Making Stressful Coasts into Austronesian Practice Ground ? : Traditional Ecological Knowledge in Yami/Tao Agro-Forests

Cheng-Heng Hu*

ABSTRACT

Austronesian peoples have maintained many coastal livelihood traditions since 4000 BC, coupled with increasing gathering, fishing and horticultural ideas before their agricultural pack moves on. Austronesian waves migrated to Batanes and Luzon from southern Taiwan about 2200 BC, followed by an increasing flow of emerging agrarian cultures which bore the Austronesian ancestry. A large number of subsistence trees, herbs and wildlife are cared for by Yami/Tao islanders in Lanyu Island between Taiwan and the Philippines, under the name of traditional ecological knowledge (TEK) recently.

Yami people do not attach on a particular fertile land. They rather invest on useful and powerful things for adventure, with strong emotion and solid TEK for exploring new space, including both the ocean- and land- orientations. Yami farmers are horticulturally styled, who do not want to keep a land for longer period, but burn their swidden as needed. They claimed the serious reason to shifting agriculture "ya maattaattaw, ya ji nogat (人是漂泊，從不停靠)," because Yami people believed that "the great journey never stops, so always prepare for next leap."

The TEK and associated management regimes have been inscribed by the integrated cultural ideas during encounters with strange tropical species. This makes the Austronesian dispersal full of movements of ancestors, things, and metaphors. Yami agroforests refer to the ideal worlds embedding in both the Sea-oriented axis (do iload) and a Land-oriented axis (do irara). A realistic topography of all Yami villages can be ideologically divided into the Tree Territory (kayakayo) and Coastal Territory (ili). Ecologically speaking, gathering and nurturing are powerful principles in Yami/Tao TEK in transforming a wild island into an affluent homeland for human dwelling.

The Yami TEK can be described as: (1) "Picking tools up (kapangap)" by assembling things in communal property (lovot) since ancestors founded, and (2)

* Assistant Professor, Department of Forestry and Nature Conservation, Chinese Culture University, Taiwan. hujackson@gmail.com

"Collectively engaging (maci-vazay) in stewarded garden (sibo)". These Yami Agroforestry ideas reflect an ancient horticultural tradition with a complex tapestry comprised of encountering species and vivid ancestral memory, setting them in close forest (kalovotan), open garden (peysisiboan), swidden (ora) and wetland (sawalan) as the whole tokotokon landscape. The Yami silvilculture treatment involves a series of management regimes accordingly to deploy selective cutting, weeding, thinning, and seedling plantation for two major purposes of logging and fruit production.

The Yami village on the eastern shore of Lanyu, Ivarino, has rich biodiversity, and relatively poor soil property of Entisols and Inceptisol. They used frequent burning practices, and adopted small-scale fires to raise the soil pH and make aluminum more insoluble and precipitated. This advantage is exhibited in swidden ashes, with increases in soil pH and higher crop productivity for 2-3 years before the next fallow rotation period. When the ash leaching is completed, crop productivity declines in an abandoned orchard. However, adaptive management regimes also develop diverse strategies shifting from gathering in communal forest to clan's open gardens. For example, Yayo villagers use the lower terrain in the nearby region for agro-gardening (peysisiboan), without frequently disturbing the distant tabooed communal forest (kalowalovotan). In Iraraley, villagers tended to go higher in the steep cliff for developing orchards, without introducing too much burning, while keeping the coastal forest intact near the village.

Yami TEK is also emotionally rooted, marked by a variety of particular trees or wildlife for specific purposes across ancestral landscape. Revisiting these ancestral images periodically serves as a significant mnemonic device that facilitates the continuation of agro-forest management regimes and Yami TEK. Adherence to these long-standing practices such as sharing and caring maintain rich food and social production, which promises mutual benefits between households. A study of Yami/Tao TEK goes beyond seeing only what is present today as a well-settled agroforestry; it provides a horizon into unpacking the magnificent achievements of "making an Austronesian island" by early humans during millennia of inter-island migration and associated ecological adaptation.

Key Words：Lanyu (Orchid Island), Yami/Tao, horticulture, agro-forest, traditional ecological knowledge (TEK)

INTRODUCTION

Austronesians pack knowledge: Anthropologist Peter Bellwood called the Neolithic dispersal of the Austronesian language family into territories previously occupied by hunters and gathers as the greatest migration event in the human history after 4000 BC, among increasing agricultural producers in southern China and Taiwan, as well as in a cultural situation of advancing technology (Bellwood 2011:181; 2011:S363). Austronesian peoples made or even "packed" many local livelihood traditions on the tropical coastlines, such as near the fishing field between Taiwan and the Philippines. For example, archaeologist Cheng, Chien-Wen explored fish bone data (from Eluanbi in southern Taiwan and also from Batanes) indicate that earliest Austronesian emigrants practice to catch open-sea pelagic dolphin fish (*Coryphaena hippurus*) by the use of trolling lures from canoes since at least 2000 BC (Cheng 2008). The present day Austronesian islanders, the Yami/Tao people of Lanyu, located between Taiwan and the Philippines, still practice ancient canoe fishing and lure trolling to catch flying fish (*Cypselurus poecilopterus*) and dolphin fish every spring. Yami people thrive in the stressful coasts by their adaptive tropical horticulture and fishing practice. There is a dramatic shift during the Neo-lithic era from Asian mainland-origin millet crops to establishing desired species of tropical fruits or non-food trees. Yami traditional ideas of tropical horticulture are particularly important, because their ancestors formed the earliest human settlement waves in migrations to Batanes and Luzon from southern Taiwan about 2200 BC (Cheng 2008; Hung 2014). These waves were followed by a considerable flow of emerging agricultural farmers and their material culture, such as red-slipped pottery, from Taiwan into the Philippines and onward into Oceania (Bellwood 2011:S372).

The ecological knowledge used by the Yami/Tao people in modifying their landscapes to provide sustenance offers an unveiling of the original ideas of Austronesian horticulture in their agro-forests. Archaeologist Roger Green (1991) has proposed an Austronesian dispersal model, called Triple I, which represents Intrusion, Innovation, and Integration, as happened when the human migration resulted in combining local agroforestry knowledge and goods-making skills. Archaeologist Hung, Hsiao-Chun (2014) notes that the technology of red-slipped pottery production was introduced by the early Austronesian-settlers from Taiwan to the Philippines, but the practice of lime-infilled decoration on the pottery was invented locally within the Philippines. Observing that Austronesian "pack" an assemblage of various local skills, rituals, and goods in evolving new traditions, their ecological knowledge offers an insight as to how humans assimilate elements during migrations and how cultural ideas change over time.

In the transition from fishing and gathering to more agrarian lifestyle, Bellwood (2005) claims the Austronesians serve as an example of "first farmers" demonstrating "the origins of agricultural societies." Early agricultural causation envisions a series of proximate causes, in addition to the mentioned states of affluent societies (Sahlin 1968). Once cultural differentiation and specialization led to greater leisure, social competition developed in the human pursuit of greater materialistic affluence. Accumulating exotic valuables, and the dietary shift from simple and palatable resources to more productive vegetation and tasty flavors serve as examples of early materialism. Resource exploration and expansion

requires a sedentary territory comprised of clans and villages, even developing into a larger entity with broader political power. The Yami/Tao continued to integrate different sources of coastal wildlife into an enriched assemblage of hunting-gathering and systematic horticulture. This evolution as accompanied by traditional ecological knowledge (TEK) based upon caring for the Austronesian environment to create bountiful harvests while overcoming stressful conditions through annual cycles of cultivation.

