

From Kauri to Kumara: Forests and people of the Pacific Islands

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Introduction

A common perception of Oceania is one of a scattering of isolated and widely separated islands, immersed in a vast expanse of ocean. Another perspective, held by the indigenous people themselves, is one of islands connected to each other by storylines and cosmologies to form a single cohesive unit, built on a history of ocean voyaging and knowledge transference to new environments. Waves of voyaging over thousands of years have disseminated traditional knowledge of the spiritual and economic values of natural forests and constructed gardens, from Hawaii in the north, to New Zealand in the south and eastwards to Easter Island. The history of exploration, discovery and settlement of the islands of the Pacific Ocean demonstrates human ingenuity and endeavour and a deep knowledge of plants and trees, enabling human settlement of depauperate islands with little to offer in the way of palatable fauna and flora.

Forests and trees feature strongly in Oceanic cultures. The cosmologies of Oceanic people reflect the values of trees as symbolising both rootedness in place and mobility across vast expanses of oceans. Roots of forest giants, such as the New Zealand kauri, represent a symbolic connection with place, while their trunks provided the

timber for the canoes that carried people on their epic ocean voyages across the Pacific.

Throughout the human history of the Pacific region, native forests and trees have been integral to the economic and spiritual life of its indigenous people. As with indigenous cultures throughout the world, the traditional life of Oceanic cultures was underpinned by beliefs and cosmologies that placed humans as part of nature, rather than a controlling influence over it.

The literature on the biological, ethno-botanical and environmental histories of the Pacific, however, tells a story of substantial and sometimes catastrophic environmental change as a result of human activities—hunting, agricultural practices, plant breeding, and introduction of new cultivars to island ecosystems. Human survival and progress were seemingly premised on ‘disturbing the natural order’, suggesting that cultural traditions and cosmologies connecting people and nature encompassed not only natural forests but also cultivated landscapes.

This paper explores the transference of traditional forest knowledge across space and time in the islands of the Pacific Ocean, and demonstrates its vulnerability in the light of pressure for economic development.

Imagining Oceania

The environmental setting for this paper is the planet’s largest ocean, the Pacific Ocean (from the Latin name *Mare Pacificum*, ‘peaceful sea’, named by the Portuguese explorer Ferdinand Magellan). The Pacific Ocean comprises about 46 per cent of the Earth’s water surface, with the continental land masses of Australia/New Guinea and central/south America bordering its western and eastern edges respectively. Within this vast expanse of ocean are situated thousands of small islands, comprising mainly independent countries, although some remain territories of other countries (Figure 1).

Oceanic islands and their cultures can be described and understood through political, cultural, biological, historical, geological or economic lenses. Representations of the latter often dwell on ‘lack’—depicting Oceania as a place lacking economic development, lacking connections, lacking land, and lacking resources. Indigenous people of

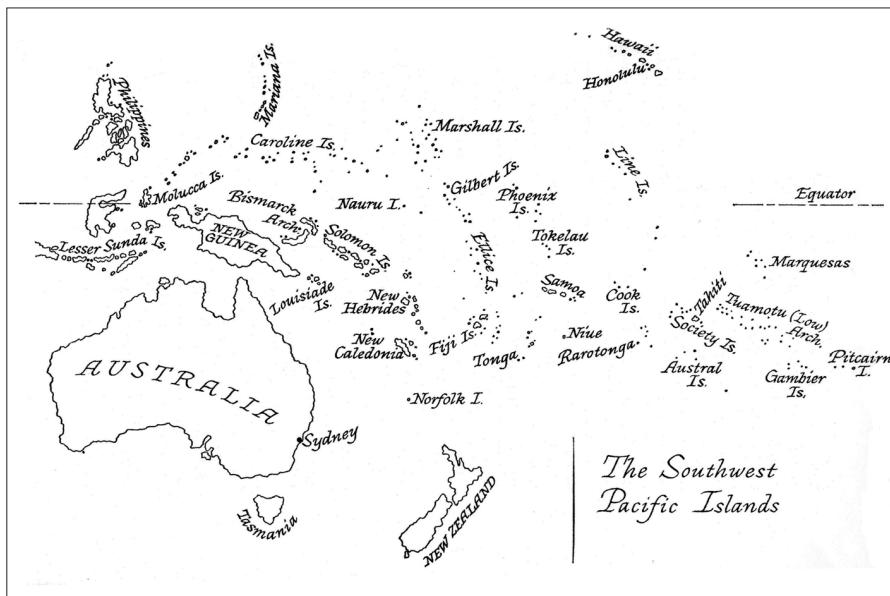


Figure 1: The countries of Oceania (from Grattan 1963, p. 191).

the Pacific have challenged this language of colonial and developmental orthodoxies and stressed, instead, the notion of a ‘sea of islands’ rather than islands in a sea (Jolly 2007). The connectivity embraced by this notion emerges from traditional connections embedded in the creation stories of Oceania, which emphasise movement—of people, of their knowledge and of their cultivated biota. Imagining Oceania in this more holistic way has been the basis for recent research into the relationships between forests and people in an area defined as the Western Pacific, for a chapter in a book being prepared by the International Union of Forest Research Organisations (IUFRO) on the state of the world’s indigenous forest knowledge (Feary *et al.* 2012).

