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TRADITIONAL STORAGE AND UTILIZATION PRACTICES ON ROOT AND TUBER CROPS OF SELECTED INDIGENOUS PEOPLE IN THE NORTHERN PHILIPPINES

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ABSTRACT

The indigenous people who reside on hills and mountains of the Philippines like the *Ivatans, Isnegs, Kalingas, Tingguians, Applais, Bagos, Kankana-eys, Iyattukas, Ibalois, Kalanguyas, Bugkalots, Aetas* and *Mangyans* are known as root and tuber crops growers and consumers. Unfortunately, there is lack of documentation and with the changing lifestyles of the younger generation, traditional root and tuber crops storage and utilization practices are at the risk of being forgotten, hence, this study. Secondary data gathering, interview-workshops with key informants and follow-up field visits were done to document and update information.

Indigenous peoples have no practices that prolong storage life of taro (*Colocasia esculenta*) and cassava (*Manihot esculenta*) though cleaned and washed. Taro corms and cassava storage roots can last for seven days if not mechanically damaged. For sweet potato (*Ipomoea batatas*), some varieties are stored in wooden boxes for six to eight months. Harvested roots and tubers of greater yam (*Dioscocrea alata*), lesser yam (*Dioscorea esculenta*), tannia (*Xanthosoma sagittifolium*), arrowroot (*Maranta arundinacea*), canna (*Cannaceae*) and yacon (*Smallanthus sanchifolius*) are stored for four to six months provided the roots and tubers are washed, cleaned and dried then kept in shaded area of the household. This can be in the rice granary, in a wooden bin or in a pit under the house or under the shade then covered or mulched with dried grasses, banana leaves and/or sacks. All kinds of edible storage roots and tubers are consumed simply as boiled or steamed, roasted and fried. On the other hand, chopped, sliced or mashed, dried, ground and fermented roots and tubers are used as ingredients in traditional dishes like *guinataan, tupig, nilubyan, kisa, tapey, binobodan, nawnaw, saloposop, sukit* and others which are used for various purposes such as substitute to rice as staple food, emergency food, viand, snack food, fermented drink, flavoring and to some extent for therapeutic purposes.

Keywords: *storage and utilization, roots and tubers, indigenous people*

INTRODUCTION

Rice is the staple food of the Philippines but rice imports have been filling up the production shortage. On the other hand, root and tuber crops have served as important alternate staple food in the olden times. In the Philippines, it is the hillside, upland and forest dwellers and the indigenous people who are the traditional consumers and producers of root crops. However, continuing economic and educational development, in- and out-migration, environment, climatic and lifestyle changes might put at risk the loss of traditional knowledge and practices of utilizing and storing roots and tubers. The loss of root crops diversity, erosion of indigenous knowledge and the label of root crops being an inferior food, a poor man's food and an unknown food could partly be attributed to the political and economic structures and lack of information to fully appreciate and develop these crops (Figure 1). This would affect the country's future food security. According to Scott *et al.* (2000), by 2020 over two billion people in many of the developing world's poorest and most food

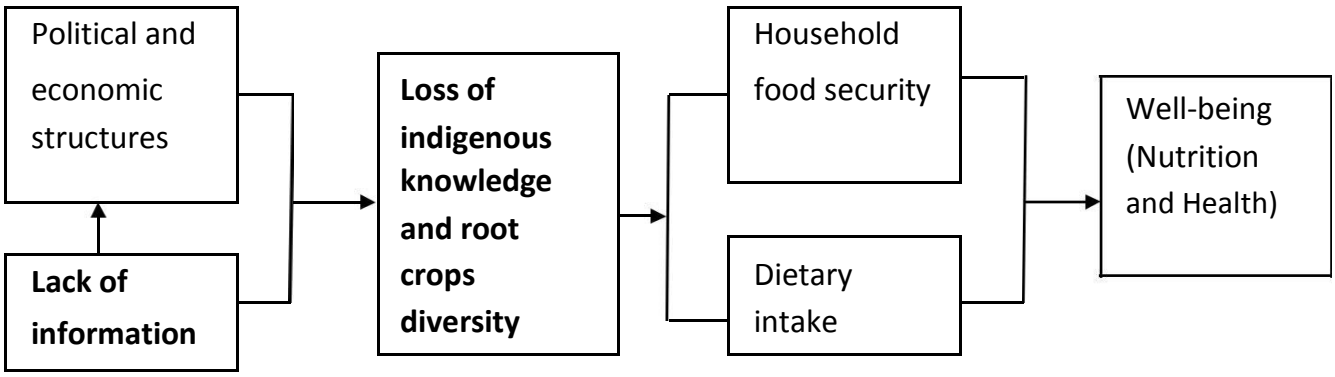

Fig. 1. Conceptual framework on the causes and consequences of losing indigenous knowledge and resources on root crops

insecure households of Asia, Africa and Latin America will continuously look up to these root and tuber crops as contributing, if not the principal, source of food, nutrition and cash income. There is thus a need to document indigenous practices including storage and utilization knowledge and other initiatives of the root and tuber household consumers and producers. Indigenous knowledge can be lost naturally as practices, get modified or left unused for a long time (Soni, 2007). Instead of re-inventing the wheel, development workers, researchers and scientists can choose from indigenous knowledge data base or combine indigenous knowledge with modern or western technology for feasible solutions (Thiagarajan, 2008).