Traditional ecological knowledge of horticulture: Wang *et al.* (2003) reported that the aborigine Tao people well cared a traditional forestry management and sustainable silvilculture in Lanyu. In the terms of tree diameter measurement, the floral structure and timber species diversity for house and boat building were similar to nature forest which had multiple layers of vegetative profiles. Local knowledge and forest management clearly have significant effects on establishing forest structure and species composition. Anthropologist Cheng, Han-Wen has worked in Lanyu exploring ethno-botany (Cheng 2004) and its associated taboos (Cheng 2011) within the Yami/Tao culture, to further explain the norms placed upon biological species within an ecological context. In Lanyu, recent documentation of TEK has focused on biological identifications, as well as narrations of taboos related to natural resources, in a manner described by the local scholar Syaman Rapoan (1997) as "affluent nature is simultaneously a result of subsistent harvest and the proceeding struggle that humans work out." Cheng's ethnography also found the Yami TEK often breaks rules while encountering unfamiliar foreign evens. The Yami elders "pack" the knowledge, norm, myth, and ritual as TEK. Humans adapt the stress but reproduce the affluent livelihood for continuous travelling, and then do not fear a degradation of recent landscape. He called "convoluted" taboo as a form of dynamic change, applying TEK context to respond to modern impacts and settle new encounters.

Yami TEK can build up modern conservation: Moreover, TEK has recently become a mainstream issue in international discourse to judge whether or not a local organizations sustain management regimes from grassroots ideas to meet in social norms. Economist Garret Hardin (1968) initiated the discussion on a situated wisdom to guard natural resources by avoiding "the tragedy of the commons", and in many cases of traditional societies exemplified as limiting access and communal ownership of common pool resources (Ostrom 1990). Spiritual Ecologist Firket Berkes defined such traditional ecological knowledge (TEK) in many aboriginal communities can be effective in sustainable management, as "a cumulative body of knowledge, belief, and practice, evolving by accumulation of TEK and handed down through generations through traditional songs, stories and beliefs (Berkes 1998)." Holling *et al.* (1998) further pointed out that TEK is a participatory solution based on a small-scaled management regime, but offers an adaptive dynamic to frame human activities between nature conservation and social development.

In my research, I came to "unpack" the Yami/Tao TEK from the perspectives of ecological landscape, instead of ethno-botany (Cheng 2004) or ethno-zoology (Hu and Rau 2013). The understanding of Yami TEK will contribute to two academic domains: one is local management regimes rooted in ancient horticultural ideas, technologies and practice found upon tribal territory in a series of ecological adaptations; the other is a new

interpretation of landscape agency that allows for deeper ancestral concepts being attached to homelands and their associated wildlife, including metaphoric knowledge of classifying species by their ancestral origins of things. Despite being an isolated island off the coast of southern Taiwan, the TEK supporting the Austronesian marine culture of such islanders' group is a heritage of considerable value to all humans.

METHODOLOGY

Through my periodical visits with participant observations (2006-2014) on Lanyu, I examined how Austronesian ideas of TEK have worked in local environmental adaptation. The past field study has been aiming at forest/garden checking, cropping practice, landscape memory, and ecological assessment on soil and biodiversity in general. To trace the TEK upon landscape, I compiled documented records from archival narratives and interviewed villagers periodically during my residency in June, July, September and November of 2001, February and April of 2002, January and February of 2003, October and November of 2006, July of 2007, and October of 2008.

Study site: Lanyu Island (*irara* or *pongso no tao*, meaning "island of the people"), is 62 kilometers off the southeastern coast of Taiwan main island in the western Pacific Ocean, with an area of only 46 square kilometers, or 38 km around the island (Figure 1). Based on the monthly records from the local weather station during 1975-2014 (Taiwan Weather Service, Fig. 1b-d), the mean wind speed is 9.1 meter per second; the mean annual temperature is 22.7 degrees Celsius (72F); the mean annual precipitation is about 3000 mm (range: 1847-3647 mm); the relative humidity ranges from 87-94%. Summer is between April and November, with an average temperature of 29.6 degrees Celsius under SW monsoon, presenting the highest relative humidity and heavy rainfall; winter is between December and March, with 19.2 degrees Celsius under a seasonal NE wind. The differences between summer and winter are relatively small (Hu 2008).

Lanyu (Orchid Island) is relatively young compared to the Eurasia Mainland, having formed in the late Pliocene of the Tertiary Period (3.4 million years B.P.). In the Pleistocene during the Quaternary, Orchid Island experienced several sea level changes. It became disconnected from the Philippine bridge when sea levels reached the current height around 380,000 B.P. Well-developed tropical forests took root and have largely remained intact as they are rarely disturbed.

The Yami ethnologically belong to Austronesian. Their current population is around 4200, with the Yami/Tao comprising nearly 87% of person residing on the island (Yu 1991). They make their living primarily through farming and fishing, and generally stay in a nuclear families (*asa a vahay*) as the basic self-sufficient social unit (Wei and Liu 1962; Yu, 1991). The uninhabited Little Orchid Island lies approximately six kilometers southeast off Lanyu, and it is where the Yami catch dolphin fish in their traditional way.

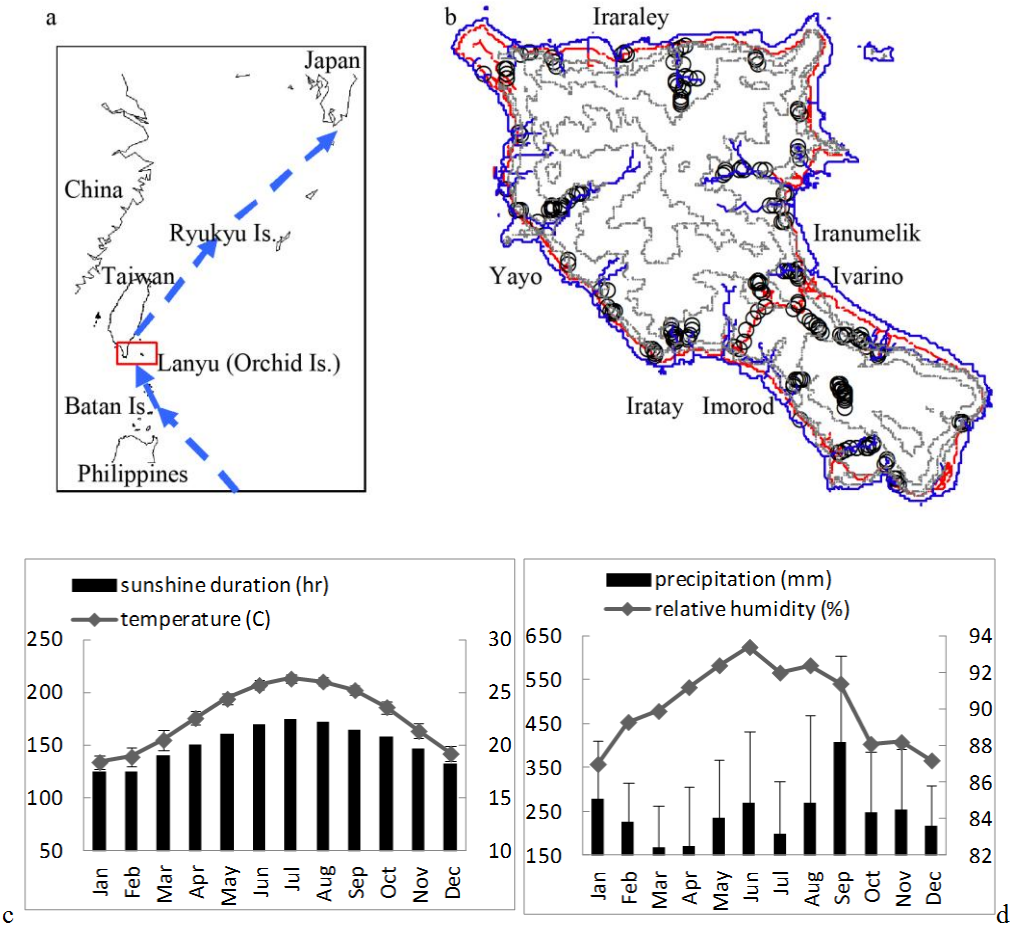

Fig. 1: The Kuroshio current, sampled agroforest plots (n=132) and weather statistics of Lanyu (Orchid Island).
(a) The Kuroshio current flows through the eastern coastlines of Taiwan and the Philippines. Arrows indicate the current with high temperature, density and salinity, and the flowing axis of maximum speed passes through between Taiwan and Orchid Island (in the box). (b) A total of 132 agroforest sites in Orchid Island from Sept. 2001 to May 2002 were surveyed. Island-wide isoclines include 20, 50, 200, and 400 meter in elevations. (c) and (d) respectively show monthly average of sunshine duration, temperature, rainfall and relative humidity, according to the weather statistics between 1975 and 2014.

