Culture and Resource Management: Factors Affecting Forests[1]

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Abstract: Efforts to manage Pacific Island forest resources are more likely to succeed if they are based on an understanding of the cultural framework of land use activities. This paper explores the relationship between agricultural systems, population density, culture, and use of forest resources on the islands of Yap. Agricultural intensification is related to population increases in the past. It appears that resources were, to some extent, managed via a highly organized stratified social system. Today, changes have resulted in a loss of insularity, and controls over resource exploitation are fading. Agricultural technology has become more extensive and forest resources are being expended rapidly. Participatory research is suggested as a means of focusing local attention on systems of food production which incorporate more sustainable use of forest resources.

This symposium deals with tropical forestry *for* people of the Pacific and we are concerned with the management of forest resources. We cannot assume that people with different cultural backgrounds perceive their environment the same way we do, or that we all share the same scientific values and attitudes (Chase and Sutton 1981, Smith 1987). This paper deals with some of the cultural factors affecting use of forests on the island of Yap in the Federated States of Micronesia. It is based on the author's observations over the last 15 years, a study of vegetation patterns, and data collected in an ongoing Forest Service study.

The Setting

Yap is a close cluster of four high islands lying within a broad fringing reef at lat. 9°33' N. and long. 138°09' E. in the Western Caroline Islands. The combined area of the four main islands is about 100 km² (39 mi²), and the highest point is 174 m (571 ft). The climate is warm and humid. Mean annual temperature is 27 °C (81 °F). Mean annual rainfall is about 3000 mm (120 in). The driest months are February to April with an average of fewer than 180 mm (7 in) precipitation each month. Wettest months are July through October, with an average monthly rainfall of 330 mm (13 in).

Estimates of Yap's population prior to written history range from 25,000 (Hunter-Anderson 1983) to 40,000 (Underwood 1969). After contact, there was a drastic drop in population due to epidemics of introduced diseases. Population decline continued through 1946 when the population was estimated at 2,400 (Useem 1946). Since 1946, the island's population has been rising rapidly.

Results of the agricultural system employed to feed the large population of the past can be seen today in the island's anthropocentric vegetation pattern. Vegetation maps based on 1976 aerial photographs (Falanruw and others 1987) show that some 26 percent of the island had been developed into a system of tree gardens with taro patches. About 34 percent of the vegetation consisted of a mosaic of native forest, secondary forest, secondary vegetation and active garden plots. Another 22 percent of the interior was savanna grassland. Mangroves made up some 12 percent of the vegetation. Other types together made up less than 6 percent of the land area.

The Traditional Agricultural System

The agricultural system which produced this vegetation pattern has been described elsewhere (Falanruw 1985). Briefly, the system consists of tree gardens with taro patches associated with villages located mainly along the coast. Intermittent mixed gardens generally occur inland of villages. Here trees are burn-girdled to admit light and remove root competition. The clearing and burning practices observed today vary from the practices generally described for "slash and burn agriculture" (FAO 1957, National Research Council 1982) in that trees are not felled and burning is generally confined to the base of trees difficult to kill by girdling. Crops are planted before, along with, or after burning activities depending on the crop, site conditions, and weather. Gardens are cleared in the dry season and planted as rains begin. By the time the rainy season sets in, crops generally cover much of the ground. The most important crop is yams (*Dioscorea* spp.), but a variety of other crops may also be planted. Today's gardens often yield a succession of up to 15 crops as well as a number of useful materials and byproducts during and after the term of the garden per se. After one to three years, the garden is allowed to go fallow.

The intermittent gardens are the most dynamic component of the agricultural system. If the gardener settles in the area, it may progress toward a tree garden "agroforest" as useful trees are planted and taro patches are developed. Otherwise, succession may proceed towards forest, or savanna grassland, depending upon the subsequent history of the plot. The extent to which regenerated forest may differ from native forest is influenced by many factors such as the severity of the burn, the frequency of subsequent burns (Manner 1981, Gourou 1958), size of the clearing, selective weeding, and other activities of the gardener. Other factors are availability of seed sources, displacement by introduced species, and availability of seeding agents, which on Yap include fruit bats as well as birds. Land crabs and rodents may also modify regrowth. Mueller-Dombois (1981) suggests that species having wide spatial separation are likely to be lost. Studies of the species composition of plots on Yap before, during, and after gardens and of plots for which the fallow period is known are ongoing.