Indigenous knowledge and practice is the knowledge or practice that people in a given community have developed over time and continuously develop to adapt to local culture and environment (NAARAP, 2009). The Convention on Biological Diversity of 1992 as cited by Tansey and Rajotte (2008) acknowledged the contribution traditional knowledge can make in protecting species, ecosystems and landscapes and those which fail to formulate policies without a concern for local environment generally fail to achieve the desired outcomes. Based on experiences from China, indigenous and foreign innovation efforts are complementary thus the encouragement of indigenous R&D and innovation activities remain an indispensable centerpiece of innovation (Fu and Soete, 2011).

Basic to indigenous R&D is the availability of data base. At present, there is limited documentation of indigenous knowledge on root and tuber practices in the Philippines unlike other countries where practices are mentioned in literatures. This might be a constraint to introducing improvements in livelihoods, diet and nutrition of the indigenous peoples and rural households. Bio-chemical traits of perishability and bulkiness are constraints in production and utilization, but are also motivations in the development of indigenous utilization and storage technology. Traditional utilization of rootcrops are as food and feeds in fresh form, boiled, roasted or fried. Processing is limited mostly to convert the short storage life of roots and tubers to more stable products through drying, fermentation and detoxification by soaking and drying (Lancaster and Coursey, 1984). Cassava, yams and sweet potato for instance are harvested when needed or buried in pits or covered with mud paste, soaked in water or pounded and fermented as *fufu, fuba, gari* or *farinha* in Africa and Brazil. These are sun-dried or dried over a fire just like the chips called *gaplek* in Indonesia and later on ground into flour for bread or porridge. Grated and dried, cassava rice called *landang, lafun* flour, *chapati* and starch for spiced sauce called *cassareep* are prepared (Lancaster and Coursey, 1984; Scott *et al*., 1992). Sweet potato roots and vines including dried chips are fed to pigs and cattle (Scott *et al*., 1992). The *Colocasia* and *Xanthosoma* species of aroids are the two most important food crops of the South Pacific, the Carribeans and West Africa (Alexander, 1969; Coursey, 1968 and Lamber, 1979; Massal and Barrau, 1955 as cited

by Lancaster and Coursey, 1984) and are normally consumed after harvest such that they are only harvested when needed. A fermented product known as *poi* or *ma* is prepared from Colocasia in Hawaii and in the Anuta Islands (Greenwell, 1947; Stewart, 1928, Massal and Barrau, 1955; Yen, 1973 as cited by Lancaster and Coursey, 1984).

Earlier, published and unpublished studies and newspaper articles in the Philippines had mentioned the importance of root crops, particularly sweetpotato, as survival crops among resource-poor families. This is to weather the ill-effects of typhoons and food crises: such as, during the World War II in the Cordillera highlands (Solimen *et al.*, 1998), during the aftermath of the 1990 earthquake in Benguet (Sano *et al.*, 1991), swidden farming of marginal farmers in the rice terraces of Ifugao (Balaki and Solimen, 1991; Verdonk, 1991), and the year-round cultivation of sweetpotato (*Ipomoea batatas*), *ubi* (*Dioscorea alata*) and *tugui* (*Dioscorea esculenta*) as subsistence crop in the Batanes island province (Dayo *et al*., 1998). This also includes the consumption of wild yams *nami* (*Dioscorea hispida*) by upland farmers in Mindanao due to crop losses resulting from drought by the El Nino and the consumption of wild yam *kamangeg* (*Dioscorea spp.*) by fishermen/ farm laborers in the coastal village of Ilocos Sur before the harvest of the wet rice cropping. These led to the wrong perception of rootcrops as starchy staples (energy source) only for the poor. According to Horton (1988), storage roots and tubers contain varied quantities of protein, essential vitamins and minerals. Furthermore, cassava, potato and sweetpotato significantly out yield the cereals in dry matter/ caloric production per unit area and even on a per day basis in the case of potato.