This study delineates the farming regimes and its preferred fruit trees between close forests and open gardens. The examination of this close human-forest relationship can explore local attitudes towards associated management. First, I check the soil properties from the past survey by the governmental report (EPA 1998), indicating ecological affordance of nearby agroforestry. Second, I examined particular cultural ideas behind that are important to integrate encountering resource and to innovate as a new package.

Site Survey: The sustainability of Yami management regimes in open garden and close forest can be assessed by soil and tree management regimes. I referred to a similar soil profile of agro-forests on Lanyu (Figure 2), and adopted a quick environmental examination of forested farms. In 2002-2003, I tracked waterways and trails to enter into inland forested habitats in order to document the techniques and customs used to open the canopy through logging and farming within the past few hundred years, whether the source of open canopy was from natural windfall or indigenous farming, etc. I observed the local Yami people maintained a 2-3 year fallow system for both their paddies and dry fields near forests. I paid particular attention to stories of trees of which villagers have a wealth of knowledge in managing within tribal territory in order to support associated crop subsistence.

Story Survey: In order to document particular TEK on Yami horticulture, the sampling strategy was to first conduct a 10 to 20 minute conversation with Yami/Tao people working in the fields, along the roadsides or on forest trails. For the contemporary interviews, interview techniques for inquiry into local narratives on various natural objects were chosen for this study in order to identify the preferred themes of TEK narrated by individual representatives. Frequently mentioned themes in ecological memory might express strong human attachment to natural objects. I have attempted to clarify the apparent emotional roots that might serve as the local operative framework for integrating TEK.

Open-ended questions were asked about stories of villagers' land and the surrounding species from their memory. More than 80 field contacts were made, and 31 key informants in six villages were invited to talk. Most informants were born between 1950 and 1980 and had worked or studied in Taiwan for less than ten years, which meant their childhood experiences differed greatly from that of the elder generation. I made appointments with informants to meet them in their houses, conducting informal interviews within a family context by asking questions beginning with "would you like tell any wildlife stories in your farm?" or "how your families work in forest or care for nearby fruit groves?" Sometimes, if interrupted, a second interview was possible for clarification on narratives regarding crops, wildlife and land. All the mentioned interviews were conducted in Mandarin Chinese with the aid of Yami translators.

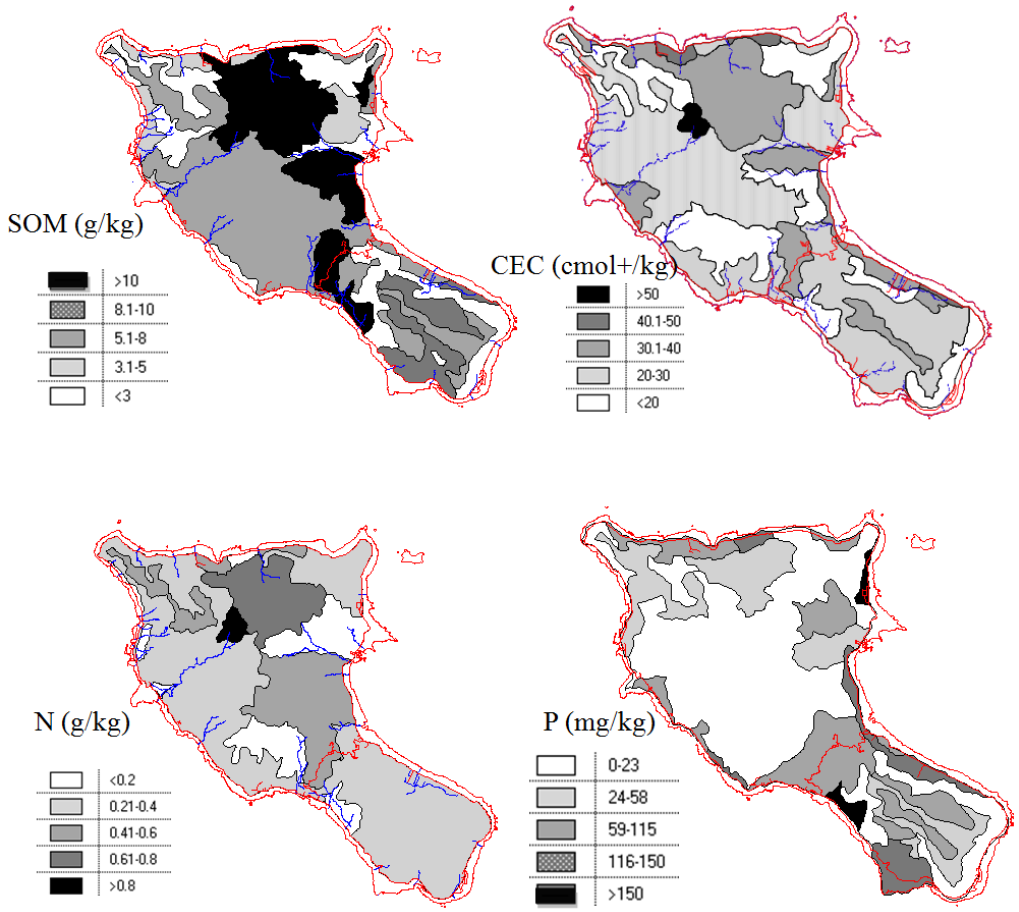

Fig. 2: Soil nutrient availability on the Orchid Island (EPA, Taiwan 1998), in terms of soil organic matter (SOM, g/kg), cation exchange ability (CEC, cmol+/kg), nitrogen (N, g/kg), and phosphorus (P, mg/kg by Extr. Bray P1 method).

TEK: INDIGENOUS THINGS ACROSS MANAGEMENT REGIMES

A limited number of fruit tree species are of particular interest to the Yami/Tao people. These were absorbed into their culture during encounters with strange tropical species along the Austronesian dispersal. Agro-diversity refers to the processes and products of agricultural diversification. Brookfield and Padoch (1994:9) describe agro-diversity as a farming system employing "the many ways in which farmers use the natural diversity of the environment for production, including not only their choice of crops but also their management of land, water, and biota as a whole." In Yami agroforestry, local communities use slash-and-burn to open up forests and to clear understory brush and saplings in order to build a forest garden or dry field, as determined by the surrounding remnants of vegetation. In Yami horticulture, Yami people also clear land for planting and harvesting in river valleys and on flat, moist upland sites. Since the Yami have rarely applied industrial fertilizer or other pesticides on this distant island, their roles and impacts regarding agricultural practices within a subsistence economy on the landscape mainly contribute to soil heating and ash input for soil nutrients, and practices of plant weeding, cultivation, and traditional fallow periods.

Communal agro-forests as tribal "common" (*lovot*)

Collectively inherited, Yami people held many big trees along the coastline and waterways as "*kabedbedan*," in which the word root of "*bedbed*" refers to tie together. The most distant and close forested land, known as *kalowalovotan,* is divided into forest blocs that are undisturbed on the higher slopes and along hilltop ridges. The Yami taboo upon these close forests results from a series of mythical legends in which ancestral spirits (*anito*) guard the Otherland by taking the form of a communal forest benefiting the entire downhill watershed.

