First - Fourth Quarters, 1984

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(Luz U. Ausejo Memorial Issue)

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Editorial Note

This issue of *SJ* is dedicated to the memory of Luz U. Ausejo (1925-1984). Both this journal and this editor were greatly inspired and supported by Dr. Ausejo over the past decade. Silliman University has indeed suffered a loss. See the *Note* elsewhere in this issue for details on Dr. Ausejo's life and the foundation that has been set up to honor her.

The articles in this issue continue themes that have become *SJ* specialties, and several of the authors will be familiar to readers also. Betty Abregana's study of the Lake Balinsasayao area is accompanied by an exciting plan for the future. As the Balinsasayao project continues let us hope that it can become a model of development that will preserve the natural environment while answering the needs of people.

Alcala and Carumbana, Calumpong, and Luchavez, and Alcala take us from the mountains to the sea, focusing on marine resources, with suggestions for their planned exploitation. George Beran's *Note* ties all together, as he discusses the bleak realities of the world food problem, and the small rays of hope that we must grasp if we are to avert disaster.

D.L.

Notice to Authors

The *Silliman Journal* welcomes contributions in all fields from both Philippine and foreign scholars, but papers should normally have some relevance to the Philippines, Asia, or the Pacific. All submissions are refereed.

Articles should be products of research, taken in its broadest sense; a scientific paper should make an original contribution to its field. Authors are advised to keep in mind that *SJ* aims at a general, international audience, and to structure their papers accordingly.

SJ also welcomes submissions for its "Notes" section, generally briefer and more tentative than full-blown articles. Reports on work in progress, queries, up-dates, reports of impressions rather than of research, responses to the work of others, even reminiscences are appropriate here. See recent issues of *SJ* for examples. Book reviews and review articles will also be considered for publication.

Manuscripts should conform to the conventions of format and style exemplified in this and following issues of *SJ*. Whenever possible, citations should appear in the body of the paper, holding footnotes to a minimum. Submit pictures only when absolutely necessary. Scientific papers should be accompanied by an abstract. All authors must submit the original and one copy of their manuscripts, typed on good-quality paper, double-spaced throughout.

The Editorial Board will endeavor to acknowledge all submissions, consider them promptly, and notify authors of its decision as soon as possible. Each author of an article is entitled to twenty-five free off-prints. More may be had by arrangement with the editor before the issue goes to press.

Comprehensive Small-scale Upland Agroforestry: An Alternative to Shifting Cultivation in the Balinsasayao Rainforest Region, Negros Oriental, Philippines

Betty C. Abregana

Tropical rainforests are threatened with rapid, widespread destruction and are in danger of extermination. Rainforests constitute the richest, most diverse, most productive, most complex terrestrial ecosystems known, and for this reason alone represent the greatest potential for the satisfaction of human needs. Their destruction will not only rob future generations but may also permanently impoverish the Earth as a home for life of all kinds (Nigh and Nations 1980).

Southeast Asia is one of the world's major rainforest regions, together with Africa and Latin America. The continued increase in the area of land devoted to agriculture has taken place at the expense of tropical rainforest which formerly covered as much as 90% of the southeast Asian region (Rambo 1981). Rambo summarized from available literature the dramatic pace of forest land conversion to agricultural use. In peninsular Malaysia, forests covered 74% of the country in 1957 but only 55% in 1977, with some 2850 square kilometers cleared for agricultural use during each of the last five years. In the Philippines, where three-fourths of the land was still forested at the end of World War II, only 38% was still under trees in 1976, with conversion to agricultural use continuing at the rate of more than 500 square kilometers per year. Equally rapid conversion rates apply to Indonesia, Thailand and Vietnam.

Nigh and Nations (1980) decried the failure to realize that alternatives to destruction exist, that even intensive human use is not contradictory to preserving the rainforest's biological diversity and potential. They maintain that "the time has come for a reevaluation of attitudes, beliefs and development philosophies." In an agricultural country like the Philippines, with large population increases annually, there is a need to assess existing policies on land use and classification, particularly in the utilization of forest land for agricultural purposes.

Several attempts at interdisciplinary study of agricultural systems in Southeast Asia have been made, particularly in Thailand, Indonesia, Malaysia and the Philippines. In these instances, agroecosystems related to forest lands in the humid tropics were the areas of interest. Despite the proliferation of empirical studies of human interactions with ecosystems, researchers have recognized that the variations within the agricultural systems are so complex and the man-nature interactions so diverse that no generalizations can be safely drawn. This viewpoint has led to the growing popularity of the "small populations approach"—a study of definable agroecosystems that takes into consideration a great variety of interconnecting factors which generate and receive a flow of material and energy (Pirie 1982).

The present study aims at identifying the nature of shifting cultivation in and around a tropical rainforest in the central Philippines. The physical changes in the site brought about by this agricultural activity are obvious—narrowing forest margin, widening *kaingin* clearings, indiscriminate felling of trees, and rampant harvesting of forest products like rattan,[1] bamboo shoots, orchids and other epiphytic plants.

Estimates made as of the first quarter of 1981 placed the increase of swidden farmers on Negros island at 80% in the last two years. Today, less than 17% of the island is covered by respectable rainforest—this area serves as virtually the entire watershed for the island's nine cities and forty-seven municipalities

Despite efforts of various agencies at reforestation, the problem of forest destruction has continued to grow. While the government has set up the Integrated Social Forestry Program, no definite formula can be prescribed for all forest occupants to arrest the problem of deforestation. If the forests are to be saved, it seems important to understand the nature of swidden farming and the reasons for this practice that may have brought about such perturbation in the forest ecosystem. Court litigation and incarceration would appear to be shortsighted solutions to a problem caused by man's basic need for food (Vergara 1981).

The Study Site.

Negros island is located in the central part of the Philippines, about 620 aerial kilometers from Manila, and has an area of about 13,000 square kilometers, divided into the two provinces of Negros Oriental and Negros Occidental. Negros Oriental, in the southern portion of the island, occupies an area of about 5,402 square kilometers and had a population of 822,923 as of the 1980 census. Dumaguete is its capital city.

The study was conducted in the rainforest of Balinsasayao, a mountain range due northeast of Cuernos de los Negros, the highest mountain peak in the province, rising to about 1870 meters, west of Dumaguete City. The mountains around the Balinsasayao area range from 760 to 1240 meters in elevation. In the midst of the mountains are two lakes of approximately 100 hectares total area: Lake Balinsasayao with a surface area of 762,581 square meters and a maximum depth of 90.5 meters; and Lake Danao with a surface area of 303,335 square meters and a maximum depth of 57.5 meters. Lake Balinsasayao is at about 830 meters elevation, while Lake Danao is at about 848 meters (see Figure 1).

The topography near Lake Balinsasayao is dominated by Guinsayawan mountain (1788 meters), about 2.5 lineal kilometers to the southwest. The twin lakes of Balinsasayao and Danao were formed from the stream valley systems of this mountain. Both lakes were probably formed about 10,000 years ago when a new volcanic peak, Guintabon (1241 meters), pushed up through the two stream valleys and dammed them. A number of smaller ponds were formed in the Balinsasayao valley. All but one of these ponds have filled with silt; the remaining one is shallow and surrounded by marsh. Neither of the twin lakes has an observable outlet; both lose water through seepage and evaporation. The water level fluctuates, following the rainfall pattern.[2]

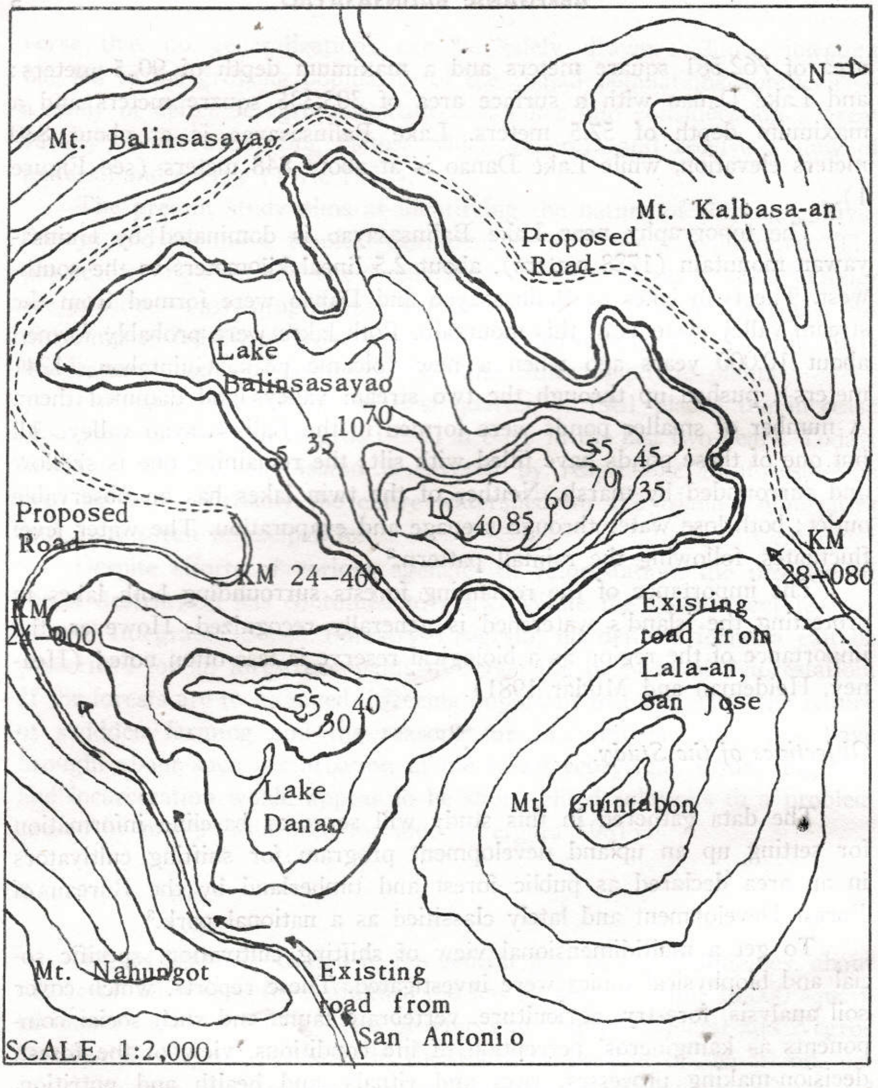
The importance of the remaining forests surrounding both lakes in protecting the island's watershed is generally recognized. However, the importance of the region as a biological reserve is less often noted (Heaney, Heideman and Mudar 1981).

Objectives of the Study.

The data gathered in this study will serve as baseline information for setting up an upland development program for shifting cultivators in an area declared as public forest and timberland by the Bureau of Forest Development and lately classified as a national park.[3]

To get a multidimensional view of shifting cultivation, specific social and biophysical topics were investigated. These reports, which cover soil analysis, forestry, agriculture, vertebrate fauna and such social components as kaingineros' perception of life conditions, view of the forest, decision-making processes, rites and rituals, and health and nutrition, form the basis of the present article.

The Balinsasayao project started with grandiose plans that were later modified to meet practical conditions at the target site, the needs of the target population, and the available human and nonhuman resources of Silliman University. During initial team sessions, members tended to be purely one-discipline-oriented, and initial discussions lacked common frames of reference. To encourage open communication and common understanding among group members about issues raised in the



1. Depths in meters.
2. Zero reckoned from mean water level May 17, 1972.
3. **Mountains, existing and proposed roads not to scale**
4. Level of Lake Danao higher by 16.04 meters than Lake Balinsasayao on May 23, 1972.

Figure 1. Map of Lake Balinsasayao-Lake Danao area.

study, resource persons (i.e., shifting cultivators, government technical men, international agency consultants and visiting researchers) were invited, topographical maps were used, and arguments and prolonged discussions were tolerated during the sessions. Out of these sessions emerged the identification of the specific goals of the study: (1) to determine the extent of shifting cultivation in the Balinsasayao rainforest; (2) to gather data on such biophysical factors as soil, vertebrate fauna, forest margin and agricultural activities at the site; and to identify some social characteristics, touching sociology, anthropology, psychology, health and nutrition; and, (3) from the above data, to evolve an alternative model to shifting agriculture. Underlying all these objectives was the group's concern with and commitment to the task of forest preservation, with consideration given both to the immediate needs of settlers in the upland area and to the protection of the watershed, thus ensuring the continuance of life among organisms in the ecosystem.

The first objective was met simply by conducting reconnaissance trips to the site to determine the ebbing margin of the contiguous or core forests. Results were plotted on a 1:10,000 scale topographic map. In addition, roads passable by four-wheel drive vehicles, major foot trails and main concentrations of population were located on the map. Soil samples from areas of diverse vegetation and slopes were collected for chemical analysis and the sampling site marked on the map.

The primary consideration in meeting the second objective was the availability of faculty members of the University to engage in research work. The choice of the specific areas of study was dependent on the human resources willing to take time from teaching or administrative assignments. A team of researchers, mostly faculty members, from various disciplines was formed. Some graduate students participated in this study.

When members of the team met for sharing of reports and discussion of issues considered relevant to the objectives of the study, all were in search of an alternative model to shifting cultivation that was person-oriented, location-specific and comprehensive. The model had to meet additional criteria: it should promote upland productivity and ecological stability and also be socially acceptable, practicable and politically viable.

Consultation with the Project Management Board.

The birth of this project was stimulated by a belief in the goals of the National Environment Protection Council (NEPC) and the

Human Interaction in Tropical Ecosystems (HITE) project of the East-West Center, University of Hawaii. The latter gave its technical support by facilitating training opportunities for the project managers of the Balinsasayao Project.

Primarily for professional exchange and for drawing ideas from the experiences of other agencies on upland research projects, the Project Management Board was organized. This Board, headed by the Director of the Silliman University Environmental Center, was composed of representatives from the program on Environmental Science and Management (PESAM) of the University of the Philippines at Los Baños, Kalahan Academy of Sta. Fe, Nueva Ecija, and the Bureau of Forest Development, national and regional levels. The members who met formally 13-15 January 1982, were briefed on the activities of the project and deliberated on the research objectives and plans. Due to budgetary constraints, the Project Management Board was not convened again until the completion of this phase of the study. Written communications, however, were sent to some members of the Board. In one instance, a member of the Board who was in Dumaguete for other reasons shared his time with the project.