MATERIALS AND METHODS

This study is part of the project, Role of Roots and Tubers in Household Food Security and Income of Indigenous Peoples in Northern Philippines. This was conducted because of the lack of baseline integrated technology information for quality planting materials, crop production, utilization and postharvest on roots and tubers needed for dissemination to small-scale cash cropping and subsistence farming clients and the increasing importance of roots and tubers as a food crop to feed the world in the coming decades in view of climate change, health and food safety. The project aimed to: (1) document the diversity and adaptation of roots and tubers grown, gathered and utilized by indigenous peoples, 2) document indigenous knowledge on crop conservation and propagation, production, utilization, storage and consumption practices, (3) document loss of root crop diversity and indigenous knowledge, (4) determine socio-economic benefits derived from the conservation, production and utilization of the roots and tubers, (5) identify areas for participatory action research on root crops with indigenous peoples' communities and (6) identify areas for further root crop R and D in order to bring back and strengthen indigenous knowledge towards improving food security. This study documenting traditional storage and utilization knowledge is part of the specific objective documenting indigenous knowledge on crop conservation and propagation, production, utilization, storage and consumption practices.

The steps in carried out for the research are shown in Figure 2, beginning with the gathering of secondary data from local government agriculture, planning and development units and from the National Commission on Indigenous People records or libraries. This also included market observation and linking for collaborative research which were simultaneously done in identified municipalities/ communities (Figure 3), populated by indigenous peoples, namely: *Ibalois, Bagos, Ivatans, Isnegs, Kalingas, Tingguians, Applais, Kankana-eys, Iyattukas, Kalanguyas, Bugkalots, Aetas* and *Mangyans*. Linking for the implementation of the research started in February 2012. Key informant interview workshops were conducted from April 2012 to October 2013 with the assistance of collaborating researchers and agencies. Respondents were selected based on familiarity in growing and consuming rootcrops, age (15 to 70 years) and length of residence in the indigenous people's community. Aided with an interview guide, informal group interviews, focus group discussion using cue cards and pictures were done. Farm visits and community walk for