From the Yami/Tao perspective, ancestral spirits (*anito*) reign over the tabooed forest, and are seen in the form of a rich diversity of wildlife. This abundance is shared with Yami/Tao people when the tribal villagers respect their common resource. *Anito* have ghostly spirits that can be transformed into butterflies, or able to herd a wide variety of animals, including cattle, rats (*raet*), civets (*panganpen, Paguma larvata taivana* (Swinhoe)), and migratory birds (*Upupa epops).* Many cultivated plants are viewed as ghost food for the *anito*, such as wild taro (*eypo, angsed, raon, etc.*)(Table 1).

The mentioned big trees for conservation keep generating organic content to improve farmland after litter degradation. In addition, when a nearby agroforest has been abandoned, the saplings immediately emerge from the seed banks uphill. Accessible big trees are cared horticulturally by parents or ancestors, in a local slang "*sira o niapoan da ori am ori omahad so pahad da, ori o komalopkop sira*" (Only parents can pacify their souls) (Syaman Jabbadu 1997). This emotional motive makes Yami people manage soil and watershed ritually when their family-owned inter-cropping system surrounded by clan-shared agro-forests.

Table 1: Yami/Tao Agroforests (*Tokotokon*) have two contrasting management regimes: 1. "Picking up to use (*kapangap*)" invites to respect close canopy and to guard tabooed forest (*kalowalovotan*); 2. "Intensive care for assembling fruit trees (*macimoamoa*)" attempts periodically clean open gardens (*peysisiboan*). It turns out complementary uses or avoidance of indigenous wildlife. :

Tabooed keepers allow to pick up (*kapangap*) in tribal communal property (*lovot*)

local name	Yami terms	Related beliefs	scientific name of species
1. Canopy trees			
白榕: white ficus	*tapa*	house of ancestral spirits	*Ficus benjamina* L.
棋盤腳: barringtonia	*teva*	fruits as fodder for civets	*Barringtonia asiatica*
2. Associated tabooed wildlife			
夜鷺: night egret	*aguwak*	spiritual embodiment	*Nycticorax nycticorax*
蘭嶼角鴞: scop owl	*totow*	spiritual embodiment	*Otus elegans botelensis*
亞洲家鼠: rat	*raet*	Cattle in Otherland as goats	*Rattus tanezumi*
果子狸: civet	*panganpen*	Cattle in Otherland as pigs	*Paguma larvata taivana*

Intensive care (*macimoamoa*) in stewarded plots (*sibo*)

local name	Yami terms	Related beliefs	scientific name of species
1. Dominant logging trees	(用材林)		
番龍眼: Yami longan	*cai*	gather *(mancacai)*	*Pometia pinnata* Forst.
青脆枝	*kamanvoag*	a single goat is ugly	*Nothapodytes nimmoniana*
檳榔: betel nut	*avoa*	long life	*Areca catechu* L.
毛柿: persimmon	*kamala*	heavy	*Diospyros philippensis*
對葉榕: ficus	*oyao, isihs, isis*	rough like fish scale	*Ficus cumingii* Miq.
2. Dominant fruit trees	(果樹林)		
黃心柿: persimmon	*vacinglaw*	black wood	*Diospyros maritima* Blume
麵包樹: breadfruit	*cipoho*	take out seeds (*mangocikot*)	*Artocarpus incisus*
蘭嶼樹杞: Ardisia	*payin*	picking up home (*kapangap*)	*Ardisia elliptica* Thunb.
大葉山欖: Yami mongo	*kolitan*	peal skin	*Palaquium formosanum*
蘭嶼芭蕉: Yami banana	*vineveh*	wild strain with many seeds	*Musa insularimontana*
絲芭蕉: fiber banana	*avaka*	separate in journey	*Musa textilis* Nee.
可可椰子: cocoa palm	*aniyoy*	long life	*Cocos nucifera* L.
3. Associated tabooed wildlife			
番鵑: lesser coucal	*tazokok*	voice is similar with the word of death (*kazakat*)	*Centropus bengalensis lignator*
珠光鳳蝶: birdwing butterfly	*pahapahad no anito*	spirits of ancestors or ghosts	*Troides magellanus*

Clan trust in grove gardens (*sibo*)

Emotional attachment on fruit trees mobilizes periodic weeding and land tending, if longan forests are shared, "*o ciai ya am, namen kabedbedan sira maran*." The key of Yami/Tao intercropping system aims to strengthen the seasonal fruit production in a stressful tropical bushland. Yami people set the understory monocot productivity by periodically opening gaps within the aforementioned close canopy. Mimicking naturally vegetative succession, fruit trees that are favored by villagers are continuously displaced by the understory shrub flora, while not changing the canopy structure of local giant forests.

The Yami people usually clean understory vines and bushes in wide circles about 10 meters in diameter to create an anticipated garden, the majority of which are near the clan-owned watersheds. They then choose a set of robust shaded tree species, including betel (*avoa*), longan (*cai*), and mango (*kolitan*) (Table 1), and move stronger crop saplings during the rainy season after performing a rite of ancestral worship, *mipazos*. Cheng (2011:45) reported a series of taboo during gathering in agro-forest, namely "*makavava*." Villagers are prohibited for over-exploiting fruits including longan (*cai*) and mango (*kolitan*) due to saving more fruits and seeds for in-situ regeneration, according to the ancestral oath ("*malapo do ininapo ta*"). The fruit trees with a long life cycle also include local banana (*vineveh, avaka),* pineapple *(keynapo*), and cocoa (*aniyoy).* During the last several hundred years, the reliable sources of forest by-products have come from indigenous farming (*sibo*), involving periodical weeding and removal of dead trees. To facilitate vegetative succession and the recovery of soil fertility in the agro-forests, grove often had scattered trees in rows serving as windbreaks on arable land along the boundaries and forest edges to prevent drying effects. The Yami gardeners regularly obtain several harvests before canopy closure, and then abandon the orchards if their household labor pool proves insufficient for maintenance. Annual and perennial crops are set to grow between natural seedlings. In-situ regeneration of both canopy trees and understory crops retain soil nutrients in addition to preventing slope erosion, as these cultivated trees become large enough to stabilize the thin tropical soil. Thick fallen litter is also rich in organic matter, maintaining nitrogen levels.

Because open gardens are planted only a short distance from the edge of the forest, canopy trees increase soil fertility due to leaf litter which also covers the top soil to prevent massive erosion. If the gap area is abandoned, seeds and mycorrhiza can quickly restore the previous logging areas. Open gardens certainly play a role in creating forest edges and sunny habitats perfectly fit for typical edge fauna in Lanyu, such as lesser coucal (*tazokok*) and birdwing butterfly (*pahapahad no anito*).

Shifting horticulture stressed by prescribed burning annually

Not limited to clan-owned grove, dry fields (*ora*) also require constantly picking regenerated vegetation up by prescribed burning. Because of low soil fertility and no intention to recover into bushland, clear-cut fields are at times necessary, but are rarely near forests. The six communities in Lanyu maintain a similar fallow system of burning dry fields every 2-3 years. In the beginning, they also construct new farms near forests through

small scale prescribed burning, in order to clean weeds and undesirable shrubs. Prescribed burns of Lanyu observed along main roads between Oct. and Dec. of 2001 are shown in Figure 3. During the winter as conventional period to prepare swiddens, a total number of 31 burnt plots was recorded in terms of estimated area size by hectare (1 ha=100m x 100m). There are almost half (48.4%) belonging to small swiddens, in which area size of burning is under 1 hectare as a shallow burn. Common burnings range between 1 and 10 hectare (35.5%), while large ones for >10 ha fires are extremely rare (16.1%). This might result from the taboos among the Yami when working in the common forest (*kayakayo*). The islanders avoided over-burnt woodland wherein floating ash can be a hazard leading to loss of soil nutrients during leaching. The metaphor that ash can make taro rotten certainly holds true with an insight of tropical soil conservation.