This current paper has been informed by the IUFRO research, with a focus on the islands commonly referred to collectively as Polynesia, Micronesia and Melanesia. Australia is excluded because it differs from the rest of the Pacific in almost every way, notwithstanding similar antiquities for the commencement of human occupation in Papua New Guinea (White and O’Connell 1982) and a colonial history comparable in part with that of New Zealand (Nettheim *et al.* 2002).

In preparing the chapter and talking with other authors preparing chapters for the IUFRO book, it became apparent that ‘indigenous knowledge’¹ meant different things to different people, depending

primarily on the social history of their country of origin. In fact, some definitions of indigenous people, including, surprisingly, that of the United Nations, would exclude Oceanic peoples (and their knowledge), as they are not minority populations in their own countries (Thaman, K. 2003). The definition of ‘indigenous knowledge’ developed by the United Nations Forum on Forests (UNFF) is:

a cumulative body of knowledge, practice and belief, handed down through generations by cultural transmission and evolving by adaptive processes, about the relationship between living beings (including humans) with each other and with their forest environment (UNFF 2004).

When indigenous knowledge is used in a populist or political context, or outside the disciplines of anthropology and other social sciences, it is often portrayed with its temporal and spatial dimensions *in absentia*. But traditional knowledge does not exist in isolation; it is something built up over millennia and passed on by countless generations of indigenous people through story telling and customary law, as a way of knowing about and connecting with local environmental and cultural settings. It is not possible to fully understand ‘traditional knowledge’ without understanding how it has evolved and continues to evolve. This is of particular relevance among Pacific peoples, whose cultural traditions are characterised by extreme mobility and adaptation of traditional knowledge to newly settled islands with unfamiliar biota.

Settling Oceania

The cultures of Oceania have both shaped and been shaped by their land and seascapes over millennia. A distinctive difference exists between the larger land masses on the region’s western and southern borders—New Zealand and New Guinea (and Australia)—and the increasingly smaller and more isolated oceanic islands moving eastwards to island Polynesia and northwards to Micronesia.

Strictly speaking, the lands of Oceania have both continental and island origins, which have had considerable implications for their discovery and settlement by humans. The largest landmass considered in this paper is New Guinea, once joined to Australia, which together with Tasmania formed the Pleistocene continent of Sahul (White and O’Connell 1982).

Eastward from New Guinea, curving to the south, tectonic activity formed the rest of Melanesia in a broad arc of islands composed of continental rocks of volcanic, sedimentary and metamorphic origin (Howells 1973). This area lies within a zone of seismic instability, and volcanic eruptions are common (Bellwood 1979). Volcanic eruptions can destroy forests and gardens, but they also produce the rich volcanic soils that benefit subsistence agriculture. Further eastward, the Polynesian islands (except New Zealand) are small and widely separated; the result of volcanic activity and subsequent erosion, producing three island types—the high islands, the low islands or atolls, and raised coral islands. Northward, the islands of Micronesia are composed almost entirely of coral atolls (Bellwood 1979).

Continental and island origins have produced vastly different soil types, which have in turn been a major determinant of the nature and extent of original forest cover and of subsequent agro-forestry and agricultural development by their human inhabitants. The rich volcanic soils of the high islands and continents contrast with the coral-based infertile soils and lack of potable water on atolls (Wilke et al. 2002). The isolation and limited size of Oceanic islands have had a dominant impact, not only on humans, but also on the entire island biota (Kirch 1979).

Broadly speaking, archaeological, linguistic and anthropological research points to a history of human occupation of the wider Pacific that commenced around 40,000 years ago in the Pleistocene landmass of a joined Australia and New Guinea (White and O'Connell 1982) and moved east and south into the islands of the Pacific Ocean (Figure 2). There is also evidence for human settlement in island Melanesia (New Ireland and Solomon Islands) soon after (Mountain 1993).

The history of settlement of the Oceanic islands involved extensive sea voyaging and the transportation of domesticated food plants and animals, which began around 3,000 years ago, and culminated in the settlement of New Zealand around 800–1,000 years ago (Bellwood 1979).

The first inhabitants were hunter-gatherers, utilising the resources of the forests and all other ecosystems. Pollen and archaeological evidence suggest that techniques of plant management and manipulation through forest burning and small-scale clearing were being practiced and developed in the New Guinea highlands long