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The Impact of Population

Population pressure would necessitate the conversion of forest land to food production. It is postulated that lands under shifting cultivation have traditionally supported a population of fewer than 20 people per square mile (Nye and Greenland 1960). With a pre-Western contact population density estimated as high as 625 to 1000 people per square mile (Hunter-Anderson 1983, Underwood 1969), fallow periods could not have been long enough to allow for the regeneration of the forest canopy.

A census of garden plots and house platforms in one municipality on Yap gives some evidence of this process: Mahoney (1958) reports 2,127 garden plots and 485 stone dwelling platforms. This would give a ratio of 4.3 garden plots per household. If garden plots were developed each year and maintained for two years, the fallowing period could be only about two years. This would not allow enough time for the development of a mature forest canopy with primary forest species.

The inhibition of the formation of a forest canopy would result in decreased transpiration and the equivalent of an increase in precipitation (Sanchez 1976). The clearing and cropping practices are likely to result in a decrease in infiltration rate (Laland and others 1975, Sanchez 1976). Daubenmire (1972) compared filtration rates under forest and savanna and found a 45:1 relationship. If, with frequent burning and a nearby source of grassland species, forest areas are converted to grasslands, the evaporation rate rises and the overall effect is "too much water in the wet season and too little in the dry season" (Komkris 1978). The lack of a canopy would result in a decrease in biomass on the site and lowered rate of nutrient cycling. The reduction in soil fertility would support fewer trees (Budowski 1956). As a result, the area would be "stalled" as a savanna grassland sere.

There is a great deal of discussion in the literature on the relationship between swidden agriculture and the origin of grasslands (for example: Budowski 1956, De Schlippe 1956, Fosberg 1960, Manner 1981, Mueller-Dombois 1981, Nunn 1991, Ruddle 1974, Scott 1978, Spenser 1966, Whitmore 1975). The matter is complex and affected by a set of factors unique to each setting. There is general agreement, however, that frequent burning activities have contributed to the expansion of areas devoid of a tree canopy. Burning is not confined to swidden agriculture, but also occurs as accidental or intentionally started wildfires.

When asked about the origin of the savanna grassland, Yapese elders reply that it has always been thus. Indeed, the type is mentioned in the legendary history of Yap as early as the period when people interacted with spirits. Legends tell that it was in the savanna of old that a spirit taught people how to make and use fire for cooking.

Agricultural Intensification: Ditched-Bed Technology

Intensive methods for managing water, weeds, and soil fertility would be required if savanna grasslands were to be used agriculturally. These methods exist in the technology of ditched garden beds. Throughout Yap one can see garden beds surrounded by ditches, and the inverse, taro patches surrounded by raised areas. In open canopy gardens, the ditches provide drainage and the soil excavated from the ditches is mounded on top of the slashed vegetation on the beds to inhibit weeds and to provide fertile soil. The process is very labor intensive, especially prior to the general availability of metal tools, when a spade made from a split trunk of an *Areca* palm was used to loosen the soil and a flat basket woven from coconut leaves was used to transport the soil from the ditch to the garden bed. The ditches then served to demarcate the garden bed and secure the investment of energy of those who created it. Heavy rains would result in some erosion, especially if they came before plantings covered the site. Hurni (1982) suggests that drainage ditches can reduce erosion from swiddens by about half. Some of the topsoil which is washed into the ditches is returned to the garden plot the next time it is used. Silt which accumulates downstream of series of ditches collects in pits used for taro patches. In low-lying areas, ditches are made within taro patches to improve water circulation.