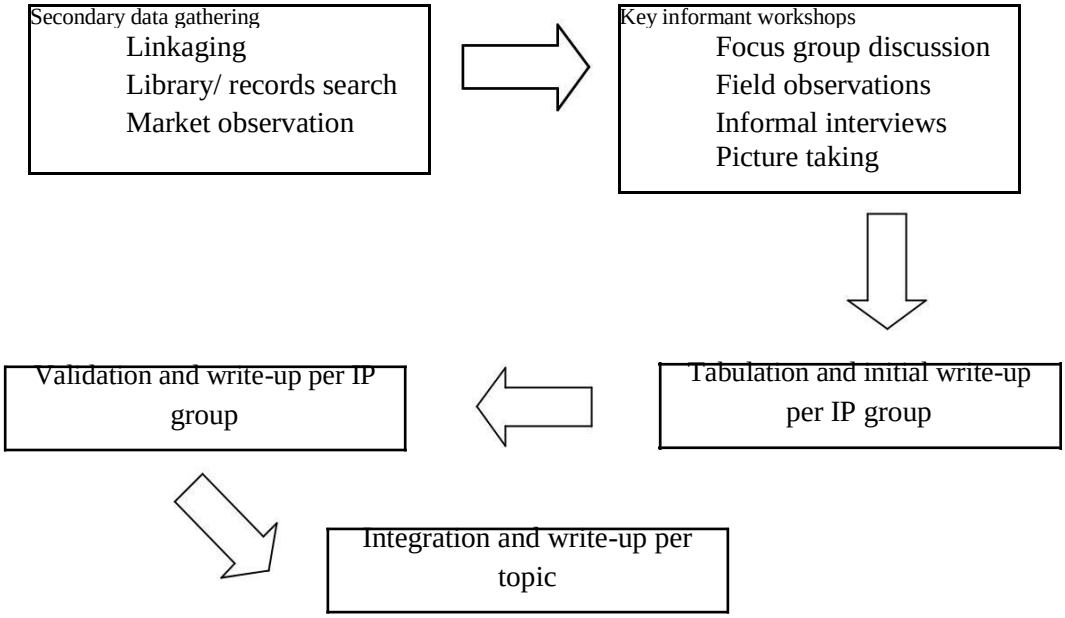

Fig. 2. Steps in conducting the research

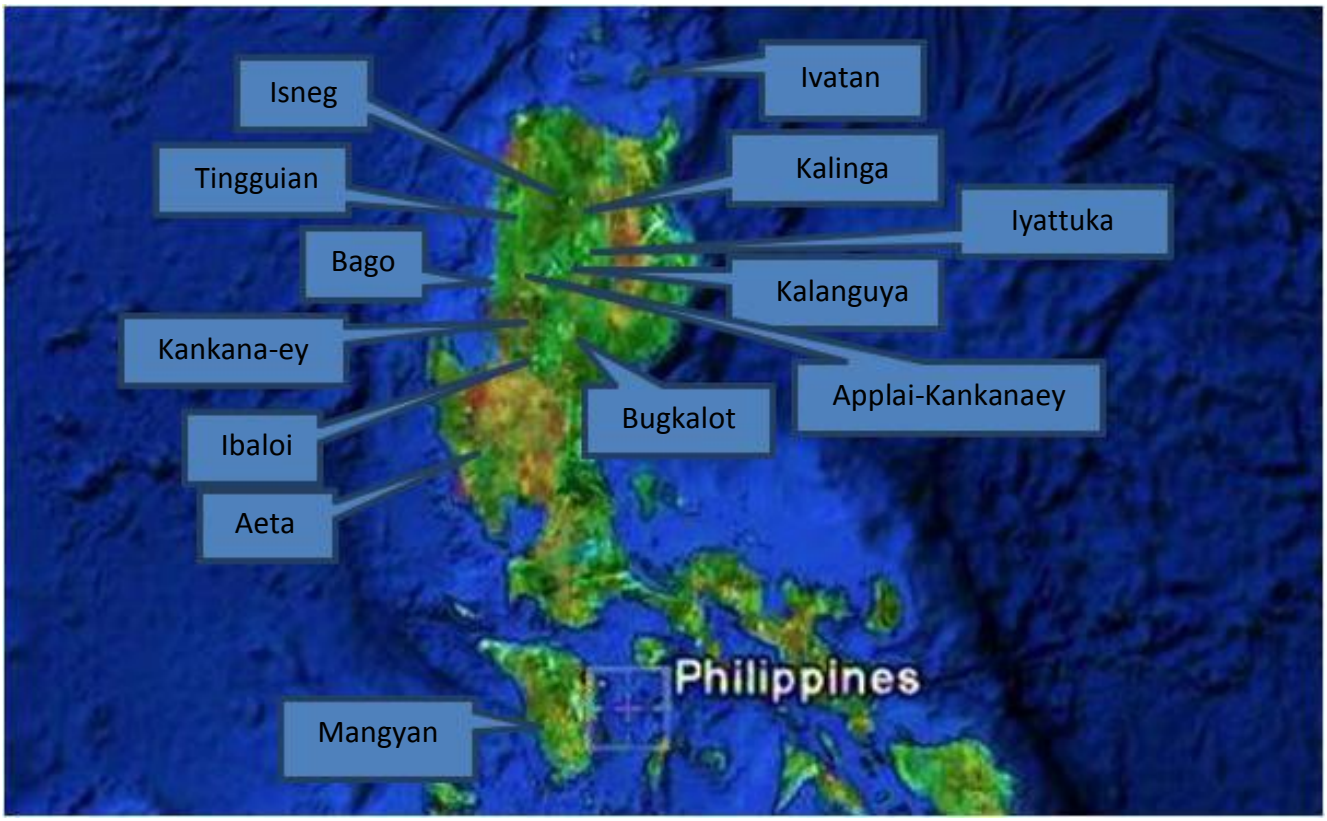

Fig.3. Location of the IP respondents in northern Philippines

observations and picture taking were done after the interviews. Tabulated information and initial write-up were made after the interviews and presented/ sent back to collaborating local researchers and some key informants for clarifications, corrections and additional information.

The research reports per IP group were published in the Traditional Roots and Tubers Knowledge Series, December 2013 to June 2014, #1-14' as part of the research commitment to the IP informants and collaborating researchers/ agencies. It is in this series that the details of the IPs and study sites were described and can be accessed at rootcrops-bsu.hostclink.net. The last part is to

integrate indigenous knowledge and practices of the concerned IPs according to major topics to present a birds-eye view of indigenous technology, one of which is this paper on traditional storage and utilization practices and the upcoming production of information materials, *e.g*. indigenous rootcrop recipes.

RESULTS AND DISCUSSION

Storage Practices

Storage techniques or practices for the harvested roots and tubers depend on the shelf-life of the different kinds and varieties of root and tuber crops (RTCs) and household use. The indigenous peoples (IPs) - the *Bugkalots, Aetas, Bagos, Tingguians* and *Ibalois* have no practices that prolong the storage life of sweet potato, taro and cassava. The storage roots are just left in the ground. Instead, priming or installment harvest is practiced when needed. Harvesting is done when roots or tubers are needed, *i.e*. households harvest only what is to be consumed, bartered or sold immediately. In-ground storage or leaving the matured storage roots in the ground also has a disadvantage, as they are prone to rotting or rodent and pest attack resulting to wastage. This happens when households do not have time to harvest because of other household chores. Households prefer to harvest more than they can eat as food. Any excess harvest is fed to animals or otherwise, these are processed into dried chips locally called *buku* to lessen wastage.

The *Ibalois* claim that sweet potato roots have shelf-life of two to three days if harvested from irrigated fields and up to seven days if harvested from the dry farms. *Bago* farmers however mentioned that sweet potato roots have 15 days shelf-life while *Aeta* farmers claimed that sweet potato roots have a shelf-life of up to one month. Sweet potato farmers can store a sack of this for one month in their homes for kitchen use. In a previous documentation, the *Bayyo* IPs claimed that one sweet potato variety (*akong*) can be stored for six to eight months in the *pokok*, a wooden box for sweet potato storage (Fang-asan *et al*., 1998; NPRCRTC, 1990). After one month, stored sweetpotato roots become sweeter because of the hydrolysis of starch to sugars (Kimber, 1972).