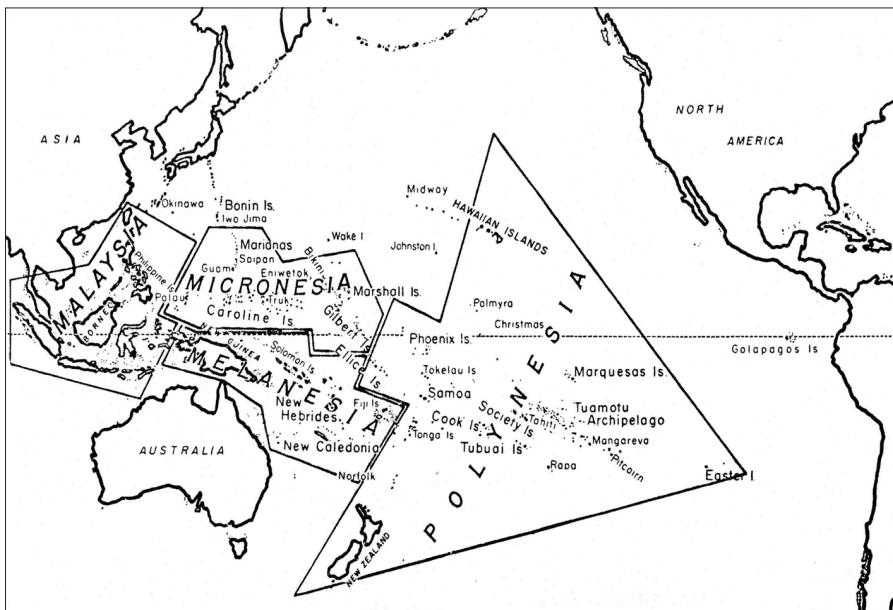


Figure 2: Main direction of human settlement in Oceania
(from Gathercole 1977, p. 190).

before full agriculture commenced around 10,000 years ago (Mountain 1993). Indigenous societies practicing early forms of agriculture would still have needed to rely heavily on wild resources to supplement the products of untested food production techniques. While some of the food resources, for example wild yams and bananas, may have been known to the colonisers, others would have required trial and error in the domestication process (Powell 1976).

The islands of Oceania are eastward of a major biogeographical boundary, Wallace's Line, and many naturally occurring edible plant foods do not occur there. Wallace's Line is the boundary between two major biogeographical provinces, and runs roughly south-north between the islands of Borneo and Sulawesi, curving east below the Philippines. The paucity of native food plants and edible animals on the coral atolls and low islands of Oceania has had important consequences for humans, who needed to bring in their own domesticated crop plants (and associated traditional knowledge) in order to colonise new islands (Kirch 1979). These came with later arrivals, the Austronesians², whose knowledge of crop production techniques was incorporated into, or in some cases replaced, established indigenous systems of land management, creating a cultural mix of horticultural and hunter-

gatherer practices. The production of food crops and manipulation of forests to increase yields of fruits or seeds brought a new dimension to the corpus of traditional knowledge which was primarily associated with the natural environment and its resources. Oceanic cultures are characterised by the subsistence practices of swidden or shifting agriculture, mainly the production of root crops; and agro-forestry, the manipulation of native trees to increase yield and to expand their geographic distribution.

The islands of Polynesia were the last places on earth to be settled by humans, so traditional knowledge for this area is relatively recent. Pottery and linguistic and other evidence points to a culture that grew out of the earliest settlements in island Melanesia around 3,000 years ago. Settlement occurred first in western Polynesia and spread to the tiny remote islands of eastern Polynesia (Gathercole 1977). It has been postulated that colonisation did not occur from island to island but involved groups of islands populated by successive waves of human sea voyagers moving between islands over millennia (Green 1993). Thus, Polynesian culture developed ‘within itself’, in response to the different environmental situations encountered. Ethno-historical sources note both similarities and differences between different Polynesian societies, due partly to the way certain resources were used. For example on high islands, the pandanus tree was used mainly for its leaves, for making a range of items such as house thatch, sails and mats. On coral islands it provided food from its buds, fruit and seeds (Gathercole 1977).

Campbell’s rendition of the discovery of the island of Tonga epitomises the early history of Polynesia:

An adventurous, sea-faring people capable of undertaking long sea voyages and of transporting colonising groups that had all the necessities for survival in an exotic and impoverished environment. In other words, colonists of both sexes made up the parties; there were probably older people and children, as well as men and women in their prime; they took with them seeds and roots of important plants that would supply not only food but also building materials, clothing, dyes, cosmetics and medicines. Seedlings of tree species that would enable the future construction of more sea going canoes must also have been included... The food plants they brought with them to Tonga were the same as were used elsewhere in the Pacific—the coconut, talo [taro], breadfruit, yam and banana (Campbell 1992: 18).

New Zealand was the last island group to be colonised by Polynesians. Many of the important plants found in the rest of Polynesia, such as coconut, pandanus and breadfruit, did not exist in the New Zealand flora, and could not be grown because the climate was too cold. New Zealand Maori adapted by developing techniques for growing and storing kumara (sweet potato), a staple of their diet. In the absence of fibres from these trees, Maori also adapted Polynesian weaving traditions to make use of the locally available flax plant, comprising several genera and species, producing the distinctive and deeply symbolic story-telling patterns of Maori material culture (Riley 2005). Gathercole (1977) called this adaptation process ‘cultural localisation’.

Traditional forest knowledge of the people of the Western Pacific is not only about the resources and cultural values of forests but also about their modification in the context of horticulture and agroforestry. Nevertheless, forests remain an important source of food, raw materials and medicines. Gathercole (1977) describes Polynesians as horticulturalists who continued to appreciate the nutritive and economic value of many wild plants and animals, particularly when yields from domesticates were unavailable or low. The languages of Polynesia demonstrate the relative importance of crop plants and forest foods. *Kai* (food) comprises two elements: ‘staple starches’, such as the cultivated taro and yams, and the ‘relishes’. The latter includes opportunistically harvested nuts and fruits from the forest; while considered to be highly desirable, they do not constitute a meal (Kirch 1979). As with most Western Pacific countries, forest foods assume a greater importance during times of hardship, such as crop failure or natural disasters.

