling lands westward to Mt. Malindang.

Soil conditions

A total of 46 soil samples from major land use areas were collected and analyzed for pH, N, P and K using the Soil Test Kit (STK). Physical characteristics like color, texture and erosion potential were also determined in the field. The soil analysis showed increasing acidity with elevation and ruggedness of terrain. There is also a trend torward soil acidification in areas using high amounts of inorganic fertilizers. N is generally low particularly in barangays Lumipac, Tipolo, Calaran, Mamalad, Landing and Sinampongan. P is also low in barangays Lumipac, Dioyo, Calaran, Unidos, Dapacan Alto and Siloy while K is mostly sufficient except in barangays Dapacan Alto, Tipolo, Mamalad and Landing. The soil color is brown to dark brown and is getting yellower and redder with elevation. Soil texture is generally heavy (clay loam) except in a few near coastal barangays (Tipolo and Landing) where some soils are light to medium in texture. Soil erosion is serious along river banks that are

put into agriculture and where quarrying is left uncontrolled. It is also a problem in cultivated kaingin and in many marginal slopes that are put into cultivation without using appropriate farming technology.

Land use patterns

The eleven lowland ecosystem barangays studied have four major land uses namely: settlement, agriculture (includes abandoned areas which turned to brushlands), reforestation and secondary forest areas which also include brushlands. Agriculture occupies the largest segment (65% average) of the area with coconut as the number one crop followed by wetland rice, corn and root crops. This is followed by settlement (15%), secondary forest (12%) and reforestation area (6%). The reforestation area is dominated by mahogany, gmelina with mangium as a far third. The agricultural and the secondary forest area also include abandoned or logged areas, formerly kaingin areas, which have turned brushlands. The latter is dominated by malatungaw (*Melastoma malabathricum*), cogon (*Imperata cylindrica*), talahib (*Crysopogon aciculatus*), and agsam (*Dicranopteris linearis*); all indicators of poor soils. Although the agricultural areas are dominated by coconuts, there is now a significant reduction in coconut hectarage because it has become a cheap alternative source of lumber. This has been aggravated by the development of irrigation facilities particularly in Groups 1 and 2 barangays. In addition to coconut, the secondary forest is the main source of firewood and materials for house construction. It is also a source of various other materials, timber or non-timber (rattan, nito) which generate additional income for the family.

Climatic conditions

Rainfall is more or less fairly distributed throughout the year. There is no pronounced dry season. The wet months are in November and December, the latter being the rainiest. Near-coastal barangays (Tipolo, Landing and Calaran) are dry in February to March while higher elevation barangays are dry in March to April. The latter is the driest month. The average annual rainfall is 1,911 mm (1988~1993 data, PAGASA). Relative humidity is 85~86% in the rainiest months and is 79% in the driest month. The mean annual temperature is 27.7 with 26.8℃ as the lowest and 28.5℃ as the highest (1951~1985 data, PAGASA). Cyclonic, northeast monsoon is the most prevalent wind system in the area occurring in November to February.

Physiographic conditions

The eleven barangays are characterized by a flat to relatively flat to mildly rolling to rough and steep topography. Flat to relatively flat areas comprise about 50% of the whole study area. The land area per barangay varies considerably, the smallest area being 147 ha (Dioyo) and the biggest is 1500 ha (Sinampongan). The elevation ranges from 25 to 610 m asl.

Drainage and major river systems

The 11 barangays are drained by several rivers. The major river systems are the Langaran and Dioyo. The Langaran River traverses through four barangays: Mamalad, Calaran, Unidos and Tipolo while the Dioyo River runs through four other barangays: Siloy, Dapacan Alto, Lumipac and Dioyo. Sixto Velez is drained by Tolon and Guinabot Rivers, Sinampongan by the Pines River while Landing drains to the Sinian River.

Transect

Transect lines were run each for the 11 barangays. The transects ran from either northeast or northwest direction as indicated in the transect map. The following biophysical parameters were also included: soil, average percent slope, agricultural crops, trees and livestock. Eventually, problems and opportunities for each transect were identified.

