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Contemporary Incipient and Swidden Cultivation in the Philippines

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There appears to be a direct relationship between technological development and the degree of environmental degradation, and a similar relationship holds between labor and time investment per unit of production. This relationship affects the efficiency of a given technology in energy transformation which leads to shifts from one technological level to another; for instance, from the foraging stage to plant and animal domestication, and so on.

Three ethnographic examples from the Philippines illustrate varying degrees of integration between technological levels and the environment. The Manobo Tasaday of Mindanao practiced food foraging in a primary forest until the introduction of metal into their culture. The minimum subsistence requirements were achieved even with underutilization of labor and time. The Tau't Batu of Palawan exploit a largely secondary forest with subsistence based on slash-and-burn cultivation and hunting. Domestic economy is maintained with a multicropping/intercropping strategy in which labor and time are maximized. The I'wak of Northern Luzon, on the other hand, exploit an area that is in a state of advanced degradation. Monocropping strategies based on taro, coupled with land-man ratio problems, have placed the people in difficult straits. Labor market, market economy, and animal husbandry have been resorted to in order to alleviate adverse economic conditions. [Philippines, Swiddeners, Adaptive Strategies, Ethnic Groups]

The shift from one technological stage to another stage more efficient in the transformation of energy, as in the change from food foraging to incipient cultivation to slash-and-burn cultivation, implies an increasing energy flow from the environment that enabled societies to develop more efficient modes of energy extraction. This relationship also suggests environmental degradation of an increasing order. Whenever there is environmental change, a concomitant shift occurs in the mode of technology that enables a society to maintain the level of production at least above the minimum subsistence requirement. The shift from hunting and gathering to the level of incipient plant domestication is suggestive of an energy transformation at least equal to the loss of energy through environmental degradation, or the amount transformed into technological change. There is thus a direct relationship between technological change and environmental degradation.

This paper illustrates the above situation in the context of Philippine ethnography by describing three ethnic communities in various stages of technological development (Fig. 1): The Tasaday of the southern Cotabato Province of Mindanao, the newly reported Tau't Batu of southwestern Palawan, and the I'wak of the southern Cordilleras of northern Luzon. Although this paper does not measure directly the correlation between environmental degradation and the technological shift to maintain the subsistence requirement of a society, the intent is to pursue avenues for more intensive research in the area of technological change, together with the social imperatives and the factors accompanying this change. Impetus for internal change is necessarily difficult to demonstrate and can be pointed out only as an implication stemming from a specific set of circumstances. External stimuli for change are, of course, more obvious, since most result from contact with the investigators themselves.

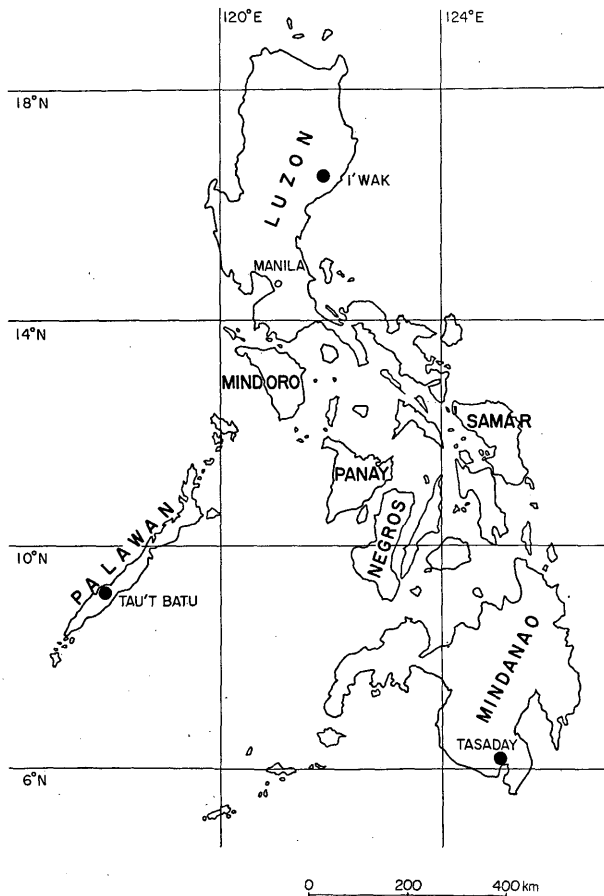


Fig. 1. Ethnic group location in the Philippines.