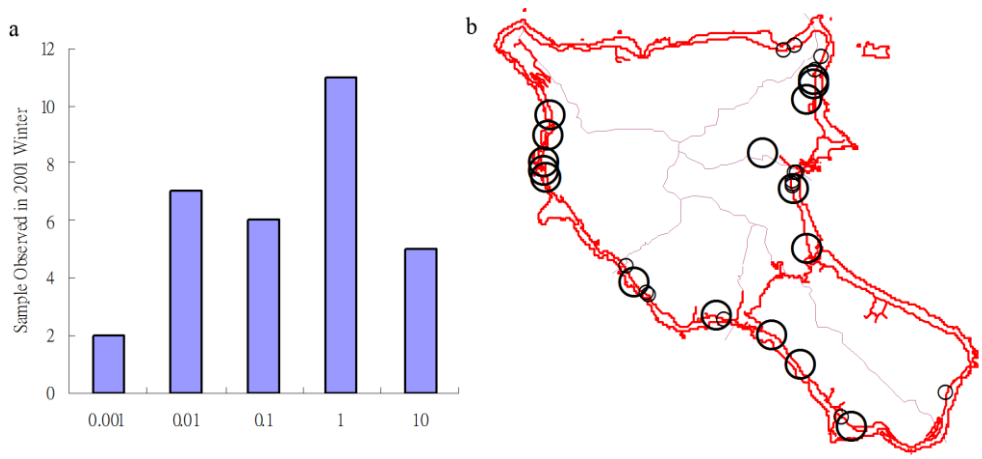

Fig. 3: Prescribed burns of Orchid Island observed along main roads between Oct. and Dec. of 2001. (a) During the winter as conventional period to prepare swidden garden, a total number of 31 burnt plots was recorded in terms of estimated area size by hectare. (b) Small circles indicate <0.1 ha burning, while large ones for >0.1 ha fires.

Local prescribed fires were established in areas with limited amounts of fuel shrubs (usually under 5 meters in height in northern windward cliffs) along humid and ocean-oriented cliff vegetations. They are weak in intensity, small in range (almost half below 1 ha), and restricted to the cold-temperature winter. As an outcome, both fallowed and cultivated Yami fields became the source of open-canopy habitats to provide keystone insect food for the owls in the forest edges and grasslands. This finding identified required habitats for harboring the endangered owls' necessary prey. According to such a dependency between owl survival and man-made habitats, community-based conservation for this endangered owl is strongly required in order to cooperate with local land uses in the indigenous agro-forest.

In the end, Yami TEK and associated management regimes of their agroforests reify a cosmo plotting design, instead of merely naming limited trees or grove sites. In Figure 4, a balanced daily subsistent movements among the Yami households must extend both to a Sea-oriented axis (*do iload*, Figure 5,7) and a Land-oriented axis (*do irara*, Figure 6,8). A realistic topography of all Yami villages can be ideologically divided into the Tree Territory (*kayakayo*) and Coastal Territory (*ili*)(Figure 5-8). The frequent weeding and annual prescribed fires can both apply to swiddens and paddies (Figure 6,8); while gathering fruits and woods were only adopted in stewarded gardens (*sibo*), indicated by unique marks on tree trunks according to most recent clan descendent as keepers. Daily subsistence also involves fishing and gathering in the Coastal Territory, namely working in the space of Coral Reef (*ahan*) and Bay (*vanoa*) (Figure 4).

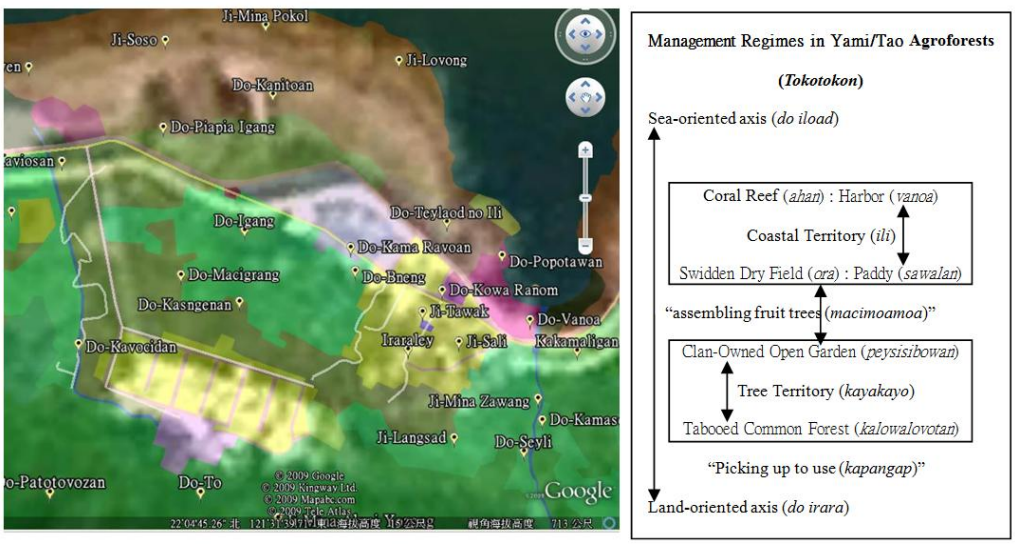

Fig. 4: Daily subsistence movements observed along two main axis between Sea-oriented (*do iload*) and Land-oriented axis (*do irara*). It is a realistic topography of the northern village in Lanyu, *Iraraley*, mapping for its corresponding management regimes from the "picking up to use (*kapangap*)" in close canopy to "assembling fruit trees (*macimoamoa*)" in open gardens.

Fig. 5: Austronesian “packed” subsistence in Bay (*vanoa*) and Coral Reef (*ahan*) along the sea-oriented axis (*do iload*), Iranumelik, 2007/7.

Fig. 6: Austronesian “packed” knowledge assembled local resources from close forest (*kalowalovotan*) to wetland (*sawalan*) along the land-oriented axis (*do irara*), Iranumelik, 2007/7.

Fig. 7: Coastal subsistence between Iratay and Imorod in Lanyu, along the sea-oriented axis (*do iload*), 2006/11.

Fig. 8: A series of settled small-scaled farmland between Iratay and Yayo, including close forest, open garden, swidden and wetland along the land-oriented axis (*do irara*), 2006/11.

Agroforestry taboo enhances soil fertility

The Yami village on the eastern shore of Lanyu, Ivarino, has rich biodiversity, and relatively poor soil property to support Entisols and Inceptisol, as the result of frequent burning practices. However, Iraraley in the northern shore has mature Ultisols and Inceptisol, and was last burnt in the winter of 2001. The reduced disturbance from swidden activities in Iraraley also links to a significantly smaller number of environmental species varieties, as indicated by orchard ant species occurring in the litter samples (Table 2).

Prescribed burning frequencies among the three villages of Yayo, Iraraley and Ivarino were recorded, and there were a total number of 31 swidden sites. Again, burnt spot numbers peaked in Ivarino (8 sites, 26% of the island-wide survey) with immature Entisols/Inceptisol (Figure 9), while Iraraley, having mature Ultisols/Inceptisol, has only two burnt sites observed in 2001 (ca. 6.5% across 6 villages). Yayo has five sites burnt (16%), and a mild soil status composed of Inceptisol, Ultisols and Alfisols (Table 2).

Table 2: Sampled sites (n=132) between open garden and close canopy with their features across three aspect, in terms of elevation and vegetative status. Soil properties refer to the geological survey in 1998 by EPA, Taiwan.