Biological conditions

In the early 1930's, most of the barangays were still densely forested with only a few patches of open grasslands. Dipterocarp species, used to grow in the forests. Recently, however, only barangay Siloy and Sinampongan have patches of natural forest. These two forested barangays are still inhabited with some endangered, economic and primitive vascular plants like Kapa-kapa (*Medinilla magnifica*), whisk fern (*Psilotum complanatum*) and a fern ally (*Tmesipteris lanceolata*). The lives of these plants are highly threatened because of habitat destruction made by the local people. Twenty nine endemic species and 86 economically important species were seen in PRA sites.

Wild animals including wild pigs, monkeys, deer, bats and various bird species used to be abundant in the forest. However, except for a few sightings of wild deer, monkeys and pigs in Siloy and Sinampongan, they have now disappeared due to over-hunting and habitat destruction.

In all barangays studied, except for Sinampongan, the major crop is coconut. It is generally grown with corn, cassava and camote as intercrops

except in Sixto Velez and most of Landing where it is a monocrop. In Tipolo, it is mainly intercropped with lanzones. It is basically sold as copra although some coconut farmers sell whole nuts. Rice and corn are the next major crops. Corn is generally for household consumption only and usually grown under coconuts. Barangays like Sixto Velez and Calaran grow it as a monocrop. Rice is grown in commercial scale and is a monocrop. It is watered by the irrigation system coming from the Nazareno Dam and the NIA.

High-value fruits like mangosteen (*Garcinia mangostana*), lanzones (*Lansium domesticum*), mangoes (*Mangifera indica*) and marang banguhan (*Artocarpus adoratissima*) abound in many of the barangays. Plantations of mangoes and lanzones can be found in Calaran and Tipolo while mangosteen is found in Sixto Velez and Sinampongan. In some barangays, these fruits are grown only in backyard or planted with other crops in small farm lots.

Vegetable gardens are becoming an increasing important feature of the landscape. High value vegetables such as carrots, ginger, bell pepper and pechay are grown and sold mainly for the market in Aloran. Eggplants, ampalaya (bitter melon), okra (ladies finger), squash and string beans are also grown commercially in Tipolo.

The incidence of pest and diseases problem has been observed. The most serious of which are tungro, green leaf hopper, black bug and rats in rice, corn borer, leaf miner and rats in coconuts and bunzalo problem in cooking banana.

Historical trend

The oral history or timeline of each barangay shows the general historical trend in the lowland ecosystem, focusing on biodiversity.

1890s.

The lowland barangays were heavily forested up to the 1890s, with only the migratory farming activities of the few IPs encroaching on the forests. The coming of the in-migrants from the Visayan islands of Bohol and Siquijor changed the environmental landscape. Subanens progressively moved to the interior as in-migrants in search of land, arrived by batches. Kaingin was done in interior areas by Subanens while the migrant settlers clear lands for settlements and for farming, particularly rice and corn. They also cut trees to build houses.

1930s.

The introduction of coconut as a cash crop in the 1930s became an inducement to clear more lands to plant coconuts. High value fruits as lanzones, mango, nangka and mangosteen were also planted in response to the growing demand for them. The commercialization of agriculture was well underway.

1960s~1970s.

In the late 1960s and 1970s, there was an intensification of coconut planting, brought about by high demand for copra. This again resulted in the clearing of remaining patches of forestlands. The granting of logging concessions resulted in further environmental degradation. During this period there was the intensification of rice and corn farming of the high-yielding varieties to meet the food requirements of the growing population. This resulted in monoculture and decreased biodiversity. The newer staple varieties were, however, heavily dependent on inorganic fertilizers and more easily attacked by pest and diseases. To hedge against pest infestation the farmers had to plant sturdier crops as camote and cassava to serve as food supplements. These rootcrops were also found to stand bad weather and required no fertilizers. During this period the farmers started raising livestock in the backyard to help meet the household needs.

During this period also, the effects of deforestation started to be felt — erosion and flooding have become a continuing feature of community life.

1980s.

Efforts aimed at attaining sustainable forestry practices have led to the development of rapidly growing species of trees as gmelina, mahogany and falcatta. These fast-growing trees are attractive alternatives because after a period of about six to seven years they could be harvested and sold. Replanting could then easily and cheaply be done. So, in the 1980s, social reforestation, also called plantation forestry, became the response to deforestation. This did not only try to curb problems associated with erosion to improve the watershed and control flooding but also served as a means of livelihood. But the single species-type of reforestation was a poor substitute to lost wildlife habitat, so the lowering of biodiversity continued. Meanwhile, ricelands were converted to coconut plantations due to the rising demand for copra.