Given the intensive labor required, the ditches must have been made during periods of dense population when resources were at a premium. When today's gardeners are asked who made them, the answer has been that the original beds were made by the ancient people. The technology continues to be employed in the open canopy production of sweet potatoes and to a lesser extent in gardens made in less fertile sites covered with secondary vegetation.

Today ditched garden beds are clearly visible on aerial photographs on at least 33 percent of savanna grasslands. In the field they can also be seen below secondary vegetation and even forests. When gardens are made in well-developed forests it is not necessary to re-excavate the ditches around garden beds. To do so would, in fact, be quite difficult because of the presence of tree roots. Given these practices, it would appear that the existence of ditched beds indicates that much of Yap was once gardened so intensively that the forest canopy was, for a time, absent. The period of depopulation which continued through World War II resulted in the natural reforestation of many of these areas. Other areas appear to be stabilized disclimaxes of secondary vegetation and savanna grass and fernlands.

Clarke (1966) compared the agricultural systems of four New Guinea communities whose methods might be considered as "stages along a hypothetical chain of development from a simple extensive forest-fallow rotation to a more elaborate and intensive grass fallow cultivation" (Clarke 1966:347). With increased population density and a shortened fallow period, forest lands may be degraded to savanna grasslands and more intensive methods would be required to produce sufficient food. The systems on Yap show a similar intensification in the ditched-bed technology. When depopulation reduced the ratio of people to resources, however, forests regenerated. This has enabled people to return to the use of extensive methods which produce adequate returns for minimal efforts. Much of today's production is obtained via the expenditure of forest reserves. If this trend continues unabated, a loss in biodiversity and eventual environmental degradation can be expected.

Traditional Management of Land Resources

It has been suggested that island cultures are adaptive to the island ecosystem (Fosberg 1978, Rappaport 1963). If this is the case, we might expect to find some mechanisms within island cultures that would counteract the human tendency to overexploit resources to the point of environmental degradation. The practice of ecosystem conservation per se is not described in literature on Yap, nor has it been brought up by any elder interviewed in this project. Some conservation measures appear to have been inherent in the traditional religion, however, and the social system did have a number of features that limited opportunities for "the tragedy of the commons." Resources were managed via a highly organized stratified social system. This system might be illustrated by considering the controls on the activities of an individual gardener *(fig. 1)*.

When a woman (A) marries into an estate, she and her children gain access to appropriate lands of that estate subject to the approval of estate elders (B). The resources of these lands are also subject to "trustees" from the sister's side of the family of the estate head, for although kinship inheritance is generally patrilineal, sisters and their children retain trustee rights. Trustees (C) may declare offensive behavior and take punitive action. They may also request resources for their needs and to fulfill obligations within their own respective groups.