	ID. aspect	1. West			2. North			3. East			
	(village)	(Yayo)			(Iraraley)			(Ivarino)			
		0	1		0	1		0	1		
		garden	forest	summary	garden	forest	summary	garden	forest	summary	total
Management Regimes		農園	森林	合計	農園	森林	合計	農園	森林	合計	總計
樣本數	n	12	18	30	16	14	30	24	48	72	132
海拔(m)	elevation (m)	55.0	120.8	94.5	87.8	58.2	74.0	54.4	218.4	163.8	127.6
Tree Abundance	Indian Barringtonia (*Barringtonia asiatica*)										
	棋盤腳	+	++		+	++		-	-		
	Betel (*Areca catechu*)										
	檳榔	++	+		++	+		++	+		
Prescribed Burning											
Plot # (% over 31 sites)				**5 (16%)**			**2 (6.5%)**			**8 (26%)**	
Soil Properties				**mild**			**mature**			**poor**	
	SOM[1]	3-5	5-10		~3	5-10		0-5	5-10		
	CEC[2]	20-30	30-40		30-40	40-50		20-30	30-40		
	N[3]	<0.2	0.2-0.4		0.4-0.6	0.6-0.8		0.2-0.4	0.4-0.6		
	P[4]	59-115	0-23		0-23	59-115		0-23	59-115		
Soil classification		Inceptisol	Ultisols/Alfisols		Ultisols	Inceptisol		Entisols	Inceptisol		
		弱育土	極育土/淋餘土		極育土	弱育土		新成土	弱育土		

[1] EPA (Taiwan) survey soil chemistry of Lanyu in1998. SOM is the soil organic matter (g/kg).
[2] CEC refers to the cation exchange ability (cmol+/kg).
[3] Nitrogen concentration in the soil solution (N, g/kg).
[4] Phosphorus concentration in the soil solution (mg/kg by Extr. Bray P1 method).

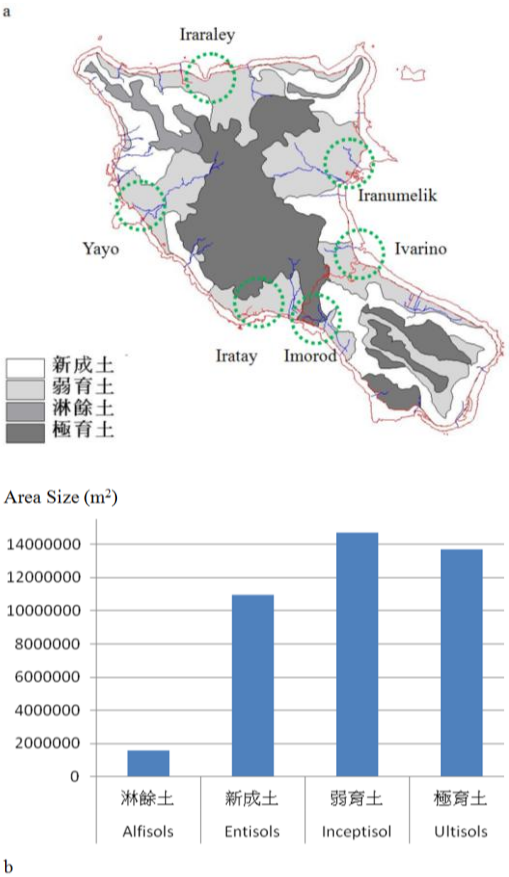

Fig. 9: Soil map for the volcano island, Lanyu. (a) Ivarino has a younger terrain weathered as Entisols/Inceptisol, while Iraraley with a mature Ultisols/Inceptisol. Yayo has a mild soil status composing of Inceptisol, Ultisols and Alfisols. (b) Farmers in Yayo and in Ivarino are more likely to use lower land terrain to access entisols, the newly formed soil after volcano weathering. Entisols covered one third of island area according to the past geological survey (EPA, 1998).

Ivarino: The periodic cultivation of clan-guard open garden (*peysisiboan*) has decreased crop productivity, usually due to reduced soluble phosphorus. The strong leaching in the humid tropics (such as in the case of Ivarino) makes it easier to remove iron and aluminum in from the soil containing weathered Entisols/Inceptisol, and its low pH will make iron and aluminum in soil granules combine with insoluble phosphorus. High concentrations of aluminum at low pH can cause toxic crop problems that are much more severe than the impact of these insoluble phosphorus and aluminum toxins upon native tree species like Barringtonia. Most crops in terms of betel, taro, and yam are historically selected and biologically fragile, since they only have a high growth rate in the richest soil nutrition. Native species are relatively more tolerant of acidic, nutrient-poor tropical soils, nutrient deficiency, and aluminum toxicity.

Yami/Tao people, especially in Ivarino on the eastern coast, widely adopted small-scale fires to raise the soil pH and make aluminum more insoluble and precipitated. This advantage is exhibited in swidden ashes, with increases in soil pH and higher crop productivity for 2-3 years before the next fallow rotation period. When the ash leaching is completed, crop productivity declines in an abandoned orchard.

Iraraley: Yami/Tao people occasionally fine tune the local management regimes in order to accommodate cliff soil distribution, particularly in Iraraley. With the richness of mature Ultisols/Inceptisol on the northern coast of Lanyu, and its close canopy that provides significant accumulations of fallen leaves, the soil organic matter content peaked in Iraraley and resulted in a reduced leaching, following a slow rate of mineralization due to lower understory temperature and a more favorable microclimate under fruit and primary trees in Iraraley.

After the seed bank of primary vegetation introduces a secondary succession, native plant species in the regeneration develop larger root systems, as well as more effective mycorrhizal spheres. Without the local fallow system, intensive cultivation will keep removing the soil's organic matter. Yami management regimes skillfully use complementary indigenous crops and primary trees in the Yami/Tao agroforest (Table 1).

Management regimes between communal close forest and a clan's open garden also lead to diverse adaptation. Farmers in Yayo and Ivarino use the lower terrain in the nearby region for agro-gardening (*peysisiboan*), without frequently disturbing the distant tabooed communal forest (*kalowalovotan*). It is noted that the average elevations across the three villages are significantly different. In Iraraley, villagers tended to go higher in the steep cliff for developing orchards, without introducing too much burning, while keeping the coastal forest intact near the village. The communal forest of Iraraley tabooed cemetery is a good example of this practice.

EMOTIONAL MOVEMENTS TRANSFORM LANDSCAPE

Emotional engagement in ancestral things across landscape through TEK

Yami people do not attach on a specific patch of land. They rather attach on things for adventure, with strong emotion and solid TEK for sailing or exploring new land. Farmers do not keep a land for longer period, but change their swidden patches as needed. They claimed a reason to shifting agriculture "*ya maattaattaw, ya ji nogat* (人是漂泊，從不停靠)," because Yami people believed that "the great journey never stops", prepare for next leap. The ancestral journey in Yami legends full with emotional expressions has been often prostrated as a prototypical model for changes. Yami's life experience is often expressed as a journey of emotional changes, for example, different play of internal conditions in their ancestral founding myth in which signifies the growth of human attitudes or social life. Migratory species such as flying fish or dolphin fish are viewed as travelling model gathered in particular moments. In a Yami slang, "*mi kamo do arilaw an* (匯集在海流轉彎

處)" means "human should gather precisely and wait for a particular action during the journey," and *do arilaw* is where the current divides.

Every day Yami people stop by a variety of particular trees or wildlife for specific purposes. Tropical affluence with emotional memory results from complementary uses of many local indigenous trees. Ancestral spirits (*anito*) thus live in such a forested house in the name of tabooed trees. Yami people respect ficus trees (*tapa, Ficus benjamina* L.), in which habituate the night egret (*aguwak, Nycticorax nycticorax*) and scop owl (*totow, Otus elegans botelensis* Kuroda). Yami people also avoid disturbance of the coastal giant tree (*teva, Barringtonia asiatica* (L.) Kurz) because their ancestors used to be buried under coastal trees within the traditional cemetery. Tabooed trees, such as the ficus and *Barringtonia*, can catch the spiritual image of parents ("*panaptan so pahad niapoan da* (依靠父母有如抓住父母的魂)"). Furthermore, tabooed uses of coastal forest avoid over-exploitation and the following erosion.