How does traditional knowledge of the forest expand to incorporate new elements associated with horticulture? Spriggs (1993) argues that for the depauperate forests of island Melanesia, transplanting of useful nut trees and other species from more productive habitats may have been occurring well in advance of the conventionally accepted date of 10,000 BP for agriculture in Melanesia. Spriggs claims that the overall effect was to mimic the New Guinea rainforests from which the island Melanesian settlers came (Spriggs 1993). If such activities were occurring, they could represent early adaptations of traditional forest knowledge to a new environment.

Human impacts

Human settlement of the scale and longevity described above could not have happened without environmental consequences, in some cases of severe proportions. All the forests of the Western Pacific have been altered by human settlement and exploitation, to a greater or lesser extent. The distribution of certain tree species important for food or raw materials is a result of deliberate plantings (Paijmans 1976), and there is sound palynological and geomorphological evidence that swidden agriculture and agro-forestry in the New Guinea Highlands has resulted in major and dramatic changes to the forested environment over the last 10,000 years (White and O'Connell 1982; Paijmans 1976; Golson 1977). The majority of the grasslands are anthropogenic, as a result of regular burning, producing sub-climax vegetation. Recently, new paradigms have emerged, advocating a greater role for climate change in modifying forests in Micronesia, which has implications for interpretation of changes to the New Guinea landscape (Hunter-Anderson 2009).

In New Zealand, a third of the original forest had been cleared for gardens prior to the arrival of the British in the early nineteenth century (Roche 1990). The slash and burn techniques brought by the Polynesians from the tropics were unsuitable in the temperate climate, and the cleared forests did not regenerate, resulting in major deforestation in the North Island (Metcalf 2006). Burning as a technique for clearing land would have been effective in forests not adapted to fire; it was necessary in order to create space for gardens and also for large groups of people to live and to build their fortifications and other structures (Guild and Dudfield 2009).

Vegetation communities in most of the islands of the Pacific are now dominated by secondary regrowth in abandoned gardens, and highly altered forests manipulated over millennia to favour certain species. Primary forests contain shade-tolerant, long-lived trees, but thousands of years of agro-forestry have replaced many of these with secondary forests of shade-intolerant, short-lived tree species (Mueller-Dombois 2008). Most modern forests are a mixture of native species, early introductions and later introductions, and in some cases introduced species have completely replaced native species, e.g. at lowland sites on older high islands in Hawaii (Mueller-Dombois 2008).

Traditionally, indigenous people were part of a functioning socio-economic system in which the natural environment was managed and its resources utilised through a cosmological lens. Application of traditional law ensured that ecosystems did not become unbalanced or that a particular resource was not overexploited. It is clear, however, that early agricultural systems did lead to unbalanced and degraded ecosystems. It has been argued that Pacific Islanders ‘prospered by disturbing the natural order’ (Sauer 1952, cited in Clarke and Thaman 1993). Newly arrived swidden agriculturalists cleared forest patches to plant the root crop plants that they had brought with them, and established tree crops by selective planting and manipulation. Clarke and Thaman (1993) argue that modification of the closed forests rendered the islands more productive of food and more congenial to human occupation. Similarly, Geertz has argued that mixed planted crops eventually come to resemble the bush that they replace; a ‘natural forest is transformed into a harvestable forest’ (Geertz 1963, cited in Kirch 1979).

It is even possible that traditional systems of forest management were initially unsustainable and led to societal collapse in pre-contact times. The eventual transformation of natural landscapes brought with it systems of agriculture and agro-forestry that were sustainable (Siwatibau 2009). Cox and Elmquist (1994) argue that although some Pacific Islanders used unsustainable practices initially, they rapidly developed cultural proscriptions against resource overuse and depletion, to guard against resource degradation turning into human and social poverty.

Cosmologies

The worldviews and cultural identities of Oceanic people are embedded in complex and ancient connections with the land, sea and sky. No distinction is made between religious and secular dimensions, and the material world is suffused with spiritual forces which had to be respected and manipulated for human survival and well-being (Reid 1995). Connections are reflected in cosmology, language and in ‘ways of doing things’, forming part of a holistic integrated system. Customs and language emerged from common Austronesian origins that became widely dispersed through a long historical process of human

migration. In the course of this history of geographic dispersal and expansion, an immense diversity of linguistic and cultural forms was produced (Reuter 2006), but common ancestry is still evident, particularly in the knowledge systems for growing root crops and in traditional agro-forestry.

Cosmologies of Oceania's indigenous peoples comprise stories relating to the origin and creation of the world and humans by gods or spirit beings. They link the present to the past through the actions of the ancestral beings and impose responsibilities on humans in their relations with the natural world. In Tongan society, *fonua* invokes a cosmology in which the environment is regarded as 'an extension of human society' (Mahina 1992, cited in Francis 2006). As a result, human agency is integral to a physical landscape that includes the land, the ocean and the sky. The concept of *fonua* 'people of/and place' described a local territorial entity that incorporated the land and natural surrounds associated with a chiefly title holding, and the people residing on that land. *Fonua* is also a descriptive term for the soil that grips the roots of plants when pulled from the earth. The old Tongan word for placenta was *fonus*, a reference to the practice of burying the placenta after the birth of a child (Francis 2006). Similarly, in New Zealand Maori cosmology, the word for land, *whenua*, is the same as that for placenta (Walker 2004).