THE TASADAY

The existence of the Manobo Tasaday was reported in June, 1971 [Fox 1971; FOX and ELIZALDE 1971]. The group, composed of 27 individuals, lives in an area 1200 m above sea level in the province of South Cotabato, on the island of Mindanao. The area is covered by a dense, humid, tropical rain forest. Basically, it is a mature dipterocarp forest with three canopies [YEN and GUTIERREZ 1976]. The floor of the forest is relatively clear, except where the sun penetrates, as along streams, where shrubs, small trees, herbs and vines proliferate. The forest cover is unbroken by secondary growth, except where landslides have destroyed the original cover. Recovery in these areas is characterized by a low vegetation of grass and shrubs.

Prior to their contact with a Manobo Blit hunter, sometime before 1966, the Tasaday were food gatherers, foragers in the true sense of the word [cf. CALDWELL 1977: 86]. Their broad spectrum diet included primarily species of *Dioscorea*, fruits, flowers, plant buds, small fauna gathered by hand from mountain streams, like the species of the giant frog (*Rana magna*) tadpoles, and freshwater fish and shrimp. Hunting was absent in the sense that no large fauna was stalked or trapped; one male Tasaday questioned on this replied that the largest animal he had hunted was a frog. The closest approximation of a hunting tool is the striking stick. Their tool kit included a Paleolithic type of retouched, high angle scraper made from cryptocrystalline quartz, hafted edge-ground axes, digging sticks, fire drills, and antlers for digging [Fox 1971]. Although deer and wild pigs are plentiful in the forest, Tasaday technology could not cope with the complexities of hunting.

The above situation changed drastically when the Tasaday were brought into contact with other cultures through Dafal, the Manobo Blit hunter who chanced upon them. Dafal introduced into the Tasaday culture metal blades, hunting paraphernalia, and the knowledge of sago manufacture, which radically changed the life-style of the people. The Presidential Assistant on National Minorities (PANAMIN) introduced more of the *bolos* (bush knives) plus sundry food items, like rice and canned goods.

When Lynch and Fernandez [1972] made their studies later, the Tasaday were already practicing hunting, minimally equipped with metal blades, and they had adopted sago as a new staple (*natek*) source. Lynch and Fernandez [1972] describe the Tasaday's style of life as conforming with the "leisure class" concept of gathering and hunting societies as postulated by Sahlins [1968, 1972]. During the limited stay of Lynch and Fernandez the group was observed to spend an average of three hours a day searching for food [cf. LEE 1968]. The food foraging range of the group is estimated at 25 km. Even with the introduction of the bow and arrow, the spear spring trap, and the noose spring trap, the Tasaday hunting prowess leaves much to be desired. They lack the necessary knowledge of the characteristic behavior of their prey; their traps, in fact, had to be reset by Dafal whenever he came upon them. Their use of the *bolo* indicated lack of familiarity with the tool, hence the high degree of broken, nicked or dulled blades resulting from misuse.

Subsequent studies by Yen [1976], who stayed with the group for a longer period, indicated some variations from the technological patterns defined in earlier studies. Yen's studies took place when hunting had already been introduced, as well as the production of sago to supplement the group's source of carbohydrates. According to Yen, the extent of the foraging activities of the Tasaday appeared to be wider than estimated by Lynch and Fernandez. The density of *biking* (*Dioscorea* spp.) also appeared to be less than the estimated 8 plants per 50 m² reported earlier. Since most roots exploited are annuals, the rate of exploitation appeared to be faster than the regenerative processes of the plants, hence the area of exploitation was continually expanding as collection grounds were depleted. To cope with the continuously decreasing number of *Dioscorea* that could be harvested, the Tasaday began intervening in the life cycle of the plant [cf. BRONSON 1977: 28; CALDWELL 1977: 80; COHEN 1977: 141]. This intervention consisted of replanting the crown of the tuber with the vine still attached into the side of the hole from which the tuber had been removed, to propagate vegetatively another tuber. The location of these is remembered and the harvesters return to the vines to dig the tubers some 6 to 9 months later: an 18–24 month period of development is estimated by Yen. In the 20 km² explored by Yen, the Tasaday pointed out only 34 *Dioscorea* vines, all of which had been previously replanted.