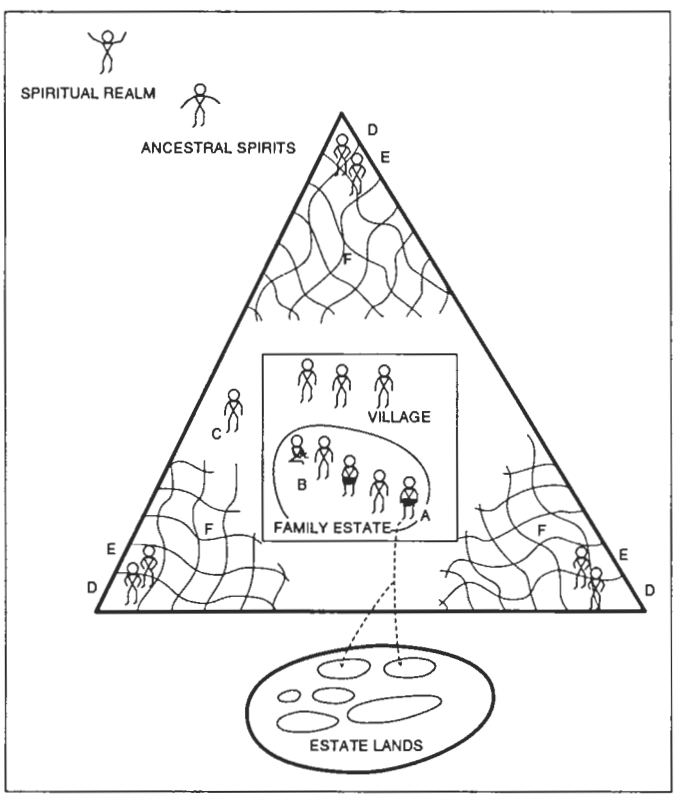

Figure 1—"Cultural constraints on use of land resources. When a woman (A) marries into an estate (oval unit), she and her children have access to appropriate lands of that estate subject to the approval of estate elders (B). The resources of these lands are also subject to "trustees" (C) from the sister's side of the family of the estate head. A number of estates exist within a village (square unit), which is directed by chiefs. Villages are organized in hierarchical relationships with three paramount villages (D), each linked with a village in another alliance (E). Each set of villages has a network of ranked villages in their respective alliance. The networks of ranked villages (F), combined with relationships of kinship, trustees and alliances, create a complex system of checks and balances on resource use.

A number of estates exist within a village, which is the basic community unit. Within villages there were three chiefs who directed the use of the village taro patch and garden lands and had some jurisdiction over other resources as well. Thus our gardener's activities are also governed partly by the chiefs of her village.

Villages are organized in hierarchical relationships with three paramount villages (D), each linked with a village in another alliance (E). Each set of villages in turn has a network of ranked villages in their respective alliance. About five social levels existed in an apparently dynamic ranking process. The networks of ranked villages (F), combined with relationships of kinship, trustees and alliances, create a complex system of checks and balances, and no one chief was capable of exerting total power or influence over his locale (Labby 1976, Lingenfelter 1975).

In addition to the social relationships governing land use, many areas were designated for specific uses. Some were sacred and should not be trespassed, others were prohibited to women. Thus even the physical area of the gardener's movement was prescribed. The social system had provisions for denying use of lands for a period of time. In addition, if one's land contained a limited resource, such as a big tree or bamboo patch needed for a community project, that resource should not be destroyed, and could be expropriated for community use. Effective physical, social, and spiritual sanctions existed in the past to support and enforce the system of controls (Falanruw 1982). The system was adapted to managing the resource-use activities of a dense population. Individual freedom was curtailed and funneled into group achievement. These achievements include major public works such as large men's houses, community houses, an extensive system of stone paths, and voyages for stone money.

The effectiveness of the control system in terms of sustainable resource management would depend on the wisdom of leadership as well as the degree of population pressure. It has been suggested that shifting agriculture in the Pacific was self-limiting (Alkire 1960, Labby 1976), and that the decreasing viability of shifting agriculture led to a predominance of taro cultivation in the South Pacific (Barrau 1961). In Southeast Asia, shifting agriculture has been supplanted by rice cultivation in many areas (Peters and Neuenschwander 1988). In the case of Yap, today's agricultural system consists of a mix of shifting agriculture, and site stable agriculture in the form of taro patches and mixed tree gardens. The combination has a greater potential for sustainability, and the systems in fact complement each other; the production of the intermittent gardens being counterpoint to that of breadfruit in the tree gardens with taro patches providing food throughout the year. Production from mixed gardens and tree crops is locally viewed as "giving the taro patches a rest," as well as providing a more varied diet.

The System at Work Today: an Example

In the past, the fruits and coconuts grown on the property of a deceased person were not harvested for about a year after the death in an observance called "lieu." The accumulated produce of the land was then gathered and presented to the appropriate relative of the deceased (Mueller 1917). Today lands of the deceased are no longer left fallow, and another type of "lieu" is practiced. The social purpose of the practice remains the same: the recognition of the relationship between the trustees of the land, and those living on the estate. The latter present generous amounts of yams to secure their residence on the land. The trustees in turn present valuables including stone and shell money, woven "begi," cases of soda and beer, hard liquor, and money. In a recent "lieu," some 710 baskets of yams totalling more than 11 tons were collected. This involved the contributions of at least 70 households, with many of the households in turn collecting contributions from within their own network.