Taro corms will rot in two to three days from harvest as claimed by the *Ibalois* and *Isnegs* especially if harvested from irrigated fields. Taro planting materials consisting of the small corms are just left in the soil as in-ground storage to be harvested for the next planting season.

According to studies, cassava storage roots turn black in three days. This could be the reason why one *Ibaloi* informant soaks the cassava roots in water to prolong its shelf-life. In West Africa, soaking of cassava roots for three to four days is being done to soften roots before peeling, pounding and boiling or steaming and eating (Lancaster and Coursey, 1984). *Isnegs* claimed that harvested cassava tubers can last seven days if not mechanically damaged and unwashed.

Harvested roots and tubers of greater yam, lesser yam, tannia, arrowroot, canna and *yacon* can be stored for four to six months without serious losses at ambient temperatures. However, the roots and tubers must be washed, cleaned, air-dried and kept in shaded area within the house (*e.g*. in the rice granary- *kamalig, agamang, donglong*, Figure 4), in a wooden bin or in a pit under the house or under the shade then covered or mulched with dried grasses, banana leaves or sacks. In other parts of Asia and Africa, freshly harvested tubers are packed in ashes and covered with soil or simply covered with little soil and grass mulch. Yams may also be stored in *silos, i.e*., hollowed out pits in the ground or in barns specifically constructed for yam storage (Lancaster and Coursey, 1984).

Utilization and Processing Practices

The indigenous peoples in the northern Philippines commonly consume storage roots and tubers as boiled or steamed, roasted and fried. Roasting is usually done in the farm when IP farmers go to their swidden farms while frying is either for fries or chips. However, there are cooking preparations or recipes that are for specific kind of storage roots or tubers.

Sweet potato. Camote cue is fried sweet potato coated with sugar and held in place by bamboo skewer, a popular snack food and usually sold as a street food. Cubed roots are also used as

ingredient in *guinataan* and *dinakan* snack foods. Occasionally, the roots are traditionally prepared as *nilubian* or *lubi-lubi*, *inis-isna* and *suman* where the boiled, mashed or freshly grated roots are mixed with or without glutinous rice, sugar and coconut milk or milk; or *maruya* where strips of sweet potato roots are coated with flour then fried. Dried sweet potato chips called *buku* or *bakol* are ground into flour, mixed with sugar and coconut, wrapped in banana leaves and steamed into a product called *tupig* or *potapot*, *saluposop* (sweet potato flour is mixed with water and sugar then steamed or cooked in the clay pot) and *pinallak* (pound or unpound camote chips mixed with rice and cooked in clay pot). Cubed roots could also be mixed in steamed rice as extender, or added in viand dishes like omelet, *adobo* and *buridibod*. The tips or leaves of sweet potato is prepared as vegetable salad, sautee'd or added to *sinigang* and added to vegetable stew with meat, fish, crab or shells and *dinengdeng* dishes. Left-over water in boiling sweet potato roots could be made into *hiit* or *in-inte*, or fermented into *hebeng*, *sabeng* or *tengba*. In *hiit*, the left-over water in boiling sweet potato is continuously heated until it becomes thick as jelly or jam. In *hebeng*, salt is added then fermented for 15 days to one month or longer. *Hebeng* among the *Kalanguyas* or *sabeng* among the *Kankana-eys*,

An improved dongdong of the *Buhid-Mangyans* | *Agamang* of the Tingguians | Alang of the *Iyattukas*

Fig. 4. Storage structures of some of the IPs are principally for rice harvest but are also used for prolonged storage of rootcrops

Fig. 5. Boiled *sudi* (taro) and *wakay* (sweetpotato) are served in place of rice in Batanes

Cassava. All the IP groups simply boil (*nilaga*, *iluknog*, Figure 6) or steamed cassava commonly eaten as snack food before meals. Grated coconut is sometimes added to boiling cassava.

Fig. 6. Boiled cassava served as snack food

is used as a substitute for vinegar and believed to prolong human life if regularly consumed.

One meal dish called *kinkinalot* or *bakkay* (mixture of rice and corn, sweet potato tops and storage roots, cassava shoots and sabeng) among the *Aplai-Kankana-eys* and a mixture of mashed taro, sweet potato and fish called *tnumi* among the *Ivatans* could be prepared. Among the *Kalingas nawnaw* soup or *laplap* among the *Iyatukkas* (mashed sweet potato roots added with water) is the last resort food (Table 1) if there is nothing else to eat. *Kalanguya* households use the term *lommog* if roots are simply boiled with the skin intact and the term *isihibak* if peeled.

As rice extenders, *Aetas* have *Kisa*, where cubed cassava roots are placed at the bottom of uncooked rice and brought to boil. This is similar, to the *Tingguian*s practice where dried grated cassava roots are added to rice then cooked as usual. They claim that cassava gives a feeling of being full for a longer time, *i.e.*, *nakelkeleg* in *Tingguian* terms.