In general, the utilization of plant resources by the Tasaday, e.g., plant buds, fruits, flowers, and the like, appears to have little damaging effect on the environment. The exploitation of *Dioscorea* is one exception, as is the introduction of sago-making. Sago-making necessitates the destruction of *Caryota* palms for which there is no vegetative replacement. The normal life cycle of the plant thus ends and reproduction is curtailed since sago-making takes place prior to fruiting. The use of the leaf-buds also aggravates the reduction of the number of plants, consequently increasing the area of exploitation as the supply is depleted locally. In an area of 20 km², Yen [1976] found only nine *Caryota* palms near maturity, none of which was ready to be exploited; over 50 plants were less than 2 m high, and intermediate sized palms were scarce, indicating the extraction of leaf-buds from these plants. Since it takes some 15 years for the palm to mature, the continued exploitation of *Caryota* by the Tasaday would require expansion of the territorial range of exploitation. Yen also covered an area of 4 km² in order to approximate the density of the *Dioscorea* plants exploited by the Tasaday, locating only seven plants, two of which were considered harvestable. The two tubers weighed less than 1 kg.

Although Yen did not fully discard his notion of the Tasaday as belonging to an "affluent and leisurely society" he did question the alleged abundance of provisions in the area, and noted the changing pattern of subsistence strategy with the introduction of new techniques of exploitation. The papers by Yen [1976] and Fox [1971] are useful in describing the incipient mode of cultivation, called *famula* by the Tasaday. Prior to contact, in 1971, the Tasaday were food foragers within the context of a primary rain forest. Subsequently, the Tasaday adjusted by obtaining a more reliable supply of food by developing technologies geared towards production,

but still without the exploitation of mammalian resources [cf. CALDWELL 1977: 86].

THE TAU'T BATU

First reported in 1978, the Tau't Batu of southwestern Palawan, Philippines, are swidden cultivators who supplement their broad spectrum agricultural production with hunting. The flora of the Singnapan Basin, where the Tau't Batu live, is characterized by a mixture of secondary growth forests growing on limestone and some patches of primary vegetation. The extensive secondary forest is the dominant element in the vegetation cover of the area. The character of the forest cover suggests a long and continual exploitation by man, over a period long enough to reduce the primary character of the virgin forest to a secondary form. This process of reduction stems from the subsistence technology of the Tau't Batu, based on slash-and-burn cultivation of a broad spectrum of crops including rice (*Oryza sativa*), corn (*Zea Mays*), cassava (*Manihot esculenta*) and sweet potato (*Ipomoea batatas*). This technology requires periodic movement through a number of fields to accommodate certain crop requirements, such as that of rice, which can be planted only in a first year field. Fallow periods that may last a number of years give rise to the proliferation of secondary vegetation in the Basin. A good proportion of the flora in the secondary forest is harvestable, thus extending the length of time the land remains in cultivation until it is cleared again for another cycle of planting.

The primary growth in the Basin is distinctive in that most of the species display strong similarities with the flora of Borneo. There is little development of an understory, however, owing to the relatively thin and infertile soil. The limestone forest on the northwestern flank of the Basin hosts a distinctive fauna and offers an excellent area for research, since this type of forest has not previously been studied in the Philippines.

All of the various types of forest in the Basin provide inferior sources of roofing materials, most of which deteriorate within one season of use. This scarcity has a marked effect on the culture of the Tau't Batu, being one of the critical factors in the pattern of transhumance. The agricultural phase is spent in the open field during the first half of the year, and the hunting-gathering stage is spent in caves, during the latter part of the year, at the height of the rainy season.

There are a limited number of birds, monkeys, squirrels and freshwater fauna in the secondary growth forest near the cave habitations in the northern portion of the Basin. Several species of cyprenids and crustaceans occur where the river goes underground. This general area is also where the Tau't Batu catch the several species of bats and swiftlets that form a substantial portion of their protein intake.

The northwestern part of the Basin, where a mixture of secondary growth and limestone forest occurs, reportedly hosts a wide range of birds and mammals. This particular area is especially attractive to fauna because of the presence of fruit-bearing trees.