Earlier Studies in the Balinsasayao Area

Alcala and Carumbana (1980) from December 1976 through July 1978 made ecological observations on the relative abundance and aspects of reproduction of some birds in southern Negros. Forty-eight species were found, as contrasted to sixty-four species earlier observed in the same area by Rabor, Alcala and Gonzales (1970). Since the study included two wooded-grassland areas aside from the Balinsasayao rainforest, they were able to show that there were more species in the latter than in the former. In fact, some species were limited to rainforests. One of the recommendations of the study was to declare the Balinsasayao area a forest reserve and wildlife sanctuary for scientific studies and recreation.

Heaney, Heideman and Mudar (1981) found 23 species of mammals in the forests surrounding Lake Balinsasayao. Eleven are rare or absent in non-forested regions. Human disturbances caused by agriculture and timber production activities have led to marked changes in the mammalian fauna. They conclude that preservation of forest habitats provides niches for rare species and breeding grounds for economically beneficial species. Cutting the forest removes these benefits and also increases habitat for economically injurious bats and rodents.

Lowrie, Alcoran and Nalam (1980) measured the levels of dissolved oxygen, biochemical oxygen demand, nitrate, phosphate, chloride and pH in Lake Balinsasayao and Lake Danao, both important sources of fish and drinking water for people living nearby. They found that the high levels of nitrate and phosphate have led to algal growths. The construction of a road near the lakes is considered to have increased the run-off, raising the levels of nutrients in the bigger lake. Deforestation around the lakes by slash-and-burn farmers leads to soil erosion, and nutrients such as nitrates and phosphates are washed into streams which feed the lakes. Oversupply of these nutrients could lead to algal blooms, or eutrophication, which would deplete the waters of dissolved oxygen and decrease the lakes' ability to support fish and other organisms. In 1933, Woltereck described the waters of the lake as "soft and transparent." At present, the waters of Balinsasayao are greenish, a sign of developing algal bloom. The authors concluded their study with a recommendation to curtail plans for further road construction around the lakes and other activities that will further soil erosion.

All these findings support the need to minimize human disturbances in the tropical rainforest ecosystem and harness available human resources and skills in regaining ecological balance in the environment in order to protect the watershed as well as maintain its genetic reserve.

Shifting Cultivation in the Balinsasayao Area

Shifting cultivation has invariably been considered a system of agriculture that has placed man in perfect harmony with his environment (Vergara 1981), and its practice is considered necessary for the sustenance of some upland populations. In some types of shifting cultivation, the forest ecosystem is maintained by giving fields time to regenerate through fallowing (Cadeliña 1980). These observations are valid in areas where the cropping period alternates with a longer rest or fallow period during which the area can regain its fertility and the ecological community can reestablish itself.

In the Balinsasayao region, the increase of population among original upland settlers and the inland push of lowland farmers has led to rapid conversion of remaining forest stands into agricultural lands. In some cases, lowland residents get a share of the forest lands by buying "rights" to cleared areas from enterprising kaingineros who are hard-pressed for cash resources. At present, the man-land ratio does not warrant long fallow periods after each cropping period. At the rate new kaingin clearings are opened, it is estimated that in less than twenty years the tropical rainforest will have vanished.

Generally, shifting cultivation at Balinsasayao does not involve a shift of domicile, although in a few cases, kaingineros have established makeshift huts near their area of work. Farm activities are commonly undertaken with hand tools like the *bunlay, sundang, sanggot* and *gabang.* A very few farmers own cattle and carabao, which are used more often as beasts of burden than in the preparation of land. Crops are often grown on slopes too steep for draft animals. Livestock such as chickens, goats, cattle, pigs and carabao play a minor role in the farm economy.

The kaingin system is a labor-intensive activity and is greatly influenced by weather and other environmental conditions. The activities include clearing the undergrowth and cutting trees and other vegetation. Small trees are usually cut about one meter from the ground, while bigger ones are usually cut at least two meters from the ground, because of the buttresses which widen their bases. Some trees are spared, especially the big ones, for a variety of reasons: to cut down on labor, to protect soil from erosion, because of superstition. When felled trees and cut vegetation have dried, they are burned. The debris is cleared and crops are planted when there is sufficient moisture. The household head sets his own schedule for planting. Paid or unpaid labor exchange may be sought, depending on the availability of manpower in the household, the size of the area to be tilled and the nature of farm work to be done. Rites or rituals are practiced by some farmers at various stages of land preparation, planting, harvesting and even in the use of farm tools.

The patch is usually abandoned for a period of only one or two years, but in one area for as long as twenty-eight years. Variation in the length of fallow is determined by the size of the household and the availability of food. Kaingin farming in the area is generally a system of low-intensity farm production.

One-third of the respondents had no farm lots of their own. These farmers either worked in their parents' fields or on somebody else's farm, following a mutually-agreed system of sharing produce. Among those who had lots of their own, farm sizes ranged from 0.25 hectare to 35 hectares. The mean total farm size of lot owners was 3.93 hectares. The mean total land area cultivated by the kaingineros at the time of the study was 1.56 hectares.

Although kaingineros engage in wanton tree-cutting, they are cognizant of the need to preserve the forest for ecological reasons. The need to struggle to survive in the here-and-now makes it difficult, if not impossible, for them to actively deal with such future concerns as forest preservation, especially if it might mean totally abandoning forest lands. The majority of the farmers in the area perceived household economic needs coupled with farm problems to be the main concern in their day-to-day living. The specific problems cited were *panginabuhi* and *pangitaan* (Cebuano for "means of living" and "source of income," respectively), minimal cash income, high prices of commodities and low prices for their farm products. In addition to these personal economic needs, they expressed uneasiness about land tenure and complained of low yields and unproductive farms. Field researchers think that the major reasons for the last two problems are inefficient farm practices and limited technical knowhow of farmers.

A Search for an Alternative to Shifting Cultivation

The Balinsasayao upland environment is suffering continual destruction of forest vegetation. Extensive deforestation may bring about changes in climatic conditions, in rainfall patterns and distribution. Lowland farms may be silted and roads washed out during the rainy season, since the areas that serve as watershed will no longer have standing trees or permanent cover. Biological or genetic composition has also been altered in the area: changes in the population of mammalian fauna; an apparent decrease in the number of birds and changes in their reproductive structures; and algal bloom in the lake due to an oversupply of nutrients from streams running along mountain slopes that have been swiddened.

Management of the Balinsasayao upland resource is an imperative task. The strategy for effective management of upland resources must address itself to the need for ecologically sound land-use practices and the basic need of upland farmers to earn a living.

Peculiarities of the model. As was earlier mentioned, the model we are formulating is location-specific. The generalizability of this model applies only to areas that approximate the conditions prevailing in our study site. Moreover, the relative proximity of Silliman University to the area and the availability of various academic units and a medical center which could be tapped for community extension work add to the uniqueness of our proposed model.

The model may impress some readers as requiring excessive work from the members of the implementation team, the local farmers and the government and semi-government agencies involved. Given the nature and the extent of the problem confronting us, we cannot afford to do less than what is demanded of us by the Balinsasayao farmers and the ever-increasing environmental pressures.

Comprehensive Small-Scale Upland Agroforestry

In this model, agroforestry is defined as a system of managing land resources in which related principles in agriculture, forestry, fisheries, animal husbandry and other components are combined, interrelated and applied so that the flow of benefits derived from these resources is sustained for the welfare of the people. It is a system of utilization, development and conservation of resources that uses management practices that suit the social and cultural characteristics of the people and the economic and ecological conditions of the area.

The Balinsasayao region, after an intensive mapping activity, will be classified into areas that are primarily cultivated, areas that are primarily forested, areas for fishing and areas primarily for livestock. The agroforestry system that is proposed considers these major components: (1) component that is agriculture-based, where the primary activity involves principles of traditional agriculture; (2) component that is forest-based, where the primary activity involves preservation and continuance of the forest, and selective exploitation of forest products; (3) component that is livestock-based, where the primary activity involves raising ruminant and nonruminant farm animals; and (4) component that is fishery-based, where the primary activity involves principles of traditional fishery. Aside from these major components, other structures may be set up by strengthening existing income-generating family-based cottage industries and by introducing other beneficial projects.

Under this scheme, upland farmers are encouraged to engage in agricultural activities within the farm lots assigned them, remaining forests are to be strictly free from further encroachments, and the two lakes are to be improved sources of fish supply for the upland community.

Agriculture-Based Agroforestry.

This system is applied to areas that are fully cultivated and have minimum tree growth. This land use classification maintains or increases total yields by combining food crops with tree crops on the same unit of land. It becomes important to grow both trees and crops on the same land to maintain or increase yields without degrading the environment. Since the upland farmers have been found to plant a random mixture of crops in the field, extension workers could use existing crops as their take-off point for improving the farmers' cropping practices. Contour tillage farming and other improved practices that consider ecologically-adapted systems of farm exploitation should be introduced since these are not presently being applied. Agricultural rituals have to be evaluated for their possible scientific basis.

Combining food crops with tree crops. The size of the farm may determine the use of alternate arrangements of food and tree crops on a given land surface. Intercropping should consider possible competition for space, sunlight, moisture and nutrients, which would reduce food crop yields (Vergara 1982). Farm practices should also deal with rapid regeneration by prolific trees like some leguminous varieties which may displace food crops and take over entire fields. In this system, the trees play an important economic and environmental role. They provide fodder for animals such as goats, food for people, fuel and building materials, leaf manure, and at the same time stabilize the natural environment and rehabilitate the soil.

Smaller farms which would not accommodate an alternate arrangement of food and tree crops could have trees planted along the borders of the plots. In this system, food crops which need little or no shading are planted in the unshaded central space. Aside from their ecological importance, the trees may serve as boundary markers, live fences and suppliers of green manure (Vergara 1982).

The recommendations from completed studies should be assessed in the light of prevailing conditions in the target area. Publications of PESAM at UP-Los Baños and the working papers of EWC-EAPI are good sources of Philippine studies on agroforestry. Ongoing and completed studies on agroecosystems in Southeast Asian countries such as Thailand, Indonesia and Malaysia should also be considered.

Permanent cultivation. The proposal that farmers engage in permanent cultivation in a specific area of land merits a closer look. Brookfield (1972), in discussing environmental variations in agricultural intensification, put forth the possibility of sustained cultivation by very simple means over long periods, under moderate population densities or even quite high densities if conditions were unusually good. Minimizing constraints on the land by adopting a very simple cultivation technology may sustain subsistence levels of production. Since the upland farmers at present are maintaining below-subsistence levels of production, the project aims at sustaining subsistence agriculture and maximizing the use of natural methods of soil regeneration, like the utilization of green manure and the planting of trees to stabilize the environment and rehabilitate the soil. The Balinsasayao soil, in general, was found to be moderate-to-good in fertility, although the levels of nitrogen and phosphorus in specific areas in the west-northwest region were only fair. To raise pH levels, lime should be applied to the soil. Using ashes from fires would minimize problems of low pH. The use of domestic wastes would help increase nitrogen and phosphorous.

Farming practices based on ecological concepts require a reorientation of the upland farmers; they must manage their farms differently from the way they manage them today. Part of the education process is to make farmers realize the value of the forest and its potential.

Climate elements. The climate of any location is a factor of geography and of the wind systems that prevail at various times of the year. Weather refers to the condition of the atmosphere at a particular time and is thought of in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility and wind. All these climate elements are closely associated with each other and to a large extent determine the final outcome of crop production, livestock raising and fish production.

Negros Oriental's climate type is characterized by not very pronounced seasons. The area is relatively dry from November to April and wet during the rest of the year. The maximum rain periods are not pronounced, with the short dry season lasting only from one to three months. The region is partly sheltered from the northeast monsoon and trade winds, is open to the southwest monsoon, and is estimated to have a 7% exposure to typhoons. Average temperature is set at 27.2° C and average rainfall at 196.24 cm (BFAR/FAO-UNDP, 1981). However, due to the distinct physical and geographic characteristics of the Balinsasayao area, location-specific meteorological data need to be established.

Forestry-Based Agroforestry.

This system should be applied to remaining forest areas that have not been fully exploited for agricultural production. Forest elements such as rattan, hardwood, vines and ferns must be allowed to mature in order to be economically beneficial on a long-term basis. The present practice of cutting rattan shoots and young hardwoods has to be controlled. Supervised harvesting of these products when mature will prove more economically gainful. The possibility of organizing local people for this purpose should be considered. A forest supervisor should be appointed to oversee activities in the forest.

Measures for the replacement of trees and other forest products have to be implemented. Similar areas in the Philippines have been found to be receptive to almaziga trees. Several varieties of fruit trees thrive well in the Balinsasayao forest, among them, lanzones, durian, avocado, jackfruit, coffee and cacao.

This system requires a massive community-based appeal to preserve the forest, consistent and efficient controls against illegal activities, and regular technical asistance to ensure productive upland farm yields.

Livestock-Based Agroforestry.

Integration of ruminant and nonruminant livestock husbandry and cropping has been found to work well in mixed tropical farming systems, although the degree of integration varies widely according to physical environment and socioeconomic conditions (Norman 1979:253). The livestock component of this model merely supplements the main crop production effort. The care and maintenance of livestock may be assigned to junior members of the family. Nonruminants like pigs and poultry can be maintained on the crop farms at a low production level with little effort. Owing to the low socioeconomic level of the residents in the Balinsasayao area, only a few can maintain stock like carabao, cattle or goats. Nonruminants can provide animal protein for the family and a source of cash income. Carabao and cattle primarily serve as transport, while goats are raised for cash income. To satisfy the nutritional requirements of the farmers' household, milk production from ruminants may be encouraged.

Norman (1979) classified the roles fulfilled by livestock: (1) Production role: for subsistence; for sale; (2) Investment role: as a current "buffering" investment; as an investment for old age or incapacity, or to bequeath to offspring; (3) Sociocultural role: as an element of social prestige; to fulfill cultural obligations, (4) Energy role: to provide draft power; to provide domestic fuel in the form of dung; (5) Nutrient role: to provide manure and ash nutrients after burning.

Fishery-Based Agroforestry.

The Balinsasayao region has twin lakes that may be utilized for additional food resources in the upland community. Because of the low calorie intake and poor quality diet of residents in the area, it is important that plant energy sources be supplemented with animal protein (e.g., fish). At present the lakes yield carp, tilapia, hito and haluan. Bangus was seeded about two years ago but fishermen do not report any significant catch of this species. Integration of fowl culture with fish culture is a possibility that requires careful consideration.