Data on garden production now being collected will help estimate the amount of forested land converted to yam gardens for such an occasion. Today's technology for gardening includes metal tools, matches, and two new techniques for burn-girdling trees. The first is to burn old tires at the base of trees. The burning tires are moved about and enable a gardener to kill trees more efficiently. The second innovation, coming but two years after the establishment of a garment factory on Yap, is the use of the large volume of discarded cloth scraps for burning thickets of bamboo. The cloth is placed between the stalks of bamboo to use as tinder. These new techniques expedite the conversion of forest to gardens.

Influence of Change on Resource Use

Goodenough (1971) refers to culture as a reservoir of all the knowledge, skills, ideas, beliefs, values, recipes, and traditions that are known to one or more members of that society. He defines a society's "culture pool" as the sum of the contents of the propriospects of all the society's members (Goodenough 1971). A propriospect is each individual's private, subjective view of the world and its contents derived from personal experience. It embraces individuals' cognitive and affective ordering of their experience. The public culture is the modal point of the mix of the individual propriospects. The change with time of the modal point around which variance clusters shift has been described as "cultural drift" (Goodenough 1971, Smith 1987). This produces change without discontinuity.

Figure 2 shows the impact of new factors on the culture pool. The impact of these factors takes various forms. Depopu-

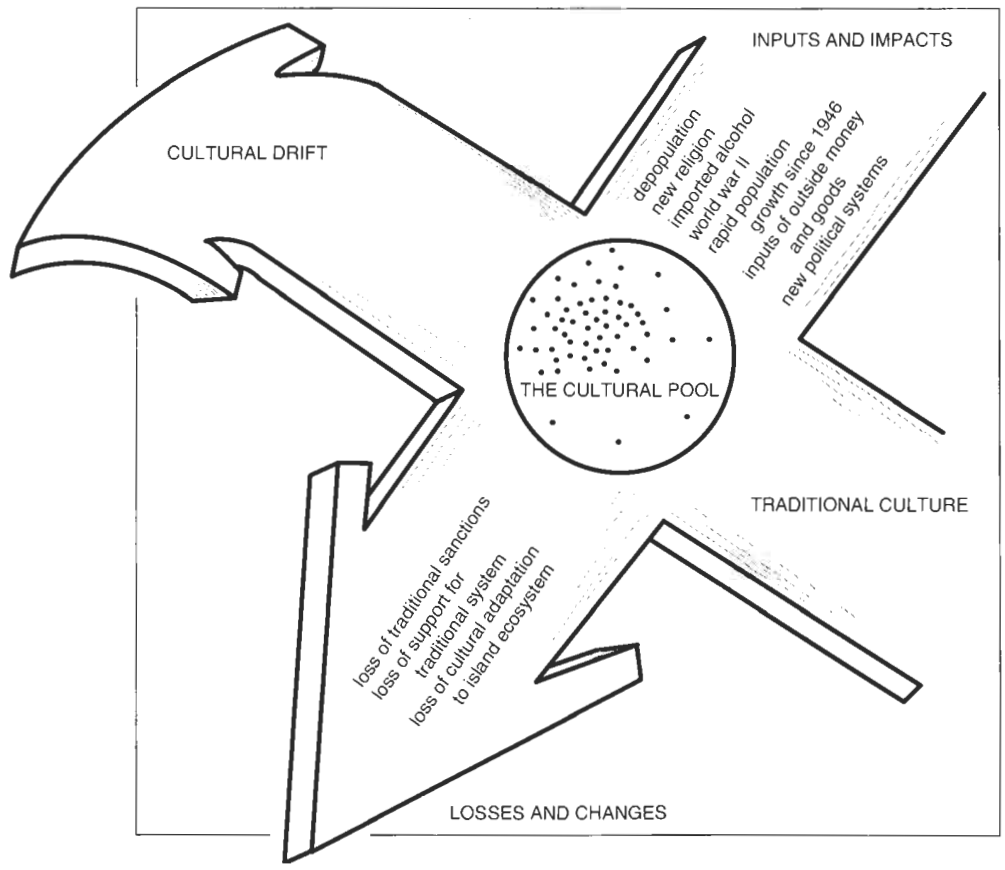

Figure 2—Influences of changes on resource use. The cultural pool consists of the propriospects of all of a society's members (Goodenough 1971). On Yap, inputs and impacts such as those listed have influenced propriospects resulting in a new modal point and cultural drift. The result has included a loss of traditional sanctions and a decrease in cultural adaptation to the island ecosystem.