"Picking-up (*kapangap*)" invites delayed collaborative care (*macimoamoa*)

In Lanyu, before Austronesian ancestors introduced ceramics, there is no record found of other human settlement previously reaching this island, until the Neolithic period. However, there are several prior hunter-gatherer occupations in Luzon during the Paleolithic period, over 24,000 years ago (Bellwood 2011:S368). So the first Austronesian emigrants must have practiced food accommodation and land management before their arrival to Luzon and then interacted with these Paleolithic foraging groups in the Philippines.

Particularly, what ideas do early agriculture techniques interact or "pack" with hunting-and-gathering group? Bellwood (2005) argued that Austronesian features of agricultural development as "operational consideration," in terms of: 1. resource management (i.e. islanders practice before agriculture began); 2. cultivation (i.e. a series of human conscious activities to generate seasonal crop plants); as well as 3. domestication (i.e. human interference with nature by taming wild species). Among the Yami, the above three considerations are integrated into the cultural and ecological package of TEK that care clan gardens and communal forest as a whole body of interactive parts, namely *tokotokon* (derived of *tokon*, meant to mountains), or *sibo* surrounded by mountains. After the Austronesian farmers arrived in the Neolithic era, artificial horticulture embedding in forest became necessarily affluent by inserting more local fruit trees and tropical crops, although indigenous burning and fallow were limited.

The mentioned Yami management regime always wait for a specific timing in order to gather particular objects, in order to act a "*kapangap*" movement (Figure 10). A "*kapangap*" movement is physically or emotionally to attempt to "pick up any available tools in hand, if stopping by anywhere to move along the direction." For example, Yami people used to plan a field trip on *tokotokon* agro-forests in the morning by combining farming and gathering nearby to match recent demands of subsistence or fests (Figure 11). Farming requires timely hard-working maintenance in returns to great harvest, while

foraging is easier in dependence to local ecological production. However, Yami "packed" house is a center to organize both farming and foraging together as a whole (*macimoamoa*).

Fig. 10: "Picking up to use (*kapangap*)" is to wait for a specific timing in order to gather particular objects: including fresh fern (*balangbang*) and migratory fish, Yayo, 2008/10.

Fig. 11: Yami "packed" house is a mobile device embedding a mini-cosmo to organize both farming and foraging together as a whole (*macimoamoa*), by harvesting tuber crop (*wakay*, *Ipomoea batatas*) from swidden (*ora*), as well as fishing by *tatala* boat, Ivarno, 2006/11.

Similar to Marshall Sahlin's affluent foragers (1968), "*kapangap*" can be an accommodative attitude of Austronesian TEK for preparing a journey, or even an adventure. The key is to save time and resource by shifting spatial location to support further dispersal. The Yami people's expression "*angay pangap so avoa a kapangap mo so gaod,*" refers to making a gathering plan by first climbing private tall trees to take betel nuts (*avoa*, *Areca catechu*), then moving to pick piper leaves (*gaod*, *Piper betle*) along the communal watershed. In a similar term,"*mangap so asa a ka vato a kapangap na so asa a ka kawalan*" meant "life is like taking a rock while looking for bamboo (Xie 2007)."

"Picking useful elements up to use (*kapangap*)" is the realistic practice of employing cropping and gathering techniques in a marginal and stressful habitat, such as Lanyu Island, which is equal to Batanes Islands in having "no flat alluvial land and no high-level water sources that could support terrace farming." (Bellwood 2011:S372) Bellwood also suggests a flexible but culturally-solid pack during the Austronesian movement:

> No "package" concept can afford to be exclusive, and there will always be a danger that people will read far more into the concept than is necessary. Allowance must always be made for indigenous contributions to the suite of moving concepts and items, if and when they are required. (Bellwood 2011:S369)

In Yami horticultural ecosystem, the economic needs are satisfied by repeatedly "picking harvest up" in a changing dynamics of agroforestry production, associated with hilly land, rare surface water, diverse but unstable tropical fruits, accessible crops, and wildlife biota. It is a generations-lasting struggle to experiment possible understory subsistence crops (such as fruits or cocoa) in the forest gaps opened by ancestors. Large-scaled, labor-intensively alluvial cultivation in tropics is definitely rather difficult than "Picking-up Management," in which a clan-owned canopy window can be maintained by regular removal of understory bush (and fruits), by the way to sustain soil fertility and agroforest productivity.

The "picking-up (*kapangap*)" management regimes in Lanyu have composed of the *tokotokon* ecosystem, in terms of communal close forest (*kalowalovotan*), clam-owned open garden (*peysisiboan*), household swidden (*ora*) and wetland (*sawalan*), accompanied by patchy tropical trees and reachable materialistic skills like proper burning. Ecological affluence is mediated by an emotional connection to ancestral beliefs, free-expanding management regimes and locally accommodated biological species, reified as Yami agroforests since the first Austronesian-speaking founder come. The rich emotional attachment upon associated landscape and involving management regimes is clearly a greatest opportunity to set Lanyu as a practice ground with shadow coral terrain and rich tropical species, just right in front of the Pacific ocean.

Yami TEK is an inter-cropping package as a portable device, combining periodically shifting tree and herb crops. They adopt a series of plantation patches embedded within the natural forest. The island-wild landscape farming system employed by Yami/Tao is a unique form of horticulture, agroforestry or agrisilviculture. *Tokotokon* is a self-sufficient

gather and farming landscape rooted in TEK. Their ecological system mosaics exhibit manageable units, and allow complete recycling of nutrients from hilltop ridge to coastal plain. Two major components serve as the constructing principle of cultivation: (1) sharing close canopy as communal property that all villagers participate the management (*kalowalovotan*, derived of *kalovotan*, or *lovot*, meant to own together) in tabooed forest thriving on the uphill slopes (*do irara*), and (2) responsible accessing to open gardens (*peysisiboan*, derived of *siboan* or *sibo*, meant to put particular someone to work in the mountains), in which strict stewardship to kin and households limits the property holding in certain local woods, fruits and crops. Partial access to natural resources (2) also guarantees further continuous exchange of barters or gifts, if not available from the communal shared pools (1).

Plant ecologists call such frequently disturbed agro-forests between (1) *lovot* and (2) *sibo* states as an attentive horticulture, although referred to as "degradative successions" by Doube (1987), wherein human knowledge and technologies are used to intensively nurture plants for human food and non-food uses by disturbing the environment over a relatively short time-scale of months. Subsequently, massive dead organic matter is exploited by understory wildlife like microorganisms and fruit-eating animals like civets. This process requires introducing as many species of useful plants on a small scale as farmers can hold around their dwellings or in specialized plots they occasionally visit (Swift 1987). Accordingly, a packed horticultural model is primarily mediated by a series of small mosaics between open gaps and close forests, departing from large agricultural fields of single crops. Agro-forests and its associated cultural plots have made the Yami/Tao management regime an integral part of Austronesian heritage. Revisiting the historic gardens and species not only suggests reconnecting to the ancestral mindset, but also demonstrates the perceptional transmission of an ideological world. The "packed" agricultural ideas have had a powerful influence upon social institutions and environmental sustainability in Lanyu, and generated a resource set, integrating close forest, open garden, swidden and wetland as a whole. This ethno-ecological work examines the indigenous farming ideas, and acknowledges their expertise in mentioned *tokotokon* agro-forests as historically practiced in southeastern Taiwan, in terms of "picking elements up to use (*kapangap*, derived of *ap*)".