On special occasions, boiled cassava tubers are pounded or grated then mixed with coconut or milk and butter/margarine and sugar. This recipe is called *nilubyan, haleya, lubi-lubi* or *inis-isna*. Grated fresh cassava tubers are also mixed with coconut or milk and butter and sugar, and then cooked as *bibingka, suman*, cassava cake, cassava roll and *pitchi-pitchi*.

IPs like the *Ibaloi, Kalanguya, Iyattuka* and *Kankana-ey* also ferment cassava roots they call *binobudan* and the juice collected as *tapey* or *tapue*y. *Tapey* or *binobudan* is from boiled cassava roots treated with *benekbek* (yeast made from fermented ground rice with pepper and *angwad* weeds) and then fermented in the *labba* (winnower) for three days before transferring to the jar to continue fermentation process for two weeks if a sweeter taste is desired or up to one month for stronger alcohol content. The traditional recipes *tupig* and *binobudan* are usually passed on by parents.

Cassava roots can also be an ingredient in snack foods like *guinataan, dinakan* and *salapusop* or an ingredient in vegetable-meat dishes, vegetable-coconut milk dishes and in vegetable stew of chicken/ duck meat or crabs (*agatol*) or snails (*susu, bisokol* and *leddeg*) spiced with hot pepper. *Ukoy* was learned from the *Kapampangans* which is made out of grated cassava roots, grated green papaya, small shrimp, onions, pepper and salt. The *Aetas* blanch and strain the cassava leaves then sautée with gata or coconut milk.

Also, among the *Aplai-Kankana-eys*, cassava roots are also ingredient in making *bakkay*. *Bakkay* is a mixture of pounded arrowroot, cassava, corn or rice and dried mushroom (*kuwat* or *kodi*) with salt, garlic, ginger, sili which is then stored or fermented for one to two months. This is used as a substitute for oil or fish sauce (*bagoong*) flavouring.

Excess harvest of cassava tubers are sometimes sliced into chips then sun dried. The dried chips are called *buku* which could be stored for several months. *Buku* are known in Indonesia as *gaplek* and *kokonte* in Ghana (Anonymous, 1941 and Dovlo, 1973 as cited by Lancaster and Coursey, 1984). These are pound/ground into course flour to make *tupig* or *potapot* and pancakes.

Taro, wild taro and tannia. Taro corms are just boiled, made into *kalamay* by the *Kapampangans*, *haleya* or *nilubya*n by the *Bagos* and *Isnegs*, or added as ingredient in *guinataan* snack food. *Kalamay*, *haleya* and tannia *nilubyan* are mashed corms added with coconut and sugar similar to the procedure in making sweet potato and cassava *nilubyan*. Taro corms can also be mixed with coconut in *guinataan*.

The corms, stalk and leaves of taro are used in vegetable or viand dishes. The *Aplai* tribe cooks taro with legumes or pechay, *endey*, chayote tops or water cress and meat. Corms and stalk of taro are cooked with *sabeng* (sweetpotato vinegar). Rolled taro leaves are sautéed in garlic or stalks are fried in oil in a native recipe called *bassa*.

Another traditional recipe of the *Aetas* is the *sukit* which is a mixture of taro, sweetpotato and lima beans or black beans (*patani* or *sitaw*) flavored with *baokok* tree leaves which is their organic substitute for monosodium glutamate seasoning. Taro is also a very good ingredient in

Table 1. Food preparation or recipes ofsweetpotato among the indigenous peoples in Northern Philippines

Ibaloi	*Bago*	*Aeta*	*Ilocano/ Kapampangan*	*Ivatan*	*Isneg*	*Buhid-Mangyan*
Boiled	Boiled	Boiled	Boiled	Boiled	Boiled	Boiled
Steamed	Cue	Roast	Fried	Fries	Cue	Roasted
Roasted	*Buku* flour	*Lubi or*	Cue	Cue	Chips	Boil leaves
Fried		*suman*	Snack ingredient	*Maruya*	*Guinataan*	
Cue	Leaf salad			*Suman*		
Buku-tupig			Vegetable ingredient like in *sinigang*	*Tnumi*		
Guinataan						
Nilubian						
Tips sautee'						
Biga-Kalinga	*Bugkalot*	*Kalanguya*	*Kankanaey*	*Tingguians*	*Iyattuka*	*Aplai-Kankana-ey*
Boiled	Boiled	*Bakol*	*Buku* flour	Boiled	Boiled	*Damdam*-roasted
Cue						
Chips		*Hebeng*	Tips sautee'	Cue	Fried	Cue
Inis-isna		*Hiit*		*Lubi-lubi*	Cue	*Patapat*
Lubi-lubi		Cake-haleya	*Sabeng*	*Guinataan*	*Laplap*	*Salapusop*
Dinakan				Omelet	*Nilubian*	*Kinkinalot or*
Nawnaw				*Buku* flour		*bakkay*
Leaf salad				Rice mixture		*Buridibod*
Dinengdeng/ stew						*Tengba*
Adobo						*In-inte*

fish and meat *sinigang* dish. *Sinigang gandus* of the *Aetas* is prepared using the stalk with leaves where *pingolbato*, a wild begonia plant growing in rocks or forest is used instead of vinegar.