Thirteen species of birds have been collected in the primary forest in the north-

eastern part of the Basin. Wild pigs and shrews were also noted. The presence of fruit-bearing trees makes this area, also, an excellent feeding ground.

Most animals are exploited by the Tau't Batu. But the faunal resources in the open areas are underutilized because of a poorly developed hunting technology. Capture levels in the caves are much higher and there is a more marked reduction in cave fauna. Hunting activities are seasonal. The months from May to August are devoted to agricultural pursuits, and since fauna born earlier in this season are still immature, hunting returns appear to be low.

Trapping is the principal mode of animal capture during this important phase in the agricultural cycle. The traps are utilized more as protective devices against possible depredation of wild pigs on cultivated fields. Pigs are attracted at this time of the year to the fields where food is more available, and pig traps are thus set all about the game trails around the fields. As opposed to agricultural activity, the true season for the exploitation of fauna is the period from October to May. These are also the months when many trees flower and bear fruit, thus making it easier to bring down game birds and animals that feed on the ripening fruits. With the food supply for the rest of the year already conserved in the granaries or cached in the caves, the remaining activities are the periodic harvests of non-grain crops for daily consumption. More time is thus available for the pursuit of game which abounds during this season in the vicinity of the caves.

A population of 86 people live in an area of only 176.05 ha; their strategy for subsistence is the production of a food base that is continuously renewable, with risks relatively spread out to allow for alternatives in case of crop failure. Given the karst topography of the Singnapan Basin, the tropical weather affected by monsoonal wind currents, and the technological development of the people, the strategy is based on horticulture with foraging to supplement production. Like other Palawan groups, the Tau't Batu are swidden cultivators, but unlike most Palawan groups, they are multicroppers, relying on cassava (*Manihot esculenta*) as the major source of carbohydrates. Cassava, is not the most important crop in a sociological sense, this position being reserved for rice (*Oryza sativa*).

The classic mode of slash-and-burn cultivation provides the principal form of production for the Tau't Batu. Multi-cropping appears to be the general pattern in the swidden; after the initial planting of one crop, another is introduced between the seedings of the first. The fields are seeded with a digging stick. Corn (*Zea Mays*) is often the initial crop, and rice is then inter-cropped. When the rice has grown to about 10 cm, taro (*Colocasia esculenta*) is introduced, together with patches of sugar cane (*Saccharum officinarum*). Cassava (*Manihot esculenta*) is planted just before the other plants flower and is cultivated for 2-3 years. The last crop planted is sweet potato (*Ipomoea batatas*) which, depending on the care given, may be cultivated for one year. Among plants that may be included in any swidden are pineapple (*Ananas sativa schultz*), bananas (*Musa sapientum*), and a variety of vegetables.

Rice is the major crop that defines the annual cycle. It is this crop, however, which does not seem to fit into the pattern of the weather and the transhumant move-

ment of the people, since the harvest of rice lasts well into the heavy downpours with the coming of the southwest monsoon. The people thus remain in their poorly constructed field houses, exposed to the elements, instead of transferring to the well-protected caves. The delay in movement to the caves suggests that the earlier cycles of the Tau't Batu did not include rice cultivation.

By the time the first harvest of rice is brought into the granaries and the supplies cached in the caves, the Tau't Batu have moved to the caves to avoid the heavy rains and the expected flooding of the basin floor. It must be remembered that even with rice harvested, several crops with differential maturation periods still remain in the field, ensuring continuous and well-spaced harvests. Excursions to the fields may occur as occasional sallies to harvest needed supplies. The concentration of root crops and the technological development of the Tau't Batu suggest that the earlier cropping of the fields was based on roots rather than grain. This is particularly evident in their attitude toward harvests, which is to some extent maintained even with reference to rice. The Tau't Batu do not store large quantities of food in their caves; rather, enough for 2-3 days is stored, and when this is exhausted, they go to the fields to obtain more. This intermittent securing of supplies is carried on even in the case of rice, which is stored in field granaries instead of in the caves (where rice would be more secure from the rains).

Although it is rather difficult to ascribe seasonality to the hunting schedule, this may be done for the Tau't Batu in terms of prey type. There is a seasonal intensification of the activity associated with the gestation cycles and feeding habits of the animals themselves. Throughout the year, hunting is pursued to complement the carbohydrate diet.