1990s.

The 1990s saw an increasing awareness toward environmental rehabilitation and conservation. Integrated Pest Management or IPM was introduced through farm modelling by the DA during this period. It was also during this period that the

presence of non-governmental organizations and people's organizations active in environmental issues such as the Foundation for the Philippine Environment (FPE) and PIPULI Foundation have started to be felt in the study sites. In 1994 Sinampongan and Siloy became protected areas. In 1996, PIPULI introduced the Sloping Agriculture Land Technology or SALT in Sinampongan. Throughout the period, the revival of organic farming methods in all the study sites has been encouraged. Finally, as the decade comes to an end and a new millennium is forthcoming, biodiversity conservation campaigns have been launched.

Network analysis

The people in the 11 barangays, through the key informants and community representatives, were asked to analyze their basic problems making use of the network analysis. The method was deeply appreciated because for the barangay folks, it did not only allow some information to surface but has in fact increased their awareness on their concrete conditions. It even gave guides for actions to improve their lot.

Summing up all the network analyses done, the lowland team has come up with a general analysis of the lowland areas where the PRA was conducted.

Low farm productivity resulting in low farm income or poverty emerged as the primary problem in the barangays studied. Low productivity is seen as a result of infertile soil on one hand, and poor farming techniques on the other. Attempts to increase or at least sustain yields, given small farm sizes, resulted in continuous cropping rather than rotations, thereby worsening soil infertility. The poor soil quality could have been remedied by the application of fertilizers — organic or inorganic. The general tendency is to apply inorganic fertilizer as it is less labor-intensive. Its application, however, is constrained by the inability to purchase the inorganic fertilizer owing to the lack of finances.

Another reason cited for low farm yield is the poor farming techniques, which include primarily the inability to combat pests and diseases. Pest infestation in recent years have resulted in the application of pesticides. While the Department of Agriculture has introduced integrated pest management, only a few have adopted it. The communities feel that the government is too slow in delivering the necessary technical assistance, aside from IPM. Meanwhile, there is already the growing concern about pesticides contaminating water supplies, rendering them unfit for draft animals to drink and for fish populations to survive.

Low farm productivity is also seen as resulting from climatic changes, erosion and flooding, which the communities acknowledged to be due to deforestation.

While the benefits of the forests such as watershed maintenance, protection of wildlife, and prevention of erosion have not escaped the farmers' awareness, the farmers lament sadly that not using the forest was to their disadvantage because the trees conserved would somehow be cut down by others anyway; forested lands left uncleared would likewise be cleared by others. This was because of the free access to the forest by just anyone before the establishment of the protected areas.

Delving into deeper analysis, the concept of externalities serves to provide reason for deforestation activities vis-a-vis declared awareness of forest conservation. Biodiversity benefits, soil erosion, damage to rivers and streams due to siltation and sedimentation are not borne by the farmers living near the forests and can be felt only by people living downstream.

Awareness of conservation laws and practices

Most of the inhabitants in the selected barangays are aware of the various laws and policies related to biodiversity conservation. However, their violations or non-observance of these policies is actually rooted from their impoverished conditions and their desire to survive. However, a few of them are now fully aware of the need to conserve our biodiversity in order to survive from and avoid future calamities.

LANDSCAPE AND LIFESCAPE RESEARCH THEME: CONSERVING BIODIVERSITY 'HOTSPOTS'

The scenario at Mt. Malindang and its environs offers an ideal opportunity for biodiversity research because of its rich biological resources which are now threatened in a state where conservation and rehabilitation are badly needed. In addition, the DENR reforestation Project is there and most of all, a major resource user of the vast biodiversity resources are living near the foot of this mountain. These are the Subanons of Mt. Malindang.

A major issue arose from this scenario, and this is the encroachment of the indigenous groups and other migrants into Mt. Malindang. Their activities for survival in terms of using Mt. Malindang resources have also made it crucial for the survival of plants and animals.