The cosmology of the Austronesian inhabitants of Oceanic islands contains both rootedness and mobility (Bonnemaison 1985). While rootedness imparts a sense of belonging to a specific place for each separate culture, mobility reflects the connections between them, resulting from sea voyaging histories and transference of knowledge throughout Oceania. Austronesian-speaking societies have constructed their sense of identity by origin narratives that tend to treat 'people' and 'land' as mutually constitutive categories within a single, place-oriented and movement-oriented schema of ancestral identity and sacred geography (Reuter 2006). In the landscape of Ambrym, an island in northern Vanuatu, the ground itself, the '*tan*', comprises the descendants of those who originated from it, absorbing the power of the ancestors who dwell in and around it, protecting its own and tormenting interlopers (Patterson 2006).

Cosmologies include improvements to the land for sustaining humans. The yam planting cycle in Oceania is intricately tied to

human health and wellbeing. Yams are one of the most important crops in Oceania and New Guinea, with great utilitarian as well as symbolic significance. Historical accounts of traditional Kanak life in New Caledonia state that people perceived themselves by analogy with objects of nature, such as the yam, whose cycle symbolised the cycle of life (Dahl 1989).

Being part of the natural world is thus fundamental to indigenous people's understanding and management of landscapes, whether they are natural forests, tree crops, managed forests or constructed gardens. Many Oceanic origin narratives recognise and attempt to reconcile conflicting value spheres of religious status and secular power within the models of society that they create. According to these models, people share a collective ritual responsibility towards the Earth, which requires and promotes social cooperation. At the same time, they acknowledge that, as individuals with a strategic interest in a political economy based on agriculture, people also have a concern for dividing and controlling land (Reuter 2006). The embeddedness of land control and division in cosmology helps to explain an apparent disjunction between harmony with the earth beliefs and the activities of agriculturalists in causing deforestation and environmental degradation.

A powerful creation story in Maori lore concerns the kauri, *Agathis australis*. This majestic tree was not only the god of the forest but also the creator of the first human.

Tāne created the forests when he separated his parents, Ranginui (the sky father) and Papatūānuku (the earth mother), and let light into the world. As Tāne Mahuta he is god of the forest, presiding over its plants and birds. As Tānenui-a-rangi he is creator of the first human. Respect for Tāne's forest was shown by performing certain tikanga (customs). Their importance is reflected in the story of Rātā. Rātā went into the forest, cut down a tree, and began to carve it into a canoe. When he returned the next day to continue his task, the tree was miraculously standing in its original position. He felled it again and set to work, but the same thing happened the following day, and the next. Finally, Rātā hid behind a bush and saw the hakuturi (forest guardians in the form of birds, insects and other life) replanting the tree. When he confronted them, they told him he had failed to perform the appropriate rites. He then did so, and the hakuturi released the tree.

The great trees of Tāne, god of the forest, were called Ngā Tokotoko-o-te-rangi (the posts that hold the heavens aloft) because they held

Ranginui (the sky father) above Papatūānuku (the earth mother) (Te Ara—The Encyclopedia of New Zealand 2009).

Other New Zealand trees are also important in mythology:

Tōtara had pride of place among the tall trees. The saying ‘kua hinga te tōtara’ (a tōtara has fallen) described the death of an important person or chief (Te Ara—The Encyclopedia of New Zealand 2009).

Taboos or *tapu* acted as a sustainability measure in traditional forest use. These occur throughout the Pacific and were usually imposed by village chiefs to prohibit use of a particular resource. The prohibitions generally related to resources in decline, with strict punishments for ignoring the bans (Government of Samoa 1998; Nalail 1996). Taboos can be temporary, to allow resources to build up, or they can be permanent. Siwatibau (1984) notes that in Fiji, superior specimens of the hardwood tree, vesi (*Intsia bijuga*), are normally only used to build the houses of important chiefs.

Connections between forests and gardens

Agricultural peoples of the Western Pacific have worldviews that maintain strong connections between their living space and the surrounding forests. Mosko (2006) describes the traditional classificatory patterning of ‘inside’ and ‘outside’ spaces with reference to the North Mekeo people of the central province of Papua New Guinea. The Mekeo world is divided between the village and the bush with constant movements and transformations between the two as part of daily life. The village is conceptualised as the outside space, which was initially ‘cleared out’ of the inside space of the bush. This means that the outside village contains much that originated in the inside bush and is a metaphor for transformations between the human body and the outside world.

Within this broader cosmos, traditional forest knowledge of Austronesians is concerned with the cultural relationships with the biota of native forests and ‘transported landscapes’ of agro-forests, irrigated swamps, dry field agriculture, and a suite of consciously and accidentally introduced organisms. Merlin (2000) provides an excellent analysis of ethno-botanical research in remote Oceania, noting that observations of traditional plant use and agro-forestry have been occurring since the voyages of James Cook in the late eighteenth

century. Botanists and anthropologists such as Barrau and Yen have greatly enhanced knowledge on the origins, taxonomy (folk and scientific) and distributions of crop plants in the Pacific (see Yen 1993).