Taro, tannia and wild taro (*bitayon* and *pikaw*) stalks and leaves are sauteed in little oil before adding to meat stew as an acrid-free cooking procedure by the *Ibalois*. *Kankana-eys* slice the stalks and dry under the sun to eliminate the itchy sensation it caused and prolong shelf-life. *Tingguians* remove its itchiness by roasting the leaves and stalk, or uncovering the pot when cooking *sinag-it* (a dish of taro stalk and corms mixed with *kuhol* or snail and cooked in coconut milk) or continuously stirring it to expose itchiness. The *Kalanguyas* avoid the frequent mixing and opening of the pot to control itchiness. *Bilagot* (wild taro) corms are placed in net bags, crushed by using wood pestle then washed thoroughly under flowing water and water is squeezed out to remove itchiness then readied for cooking and eating like rice. *Baksay*, *guinataang pihing* and *in-utom* are traditional recipes of the *Kalanguyas*. In *baksay*, the leaves and stalks are rolled then steamed or placed above the sweet potato roots being boiled. *Guinataang pihing* is a mixture of taro stalks and leaves with roasted ground peanut in place of coconut milk. *Kankana-eys* also sautée taro stalks and leaves alone or mix with either peanut or *Karing*, *gata*, noodles, *etag* or legumes. The *in-utom* recipe is taro stalks and leaves wrapped with banana or *rono* leaves placed inside a bamboo stem then cooked by roasting. As for *Mangyans*, they prefer to roast the taro leaves without the stalks.

Isnegs mix taro stalks with shoots of squash and cooked in coconut milk; or mix *lanipog* (wild taro) stalks and leaves with *sili*, sardines (optional), *bagoong* (fish sauce), tomato and onions as a dish

Table 2. Food preparation and recipes of cassava among the indigenous peoples in northern Philippines

Ibaloi	*Bago*	*Aeta*	*Ilocano/ Kapampangan*	*Ivatan*	*Isneg*	*Buhid-Mangyan*
Boiled w/ or w/out gata *Suman* *Buku-tupig* *Binobudan* Steamed/ baked cake	Boiled *Nilubyan* *Haleya* *Guinataan*	Boiled *Kisa*	Boiled *Ukoy*	Boiled *Suman* *Bibingka* *Pitchi-pitchi*	Boiled *Nilubyan* *Guinataan* Vegetable dish	Boiled Roast
Biga-Kalinga	*Bugkalot*	*Kalanguya*	*Kankanaey*	*Tingguians*	*Iyattuka*	*Aplai-Kankana-ey*
Iluknog *Inis-isna* *Lubi-lubi* *Dinakan* Vegetable stew	Boiled	Boiled Cassava roll *Tupig*	Boiled Binobudan	Boiled *Lubi-lubi* *Guinataan* Pancakes *Buku* flour Rice mixture	Boiled *Tapuey* *Binobudan* Flour	Boiled Chips *Potapot* *Salapusop*

called *Sinorsor* or *Binasal*. Fish sauce (*bagoong*), coconut milk and hot pepper are also added by the *Kalingas* while the*Tingguians* roll the *pikaw* stalks and leaves and then sautée it with sardines or squid.

The *Ivatans* utilize the stalk in a recipe called *winakajapa*, or salted taro stalks, or *rinakan*, a vegetable dish using the stalks alone. Dried *sudi* stalks called *venes* or *vunes* (Figure 7) are cooked as vegetables. These stalks are gathered only when dried in the field, usually during dry season or summer months.

Fig. 7. *Venes /vunes* (dried taro stalks) product of *Ivatans*

Greater yam, lesser yam, wild yam. Yam species are simply eaten boiled or mashed with sugar, butter or margarine, milk or coconut milk and cooked slowly until thick or dry to become *haleya* or *nilubyan*. The retained water in boiling the violet yam tuber is fermented to become ube wine, a recently acquired know-how of the *Ibalois*. Yam tubers are also added to *guinataan*. *Ivatans* make use of lesser yam tubers as vegetable ingredient or as substitute of macaroni noodles in making salad. *Ivatans* consume yam in place of rice especially when isolated from the mainland Luzon.

Lesser yam (*luktoh*) is, among the *Iyatukkas*, boiled and kept in the *alang* for two weeks to sweeten the product called *pukupok* while the *Tingguians* sometimes eat them raw. For the wild yam (*karot*), the *Buhid-Mangyans* processing technology includes the following steps: (1) peel the skin, (2) chip the tuber, (3) spread in tree barks to dry under the sun for two to three days, (4) soak the dried chipped tubers for two days and (4) wash three times before cooking and lastly broil or pan roast until done. This can be eaten alone or mixed with *kamote* tops or *gabi* leaves.