Due to polyculture of fish species in the lake, detailed studies on predator-prey relationships in the lake need to be conducted. In addition, population control of prolific species is necessary to obtain large-size fish. Commonly used population control measures are monosex cultivation and the use of predators. The ratio of tilapia, for instance, to predators has been thoroughly studied (BFAR/FAO-UNDP 1981).

Lake Balinsasayao was observed by farmers to have turned reddish at one time and fish were reportedly in a dazed condition. Algal growths and factors of water chemistry such as salinity, oxygen, pH and water soluble nutrients (such as dissolved nitrogen, soluble phosphate and potassium levels) need to be checked periodically.

Fish pests may include other fish, snails, crabs, insects and vegetation. Some pest control measures need to be identified and effected, since these pests compete for food with the productive species. Other pests compete with natural food production by either disturbing the lake mechanically, or disturbing the food chain.

Other Support Components.

The introduction and cultivation of nonconventional food sources should be considered. *Rana magna*, the edible frog, thrives in the area and may be introduced to the community as an additional protein source. Nonconventional methods of food production, such as bee culturing for honey, should also be studied.

Some families in the area are engaged in such cottage industries as broom-making using tambo, a weed that grows along water banks, as material, making of fishing equipment using sig-id, a vine that dominates the edges of the forest, and hat- and mat-making using pandan as material. Raising of flowers and growing of domestic plants may also be encouraged to augment family cash income.

Implementation Approach

Silliman University, through its research and extension arms, will determine the structure and composition of the project staff that will see to the operationalization of this model.

Identification of Foothold and Target Beneficiaries.

This program covers all the actual settlers within the proposed National Park under the political jurisdiction of Sibulan town. The Bureau of Forest Development has listed 84 families engaged in kaingin within the area. The fieldworkers of this study estimate there are no less than 100 families practicing kaingin in the area.

Mapping activity. In identifying the qualified beneficiaries, it is proposed that the entire National Park area of 3,880 hectares be covered on foot to determine the total number of domiciles considered as permanent homes, and the exact location and sizes of kaingin lots. The output of this activity would be a spot map indicating all households and clearings, with estimated sizes, dates and basis for occupancy. This map and census will serve as a control sheet for regulating entry of new occupants and for prohibition of new clearings, and for identifying forest zones to be placed strictly off limits for agricultural work. From this map, program planners and implementors can classify the site into areas for cultivation, forestry, fishing and livestock production.

There appears to be an implicit arrangement among the kaingineros as to who has the right to till which part of the forest. Each sitio has its own share or division in the forest and these delineations are respected and adhered to by all concerned. Through our mapping, we can identify persons who have "property and supervisory rights" over the remaining forests. With these persons, we may be able to establish and effect concrete measures for keeping kaingin clearings on the forest margin in check.

Permits. Once there is an updated list of actual settlers, it is strongly proposed that the kaingineros be granted official permits to occupy the land they are presently cultivating, on the condition that they refrain from opening new clearings and with the understanding that they have no right to dispose of the land through sale, barter or lease. The farm size per household shall be determined only after an accurate household enumeration has been taken and total cultivable land area has been computed.

Implementation Strategies.

Entry approach. The project plans to use health and nutrition drives for the residents in the area as the vehicle for the agroforestry scheme. Our assessments of the household members' nutritional status reveal low intake of calories and protein. The respondents and their families have also been found to be susceptible to common respiratory ailments. Protein and calorie deficiencies, vitamin deficiencies, and respiratory problems may be caused by low food output per household, inadequate nutritional knowledge and poor health services delivered to the area.

The Silliman University Medical Center and the Silliman College of Nursing will be tapped to send a team of health workers to the area on a regular basis, focusing primarily on the health care of children. Preventive measures should be the main emphasis. Local residents, especially housewives, will be given training in the preparation and medicinal use of local herbs and other plants for treating ailments.

The Department of Home Economics of Silliman University will be asked to initiate a nutrition drive, concentrating on the selection and preparation of food from local sources. Residents will be made aware of the dietary needs of members of the family, taking into consideration the age levels and the nature of work these household members may be engaged in. Special dietary requirements of children, the weak, the sick and the elderly will also be presented.

Building on these initial contacts, parents may be called to discussions of common health and nutrition problems. It is hoped that such discussions will lead parents to possible solutions to health problems, as well as emphasize to them the importance of improving the quality, variety and productivity of their farms. The agroforestry scheme will be launched at this time, taking advantage of the new awareness of the link between farming methods and health and nutrition.

Community involvement. Since kaingineros in the area feel that the community extension services they received in the past did not help them solve their problems, they will be involved in planning, identifying problems and proposing measures related to farm production, forest conservation, fishing and livestock raising. Their involvement in goal setting, implementation and monitoring of the program should facilitate the acceptance of alternatives to shifting cultivation. Informal community meetings presided over by their perceived leaders might be scheduled during *tabu*, a day regularly set for the sale of products, community games and informal discussions.

Educational campaigns. Kaingineros in the area engage in traditional, below-subsistence farming and maintain low-intensity farm production. Any alternative model must meet the subsistence needs of farmers. Since upland farmers have mixed feelings about forest conservation, a mode of technical agricultural assistance with a built-in mechanism for the dissemination of ecological information must be devised. It is also important that farmers begin to adopt a systemic view of their farms in relation to other farms and components of the community, as opposed to the present singularistic concept of farm management .

Consideration of respondents' social and personality systems. Innovations have to be geared to the economic and cognitive levels of the target beneficiaries, and should take into account social and personality systems. At the initial stage of operation, implementors of the project must start with activities which are familiar to the farmers. Cropping practices are determined primarily by family tradition and are influenced by superstitions. Decision-making in the acquisition of tools and land, the use of fertilizers and the choice of crops to be planted are influenced by internal agents of change (parents, relatives and close friends in the community) rather than by external agents.

Selection of demonstration fields and nursery site. The choice of demonstration fields for the agroforestry model will be primarily determined by the owners' willingness to be directly involved in the project. Demonstration fields will serve as pilot farms for innovations in agricultural practices. A nursery site has to be decided upon by the kaingineros themselves, likely influenced by the accessibility of the area to the members of the group.

Off-community leadership training. The owners of demonstration plots are likely to be farmers who are open to the idea of adopting the agroforestry model. They can be motivated to effect some of the needed changes through trips to other places, like Cebu, where successful pilot projects in upland agroforestry exist. Such field trips might prove more effective than the more usual sending of extension workers appointed by the project.

Support of local leaders. The project will enlist the support of local leaders: the mayor of Sibulan town, the barangay captains in the area and other perceived leaders of the community. The provincial governor, the city mayor, BFD officials and others concerned will also be asked to support the project.

Linkages. The project will collaborate with political units which plan and carry out government policies on forest utilization and management. These include the Bureau of Forest Development, the Bureau of Plant Industry, the Bureau of Animal Industry, the Bureau ot Agricultral Extension and the Bureau of Fisheries and Aquatic Resources. Linkages with quasi-government and private institutions engaged in similar ventures may also be established. To study rainforest vegetation, for example, a collaborative undertaking with the Forestry and Botany departments of the University of the Philippines at Los Baños is currently being arranged.

Cooperatives. At a later stage, when farmers are producing above the level of household consumption, cooperatives may be introduced. These can take the form of marketing, consumer and/or credit cooperatives. Upland farmers presently have some difficulty in marketing their produce. For instance, chayote (*Sechium edule*), a major vegetable crop in the area, literally grows wild in the forest, needing minimal or no care at all by the farmers. But farmers do not earn much income from this crop because the absence of transportation facilities makes it difficult to carry to the lowlands.

Project Directions.

Year I of the Balinsasayao Rainforest Project was devoted to gathering primary data on shifting cultivation in the area as a basis for developing an upland development program for the kaingineros and at the same time saving the rainforest ecosystem from further destruction. Year II will attempt to implement the proposed program of action. The proposed activities for year II are outlined as follows: Health and nutrition activities will continue throughout the year. Mapping activity will be concentrated in the first two months. Approximately five months of social preparation will lead into presentation of the agroforestry scheme for the balance of the year.

In addition to these major activities, the research will continue. There is a need, for instance, to establish scientific meteorological data for the site. Demonstration fields require much research. For example, what are the most satisfactory tree-crop combinations for the area? How are major pests or diseases of crops to be resisted? Which farm practices will cause the least surface run-off, nutrient leaching and soil erosion, especially on cultivated slopes?

The other components of the model—forestry, fishery, livestock, cottage industry—also offer much room for research. In addition, beyond Year II an evaluation must be conducted to assess the project's achievements and to determine errors so that modifications may be made and alternative directions taken in response to changing demands.

A Step toward Implementation of the Model.

On 8 February 1983, Silliman University organized a conference of officials from the provincial governor's office, the Dumaguete City mayor's office, the Sibulan town mayor's office, the Bureau of Forest Development, the National Power Corporation and the Philippine National Oil Corporation. The latter two semi-government entities are engaged in the generation of power and are involved in watershed management. At the conference, alternatives to shifting cultivation were presented. These agencies represented gave their support to the project. Those involved with the project see this as a small, but nevertheless significant step towards realizing the goal of efficient management and utilization of upland resources.

Acknowledgements

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Biophysical aspects of the Balinsasayao project: An integrated report. Rodolfo B. Gonzales.

The forest and the kaingins in the Balinsasayao area. Emmanuel Bascug.

Profile of agricultural practices in the Balinsasayao area. Lemuel Montenegro.

Measures of soil fertility in the Balinsasayao region. Stephen Lowrie.

Survey of the vertebrate fauna of the Balinsasayao area. Ma. Louella Dolar.

The views and practices of upland farmers: An introduction. Betty C. Abregana.

The sociology of shifting cultivation around Lake Balinsasayao: A focus on decision making. Philips Munar.

The anthropology of upland farmers: The case of the Balinsasayao farmer. Rolando Mascuñana.

Assessment of nutritional status of residents at Lake Balinsasayao. Carmen Fontelo.

Assessment of health threats in the Balinsasayao area. Luningning Apostol.

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Notes

1. A preliminary profile by Keith R. Erickson and Paul D. Heideman of the Balinsasayao primary forest reported their suspicion that all rattans reaching about three to four meters in length are harvested by rattan hunters. Neither saw a rattan more than four meters long, nor did they see any rattan with reproductive structures during their field work. They suspect that these rattans are simply shoots growing from the bases of very old plants. Unless these are dwarf species, seeding at a small size, the rattans in this forest will become extinct as the plant bases gradually die. Heideman and Erickson stayed in the Balinsasayao area for seven months at the time this report was written, conducting an intensive study of bat ecology for Heideman's Ph.D. dissertation at the University of Michigan.
2. Paul D. Heideman, field notes.
3. The municipality of Sibulan presented to the Bureau of Forest Development a proposal that declared 3,880 hectares of land in the area of the study as a National Park. The proposal was formally endorsed by the BFD Director and is awaiting a presidential directive. The National Park scheme has no definite program for implementation.

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Edible Molluscs, Crustaceans and Holothurians from North and South Bais Bays, Negros Oriental, Philippines*

Angel C. Alcala and Sally Alcazar

ABSTRACT. The standing stock, distribution and harvest of the common molluscan, crustacean and holothurian species occurring in North and South Bais Bays, southern Negros, Philippines were studied for 12 months from January through December 1982. Twenty-seven species of pelecypods and gastropods, several species of crustaceans in the families Gecarcinidae, Penaeidae, Portunidae and Grapsidae, and 16 species of holothurians were found to be harvested for food. Standing stock of pelecypods and gastropods in an area of approximately 267 ha was estimated to be about 33.5 tons (wet weight), exclusive of the mussel **Modiolus metcalfei** and the sea hare **Dolabella auricularia. Dolabella** had a standing stock of about 217 kg (wet weight) per ha in favorable areas of the bays. Standing stocks of crustaceans are unknown except for that of **Cardisoma carnifex,** estimated at 3300 adults and subadults per ha. Standing stock of five major species of holothurians was about 2.6 tons (wet weight) per ha in favorable habitats. Annual harvest in 1982 of molluscs, crabs, shrimps, holothurians and sea hare egg masses was estimated at about 16 tons, with a market value of ₱77,000. Although 26 species of algae occurred in the Bays, the basis for animal production was most likely the mangrove forest and seagrass bed.

North and South Bais Bays on southern Negros Island have long been sources of food molluscs, crustaceans and holothurians for local populations in Bais City and neighboring towns including Dumaguete City. Because of the concern that the marine productivity of the bays might be affected by such factors as unrestrained exploitation, destruction of their mangrove forests and pollution, this study was conducted. The data gathered could serve as a baseline for future studies of biological resources in the bays.

Previous studies of the Bais Bays have dealt with effects of pulp and paper mill effluent on certain benthos (Alcala and Ortega 1976), levels of mercury in sediments and shellfish (Lowrie et al. 1979), structure of intertidal macrobenthos (Maravilla 1975, Notosoedarmo 1979), effects of siltation on corals (Alcala 1977), ecology of certain economically important species (Alcala 1979, Calumpong 1979), ecology of seagrasses (Meñez, et al. 1983), distribution and density of plankton (Alcazar 1983) and growth, reproduction and mortality of the sea hare *Dolabella auricularia* (Pauly and Calumpong 1984). The present paper reports the various species of molluscs, crustaceans and holothurians harvested for food from the two bays, estimating their distributions and

* Contribution from the Marine Laboratory, Silliman University.

standing stocks and, where possible, the value in Philippine pesos of the harvests.

Methods and Materials

Data were gathered by direct observations, by interview with fishermen and by use of the transect-quadrat method. Transects were located in permanent stations and were laid out perpendicular to the shoreline.

Samples of organisms were collected from 1 m x 1 m quadrats to a depth of 10-15 cm, using a trowel. They were weighed after excess water was blotted, then fixed in formalin and preserved in alcohol. Sample specimens of molluscs and holothurians were sent to the Smithsonian Institution, Washington, D.C. for identification. Dr. David Pawson identified the holothurians and Dr. Joseph Rosewater the molluscs. Voucher specimens are deposited in the Silliman University Marine Laboratory and the U.S. National Museum, Smithsonian Institution. Dr. Ernani G. Meñez, Smithsonian Institution, kindly provided us a list of algae taken from South Bais Bay.