lation left many "positions" in the highly organized and stratified society unfilled (Mahoney 1958), greatly weakening lines of support for the system itself. Christianity was introduced shortly thereafter, and traders began selling distilled alcohol. The Japanese occupation of the island and World War II followed. After the war, Americans introduced a democratic form of Government and directed aid through this system rather than through the system that supported the traditional hierarchy. In spite of all these changes, many aspects of the social system, such as kinship patterns and obligations, persist.

In the matter of controls over the use of natural resources, however, there seems to have been considerable change. Depopulation resulted in a lower ratio of people to resources, and the need for intensive methods decreased. Neither the new religion nor the new government placed controls on resource use. At the same time, Yapese culture was given a demonstration of the power of modern technology: nonbiodegradable materials, chemicals, fossil fueled machinery, electricity, and a dollar economy. These things are very impressive, and gradually the insular consciousness has changed to one which is not referenced to island resources alone. Sanctions have faded. When an old man tending an important shrine died, his successor on the land burned the area to make a garden and then built his house there. Within the context of the traditional religion, some misfortune should have befallen him as a result of his burning a sacred place. He suffered no such misfortune. Christianity taught people to share, and, as outside resources flowed in, there was much to share and use in traditional social exchanges. It is hard for a cognitive model in which resources are limited to persist under such conditions. The criterion of adequacy for a cognitive model is that it functions, not that it is accurate (Ellen 1982). Though Yap's natural resource base has not increased, outside inputs have made it possible for people to trespass the basic rules of caloric self-sufficiency without feeling the consequences. The culture has drifted away from one which was referenced and adaptive to the island environment to one which is much more reliant on outside support (Yap State Government 1980).

Implications for Forestry

It appears that although Yapese culture today retains its focus on social obligations, it has lost many of the controls over resource exploitation. This comes at an inopportune time. The combination of decreasing aid funds under the Compact of Free Association with the United States and a rapidly expanding population and more consumptive lifestyle will bring about greater exploitation of natural resources. There is definite need for sustainable resource management. If we are to assist people in managing their resources on a sustainable basis, we must help them to evaluate their use of resources and build appropriate experience in rational resource utilization. One way to do this is via participatory research projects. Sometimes "facts" are not as important as the context in which the "facts" are gathered (Ellen 1982). If a participatory approach is used in research and projects, the information and experience gathered will influence individual propiospects that make up the culture pool, and allow culture to readapt to ecological realities of the island ecosystem. Hopefully this change will occur before useful traditional technologies are forgotten.

Given traditional patterns of resource use, an important area of focus for participatory research projects lies in the area of food production systems involving a forest canopy. Although "slash and burn agriculture" as practiced by displaced peoples contributes to tropical deforestation (FAO 1957), its practice by generations of people confined to a small island may provide insight into the incorporation of natural processes of succession in agricultural systems. Site stable agriculture requires large inputs in order to suppress natural succession to "weeds," and to manage soil fertility and moisture. These inputs are expensive and often have undesirable impacts on the natural ecosystem. Traditional "nature intensive" systems utilize the ecological services of trees for these functions, and minimize human input. They allow for a succession of crops and secondary species and the maintenance of some wild species in the system. The impact on soil flora and fauna and important natural processes involved in nutrient recycling is less than that of chemical and mechanized agriculture. Land resources on islands are limited. If forestry does not address the matter of swidden agriculture, it will come into conflict with it at some point. It would be more effective to work with the practitioners of swidden agriculture, to enhance the system in a way which would make use of the services of trees while taking pressure off native forest resources.

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