The Tau't Batu use three types of traps: a spear spring trap for bigger game; a vertical noose spring trap for smaller game; and a horizontal noose trap for birds. Spears and the blowgun are also used for hunting. The Tau't Batu have devised an unconventional combination of blockades and swatting stations principally to catch swiftlets (*Collocalia* spp.) and bats in the caves and passages through trees and on the upper slopes of the basin. Channels are cut through trees in the open area and a raised platform is placed at one end of the channel, where the hunter can stand with a bird-swat woven from a *Caryota* palm frond. Passages in the caves are blocked off using tree branches, leaving only one passageway for the birds to pass through; a platform is also raised in this passage for the bird swatter. The same system is used for catching bats, except that a long bamboo pole wrapped with *Calamus* thorns is used to swat the bats.

The river is also a reliable source of protein. The women, in particular, are adept at exploiting this resource, generally using a fish weir supplemented by dip nets. Bare hands are also effective, especially in securing various species of crustaceans, and plant poisons are used to intoxicate fish in streams.

Hunting remains a secondary production mode. Most of the larger game are obtained opportunistically, or caught in traps. The relative frequency of capture is higher when the rice crop is ripening because pigs feed on the grain; in addition more

traps are activated during this period. At the end of the agricultural cycle, the focus of hunting shifts to the caves, where it is directed principally toward the bats and swiftlets. This period coincides with the maturation period of the bats, and hunting becomes more efficient in terms of energy expenditure as against protein capture during this time. The bats are mature enough to use the higher caverns for access routes. At this time, the bats are not only more vulnerable but also more profitable to catch. The caves now utilized by the Tau't Batu are more easily managed and the frequency of catches is higher during this period of the year.

At the height of the rainy season snails become plentiful about the rocks and vegetation near the caves and the streams. Snails form a substantial part of the Tau't Batu diet, since these are easily collected and require very little energy expenditure.

The Basin drains fast at the end of the rainy season and the water resources higher up the slopes diminish, marking the beginning of a new agricultural phase. The fauna is drawn down from the caves. The blowgun becomes more effective during this time, since it is easier for the hunter to lie in wait for his prey near the watering places. The hunting lore of the Tau't Batu appears to be highly developed, including a knowledge of the seasonal feeding habits of the animals. The Tau't Batu are known to exploit over 30 species of birds, and the people know the kind of food these birds eat, and when in the year these foods are used by the different birds. The same is true with regard to all the other fauna exploited.

THE I'WAK

The I'wak are a group of about 2,000 individuals living in scattered enclaves in the provinces of Benguet, Nueva Vizcaya, Nueva Ecija, and Pangasinan, at the foot of the southern Cordillera of Luzon. The subgroup living in the Province of Nueva Vizcaya, in the vicinity of Boyasyas, are dispersed in eight communities located some 840 m above sea level. The terrain is rugged, marked by secondary forest thinned with grassland at the lower reaches, but characterized by increasing maturity as elevation increases, nearing a climax at the summits and in the ravines of the higher slopes. The dominant species is the tropical oak (*Quercus soleriana*), and the soil is classified as Guimbalaon clay in its eroded phase. The soil particles are sticky when wet, but loose and friable when dry. The soil is highly permeable, which facilitates the process of weathering when the vegetation cover is removed. The eroded phase of this kind of soil varies in thickness from 5–10 cm. Relief ranges from rolling to mountainous, and is characterized by boulders and rock outcrops.

Considering the soil type and other factors, the land exploited by the I'wak is in an advanced stage of degradation, which has a marked effect on both the vegetation cover and the fauna. Thus, the more exposed areas here are grasslands dominated by *Imperata cylindrica* and *Saccharum spontaneum*—coarse grasses that appear when the original forest cover is removed, and *Miscanthus japonicus*, a reed that constitutes a thick cover. There are few major economic animals, primarily deer (*Cervus*

sp.) and wild pig (*Sus* sp.). Rats (*Rattus* sp.) and chicken (*Gallus gallus*) still abound and various migratory birds and bats are also exploited. Animal life in the streams contributes to the total subsistence production.