The study area was sampled eight times in one year, at intervals of 1.5 months from January through December 1982. The duration of every visit was two days. Our observations for molluscs and holothurians were generally made in an area of about 377 hectares, but data for crustaceans pertain to a much larger area. Standing stocks of molluscs and holothurians were determined in North Bais Bay (4 stations) and South Bais Bay (2 stations).

Water temperature, salinity and nature of substrate were recorded. Salinity was measured with a direct-reading salinometer.

The Study Area

North and South Bais Bays (Fig. 1) have a total area of about 50 km² (North Bay, 32 km²; South Bay, 18 km²), exclusive of the two large coral reef areas at the mouth of North Bais Bay. If these reefs are included, the total area would be about 64 km². The two bays varied in depth at mean low water from less than a fathom to 30 fathoms. Mangrove trees lined most of the landward margins; five species of seagrasses occupied some parts of the bays.

The two bays are separated by Daco Island, consisting of 237 ha of dry land, 146 m at its highest point, and a 206-ha Talabong mangrove forest. This forest, composed mainly of young trees of the genera

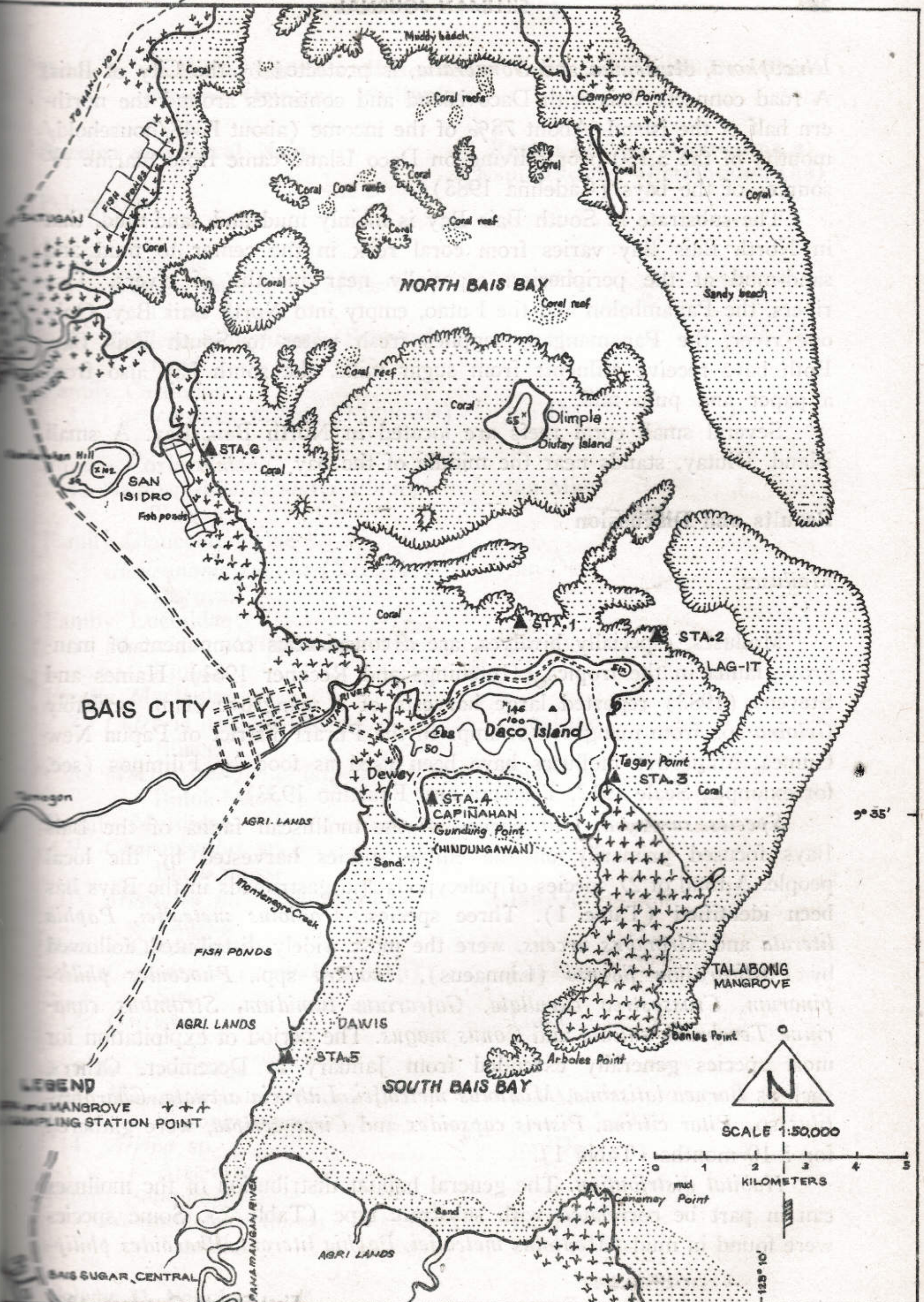

Figure 1. Map of North and South Bais Bays, Negros Oriental, Philippines

Rhizophora, Avicennia and *Sonneratia,* is protected by the City of Bais. A road connects Bais with Daco island and continues around the northern half of the island. About 78% of the income (about ₱348/household/month) of the 5,150 people living on Daco Island came from marine resources of the bays (Cadeliña 1983).

The substrate in South Bais Bay is mainly mud and sand-mud, that in North Bais Bay varies from coral rock in the center to mud and sand-mud at the peripheries, especially near mouths of rivers. Two rivers, the Panambalon and the Lutao, empty into North Bais Bay. Only one river, the Panamangan, supplies fresh water to South Bais Bay. Both bays receive effluents from sugar mills, the south bay also from a paper and pulp mill.

Several small coral reefs are located in North Bais Bay. A small island, Diutay, stands near the middle of the bay.

Results and Discussion

Molluscs.

Molluscs, especially bivalves, are a conspicuous component of mangrove fauna in the tropics (Hutchings and Rechner 1981). Haines and Stevens (1983) reported large harvests of a mangrove clam, probably *Geloina* sp., from mangrove swamps in the Purari district of Papua New Guinea. Mangrove molluscs have been used as food by Filipinos (see, for example, Seale 1912, Talavera and Faustino 1933).

Species surveyed. Our survey of the molluscan fauna of the Bais Bays focused primarily on the edible species harvested by the local people. A total of 27 species of pelecypods and gastropods in the Bays has been identified (Table 1). Three species, *Modiolus metcalfei, Paphia literata* and *Strombus urceus,* were the most widely distributed, followed by *Vasticardium flavum* (Linnaeus), *Anadara* spp., *Phocoides philippinarum, Crassostrea cucullata, Gafrarium tumidum, Strombus canarium, Terebralia sulcata* and *Conus magus.* The period of exploitation for most species generally extended from January to December. Others, such as *Barnea latissima, Modiolus metcalfei, Lutraria arcuata, Charomytilus* sp., *Pitar citrina, Pistris capsoides* and *Circe scripta,* were gathered for 5-10 months (Table 1).

Habitat distribution. The general habitat distribution of the molluscs can in part be correlated with substrate type (Table 2). Some species were found in mud (*Modiolus metcalfei, Paphia literata, Phacoides philip-*

Table 1. A list of edible molluscs from North and South Bais Bays, Negros Oriental, Philippines

Species and Local Name	Period of Exploitation	Approximate Distribution (ha)
Pelecypods		
Family Arcidae		
1. *Anadara antiquata* (Meuschen) Litub	Jan-Dec	10
2. *Anadara broughtonii* (Schrenck) Litub	Jan-Dec	10
Family Cardiidae		
3. *Vasticardium flavum* (Linnaeus) Litub	Jan-Dec	20
Family Corbiculidae		
4. *Geloina suborbicularis* Philippi Tuway	Jan-May	3
Family Glauconomyidae		
5. *Glauconome rugosa* (Reeve) Bayuyan	Jan-Dec	4
Family Lucinidae		
6. *Phacoides philippinarum* (Reeve) Embao	Jan-Dec	10
Family Mactridae		
7. *Lutraria arcuata* (Reeve) Bilaog	Jan-June	4
8. *Mactra antiquata* (Spengler) Bulok-bulok	June-Dec	2
Family Mytilidae		
9. *Charomytilus* sp. Black mussel	Feb-June	2
10. *Modiolus metcalfei* (Hanley) Tahong	Jan-Oct	50
Family Ostreidae		
11. *Crassostrea cucullata* (Born) Sisi	Jan-Dec	10
12. *Ostrea* sp. Kuya	Jan-May	5
Family Pholadidae		
13. *Barnea latissima* (Sowerby) Sugong-sugong	Jan-May	4
14. *Atrina* sp. Atsa-atsa	Jan-Dec	5
Family Sanguinolariidae		
15. *Sanguinolaria togata* (Deshayes) Tamislot	Jan-Dec	4

Table 2. Habitat distribution of edible molluscs in the Bais Bays (part of the habitat exposed at low tides)

Species	Distribution	Description of Habitat
Barnea latissima	Station 6	Sand and mud substrate; pure stands of *Thalassia*, salinity 33 ppt; temperature 30-31°C
Lutraria arcuata, Mactra antiquata	Station 6	As above
Paphia semirugata, Anadara sp., *Pitar citrina, Clauconome rugosa, Pistris capsoides, Solen* sp., *Circe scripta, Sanguinolaria togata*	Station 2	Sand and coral rubble substrate with little mud; seagrass bed composed of *Enhalus* and *Thalassia;* salinity 33 ppt; temperature 30-31°C
Modiolus metcalfei, Paphia literata, Phacoides philippinarum, Gafrarium tumidum, Ostrea sp., *Strombus canarum, Charomytilus* sp., *Telescopium telescopium, Terebralia sulcata*	Stations 4 and 5	Mud substrates near and in mangrove 0.5-1 m deep; seagrasses absent; salinity 28-32 ppt; temperature 29-30°C
Crassostrea cucullata	Stations 4 and 5	Attached to roots and trunks of mangrove trees; salinity 28-33 ppt
Geloina suborbicularis	Stations 4 and 5	Muddy canals in nipa groves; salinity 0-28 ppt
Conus magus, Vasticardium flavum, Strombus urceus, Atrina sp.	Stations 1, 2, 3	Sand and coral rubble substrate; seagrasses *Enhalus* and *Thalassia;* the algae *Hydroclathrus* and *Gracilaria* also occurred at Station 3

pinarum, Gafrarium tumidum, Telescopium telescopium), while others (*Lutraria arcuata, Mactra antiquata, Pistris capsoides,* etc.) were found in mixtures of sand and mud or rubble and mud. Those species found in mud (substrate infauna) together with some species of oysters (substrate epifauna) attached to roots and lower trunks of mangrove trees might be considered truly mangrove species. The clam *Geloina suborbicularis* is especially adapted to cooler, less saline microhabitats in mangrove swamps, usually associated with *Nypa.* Other molluscan species inhabited seagrass beds having mostly sandy or sandy-muddy substrates (Stations 1, 2, 3 in Table 2).

Standing stocks. The standing stock of molluscs in three areas in the Bais Bay, as determined by the transect-quadrat method in January-March 1980, are summarized in Tables 3 anl 4. The mean number of individuals per 20 m^2 ranged from 26.5 to 39.7 and the mean wet weights from 137.1 to 351.2 g. The weight per hectare was 68.6 to 175.6 kg. Table 4 gives an idea of the mean number of individuals and their mean wet weights for seven common genera sampled at three stations.

A more thorough sampling at six stations, February-December 1982, gave comparable standing stock estimates on a 20 m^2 area basis—10.75 to 44 individuals weighing 139.58 to 496 g, except for larger numbers and greater wet weight for *Modiolus metcalfei* and *Paphia literata* at Station 5 (Table 5). *Modiolus metcalfei* grew large colonies at Station 5 from February to October 1982 and were totally harvested shortly after our sampling. Excluding the estimates for Station 5, the average estimated wet weights of the molluscs was 148 kg/hectare. On this basis the approximately 267 hectares of "shell" areas would have a standing stock of about 33,516 kg or 33.5 tons, exclusive of *Modiolus metcalfei.*

Economic value. The economic value of edible molluscs in the 267 hectares of "shell" area is not accurately known because of the difficulty of determining the harvest. Our earlier estimate of 2,000 kg wet weight per month or 24,000 kg in one year valued at ₱48,000 per year (Alcala 1979) is probably too high. The best estimate would be about 12,000 kg (12 tons) per year (exclusive of the harvest of the mussel *Modiolus metcalfei*), with an annual value of ₱24,000. The harvest of *Modiolus* by about 20 families appears to be substantial. For example, one family harvested 20 sacks weighing 500 kg during the 12 months in 1980, with a value of ₱1,000.

The sea hare *Dolabella auricularia* is important because of the edible egg masses it produces year round (Pauly and Calumpong 1984). It has

Table 3. **Mean monthly standing stock of molluscs in the Bais Bays in 20 1-m² quadrats, January-March 1980, exclusive of the Sea Hare,** Dolabella auricularia

	Okiot	Lag-it	Sanlagan
Mean no. of individuals	33.7	39.7	26.5
Mean wet weight (g)	137.1	139.4	351.2
Weight/hectare (kg)	68.6	69.7	175.6

Station: Species Sampled	Mean No. ± SD of Individuals per Sample	Mean Wet Weight per Sample (g)	Estimated No. of Individuals/ha	Estimated Wet Weight/ha (kg)
1 *Vasticardium flavum*				
Conus magus				
Paphia literata				
Strombus urceus				
Anadara antiquata				
Atrina sp.	11.37 ± 8.35*	247.64 ± 267.70	11,370	247.6
2 *Strombus urceus*				
Conus magus				
Anadara sp.				
Atrina sp.	10.75 ± 5.82+	139.58 ± 56.02	5,375	69.8
3 *Strombus* sp.				
Vasticardium flavum				
Anadara antiquata				
Atrina sp.				
Gafrarium tumidum	12.62 ± 5.55*	122.73 ± 63.03	12,620	122.7
4 *Strombus canarium*				
Strombus urceus				
Gafrarium tumidum	12.38 ± 3.93*	154.05 + 36.24	12,380	154.0
5 *Modiulus metcalfei*				
Paphia literata	596.57 ±333.60#	2,783.8 ± 861.77	298,285	1,391.9
6 *Pitar citrina*				
Pistris capsoides				
Solen sp.				
Circe scripta				
Sanguinolaria togata				
Glauconome rugosa	21.63 ± 9.07*	146.16 ± 58.76	21,630	146.2

* 10 1-m² quadrats, or 10 m² total area sampled
+ 20 1-m² quadrats, or 20 m² total area sampled
# Sampling from February through October 1982

Table 6. List of crustaceans commonly found in the Bais Bays

Family Gecarcinidae

1. *Cardisoma carnifex* Herbst

Family Grapsidae

2. *Neoepisesarma mederi* (Milne-Edwards)
3. *Neosarmatium meinerti* (De Man)
4. *Varuna litterata* Fabricius

Family Ocypodidae

5. *Uca c. coarctata* (Milne-Edwards)
6. *Uca demani* Ortmann
7. *Uca d. dussumieri* (Milne-Edwards)
8. *Uca lactea annulipes* (Milne-Edwards)
9. *Uca lactea perplexa* (Milne-Edwards)
10. *Uca t. triangularis* (Milne-Edwards)
11. *Uca v. vocans* (Linnaeus)

Family Penaeidae

12. *Metapenaeus* spp.
13. *Penaeus* spp.