For Papua New Guinea, Powell (1976) provides an excellent synthesis of previous ethno-botanical research. Based on this and his direct observation, he gives comprehensive species lists of plant foods, distinguishing six main categories of levels of plant domestication and use by local indigenous people. Powell's analysis indicates that staple foods are primarily starchy underground roots and tubers, whereas supplementary foods are a very wide range of fruits, nuts and greens. No wild foods were cultivated as staples, although wild forms of root crops such as taro and yam exist. Most forest foods were identified as supplementary foods and many wild foods are transplanted and cultivated as crops within forests or as productive trees around villages.

Further south, in New Zealand the large forest tree, totara (*Podocarpus totara*), was used by Maori for making fire and manufacturing canoes and was highly valued for carving. A new totara tree had to be planted each time one was felled, to appease Tane, the god of the forests, for removing one of his children. This practice also ensured sustainable practices for use of valuable trees. The tall, straight kahikatea (*Dacryridium dacryoides*) bears sweet fruits that were highly prized by Maori. Fruits of the miro (*Prumnopitys ferruginea*) are very attractive to the New Zealand pigeon, and Maori used to place carefully snared water troughs in miro trees to catch the pigeons while they drank (Metcalf 2006).

Letters by John Deans to his father in 1845 contained observations of traditional Maori life in the Riccarton–Christchurch region of the South Island, where a sophisticated socio-economic system produced surplus goods for trade and supported powerful tribal chiefs:

Effective techniques for obtaining the different foods, whilst at the same time conserving the resource, had been perfected, and a sophisticated social system had been developed to do the required work...Each whanau (extended family) had its allotted rights to take its requirements within the rules laid down, and its allotted part to play in producing a surplus for the tribal headquarters, and for the use of groups in other parts of the tribal territory, who would supply something else in return. Thus a Maori community living at Putaringamotu would specialize in products from the local forest—preserved pigeons, carved totara and canoes...(Molloy 1995: 3–4).

Cultivated landscapes of the Western Pacific

The replacement of natural forest ecosystems with human agricultural systems over the last few millennia means that today approximately six million Pacific Islanders rely on traditional agriculture for their subsistence needs (Manner 2005). Most traditional agricultural systems depend on connections with a range of natural ecosystems, and many terms have been used to describe land-use practices in the Pacific, for example, agro-forestry, agro-ecosystems and arboriculture (Kennedy and Clarke 2004; Thaman 1989), and classificatory systems have been developed to describe the various methods of cultivation and land use (Manner 2005). The term 'cultivated landscapes' is used here, after Kennedy and Clarke (2004) who use archaeological, geographical and anthropological sources to demonstrate the antiquity of forest transference and manipulation within a broader socio-economic system of landscape management. In these integrated systems of land management, coconuts, breadfruit trees and other economically valuable trees are components of traditional Pacific agro-forestry systems, in which forest, orchard, field and garden are integrated both spatially and temporally (Clarke and Thaman 1993; Kennedy and Clarke 2004).

Traditional agro-forestry systems across the Pacific exhibit common characteristics of high species diversity, incorporating cultivated and protected native and introduced tree species (up to 300 on the larger Melanesian islands). These include tree crops such as coconuts, breadfruit and bananas, as well as a wide range of fruit and nut species, deliberately planted, encouraged and protected in the regeneration of regrowth or spared when clearing new garden plots (Thaman 1989). Within a given species of tree or root crop there are many locally differentiable cultivars and varieties, with variable yields and seasonalities, spreading distribution of food more evenly across the annual cycle. Different cultivars exhibit differential adaptations to ecological conditions such as salt spray, pest and disease resistance, soil type and shade tolerance. Some cultivars were selected for a specific use; different coconut cultivars, for instance, are used for drinking, eating or production of coir for making ropes (Thaman 1989).

Siwatibau (1984) discusses traditional environmental practices in Fiji to demonstrate that Fijians have developed methods of shifting

cultivation that optimised resource utilisation without depleting the resource base. The optimum location for a new garden was carefully chosen and the garden was established by slashing the forest, often leaving the large trees. Ground disturbance was minimised (and effort reduced) by leaving tree stumps to rot. The slashed vegetation was burnt and weeded, and if slopes were steep the rubble was placed along contours to reduce soil erosion. New crops were then planted using methods appropriate to the plant species.

Thaman et al. (undated) note that Pacific Island agricultural and land-use systems were built on a foundation of protecting and planting trees, developed and managed for human need and for ecological services. Traditional land management in Tonga involves a complex mix of trees, shrubs and short-term ground crops incorporated into short-term shifting agriculture on small plots of land. Cleared vegetation is allowed to dry and is then burnt, with large, important food trees (cultivated or native) left unburnt. Some are pruned to allow light in and to produce leaves, which fall to the ground and act as mulch. Larger branches are used as trellises for the yams, and then as firewood after yam harvest. Trees such as pandanus or hibiscus are planted along garden edges to act as boundaries or windbreaks, and to provide food and other products. Living fences could consist of important timber trees such as *Casuarina* sp. The root crops are planted and harvested sequentially, and the cycle is sometimes extended by planting kava or paper mulberry, used for making the traditional tapa cloth. The garden slowly returns to fallow over four to ten years, but the existing trees continue to provide food, medicines and other products. Thaman et al. (undated) aptly describe these systems as 'long term investment of time, knowledge and effort in a living, growing bank account'.