The existence of the I'wak was reported as early as 1594 and the fact that taro (*Colocasia esculenta*) is their principal food was noted in early Spanish chronicles dated 1595 [cf. BRONSON 1977: 26]. The I'wak remain the only Philippine group who rely on the dry cultivation of taro as the principal crop; taro maintains its important ritual position to the present. Rice, regarded as a prestige crop, is also now being cultivated to a limited extent.

Taro is known as *aba*, among the I'wak, except in ritual, when it is termed *labenga*. Of the approximately 1000 known horticultural varieties of this genus [HILL 1952], ten are cultivated by the I'wak. All are planted in swidden fields using either the intensive wet method or the more common dry technique. In recent years, there has been an increasing trend toward sweet potato (*Ipomoea batatas*) cultivation as well as a shift to more dry cultivation of taro (as some of the wet paddies to the south of the area were converted for wet rice cultivation). Rice agriculture was moved to the upper reaches of the river, but the practice was later abandoned. Major cropping in this area is now limited to taro and sweet potato, though a few rice paddies are still found in the lower reaches of the area. In marked contrast to the Tau't Batu, the I'wak are dependent on taro as a major crop.

Dry taro cultivation has an associated seasonality, although it differs somewhat from that associated with maize or rice. The taro plant itself is not seasonal, but the association with the slash-and-burn technique lends an aspect of seasonality to the cropping. The cultivation follows the classic model described by Conklin [1957], the start of the cycle being triggered by the onset of the dry season. Three zones are available to the I'wak: the secondary forest, the reed-covered slopes, and, to some extent, the grasslands that are slowly encroaching on their fields. Total agricultural production, however, is insufficient to meet their minimum subsistence requirements, even when the total harvest from taro, sweet potato, rice, other cultigens, and products of silviculture are combined. To supplement production, the I'wak turn to animal husbandry, craft production, and wage labor. Foraging and hunting constitute a minimal contribution to production owing to the degraded nature of the environment. Some seasonal protein capture is accomplished when migratory birds are caught at night using lights and nets. But more bats than birds are caught by the I'wak.

I'wak subsistence is in a very difficult position owing to a combination of socio-economic, environmental and other factors. The first problem is that the culture of the I'wak is tied up with the taro crop, as reflected in terms of social organization, ritual systems and technology, all of which assume an annual cycle when coupled with shifting cultivation techniques. The I'wak have been undergoing a process of integration into the mainstream of Philippine society, and encounters with more dominant cultures have occurred. Land tenure has become a problem owing to encroachment by cattle raisers, land claims, and the increase of grasslands dominated

by *Imperata cylindrica*. The land available to the I'wak is, therefore, diminishing and can sustain their subsistence technologies only with difficulty. Although these people were largely monocroppers in earlier days, they now must resort to a different strategy of product mix, including intercropping of sweet potato, a higher yielding crop since the opportunity costs are low. Sweet potato is characterized, however, by diminishing returns because it depletes the soil more readily. Agricultural production thus fails to meet the minimum subsistence requirements and recourse is made to the market economy, including wage labor. Rice remains almost peripheral to basic subsistence, but assumes a culturally prestigious position. The same factors that established the limits of agricultural production also affect the hunting activities of the group, with captures becoming rare events. A more stable protein source is obtained through the raising of pigs by every household, and these are distributed through the ritual meat exchange system that links the various social units.

SUMMARY AND DISCUSSION

Although the three groups are not necessarily representative of the prehistoric developmental sequences that took place in the Philippines, they do represent different levels of development and integration relative to subsistence technology. It is difficult, if not impossible, to indicate with any degree of precision the chronological sequence of technological development for the Philippines, a consequence of the roughly textured geographic and sociocultural environments of the country, which suggest differential sequences at any one time in different places. At the same time, it is difficult to indicate a one to one correspondence between existing cultures and those existing at some earlier point in time, even though there is an expected similarity of technological stage. There is some value, however, in utilizing these present cultures to try to understand the earlier ones, if only to illustrate adjustments of a group to a particular set of factors.