Family Portunidae

14. *Portunus* spp.
15. *Scylla serrata* Forskal

Family Thallasinidae

16. *Thallasina anomala* Herbst

Table 7. Edible holothurians in North and South Bais Bays, Negros Oriental, Philippines

Species	Local Name
1. *Actinopyga mauritana* (Quoy & Gaimard)	balat-sunlatan
2. *A. echinites* (Jaeger)	balat-tagukan
3. *Bohadschia marmorata* Jaeger	pisot
4. *B. argus* Jaeger	balat-hanginan
5. *Holothuria leucospilota* Brandt	batuli
6. *H. edulis* Lesson	balat-tagukan
7. *H. hilla* Lesson	balat-tagukan
8. *H. pulla* Selenka	balat-tagukan
9. *H. atra* Jaeger	balat-tagukan
10. *H. aculeata* Semper	balat-sus-an
11. *H. scabra* Jaeger	balat-bagisan
12. *H. fuscacinerea* Jaeger	balat-bagisan
13. *H. imitans* Ludwig	balat-bagisan
14. *H. impatiens* Forskal	balat-bagisan
15. *Stichopus variegatus* Semper	balat-bagisan
16. *Thelenota ananas* Jaeger	balat-monang

Economic value. Two crustacean families, the Penaeidae (prawns and shrimps) and Portunidae (crabs) were highly valued as food items. The mean monthly harvest of shrimps in the Bays was about 176 kg, which, if extrapolated for one year, could amount to about 2,111 kg, with a value of over ₱31,000. Crabs (*Portunus spp.* and *Scylla serrata*) were also highly desired food items. Only the catch of *Scylla serrata* was known. The mean monthly harvest of this crab was 196 kg, 2,356 kg in one year, valued at over ₱15,000 (Table 8). (The taxonomy of the genus *Scylla* is still in question. Most authors recognize only one species, but Estampador in 1949 tried to show that there were three species, based on adult coloration, differences in chromosome morphology and structure and in gametogenesis.)

It is known that penaeid shrimps are caught in large quantities in Philippine mangrove swamps. However, quantification of yields is lacking. Prawn production is dependent on intact mangrove forests, and destruction of these forests has resulted in reduced harvest (Krishnamurthy and Jeyaseelan 1980). A major reason for this reduction in yield is diminution of the food supply of the shrimps, as it is now well established that mangrove detritus serves as the energy base of food webs in mangrove swamps (see Odum and Heald 1975, Odum 1982, Odum et al. 1982).

Holothurians.

Sixteen species of edible sea cucumbers have been identified in the Bays (Table 7 and Fig. 2). They were distributed in an area of about 110 ha at the seaward (eastern) edge of Daco Island and in the Talabong mangrove forest. Here the substrate was predominantly sand mixed with coral rubble and the conspicuous plants were the seagrasses *Enhalus* and *Thalassia* and the algae *Hydroclathrus* and *Gracilaria*. These sea cucumbers are not strictly mangrove species, as all of them except *Holothuria pulla, H. aculeata, H. scabra, H. fuscocinerea* and *H. imitans* have also been reported from coral reefs (Clark 1976).

Standing stock. The mean density of five species, *Actinopyga mauritiana, A. echinites, Holothuria pulla, H. hilla* and *Bohadschia argus*, determined at Station 2 from February to December 1982 using the transect-quadrat method, was 6.75 ± 2.38 individuals or 3,375 individuals per hectare, with a mean wet weight of 541 kg. The mean density of another group of six species, *Holothuria leucospilota, H. aculeata, H. atra, H. edulis, Bohadschia marmorata* and *Thelenota ananas*, was sim-

Figure 2. A. Holothurians (*Bohadschia* and *Holothuria*) and

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Table 9. Marine benthic algae found in the mangrove swamp at South Bais Bay

Rhodophyceae (red algae)

1. *Leveillea jungermannioides* (Martens & Hering) Harvey
2. *Amphiroa fragilissima* (Linnaeus) Lamouroux
3. *Tolypiocladia glomerulata* (C. Agardh) Schmitz
4. *Catenella caespitosa* (Withering) L. Irvine
5. *Acanthophora spicifera* (Forskal) Borgesen
6. *Gracilaria salicornia* (C. Agardh) Dawson
7. *Bostrychia tenella* (Lamouroux) J. Agardh
8. *Actinotrichia fragilis* (Forskal) Borgesen
9. *Laurencia papillosa* (Forskal) Greville

Clorophyceae (green algae)

10. *Boergesenia forbesii* (Harvey) Feldmann
11. *Neomeris vanbosseae* Howe
12. *Ulva reticulata* Forskal
13. *Caulerpa racemosa* (Forskal) J. Agardh
14. *Enteromorpha intestinalis* (Linnaeus) Nees
15. *Chaetomorpha crassa* (C. Agardh) Kutzing
16. *Udotea* sp.
17. *Avrainvillea* sp.
18. *Halimeda opuntia* (Linnaeus) Lamouroux
19. *Halimeda macroloba* Decaisne
20. *Chaetomorpha spiralis* Okamura
21. *Chaetomorpha linum* (Muller) Kutzing

Phaeophycease (brown algae)

22. *Hydroclathrus clathratus* (C. Agardh) M. A. Howe
23. *Padina tenuis Bory*
24. *Giffordia duchassaigniana* (Grunow) Taylor

Cyanophyceae (blue-green algae)

25. *Lyngbya majuscula* Gomont
26. *Brachytrichia* sp.

ilarly determined at Station 3 during the same period to be 39.75 ± 13.06 per 20 m² or 19, 875 individuals per hectare, with a wet weight of about 2.6 tons per hectare. These biomass estimates, though based on limited samples, indicate that the standing stock of edible holothurians in certain areas of the bays is substantial.

Harvest and economic value. It is very difficult to estimate the actual harvest of holothurians in the bays. Our preliminary data indicate that about 108 kg per month (1.3 tons per year) were gathered for local consumption, valued at about ₱2,800 per year (Table 8). To this amount must be added ₱9,000, the value of 600 kg of dried holothurians (*trepang or beche de mer*) sold by a trader in 1980. An unknown portion of the holothurian harvest came from deeper water and was not strictly part of the mangrove fauna. A *trepang* (dried sea cucumber) fishery has existed in the Philippines for some time (see, for example, Seale 1917).

Algae

Twenty-six species of marine benthic algae distributed in the four algal classes have been found in South Bais Bay by Dr. Ernani Meñez, Smithsonian Institution (Table 9). All of these species were attached to rocks or to sand-mud substrate, except for *Bostrychia tenella* and *Catenella caespitosa,* which were attached to mangrove roots, and a few others that were epiphytic on other algae.

Among the green algae, *Caulerpa racemosa* and *Enteromorpha intestinalis* would appear to have direct use to man, the former being used as salad and the latter serving as bait for rabbitfish (*Siganus*) traps.

Acknowledgments

We are pleased to acknowledge the grant from the Philippine Council for Agricultural and Resources Research and Development (PCARRD) that enabled us to conduct this study. The Silliman Marine Laboratory provided vehicles for field work, laboratory facilities and library. Aiding us in the collection, sorting and preliminary identification of organisms were Hilconida P. Calumpong, Annadel S. Cabanban and Eduardo Duran. We are also indebted to specialists at the Smithsonian Institution, Washington, D.C., U.S.A., who aided us either in facilitating identification or identifying our material: Dr. Leslie W. Knapp, Dr. Ernani Meñez, Dr. Gordon Hendler, Dr. Joseph Rosewater, Dr. David Pawson and Dr. Raymond Manning. Dr. Knapp and Dr. Meñez were instrumental in obtaining a grant from the Smithsonian that enabled Alcala and his wife Naomi to spend time there. Alcala's sabbatical program was sponsored by the United Board for Christian Higher Education in Asia. Mrs. Carol Hahn, a librarian at the U.S. National Museum of Natural History was most helpful in providing reference materials. Mr. Charles A. Ross, Division of Birds, National Museum, and his wife Glory generously shared their home with the Alcalas during their three-month stay at the Smithsonian. Gustavo Gloria and Teodulo Luchavez kindly prepared the illustrations. Araceli Meñez and Pacita Raterta typed the manuscript.

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Abundance and Harvest of Caulerpa racemosa (lato) at Siquijor Island, Central Visayas, Philippines*

Hilconida P. Calumpong

ABSTRACT. The abundance and harvest of edible **Caulerpa racemosa** at Siquijor Island, central Philippines, were surveyed. The **C. racemosa** community occupied an area of about 0.9 km^2 (90 ha), where 13 families harvest a total of 60 baskets daily, each weighing (wet) 30-40 kg and selling at ₱8.00/basket. The area yields an annual harvest of 21,900 baskets (657,000-876,000 kg wet weight) valued at a minimum of ₱175,200. Greatest values for standing crop and biomass (0.734 kg/m^2; 1.123 kg/m^2 wet weights) were taken from depths ot 0.5 to 1.0 m in the lower intertidal, approximately 160 m from shore, where the substrate was mud.

Of the fifty-three taxa of *Caulerpa* reported from the Philippines, twenty occur in the central Visayas (Meñez and Calumpong 1982), the most important economically being *C. lentillifera, C. microphysa* and the different varieties of *C. racemosa*. These "grapelike" representatives of *Caulerpa* are eaten in most parts of Asia as an appetizer in the form of salad.

In certain parts of the Philippines, like Lingayen Gulf in Luzon and Mactan Island in Cebu, edible *Caulerpa* is farmed in ponds for local consumption and for export to Japan. The harvests and potential of this farming have been documented (Horstmann 1978; Sotto 1978). In other parts of the country, *Caulerpa* is harvested from its natural habitat. This paper reports on the abundance and harvest of wild *C. racemosa* at Siquijor Island.

Study Area

Located off the island of Negros in the central Visayas, Siquijor Island is characterized by wide intertidal areas generally dominated by seagrass communities fringed with coral reefs (Fig. 1). Eleven species of *Caulerpa* (*lato* in the Cebuano language) grow abundantly on the island's northwestern side, particularly in the adjacent barrios of Pasihagon, Tambisan, Cang-alwang and Solongon, where the substrate is generally mud.

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*Paper read at the 11th International Seaweed Symposium, June 19-25, 1983, Qingdao, China. A contribution of the Silliman University Marine Laboratory.

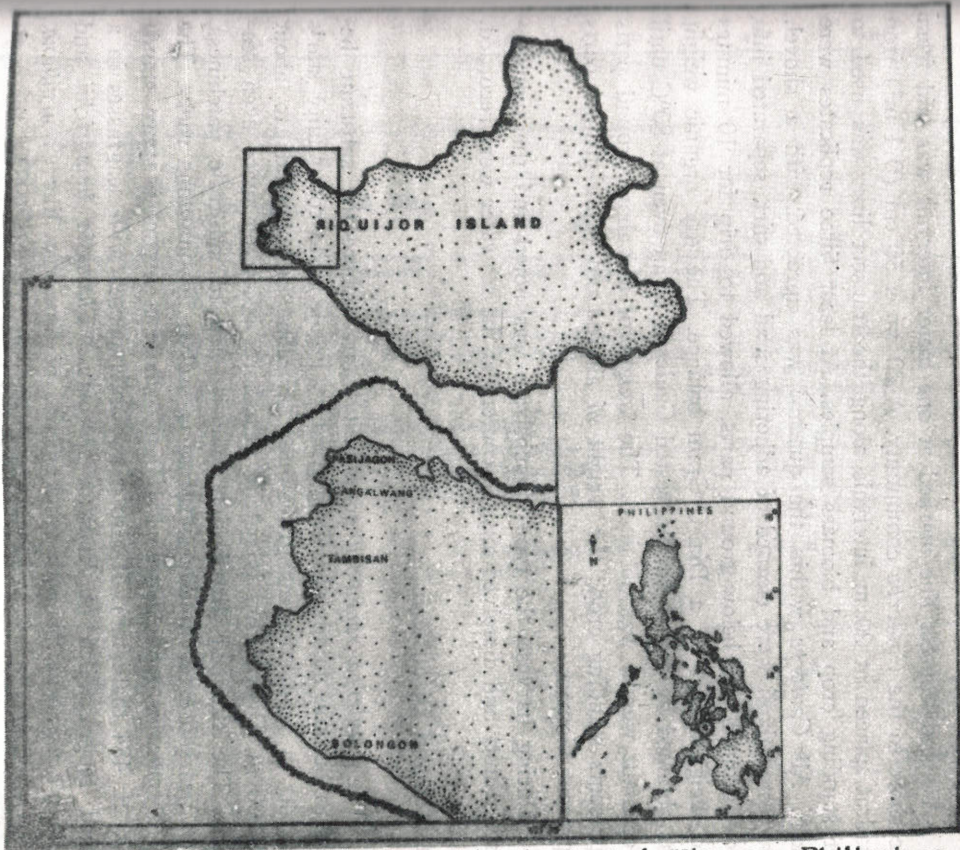

Figure 1. Study site. Siquijor Island, Central Visayas, Philippines.