Figure 3 shows an example of this, from the Papua New Guinea highlands, where crops are planted under the forest canopy, and when they begin to grow, trees are felled on top of them. This practice was viewed with trepidation by Australian patrol officers, but is in fact uniquely suited to maintaining the resilience of the rainforest by minimising soil disturbance and enabling the area to be quickly reclaimed after the garden is abandoned. The undergrowth beneath the forest canopy is cleared, and planting material such as taro tops and banana suckers is planted into the humus on the forest floor. The canopy protects the new garden from rain, and filters the sun in its first

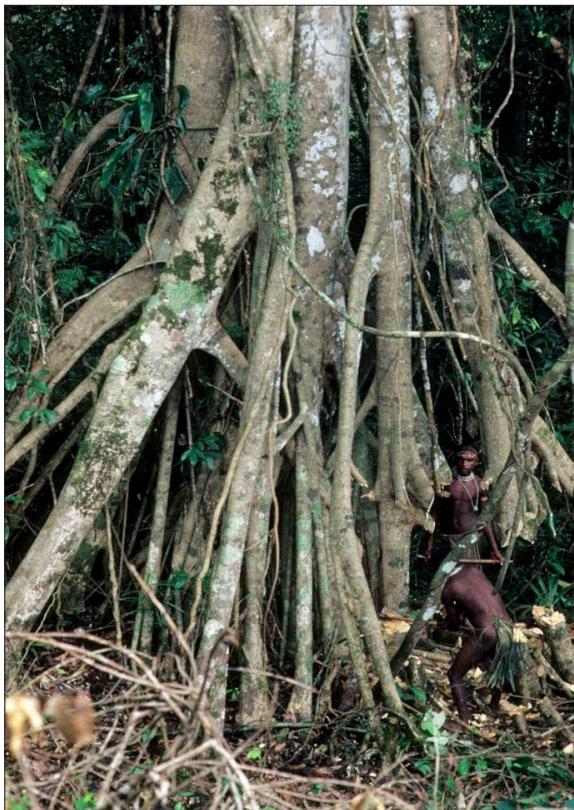


Figure 3:
Traditional agriculture in
the Papua New Guinea
Highlands.

(Top) A. Crops growing
through felled trees.

(Left) B. Forest giants being
felled in highland Papua
New Guinea.

weeks. Each tree in the garden area then has a scarf cut into one side to direct its fall, and after a few weeks when the crop has ‘taken root’ a large tree is cut, creating a ‘domino effect’ resulting in all of the trees falling ‘slowly’ together in a tangled mass. The fall is softened by the branches breaking and dissipating energy. The crops can easily grow through the tangle. Other advantages of this method of agriculture include the protection of the soil from leaching and baking by the initial mulch of leaves and twigs, the release of nutrients as the mulch decomposes, and breaking up heavy raindrops by the tangle of fallen trees, preventing erosion from runoff. The original condition of the forest floor is maintained enabling a quick reversion to rainforest after the garden is abandoned. Additionally, it is a low energy method of clearing in a sparsely populated area, and the fallen tangle of trees forms an excellent defence for houses built in the centre of the garden area, as well as a ready supply of firewood and fencing materials.³

Traditional knowledge in a modern world

There is an emerging body of populist and scientific literature urging modern society to learn from the traditional forest practices of indigenous cultures, e.g. Knudtson and Suzuki (1992); Sveiby and Skuthorpe (2006); Jansen and Tutua (2001). It has been suggested that sustainable forest management in a modern world would benefit from increased recognition and application of the knowledge and traditions held by indigenous peoples (Colfer et al. 2005).

However, as indigenous cultures modernise and become part of the market economy, traditional systems and knowledge are becoming increasingly irrelevant and are being lost. In Papua New Guinea, local villagers articulated the tensions between modern education and traditional knowledge in the following way:

We cannot use the same practices used by our ancestors nowadays, because educated people do not respect and listen to the village elders. Educated people are proud of themselves, they think they have been to school and are more knowledgeable than the village elders. Therefore, if village elders make rules to conserve a certain area, people that have some form of western education will not adhere to those rules (Ellis 1997, cited in Filer 2000: 14).

Exposure of many Pacific countries, especially Melanesian countries,

to the global market economy has often resulted in the dominant values of forests being equated with large-scale timber extraction, contributing to deforestation (Lindberg et al. 1997). Deforestation and forest clearing for cash cropping in the Pacific Islands has gone hand in hand with erosion of people's knowledge of nature, together with decreasing respect for their relationships with it (Siwatibau 2003). Large-scale logging and other extractive activities are creating environmental imbalances, which affect the lifestyle of traditional people and create a cultural vacuum. The push for economic development has side effects that have posed serious threats to the natural environment, and to traditional life and culture, with youth resorting to violent crime because of losing traditional roots (Basu 2000).