Prior to contact with a member of the Blit group, the Tasaday were mainly food foragers, with hunting *per se* beyond their technological capability. In a primary forest habitat they managed to extract subsistence from this mature system, degrading to some extent the source of their subsistence base, the *Dioscorea*, and resorting in the process to incipient cultivation as an adjustment to the imbalance. The introduction of metal tools and greater contact with the outside world increased their hunting skills and extractive capabilities, thus further degrading another element of their environment, the *Caryota* palms.

There appears to be some correspondence between the technological levels and the type of environments in which these technologies operate. The Tasaday were able to subsist in a primary forest environment purely on a domestic type of micro-economy based on foraging (without hunting), although they pushed the limits of the local carrying capacity with regard to the availability of *Dioscorea*. The Tasaday do not live in an area conducive to the development of grain subsistence [cf. GORMAN 1977: 339], but are, rather, reliant on *Dioscorea*. The forest cover has thus far prevented the intrusion of understory growth (especially grasses) and the high elevation would have inhibited the proliferation of grain crops.

Although the Tau't Batu of Palawan practice hunting and a multi-crop swidden cultivation, these pursuits are practiced in a huge karst sinkhole that is dominated by

secondary growth with patches of primary growth and limestone forests. The product mix results from the uncertainty of relying on a major subsistence base which the environment cannot support. The strategy here is to distribute the risks over a number of staples including grains, like rice and corn, and roots, such as varieties of *Dioscorea*, *Colocasia*, *Ipomoea* and *Manihot*. Grain production is generally not enough among the Tau't Batu to last more than three months, even with judicious consumption, and the group constantly falls back on their root crops for the rest of the year. In fact, when all else fails, the root crops must fill the gap, since these plants are not subject to the seasonal shifts that often leave a period of hunger between harvests. This pattern is characteristic of other Palawan groups who are dry rice cultivators. Although rice is a major prestige crop, the life cycle of the plant does not fit with the environmental adaptation of the Tau't Batu, with specific reference to the weather and the transhumant pattern.

Although largely degraded to secondary growth, the forest cover still supports a wide range of fauna. Coupled with equipment and technology not exhibited by the Tasaday, the Tau't Batu engage in hunting to increase their protein base. Although an open society, the group maintains a more or less constant population through sociocultural means to limit the density within a range tolerable for minimum subsistence. This, however, did not prevent a decline in the populations of the indigenous fauna as hunting skills and exploitation developed.

The I'wak of the Cordilleras, on the other hand, maintain an unstable existence in an area of advanced environmental degradation dominated by monocropping of *Colocasia*. The technology of shifting cultivation is precariously maintained in heavily exploited forest already characterized by advancing grass infestation. A more intensive approach to cultivation through intercropping is being resorted to, together with attempts at wet rice cultivation; the costs of shifting the techniques of wet taro cultivation to wet rice are less than if a total technological shift were made. With the diminishing forest cover, the populations of economic fauna have diminished to the point that even with developed hunting technology the returns from such activities have been minimal. Intensive pig raising is conducted as an alternative strategy, and pigs are socioculturally important and ritualized. Failure in the agricultural sector forced the I'wak into the national market economy. There is an indirect relationship, in the Philippines, between environmental degradation and technological levels of integration: as the exploitation of natural resources advances, there is a corresponding development of more efficient methods of energy extraction. The upper limits of such extraction are reached when environmental resources become so depleted as to make returns no longer profitable, thus increasing the pressure for technological change.

However, as shown in the above examples, the most stable subsistence base is root crops: among the Tasaday, *Dioscorea*; among the Tau't Batu, *Manihot*; and for the I'wak, *Colocasia*. Although the first two groups cultivate rice, its relationship to the culture and aspects of the environment suggests a development more along the lines of a root crop rather than a grain. Direct archaeological evidence of rice in the Philippines consists of burnt grains found in Nauhan, Oriental Mindoro, in association with Sung dynasty ceramics. Grain crops have penetrated the cultures by degrees, with corresponding disruption of existing cycles and concomitant adjustment in the social organization. To a large extent, the various cultivation

techniques, depending on their efficiency, have a direct relationship with the degree of environmental degradation, and the labor and time investments per unit product. The cost of transforming energy, thus, increases as the technology develops.

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Photo. 1. Aerial view of Tiningluan, Singnapan Basin showing the river, secondary growth and fallow fields.



Photo. 2. Aerial view of Kabasakan, Singnapan Basin showing the field houses among the swiddens.