Methods

A combination of transect and quadrat was used to determine the extent of the *Caulerpa* community, standing crop and biomass. Data on the amount of harvest/day, selling price and type of harvesting were gathered.

A nylon transect line marked at one meter intervals was laid from the shore to the *Caulerpa* community. A 20 cm x 50 cm (0.1 m^2) iron quadrat, placed at 20 m intervals along the transect line, was used to get standing crop and biomass samples. At least three replicates were taken. All *Caulerpa* within the quadrat was uprooted with a shovel. Harvested thalli were cleaned of adhering sand and dirt, separated into above-ground and below-ground parts, allowed to drip for 10 minutes and weighed wet on a Dial-O-Gram balance. The dry organic weight was obtained by drying the harvested Caulerpa in an oven at 80°C until a constant weight was obtained. The weight of the above-ground parts represents standing crop; the weight of above- and below-ground parts represent biomass.

During harvest, the type of substrate was noted and the temperature, salinity and dissolved oxygen content of the seawater were recorded.

Results and Discussion

The *Caulerpa racemosa* community starts where the substrate begins to become muddy. In Cang-alwang (Fig. 2) the community starts 130-140 m from the mangrove-lined shoreline and extends to about 400-600 m. Distribution is patchy nearshore, becoming more even seaward. The clumped distribution may be due to substrate patchiness, since nearshore the muddy substrate is broken by limestone rocks. The *C. racemosa* is most dense at 160 m, where it occurs in pure stands (773 ± 484 thalli/m^2). It also grows interspersed with seagrasses in a mixed seagrass bed of *Enhalus acoroides, Thalassia hemprichii* and *Halodule uninervis* or with other species of *Caulerpa*, like *C. urvillana, C. sertularioides* and *C. taxifolia.* In Pasihagon (Baguio 1983), the community starts 20-60 m from the shoreline and extends to 300-600 m. It is most dense at 150-250 m, where the substrate is mud and water depth ranges from 0.5 to 1 m at low tide. Water salinity at the time of sampling ranged from 31 to 33 parts per thousand; water temperature was 26.5-27°C and dissolved oxygen varied between 14.76 and 18.27 parts per million.

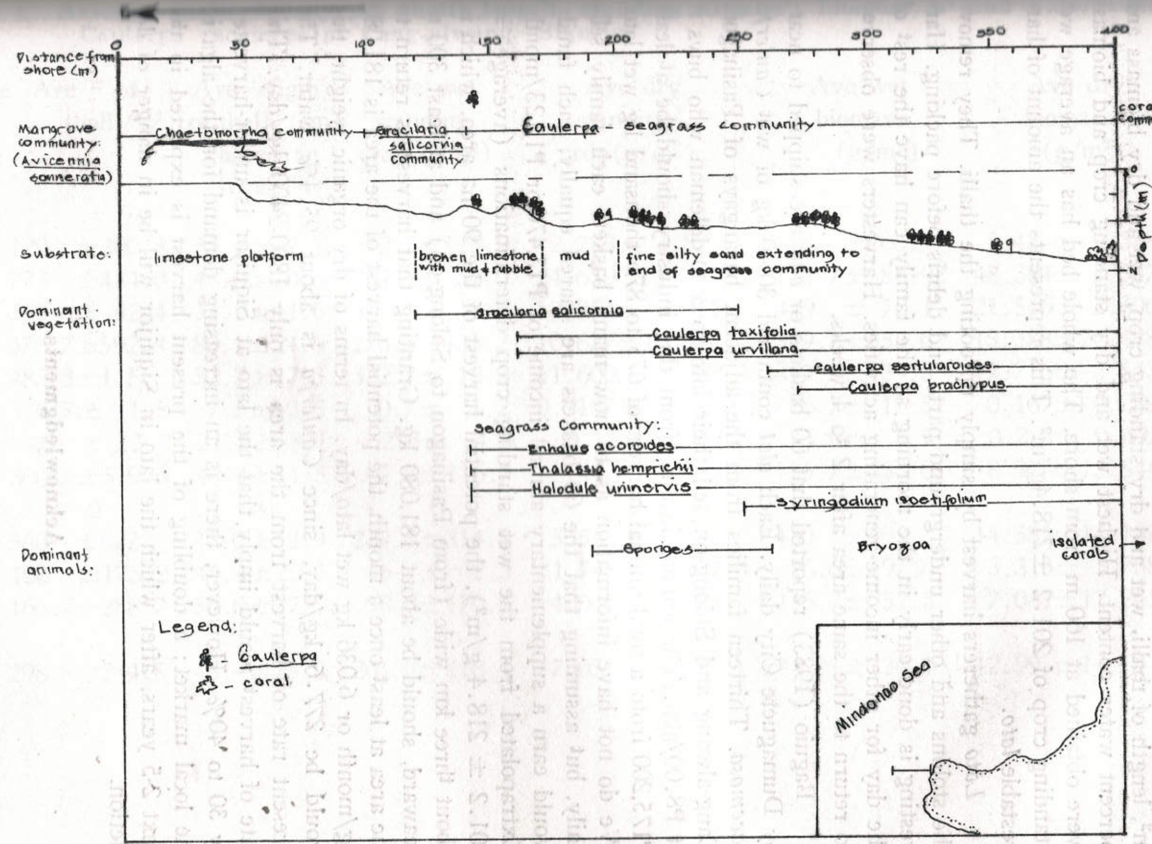

Figure 2. Profile of the study area in Cang-alwang, with inset to show transect site.

The *Caulerpa racemosa* bed at Cang-alwang has an average thalli density of 298.8 ± 244.8/m². The thalli may grow as tall as 80.1 ± 24.6 cm. (Average = 43.4 ± 18.8 cm). Table 1 shows the number of thalli/m², length of thalli, wet and dry standing crop, wet and dry biomass and percent water content. Highest wet and dry standing crop and biomass were obtained at 160 m from shore. The whole bed has an average wet standing crop of 201.2 ±218.4g/m². This represents the amount of harvestable *lato*.

Lato gatherers harvest by simply uprooting the thalli. They remove the stolons and other underground parts and debris before packing. Harvesting is done early in the morning so the family can have the rest of the day for other income-generating activities. Harvesters were observed to return to the same area after 2 to 4 weeks.

Baguio (1983) reported that 60 baskets or *alat* are shipped to nearby Dumaguete City daily. Each *alat* contained 30-40 kg of wet *Caulerpa racemosa*. Thirteen families from the adjacent barangays of Pasihagon, Cang-alwang and Solong-on sell their lato to a middleman who buys it at ₱8.00/alat. The annual income from this industry should be at least ₱175,200 from a total annual harvest of 675 to 876 thousand kg wet lato. We do not have information as to how many baskets each family sells daily, but assuming that the 60 baskets are shared equally, each family would earn a supplementary annual income of ₱13,476,or ₱1,123/month. Extrapolated from the wet standing crop determinations (average = 201.2 ± 218.4 g/m²), the potential harvest of the 90 ha area, which is about three km wide (from Pasihagon to Solong-on) and at least 300 m seaward, should be about 181,080 kg. Granting that harvesters return to the area at least once a month, the potential harvest of the area is 181,080 kg/month or 6,036 kg wet lato/day. In terms of dry organic weight, this would be 277.6 kg/day, since *Caulerpa* is about 95.4% water. The present rate of harvest from the area is only 1800-2400 kg/day. This rate of harvest would imply that the lato at Siquijor is under-harvested by 30 to 40%. However, there is an increasing demand for the alga in the local market; a doubling of the present harvest is expected in the next 2-5 years, after which the lato in Siquijor will be in danger of depletion.

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Fish and Invertebrate Yields of the Coral Reefs of Selinog Island in the Mindanao Sea and Hulao-hulao in Panay Gulf, Philippines*

Teodulo Luchavez, Julieta Luchavez and A. C. Alcala

ABSTRACT. The fish and invertebrates caught at the reefs of Selinog Island in the Mindanao Sea and Hulao-hulao in Panay Gulf were studied from April 1982 to August 1984. The fish and invertebrate yield of Selinog was estimated at 5.88 m t/yr/sq km and that of Hulao-hulao at 5.0 m t/yr/sq km. In addition to reef fishes, the harvest included fishes of the families Carangidae, Belonidae, Scombridae, Sphyraenidae and some cartilaginous fishes such as rays and sharks.

Selinog reef has an area of about 126.3 ha, while Hulao-hulao reef is about 50 ha. Both reefs have been dynamited and subjected to fishing with **muro ami**. Live coral cover was approximately 29% for Selinog and 27% for Hulao-hulao. Selinog reef is bordered by "dropoffs" at certain points; in contrast, Hulao-hulao is generally flat.

The income of the 120 Selinog fishermen, who fished for cash, was variable, ranging from ₱0.13 to ₱35.00 per man-hour. The value of the fish catch of the 60 Hulao-hulao fishermen, who fished only for home consumption, was much lower—about ₱0.12 to ₱13.71 per man-hour.

This paper is the third in a series of reports on coral reef fisheries, the other two dealing with reef fish yields of the central Visayan islands of Sumilon (Alcala 1981) and Apo (Alcala and Luchavez 1981). The present paper extends our knowledge of reef fish yields to the Mindanao Sea (Selinog Island) and Panay Gulf (Hulao-hulao Reef).

The relevant literature on fish yields of coral reefs has been reviewed in the two papers mentioned above and by Martin and Polovina (1982). The interested reader is referred to them.

As in the previous studies, the objectives of the present study were to determine the quantity of the fish and invertebrates caught by fishermen and to correlate quantity and quality of the fish yield to certain characteristics of the reefs.

Study Areas

Selinog Island Reef.

Selinog Island, which belongs politically to Dapitan City, Zamboanga del Norte, lies in the Mindanao Sea, about 15 km from Tagolo Point on the Mindanao mainland. It is a 90-hectare, flat coralline island with a population of about 620, including 120 fishermen. Fishing is the main

*Contribution from the Marine Laboratory, Silliman University.

source of income for the inhabitants. Income from coconuts, banca building, and making mats from leaves of *Pandanus* grown on the island supplements income from fishing for some families.

The island is roughly spindle-shaped, its long axis oriented north-south (Fig. 1). Sandy beaches form most of its coastline, except for parts of the eastern and western sides, which are rocky. A sand spit is found at the southern tip. The prevailing current during the northeast monsoon months flows southward.

A 126.3-ha fringing reef extending to the 30-meter isobath practically surrounds the island (Fig. 1). Live coral cover, in general, was low (28.63%), with a relief of approximately 10 to 100 cm. About 71% of the reef surface area was coral rubble, dead corals and sand. Dominant hard coral genera include *Acropora, Porites, Pocillopora, Turbinaria, Millepora, Favia Heliopora, Galaxea, Montipora* and *Seriatopora.* Soft corals were also present. A fairly good diversity of fish, invertebrates (such as octopi, lobsters, gastropod shells, sea cucumbers and sea urchins) and various species of algae compose the benthic biota. The red algae were the most abundant, including *Laurencia* spp., *Hypnea* spp., *Chondria* spp., *Gracilaria* spp., *Spyridia, Champia, Mastophora and Rhodymania.* A few species of green and brown algae were also present. These algae grow abundantly on dead corals and coralline bedrock. Patches of dead standing corals seen among thriving colonies probably resulted from predation by the Crown-of-Thorns starfish (*Acanthaster*) and other coral predators. Damage to hard corals on the reef "drop-offs" must have been inflicted by dynamite fishermen, boat anchors, *muro-ami* fishing, fish traps and storms.

Fishing on the reef occurred throughout the year, being limited only by strong current and rough seas brought about by typhoons and monsoon winds. The fishermen used non-motorized, dug-out canoes and motorized outrigger bancas. Their fishing gear included bamboo traps, spearguns, handlines, gill nets and bottom lines.

Hulao-hulao Reef.

Hulao-hulao reef is a small barrier reef located off Calaogao Sitio, Cauayan, Negros Occidental, in Panay Gulf. It is 250 meters from the shoreline, separated from mainland Negros by a 10 m deep channel. The reef appears to be rising, presumably as a result of tectonic movements in the volcanic arc of the Negros arc-trench system.

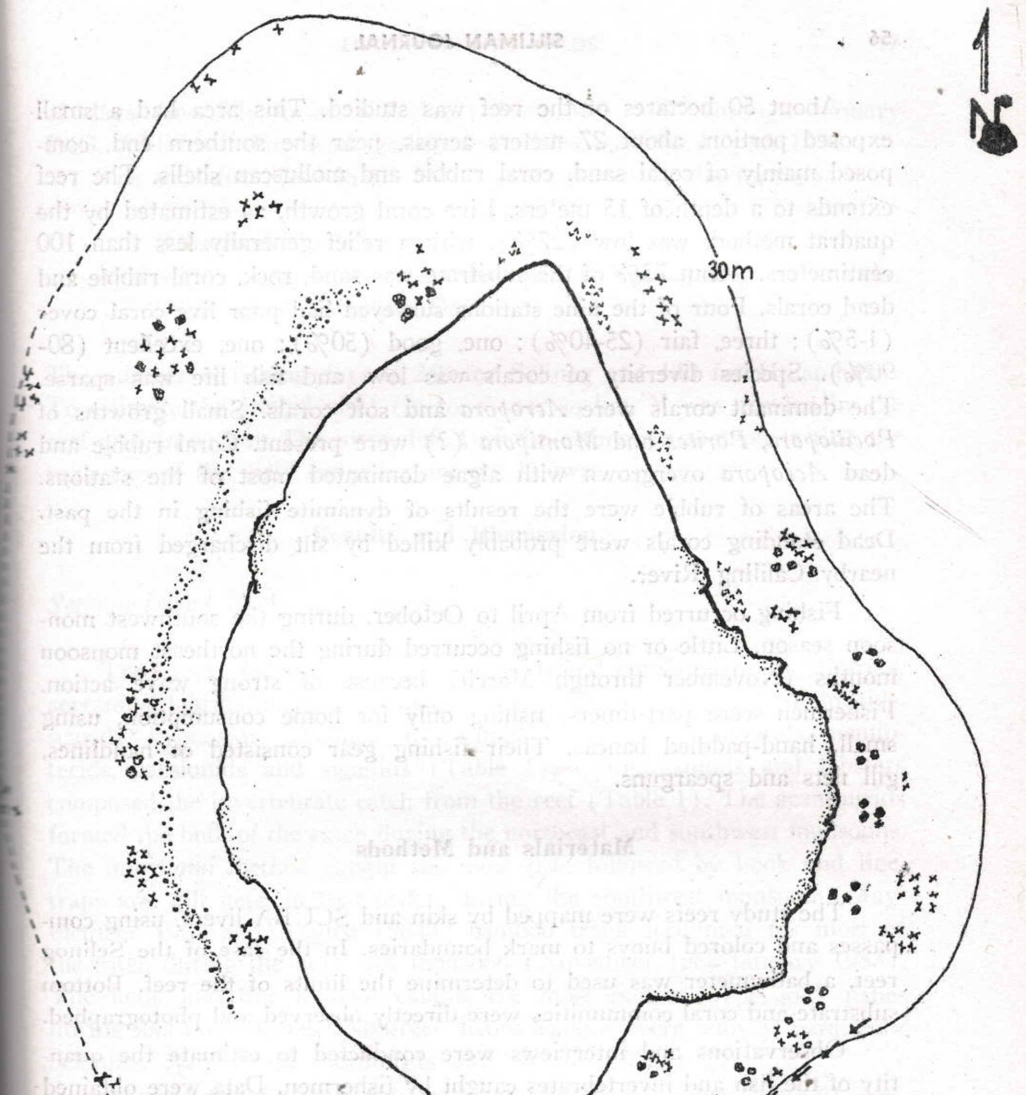

Figure 1. Map of Selinog Island showing the extent of the reef and the nature of the bottom.