Siwatibau (2009) notes that traditional knowledge and appreciation of forests and their potential for future benefits are being lost because island communities have reduced their reliance on forest products in response to the loss of forest species. The more the natural landscape is altered, the more people become disconnected from it, with a concomitant reduction of an appreciation of its social, environmental and economic values (Filer 2000).

Thaman (1989) coined the term 'agrodeforestation', referring to present generations of Pacific Islanders planting fewer trees around their villages, traditionally used for a wide range of purposes. This reduction in number and diversity is a major issue on small atolls where there is little native forest to provide supplementary foods and raw materials for building and fuel-wood. Preferences are also forming for imported foods, and there is an increasing dependence on species grown as monospecific cash crops, as well as for new cultivars of staple plants, often at the expense of traditional varieties. Collectively, these factors contribute to a loss of traditional knowledge which in turn renders it less relevant. A study in the Solomon Islands showed that instead of the 87 plants harvested from forests less than 50 years ago, there are now fewer than 10 still being utilised. Thus, forests are no longer perceived as a culturally valuable, multifunctioning phenomenon, capable of sustaining humans, but as more of a commodity (Jansen and Tutua 2001).

Increasingly, though, indigenous communities desirous of conserving their forests and their culture are seeking commercial alternatives to assist in retaining traditional knowledge (Wilke et al.

2002). Commercialisation of non-timber forest products (NTFP) and ecotourism are identified in the State of the Worlds Forests report 2009 as alternatives to large-scale logging and key areas of the Food and Agriculture Organisation's forestry programme.⁴ The success of this programme relies on the continued existence of intact forests, and there are links between development of these industries and the conservation of forested areas, although development and conservation goals do not always align (Arnold and Ruiz-Perez 2005).

Although there are links between conserving forest areas and NTFP industries, in the absence of land-use planning, extensive cash cropping of NTFP can also lead to deforestation. Commercialisation of the kava/sakan plant (*Piper methysticum*) on the Micronesian island of Pohnpei is a case in point. This plant has been used for centuries in Oceania to produce a psychoactive drink prepared traditionally from chewing and pounding the roots of the tree. Kava is a sacred plant to many Oceanic peoples and its use was controlled through customary law, being restricted to chiefs and religious people, and for medicinal purposes. Today it is widely used as a recreational drink, causing social and environmental problems in Pohnpei, particularly the destruction of the montane forests. A partnership between a non-government organisation and local community groups has enabled an integration of cash crops, such as kava, back into the traditional agro-forests, rather than farmers neglecting their subsistence activities to concentrate on cash cropping (Merlin and Raynor 2005).

Thaman and others argue that integration of traditional agro-forestry practices into appropriate cash cropping systems is essential for the well-being and sustainable development of Pacific societies (e.g. Thaman 1989; Kennedy and Clarke 2004). They argue that in order to maintain species diversity there needs to be a balance between monocropping of commercial export crops and subsistence crops, and between modern agro-forestry and preservation of traditional polycultural agro-forestry. Thaman is a strong advocate for a more traditional, less capital-intensive and less monocultural approach to modern agricultural economies in the Pacific through legislation and systems for protecting and promoting important or endangered tree species as part of agricultural programmes. This would involve going back to traditional holistic approaches rather than government or overseas aid-driven compartmentalised approaches (Thaman 1989, 2002).

Replanting with traditional species and reforestation programmes can be effectively developed through forestry and agricultural extension programmes. Many local farmers are keen to plant in current or old garden sites, especially if they are provided with seedlings free of charge. These programmes are also an effective way to retain and pass on knowledge about traditional agro-forestry. Local farmers want to grow cash crops for both domestic and commercial use but adequate planning and training are needed to ensure that forests are not cut out as a consequence.

Conclusion

The history of indigenous people's settlement and development in the Oceanic islands of the Pacific has produced a deep knowledge of forests in the context of both their 'wildness' and their capacity to be transformed into cultivated landscapes. Most Pacific peoples continue to practice subsistence agriculture using eons-old traditional knowledge, combining forest use and manipulation with construction and maintenance of gardens as part of integrated traditional agro-forestry systems.

In recent decades development pressures have led to loss of forests through cash cropping and large-scale commercial logging. This has caused concern among communities, non-governmental organisations and some practitioners, who have drawn direct links between loss of forests and loss of traditional forest knowledge. There have been calls for government policies to give greater recognition to traditional forest and garden knowledge to improve the sustainability of current forest management. While it may be unrealistic to believe that traditional ways will, on their own, overcome environmental or social problems, advocates of traditional systems are developing techniques for incorporating traditional agro-forestry systems into contemporary forest management.

Notes

- 1 This term is used interchangeably with 'traditional knowledge', 'traditional ecological knowledge' and 'traditional forest knowledge'. Indigenous knowledge is also called 'local knowledge' although they are not necessarily the same. Other terms are 'folk knowledge' and 'non-scientific knowledge'.
- 2 Austronesians are people with a shared ancestry and belong to a widespread family of languages with a possible origin in Taiwan around 5,000 years ago (Bellwood et al. 1995).
- 3 Information and photographs courtesy of David Eastburn, The Australian National University.
- 4 See <http://www.fao.org/forestry/nwfp/en/>

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