CONCLUSION

Through my participant observation, narrative analysis, and landscape survey, this study examines the complex relationship between local practice and ecological entities of TEK, such as tropical trees, encountering wildlife, and management regimes. The Austronesian natives, Yami/Tao, have maintained a vivid TEK in tabooed agro-forests, resulting to regulate daily and historical movements, including (1) sharing ancestral communal property (*lovot*), and (2) engaging in collaborative care from work together (*maci-vazay*) to distribute together (*maci-vonong*).

Yami TEK encourages to appropriate newly introduced human-thing set to fulfill cultural purposes with emotional attachment. Primary close forest (*lovot*) have recently become protected areas for communal use; while local orchards and open gardens (*sibo*) are frequently cared with clan relatives. On the other hand, the particular uses of trees in general management regimes are further transformed into a cultural design of human-thing cooperate as a packed union (*macimoamoa*). With persistent practices in regards to ancestral gardens, cultivars, and wildlife, the ancestral ideas of Austronesian TEK such as cropping and entrenched agroforestry illustrate a meaningful mindset against social and environmental degradation.

REFERENCES

Bellwood, P.

2001 Early agriculturalist population diasporas? farming, languages and genes. *Annual Review of Anthropology* 30:181-207.

2005 *First farmers.* Oxford: Blackwell.

2011 Holocene Population History in the Pacific Region as a Model for Worldwide Food Producer Dispersals. *Current Anthropology, 5*2(4): S363-S378.

Berkes, F.

1998 Indigenous knowledge and resource management systems in the Canadian subarctic. in *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. pp98-128, ed. A. M. Jansson, M. Hammer, C. Folke, and R. Costanza. Washington DC: Island Press.

Brookfield, H. and C. Padoch

1994 Appreciating agrodiversity: A look at the dynamics and diversity of indigenous farming system. *Environment* 36(5):6-11, 36-45.

Cheng, Chien-Wen (鄭建文)

2008 *Cultural Change and Regional Relationship of Prehistoric Taiwan: A Case Study of Oluanpi II Site*. Ph.D. Dissertation, National Taiwan University. (in Chinese)

Cheng, Han-Wen (鄭漢文)

2004 *The Convoluted of Yami Boat Culture: The approach of social phenomenon of Big Boat culture*. Master thesis. National Dong-Hua University. (in Chinese)

2011 *The Effect of Nonhuman Face: ji macipayok so moing Ecological Practice of Cultural Perception of Yami.*Ph.D. thesis. National Dong-Hua University. (in Chinese)

EPA (Environmental Protection Agent)

1998 *Soil survey of Lanyu Island*. Administration of Interior Affair, Republic of China, Taiwan.

Green, Roger

1991 The Lapita Cultural Complex: current evidence and proposed models. *Bulletin of the Indo-Pacific Prehistory Association* 11: 295-305.

Hardin, G.

1968 The Tragedy of the Commons. *Science* 162:1243-8.

Holling, C. S., F. Berkes, and C. Folke

1998 Science, sustainability and resource management. in *Linking Social and Ecological Systems: Managing Practices and Social Mechanisms for Building Resilience.* pp 342-62, ed. F. Berkes and C. Folke. Cambridge University Press, London.

Hu, Cheng-heng
2008 Spirits Fly Slow (*pahapahad no anito*): Traditional Ecological Knowledge and Cultural Revivalism in Lan-Yu. *Journal of Archaeology and Anthropology* 69:45-107.
2013 Ecological Embodiment and Cognitive Semantics of Tao Fish Names, *Analyzing Language and Discourse as Intercultural and Intracultural Mediation*, pp187-227.

Hung, Hsiao-Chun
2014 Red-slipped pottery, lime-infilled decoration, and betelnut-chewing culture --migrations and cultural Interactions of early Austronesian-speaking Populations. *The 2014 International Conference on Formosan Indigenous Peoples: Contemporary Perspectives*. 15-17 September, 2014. Taipei, Taiwan: Academia Sinica.

Sahlins, Marshall
1968 *Tribesmen* (Foundations of Modern Anthropology). Printice Hall.

Syaman Jabbadu (施馬高)
1997 *A Study on Lanyu Tribal Landscape and Culture*. Taitung: Cultural Center of Taitung County. (in Chinese)

Syaman Rapoan (施努來)
1997 *Cold Sea Loves Me Tenderly*. Taipei: Unitas. (in Chinese)

Wang, Hsiang-hua (王相華), Li-wan Chang, and Yui-ching Kao
2003 Forest management of aborigines Tao in Lanyu (Botel Tabago) and its effects to forest structure and species composition. *Journal of National Park* 13, 1:75-94. (in Chinese)

Wei, Hwei-lin (衛惠林) and Liu, Pin-hsiung (劉斌雄)
1962 *Social structure of the Yami, Botel Tobago.* Institute of ethnology, Academia Sinica, Monograph No.1. Taipei. (in Chinese)

Xie, Chun-ying (謝春英, eds.)
2007 *A Tale in Lanyu - Tribal (Traditional) Territory: Mountains, Rivers and Seas.* Taitung: Lanyu Township Administration. (in Chinese)

Yu, Guang-Hong (余光弘)
1991 *Ritual, Society and Culture among the Yami*. Ph.D. Dissertation, University of Michigan.

讓艱困海岸成為練習場？：雅美／達悟族森林農藝裡的傳統生態知識

胡正恆*

摘要

本文旨在探究雅美／達悟人經營森林園藝（agro-forest horticulture）時所表達的管理慣俗，整理了過去所調查蘭嶼鬱閉森林和開墾果園間的農藝多樣性與訪談語料。雅美傳統生態知識所成就的園藝果樹林，特色是規模小、卻照顧多樣作物，迥異於大面積、嚴格分工定植的農業脈絡。而雅美／達悟人栽植多重相嵌的複層林中，藉由回憶情感記號以溯事物起源的分類體系，是整合食物到土地各層次的功能地景，也是與當代發展計畫互動、做出有力回應的生態政治對話基礎。

雅美／達悟人長期以來維繫了當地自然特有的豐饒，傳統生態知識源出一套南島文化核心邏輯，落實於此一熱帶生態系統，並以之開展出蘭嶼獨特的島嶼農藝地景。南島傳統生態知識是慣俗知識、也激發出情感價值，它的主要經營作為深寓於當地種植系統的二項大地實踐，並藉由生態情感在物我間有所互動：包括採集 *kapangap* 部落共有森林（*lovot*），和共作照顧 *macimoamoa* 果樹於專有果園（*sibo*）。雅美園藝照護特別強調了南島語中的兩類工作動詞：*kapangap* 是「隨時採擷上手使用」；與 *macimoamoa*「讓樹跟人一起工作」。

雅美傳統生態知識相信鬱閉森林是神靈的居所，必須持守禁忌；而開墾的果樹林則遍植古今熱切渴望的檳榔、龍眼、毛柿、山欖等嗜好物。這兩類公共地的農藝都有賴當地生態管理制度來回穿梭於隨遇上手（*kapangap*）與物我共作（*macimoamoa*）概念之間。雅美地景上連結祖源情感的文化設計，實際管制了長期公共財取用，讓整體運作用材林與果樹林的生態效益擴大，連帶保證了祖地出產作物的豐富意涵。人工鬱閉森林栽培了古老的大徑木，如棋盤腳、龍眼和芒果；而果園經營者依賴經驗去斟酌椰油、朗島和野銀等殊異的土壤特質，使用小規模的精細燒墾使森林和果園間的連續帶藏著諸多地方蕨菜、芋頭、貓頭鷹，甚至特有蝴蝶。在過去的幾百年中，雅美族人保持梯田與旱田的輪動採集，共作撫育了在地寓居的野生動物和林間副產，實為南島人群以守候機遇為生計態度的重要文化理路。

關鍵詞：蘭嶼、雅美族／達悟族、園藝、混農林、傳統生態知識

* 中國文化大學森林暨自然保育學系助理教授。hujackson@gmail.com