About 50 hectares of the reef was studied. This area had a small exposed portion, about 27 meters across, near the southern end, composed mainly of coral sand, coral rubble and molluscan shells. The reef extends to a depth of 15 meters. Live coral growth, as estimated by the quadrat method, was low (27%), with a relief generally less than 100 centimeters. About 73% of the substrate was sand, rock, coral rubble and dead corals. Four of the nine stations surveyed had poor live coral cover (1-5%); three, fair (25-40%); one, good (50%); one, excellent (80-90%). Species diversity of corals was low, and fish life was sparse. The dominant corals were *Acropora* and soft corals. Small growths of *Pocillopora, Porites* and *Montipora* (?) were present. Coral rubble and dead *Acropora* overgrown with algae dominated most of the stations. The areas of rubble were the results of dynamite fishing in the past. Dead standing corals were probably killed by silt discharged from the nearby Caliling River.

Fishing occurred from April to October, during the southwest monsoon season. Little or no fishing occurred during the northeast monsoon months (November through March) because of strong wave action. Fishermen were part-timers, fishing only for home consumption, using small, hand-paddled bancas. Their fishing gear consisted of handlines, gill nets and spearguns.

Materials and Methods

The study reefs were mapped by skin and SCUBA livers, using compasses and colored buoys to mark boundaries. In the case of the Selinog reef, a bathymeter was used to determine the limits of the reef. Bottom substrate and coral communities were directly observed and photographed.

Observations and interviews were conducted to estimate the quantity of the fish and invertebrates caught by fishermen. Data were obtained on the species of fish caught, fishing gear employed, actual or estimated weights and monetary values of the catch, fish consumed by the fishermen, and influence on fishing of tidal patterns, weather conditions and social activities. To obtain data we either followed the fishermen as they fished or waited for them to land their catch.

Fish and invertebrate catch-data from the Hulao-hulao reef were gathered by a trained assistant on 61 days for seven months from April 1982 to January 1983 (average of 8.7 days per month). Those from the Selinog reef were gathered by the researchers and trained assistants on

61 days (monthly mean, 8.7 days) from May 1982 through January 1983. Additional data were gathered on three days in August 1984.

The total fish yield in kg (Y) was estimated by the formula:

$$Y = \frac{\text{Observed Catch (kg)}}{\text{Number of Sampling Days}} \times \text{Number of Fishing Days in a Year.}$$

The number of fishing days is 240 for Selinog and 140 for Hulao-hulao. To estimate the annual yield (in tons) per sq km, Y was divided by the reef area in sq km. The main defect of the estimation method is that the variances of the yield estimates are not known.

Results and Discussion

Selinog Island Reef.

The "reef" fishes caught at Selinog Island consisted of acanthurids, serranids, labrids, balistids, pomacentrids, mullids, holocentrids, lethrinids, scarids, kyphosids, lutianids, muraenids, plotosids, synodontids, nemipterids, caesionids and siganids (Table 1). Octopi, squids and lobsters composed the invertebrate catch from the reef (Table 1). The acanthurids formed the bulk of the catch during the northeast and southwest monsoons. The *muro-ami* method caught the most fish. followed by hook and line, traps and gill nets, in that order, during the southwest monsoon (May-October 1982 and August 1984); bamboo traps accounted for most of the catch during the northeast monsoon (November 1982-January 1983). The hook and line method caught the most non-reef (pelagic) fishes during both monsoons. Non-reef fishes caught were mostly carangids, belonids, sphyraenids, scombrids and elopids (Table 2).

About 3,460.57 kg of fish and molluscs were caught on the 61 sampling days from May 1982 to August 1984 and only about 299.1 kg on the six sampling days in November 1982 and January 1983 (Table 5). The fishermen also fished for non-reef species. A total of 1,400.65 kg of non-reef fish was caught on 31 sampling days from May 1982 to August 1984 and about 10.9 kg on the three sampling days in November 1982 and January 1983 (Tables 2 and 6). About 5,120 kg of mackerel (*Auxis*) was caught on the 61 sampling days in July-October 1982 (Table 7) and about 2,300 kg of manta rays (unidentified species) was caught on two sampling days in January 1983. The quantity of fish consumed

Table 1. Groups of reef fishes and invertebrates caught at Selinog in 1982–83 and 1984

Taxonomic Group	Weight (kg)	% Total
1. Assorted species (acanthurids, labrids, caesionids, scarids, mullids, small serranids, and **Abudefduf**)	1,872.75	54.12
2. Acanthuridae (**Naso** and **Acanthurus**)	894.3	25.84
3. Serranidae (**Epinephelus** and other genera)	137.85	3.98
4. Molluscs (squids and octopi)	120.85	3.5
5. Scaridae (**Scarus**)	108.25	3.13
6. Kyphosidae (**Kyphosus**)	106.25	3.07
7. Nemipteridae	67.85	1.96
8. Labridae	44.3	1.3
9. Lutjanidae	28	0.81
10. Lethrinidae	20.4	0.59
11. Balistidae	14.5	
12. Pomacentridae	13.52	
13. Mullidae	12.2	
14. Holocentridae	9.15	
15. Muraenidae	8.05	
16. Crustacea (lobsters)	0.9	
17. Caesionidae	0.6	
18. Plotosidae	0.4	
19. Synodontidae	0.3	
20. Siganidae	0.05	
TOTAL	3,460.57	98.3

Table 2. Groups of non-reef fish caught at Selinog in 1982–83 and 1984

Taxonomic Group	Weight (kg)	% Total
1. Carangidae	1,006.15	71.83
2. Belonidae	292.2	20.86
3. Sphyraenidae	47.1	3.36
4. Scombridae	33.5	2.39
5. Elopidae	11.6	0.83
6. Dussumieridae (?)	10	0.71
7. Mugilidae	0.1	
TOTAL	1,400.65	99.98

Table 3. Groups of reef fish and invertebrates caught at Hulao-hulao reef in 1982

Taxonomic Group	Weight (kg)	% Total
1. Assorted reef species	970.15	88.77
2. Molluscs (octopi, squids, shellfish)	92.3	8.45
3. Serranidae (**Epinephelus** and other genera)	14.25	1.30
4. Balistidae (**Balistoides** and allied species)	9	0.82
5. Crustacea (lobsters)	2.5	0.22
6. Dasyatidae (**Dasyatis**)	2	0.18
7. Plectorhynchidae (**Plectorhynchus**)	1	
8. Mullidae (**Parupeneus** and **Upeneus**)	1	
9. Scaridae (**Scarus**)	0.6	
10. Siganidae (**Siganus**)	0.05	
TOTAL	1,092.85	97.74

(sampled for nine days) was 33.1 kg of small reef fish and 295 kg of sharks.

The reef fish yield was computed as follows: A total of 1,343.57 kg, exclusive of the 2,126 kg caught with *muro-ami* in May 1982, was caught by fishermen on 61 fishing days, or an average of 22.02 kg per fishing day. This was multiplied by 240, the total number of fishing days in one year (average of 20 days per month), to obtain an estimate for one year, 5,286.17 kg. To this figure was added the *muro-ami* catch of 2,126 kg, giving the total caught in one year during the period of sampling as 7,412.17 kg. If this is divided by 1.26 sq km, the reef area, the annual yield is 5.88 tons/sq km/yr.

The data show that more fish were caught during the southwest monsoon than during the northeast monsoon. Two reasons could account for this finding. One is that the northern and northeastern portions of the reef, which are shielded from the southwest monsoon, are the more productive parts of the reef. The productivity during the southwest monsoon is further enhanced by a three-month shift (July through September) from reef fishing to offshore fishing for mackerel and manta rays. The other reason is that there are more calm days favorable for fishing during the southwest monsoon months. As mentioned earlier, these reef portions have the most extensive live coral cover.

The monetary value of the 3,469.57 kg of reef fish and invertebrates caught on 61 sampling days was ₱10,943.93 (Table 5) and that of the 1,400.65 kg of non-reef fish caught on 34 sampling days was ₱5,794.00 (Table 6). The income of the fishermen from reef fish and invertebrates was variable, ranging from ₱0.13 to ₱10.53 per man per hour (Table 5); that from non-reef fish was also variable, but generally higher, ranging from ₱0.16 to ₱35.00 per man per hour (Table 6). (A fisherman spent about five hours fishing per day, on the average.) These estimates do not include the value of fish the fishermen consumed. As can be gleaned from Tables 5 and 6, the selling price of fish at Selinog during the time of study was low—₱2.00-₱5.00 per kg.

Pelagic fish harvested outside the reef by Selinog fishermen during the sampling period included mackerel (*Auxis* spp.), manta rays and hammerhead sharks. Mackerels were harvested during four months (July to October) and manta rays during two months (December to January). Manta rays were sold on the nearby island of Siquijor for a good price, ₱100.00 to ₱800.00 per fish, while sharks (and occasionally dolphin) were either consumed or given away. The meat of sharks and dolphins

Table 4. Groups of nonreef fish caught at Hulao-hulao reef in 1982

Taxonomic Group	Weight (kg)	% Total
1. Belonidae	280.5	95.6
2. Carangidae (Scombroides)	7	2.4
3. Scombridae (Rastrelliger)	6	2.0
TOTAL	293.5	100.0

Table 5. Biomass and value of reef fish and invertebrates caught at Selinog in 1982–83 and 1984

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
6–20 May – 2 June, 1982	8	2,212	6,276.00	0.14 – 6.43
3–31 July 1982	11	436.87	1,510.37	0.26 – 0.43
1–23 August 1982	12	116.2	494.85	0.31 – 1.26
2–27 September 1982	8	49.7	178.45	0.37 – 3.20
6–18 October 1982	14	255	934.00	1.17 – 10.53
19–21 November 1982 –	6	299.1	803.16	0.13 – 1.74
25 January 1983		– ca 9 l*	22.50	0.42
19–20 August 1984	2	91.7	724.60	0.60 – 8.57
TOTAL	61	3,469.57	10,943.93	

* Gonads of sea urchins (**Tripneustes gratilla**) consumed by residents are valued at ₱2.50 per liter.

Table 6. Biomass and value of non-reef fish caught at Selinog in 1982–83 and 1984

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
6 May – 2 June 1982	10	608	2,240.00	1.09 – 33.33
7 – 31 July 1982	9	468.6	2,051.30	0.67 – 7.73
2–10 August 1982	4	57.2	314.30	1.22 – 26.58
5–9 September 1982	2	158	632.00	8.00 – 13.07
10–19 October 1982	4	76	319.00	2.80 – 35.00
19–21 November 1982	2	2.4	8.80	> 0.16 – 25.00
25–January 1983	1	8.5	51.00	
19–20 August 1984	2	21.95	177.60	0.50 – 6.75
TOTAL	34	1,400.65	5,794.00	

was not saleable and, like small acanthurids, abrids and pomacentrids, was mainly consumed at home.

The catch per unit effort (c/f) of the Selinog Island fishermen was generally low. The one exception was when *muro-ami* was used during the southwest monsoon for a very high c/f of ₱51.55 kg/man-hour. The c/f for gill netting, hook and line and speargun was higher during the southwest monsoon (8.70 kg/man-hour, 2.91 kg/man-hour and 2.55 kg/man-hour, respectively) than during the northeast monsoon (4.77 kg/man-hour, 1.18 kg/man-hour, 1.16 kg/man-hour, respectively), but that for bamboo traps was lower during the southwest monsoon (0.114 kg/man-hour) than during the northeast monsoon (0.23 kg/man-hour). The c/f from mackerel fishing was 2.48 kg/man-hour.

Hulao-hulao Reef.

The reef fish at Hulao-hulao included serranids, balistids, dasyatids, haemulids, mullids, scarids and siganids; pelagic species were belonids, carangids and scombrids. The invertebrates included octopi, squids, shellfishes and lobsters (Table 3). Among these groups, the belonids, which were caught in gill nets, composed most of the catch (Table 4).

Tables 8 and 9 show that about 1,386.35 kg of fish and molluscs were caught from the reef on 61 sampling days from April to October 1982. The annual yield was estimated as follows: The reef fish caught in seven months weighed 1,092.85 kg for 61 days, or 17.42 kg per fishing day. On this basis, the total yield expected for 140 fishing days in one year would be 2,508.2 kg. If this is divided by 0.5 sq km, the annual yield comes to about 5.02 tons/sq km/yr. There was no fishing during the northeast monsoon, as the reef is inaccessible, being exposed to the strong winds.

There is no question that the Hulao-hulao reef is now relatively unproductive. The junior author remembers that this reef teemed with fish and other forms of marine life 30-40 years ago. The low yield of the reef is due to the combined effects of dynamite-fishing and overexploitation. As already stated, most of the area has been damaged by blast fishing and is now being colonized by algae and soft corals. Overexploitation is indicated by the smaller sizes of the fish caught there, compared with those taken at Selinog (Table 10).