There is a massive destruction of biodiversity resources. For instance, in spite of the presence of the reforestation project in the buffer zone, people in the vicinity of this project still prefer to cut down trees for housing purposes. This situation also results in the destruction of important biological species, now considered as endangered, e.g., whisk ferns (*Psilotum complanatum* and *Tmesipteris lanceolata*) which grow and attached only on trunks of tree fern. The whisk fern is botanically important as a primitive plant. In addition, there is the presence of endangered and ornamental kapa-kapa (*Medinilla magnifica*).

The Subanons, as a major resource user of the biodiversity resources could be harnessed to reinforce conservation activities through their indigenous knowledge system that support biodiversity conservation. These Subanons are engaged in biological farming, such as biological control of pests. The IPM definitely supports biodiversity, along with organic farming activities of these indigenous groups which avoid the use of chemicals and fertilizers.

These biodiversity research activities would look into indigenous knowledge systems that could support our efforts at biodiversity conservation (e.g. preserving trees with medicinal values, conserving wildlife and their corridors, etc.) This scenario also offers a perspective that even if these resource users live in the adjacent lowland areas of Mt. Malindang, they would not anymore encroach on the biodiversity resources in the upland since their sustainable biological agriculture would enable them to produce enough food for the family.

The use of herbals for medicinal purposes by the indigenous groups (the Subanons) would also promote the conservation of plants with medicinal value. The BRP could be a tool for the proper propagation of these medicinal and other economically important plants by establishing a tissue culture laboratory and a Botanical Garden which could serve as venues for the ex situ conservation.

The rich biological resources in Mt. Malindang, once conserved and properly managed, could showcase an environment of high biodiversity value and eventually, plant and animal life, which are endangered and of economic value could be conserved and appropriately propagated. Among these are *Tmesipteris lanceolata*, *Psilotum complanatum* (plants with high botanical value) and the *Medinilla magnifica* (a highly priced and rare ornamental plant).. In addition, wild deers and wild monkeys were sighted in Mt. Malindang. All these organisms could be conserved in situ with the assistance of the Subanons.

Land use practices in the area do not favor soil conservation in hilly and rolling lands. Soil erosion is evident and fertility of the soil is very low. Organic farming technology and other indigenous practices (composting, etc.) would be introduced and promoted. Some areas in Siloy and other nearby areas also suffer from erosion.

Once conserved, we can see Mt. Malindang and her environs as an ideal biodiversity site where plant and animal life and other resources grow in abundance and where the environment supports the existence of endangered, endemic and rare species found only in this part of the world.

CONCLUSIONS

1. Of the 11 barangays, only Siloy and Sinampongan have patches of natural forests. These two forested barangays are still inhabited by some endangered, economic and rare primitive vascular plants and other wildlife. However, the lives of these are highly threatened by habitat destruction and therefore, urgently need to be protected.
2. Soil analyses revealed that acidity increases with elevation and ruggedness of terrain. Moreover, an increasing acidification in areas using high amount of inorganic fertilizers have also been observed.
3. Although the agricultural areas are dominated by coconuts, there is a significant reduction in coconut hectarage because it has become a cheap alternative source of lumber and indiscriminate conversion of coco lands into rice lands.
4. Intrusion of sea water into the two major river systems, the Langaran and Dioyo rivers, has been observed. This situation may have some influence on the diversity of the aquatic ecosystems.
5. Low yield in plantation crops is due to the incidence of pest and diseases, like 'tungro', green leaf hopper, black bug and rats in rice; corn borer; leaf miner and rats in coconuts, and 'bunzalo' in the 'sab-a' banana.
6. Population density appears to decrease with elevation. This situation, when linked with biodiversity, points to a greater biodiversity loss in areas with high population density -the lower elevation areas. On the other hand, poverty has been observed to worsen with elevation. This is leading as well, and very significantly, to reduced biodiversity in higher elevation areas.
7. Poverty, landlessness, and the commerciali-

zation of the economy lead to deforestation and the resulting biodiversity loss. The satisfaction of the basic survival needs of the Malindang communities, as well as the profit motives inherent in commercialization, are powerful forces of environmental destruction. Assistance programs aimed at addressing livelihood and landlessness problems may thus be channeled to directions that protect the environment. On the other hand, assistance efforts towards biodiversity conservation are bound to fail if they ignore poverty issues and the market forces.

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