Photo. 3. The three mouths of Maribung Cave inhabited by a multihousehold group of the Tau't Batu.

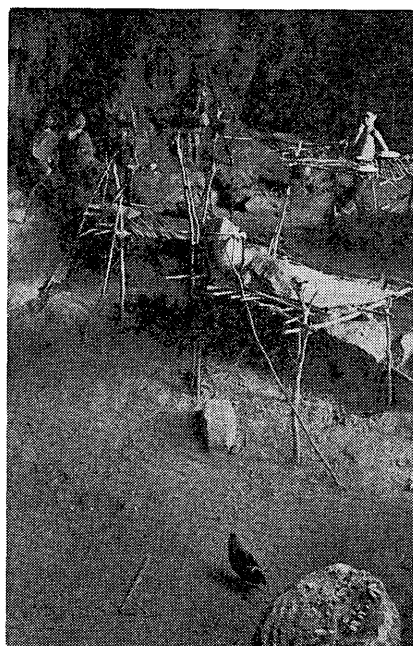
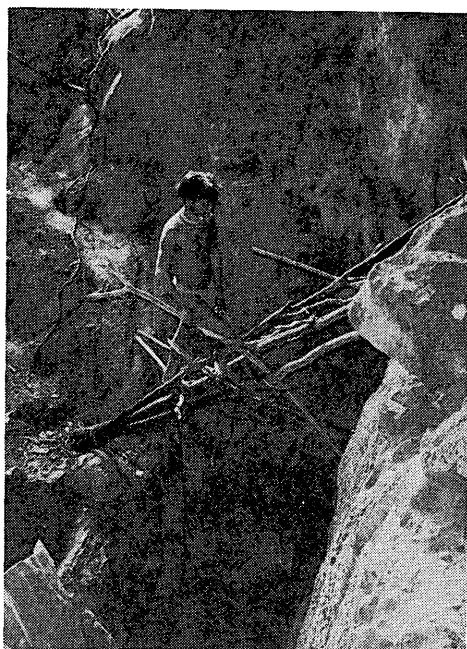


Photo. 4. The multi-purpose platforms in Pangi-pangi Cave. Bridge crossing a chasm inside Pangi-pangi cave for access to a ledge utilized by a household.



Photo. 5. Clearing a secondary forest for another season of swidden activities.



Photo. 6. A burned field prior to planting. Diklay is the acknowledged leader among the Tau't Batu.



Photo. 7. Burning of dried brush in an I'wak swidden.

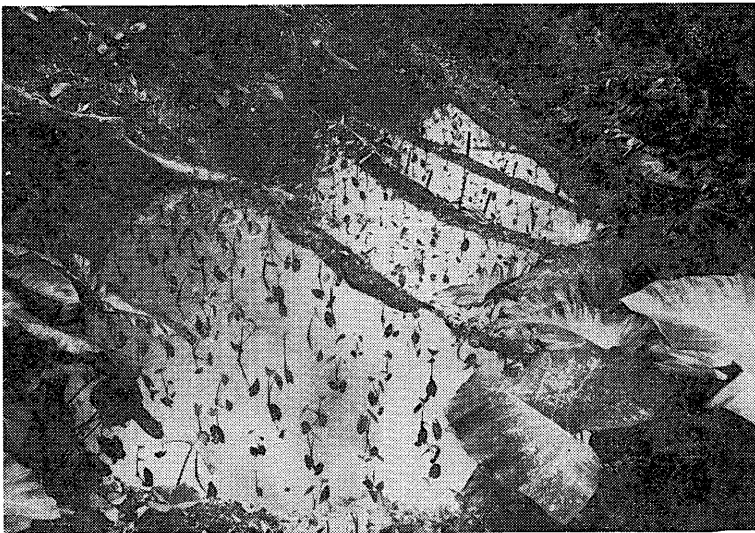


Photo. 8. Small terraces of taro in a catch basin.



Photo. 9. Planting taro cuttings in a field in an advanced state of degradation.



Photo. 10. Planting of taro in a typical I'wak field in a denuded area.



Photo. 11. Exploitation of a freshwater stream in Boyasyas by an I'wak male.



Photo. 12. Grandmother and child with a harvest of sweet potatoes.