Tables 8 and 9 further show the Philippine peso value of the fish catch of the Hulao-hulao fishermen, which ranged from ₱0.12 to ₱17.25 for reef fish and invertebrates and from ₱0.10 to ₱13.71 for non-reef

Table 7. Biomass and value of non-reef fish (*Auxis sp.*) caught with multiple hook and line off Selinog Island in 1982

Date	No. of sampling days	Catch (kg)	Value in pesos	Income/man/trip* in pesos	
				Range	Mean
2–30 July	22	1,824.8	6,386.80	2.72– 99.00	39.56
1–31 August	16	1,494.5	5,230.75	9.45– 94.50	45.01
11–30 September	18	1,371.9	4,801.65	8.75–119.63	43.58
1–5 October	5	428.8	1,500.80	7.88– 82.47	41.12
TOTAL	61	5,120.00	17,920.00		

*Fishing trip takes about 5 hours.

Table 8. Reef fish and invertebrates caught at Hulao-hulao in 1982

Date*	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour in pesos (Range)
April	10	92.5	375.00	0.25 – 11.20
May	10	281.3	1,132.50	0.17 – 10.67
June	10	539.4	2,180.00	0.50 – 1.67
July	6	14	192.50	1.33 – 4.00
August	10	88.6	384.90	0.44 – 17.25
September	10	55.8	227.30	0.12 – 2.33
October	5	21.25	89.50	0.56 – 3.67
TOTAL	61	1,092.85	4,581.70	

* Reef not accessible to fishermen during northeast monsoon—November to March (5 months).

Table 9. Non-reef fish caught at Hulao-hulao in 1982

Date	No. of sampling days	Catch (kg)	Value in pesos	Income per man per hour (Range)
April	2	121.5	486.00	0.64 – 13.71
July	3	35	132.00	4.00 – 6.00
August	2	7	28.00	0.10 – 1.60
September	7	33	132.00	1.11 – 2.67
October	7	99	396.00	0.95 – 3.56
TOTAL	21	295.5	1,174.00	

Table 10. A comparison of sizes (total length in cm) of fish caught at Hulao-hulao and Selinog reefs, April through November 1982. Fish were caught with gill nets, spears, fish traps and handlines

Family	Hulao-hulao			Selinog		
	Number	Range	Mean – SD	Number	Range	Mean – SD
Acanthuridae	58	8.9–38.1	18.1 ± 6.5	75	8.0–64.0	32.1 ± 15.3
Serranidae	40	4.0–40.5	14.6 ± 5.9	30	22.0–62.0	31.9 ± 9.7
Scaridae	68	7.0–33.4	19.5 ± 6.2	3	18.0–31.0	24.7 ± 6.5
Labridae	10	10.2–27.9	16.4 ± 5.7	17	8.0–40.0	18.3 ± 9.4
Mullidae	17	10.2–25.4	17.3 ± 5.0	7	18.0–32.0	23.4 ± 4.8

fish per man-hour. It must be emphasized that these fishermen fished only for home consumption, in contrast to their Selinog counterparts, who fished for cash.

The catch per unit effort of the Hulao-hulao fishermen was quite low except for gill netting (2.81 kg/man-hour) and for *muro-ami* (141.64 kg/man-hour). The c/f for handline and speargun were 1.25 kg/man-hour and 0.99 kg/man-hour, respectively.

Comparisons and Conclusions

Selinog reef has a silghtly higher fish production than Hulao-hulao reef, and with more intensive fishing it could yield more. This difference is most likely due to the larger extent of deeper water and the presence of "drop offs" at Selinog. Hulao-hulao reef, in contrast, is shallow and lacks "drop offs". Our previous experience at Sumilon indicates that "drop offs" may contribute to a high production. Both reefs have been subjected to blast fishing and *muro-ami,* and both have about the same live coral cover. Hulao-hulao appears to be overfished, as indicated by the smaller size of the fish species caught.

There is a significant quantity of caesionids at Selinog reef. However, our catch data are limited because our sampling periods did not coincide with the time for catching *Caesio*. At Selinog, *Caesio* are mainly caught in gill nets, unlike at other reefs where *Caesio* are caught in traps. The mesh size of traps at Selinog is too large for *Caesio*.

In terms of annual yields per sq km, the Selinog Island reef has lower productivity than the Apo Island reef, which yields about 11.4-11.5 m t, and the Sumilon reef, which produces from 14 to 24 m t. The fish yield of Philippine reefs appears to range from a low of about 5 to a high of 24 m t/yr/sq km. This variability would seem related to such factors as intensity of fishing, type of bottom configuration and quality of coral cover. The relative contributions of these factors to fish yield remains to be quantified.

The low peso value of the fish catch of the fishermen at the two reefs studied confirms the findings of Smith et al. (1980) that municipal fishermen in the Philippines fall into the low income groups of the Philippine population.

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International Food Problems: A Multidisciplinary Perspective

George W. Beran

Each of us, whether of high or low estate, whether poor or rich or in the large range in between, needs to consider for himself what is most important to his life. The list of items to consider would probably include many of the following:

Faith in God	Economic security
Spouse and family	Clean air, quiet and beautiful surroundings
Health: a strong body	Friends and coworkers
Food—adequate or even more	Work and responsibility
Education	Art, literature and music
Home and land	Freedom to develop my own life

Which one of these would you choose as most important to you if you had to give up all the others? "Of course," you will say, "without food or health there is no life, and of what importance are all the others?" Yet this question must be asked because all of these items can be taken away or lost; the quality of your life depends on where you place your emphases.

It is widely held today that food should be placed as the number one priority, over all other aspects of life, and that it should receive the primary attention of governments throughout the world. Such would be a "Food First Policy." I do not at this time speak as an advocate of "food first" but I do place considerable emphasis on the "World Food Issue." The present world food situation is not a cause for optimism, not even cautious optimism.

World food production is currently increasing at about 2.4% per year. Approximately 60% of the world's people live in food deficit countries, and this situation, while fluctuating, is showing no basic improvement.

The world population is increasing approximately 2.1—2.2% per year. This is down from about 2.3—2.4% in 1970. This decrease may sound like a ground for optimism but unfortunately it is not. The countries with significant downward trends in population growth have been those in Europe, those in North America, plus Japan, China and Taiwan, and Australasia. The dramatic decrease in growth rates in these countries has over-balanced the static or still-increasing growth rates of Latin America, Africa, and South and Southeast Asia, accounting for a net drop. Many of the countries which decreased their population growth during the 1970s have hit or are approaching the bottom of such change. East Germany, West Germany, Belgium and Switzerland have now reached negative population growth; they are actually decreasing in national population. Other countries are approaching this. The countries with high population growth—3.2% per year or higher—are leveling off because they are nearing a biological maximum, but they are not achieving any marked decreases in growth rate.

World population is now about 4.5 billion people. By the year 2000, it will be anywhere from 6.7 to 7.2 billion. The practical carrying capacity of the world is considered to be between 8 and 11 billion people.

The result of this growth is that the rural poor, who are subsistence farmers, continue to devote 80% or more of their time to food planting, caring, harvesting, preparing, eating and cleaning. The urban poor eat what food is cheapest—which, interestingly, is often also most nutritious—but still spend such a large portion of their earnings for food that they struggle unsuccessfully to rise economically. The middle class, already small in many developing countries, is hit very hard. Rising food prices in relation to earnings require an ever higher percentage of the budget. When a middle class family spends over one-half of its earnings for food, it loses middle class status. The wealthy build ever higher walls around their homes and separate themselves even more fully from the rest of society, a precarious situation indeed.

People of all classes hope for great breakthroughs in science and great advances in technology which will provide sufficient food for everyone. The prevailing concept is that these advances are to be achieved by "experts," but the beneficiaries are to be all of us. Unfortunately, the agronomists say they cannot feed the exploding world population, so the population workers must reduce the number of mouths to feed. The population experts say they cannot halt the world population explosion, so they must rely on the agronomists to provide food for all the people.

Actually, the trend of this decade has shown increases in food production to come stepwise, largely based on improvements in and application of present technology. The world need is great for scientific and technological teamwork and for integration of the multiple efforts and contributions of many disciplines at all levels from theoretician to farmer to consumer. No one person, nor his discipline, is going to solve the world food problem.

The roles of food related disciplines and their interaction in feeding the people of the world were treated in a graduate level course I coordinated in 1978 at Iowa State University. We invited scientists from many departments to discuss their role in feeding people, and then built panel discussions around integration and application of these roles. Our students were largely in preparation for international service, back in other homelands or as Americans abroad, and they came from many disciplines. These students, who upon receipt of their graduate degrees will find themselves experts in their disciplines, need to know how to work with experts in other disciplines focusing on this common goal, that people may have food. Iowa State University has no less than fourteen courses related to international food issues; several universities are developing entire curricula. I wish that consideration could be given at Silliman University to developing an interdisciplinary specialty in feeding the people of the Philippines.

Among the disciplines involved in feeding the people of the world, agronomy must receive first, but not sole consideration. Plant foods are staple for most of the people of the world and supplement the diets of even the minority, who basically eat meat and sea foods. The people of the world rely on grains, legumes, vegetables, fruits and other plant foods. Application of genetics has led to some dramatic improvements in productivity of grains and vegetables and further progress will be achieved, but probably not spectacular progress. Photosynthetic activity, which is basic to plant food production, is approaching maximum levels based on leaf coverage of sunlit surfaces in rice, corn and several other crops, limiting probabilities of dramatic future progress in this area. However, the application of symbiotic microbial nitrogen fixation to non-leguminous crops would dramatically improve yields of plants in which nitrogen is the limiting factor in yield. This is in the province of microbial genetic engineering through recombinant DNA. Such "engineered" plants, able to produce their own fertilizer, will greatly reduce dependence on costly nitrogenous fertilizers and could mark a significant breakthrough in food production. The use of genetics and perhaps of genetic engineering to increase protein content and modify amino acid balances in familiar plant foods will also help. On the farm, intercropping, especially in the tropics, holds promise of increasing the productivity of the land.

Livestock will remain important, though patterns of production will change in feeding the people of the world. Some genetic improvements in productivity and lean meat-to-fat ratios will be achieved, and further conquest of productivity-depleting diseases and parasites will be realized. Increasing use of drugs in production will continue to pose human health hazards; the problem may worsen as solutions fail to keep pace with the expansion of the practice. Luxury meat production in feedlots, using feeds which could be used for human consumption or feeds raised on land which could grow crops for human consumption, will steadily decrease except for large, highly integrated units in proximity to large population centers with requirements for very large amounts of food. Much of the world's livestock production will be on land unsuitable for crops or where extensive by-products of plant food processing are available. Steady progress will be made on forage crops, which will replace native grasses for ruminant animal production. Increasing use will be made of animal by-products, including salvaging animal wastes for feeding back to livestock, for fuel and for production of biogas.

The ocean is not the great hope for feeding the world. Fish and seafood harvests peaked at about 72 million metric tons in 1972 and have been decreasing since. Over-harvesting of the natural productivity of the sea characterizes the industry today, and pollution of the sea waters is decreasing offshore and even deepsea harvests. There do not appear to be any economically feasible hopes for fertilizing or aerating the oceans. Expanded harvests of plankton, kelp and rough fish will be at the expense of desired fish higher on the food chain.

Mariculture and aquaculture have great potential for increasing the supply of sea and aquatic foods. Development of highly productive species and improvement in cultural practices are making dramatic progress. But increasing pollution and diseases of fish and molluscs pose serious problems for the future. Very little is known about diseases in these species and preventive measures such as vaccination.

Soil science faces the most significant problem of holding down erosion and soil loss. At least 5% of the cultivated soil of the world is lost annually; in certain areas of mountain slope agriculture the entire topsoil cover is lost in a year, when forest covers are removed and crops planted in their place. Significant developments may be achieved in modifying the chemical structure of manganese soils and in modifying the water-holding properties of soils, but the applications of such advances will take time and extensive investment capital.

Meteorology as a science is still based largely on understanding and predicting natural phenomena. Weather modification, while stimulating to the imagination, will probably be costly and have limited application for the foreseeable future.

Forestry, which on a world basis has largely centered on harvesting and product utilization, must make rapid strides simply to reforest otherwise unusable land, slow down deterioration by soil erosion, prevent runoff of water and minimize reflection of solar energy. The deforestation of the humid tropics has probably been the greatest disaster to productive crop and livestock agriculture of this century. Fuel is one of the greatest shortages on a world basis. Conversion of wood into food has possibilities for animal feed, but has little practical application on a world basis considering the present situation and needs.

Engineering offers real promise in development of practical food storage. Present losses of stored foods on a world basis average at least 20%; in isolated situations all stored foods are frequently lost to human use. Some developments in food processing will be achieved, but in the food deficit areas of the world food processing represents more of a luxury than a practical approach to feeding the population. Major improvements in tillage will focus more on soil conservation and maintenance than on increasing productivity.

Science and technology hold promise of continued stepwise development in feeding the world's population with some promise also of significant breakthroughs. The effects of this progress will depend on the integration of science in agriculture with education, sociology, politics, economics, health and population control. Scientists in all fields need to interrelate to keep progress ahead of deterioration.

The future is not really bright, but it does not appear hopeless either. I am willing to add both faith and work to keeping things going. What about you?

Luz U. Ausejo and the Luz U. Ausejo Foundation

Luz U. Ausejo (1925-1984) came to Silliman University more than forty years ago as a student. She stayed on to teach history, acquiring graduate degrees from Columbia University (M.A.) and the University of Chicago (Ph.D.) through the years. At the time of her death she had been Dean of the College of Arts and Sciences for seven years.

Although she was a respected scholar and teacher, it is perhaps as Dean that Dr. Ausejo had her greatest impact. Constantly questioning and prodding, she goaded students and faculty alike to greater cooperative involvement in the process of education. Dr. Ausejo had a way of making education exciting. Even given the University's limited resources, she made things happen: teachers wanted to teach, students wanted to learn.

The Luz U. Ausejo Foundation will seek to perpetuate this intellectual and cultural excitement on the Silliman campus. Specially, the Foundation will sponsor or support lectures and seminars, promote and fund research and scholarly publication, assist in faculty development and student financial aid, aid the University Library and University extension programs. Several of these projects are well underway.

Support from individuals and organizations is now being solicited. The Luz U. Ausejo Foundation, Inc. may be addressed c/o Silliman University, Dumaguete City 6501, Philippines.

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