Table 3. Food preparation and recipes of taro, wild taro and tannia among the indigenous peoples in the northern Philippines

Ibaloi	*Bago*	*Aeta*	*Ilocano/ Kapampangan*	*Ivatan*	*Isneg*	*Buhid-Mangyan*
Boiled Veg. dish Tannia shoot sautee	Boiled *Nilubyan* *Haleya* Guinataan	Boiled *Sukit*	Boiled *Kalamay*	Boiled *Winakajapa* *Rinakan* *Venes*	Boiled *Binasal* *Guinataan* Veg. dish Nilubyan	Boiled Roast (Leaves)
Biga-Kalinga	*Bugkalot*	*Kalanguya*	*Kankanaey*	*Tingguians*	*Iyattuka*	*Aplai-Kankana-ey*
Veg. dish	Boiled	Boiled *Baksay* *Guinataan* In-utom Steamed (*bilagot*)	Boiled Veg.-meat dish Tannia shoot salad	Boiled *Sinag-it* Guinataan Rolled *pikaw* sautee	Veg. coconut dish Flour	Veg. dish Veg. with *sabeng* Sauteed leaves *Bassa*

Arrowroot. The *Aplai* key informants mentioned that arrowroot is one of the ingredients in making *bakkay*, a mixture of pound arrowroot, cassava, corn or rice, dried mushroom (*kuwator kodi*) with salt, garlic, ginger, chilli then stored or fermented for one to two months. This is used as a substitute for *bagoong* and as an alternative medicine. The *Kalinga* and *Bago* people sometimes eat them raw, especially the children.

Canna. The *Ibaloi* and *Kankana-ey* also use *canna* (*kulintas, gaddang, galumaca*) in *buku* making. The dried chips are around then wrapped with banana leaves, boiled and consumed as snack called *tupig* or as substitute to rice during rainy season in the olden days. According to one of the Ibaloi informants, canna flour is mixed with wheat flour instead of baking powder to improve texture of wheat flour in pancake making.

CONCLUSIONS AND RECOMMENDATIONS

Shelf-life and use of the different roots and tubers of certain crops dictate the indigenous peoples' storage and food preparation practices. Roots and tubers with short shelf-life (taro, cassava, some sweetpotato varieties) are harvested (by priming or in installment basis) when needed. Dry, undamaged roots and tubers especially those with longer dormancy period (greater yam, lesser yam, tannia, arrowroot, canna and yacon) are kept for 4-6 months) in dry, shaded or covered areas such as a corner in the kitchen or in a storage such as the *alang* and the *pokok*.

Boiling, steaming, roasting and frying are the common cooking methods for roots and tubers. There are traditional food preparation uses or recipes from these rootcrops such as *tupig, nilubyan, kisa, tapey, binobodan, nawnaw, saloposop, sukit* and others. These are also use for various purposes such as substitute to rice as a staple food, emergency food, viand, snack, fermented drink, flavouring and sometimes for therapeutic purposes. New food preparation recipes like cassava roll are also being learned.

Table 4. Food preparation and recipes of greater yam, lesser yam and wild yams among the indigenous peoples in northern Philippines

Ibaloi	*Bago*	*Aeta*	*Ilocano/ Kapampangan*	*Ivatan*	*Isneg*	*Buhid-Mangyan*
Boiled *Haleya* *Nilubian* *Guinataan* Wine	Boiled *Haleya*	Boiled	Boiled	Boiled *Dukay* salad	Boiled	Boiled Pan roast or broil
Biga-Kalinga	*Bugkalot*	*Kalanguya*	*Kankanaey*	*Tingguians*	*Iyattuka*	*Aplai-Kankana-ey*
Boiled	Boiled	Boiled *Haleya*	Boiled	Boiled *Guinataan* Veg. dish Raw (*tugui*)	Boiled *Pukopuk*	

This documentation of traditional storage and food preparation recognizes indigenous technology and recommended for further research and development taking into account the cultural, food and nutritional value of the traditional recipes, as well as the food safety quality of the preparation practices. Because of changing food terms, food habits and livelihoods, traditional food and preparation practices are also becoming less utilized and therefore are at risk of being forgotten, Therefore there is a need for a continuing promotion and transfer of traditional and new knowledge on the habitat, production, utilization and processing of the root and tuber resources to ensure conservation and sustained production. In the long run, increased consumption of roots and tubers may reduce rice staple food importation. Teaching the important role of roots and tubers in household food security and income should start by teaching children to regularly eat roots and tubers in the same manner that rice, vegetables and fruits are eaten.

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LITERATURE CITED

Balaki, E. and J. Solimen.1991. The Role of Sweet potato in the Diet, Culture and Ecology of an Ethno-community. In UPWARD. 1991. Sweet Potato Cultures of Asia and South Pacific. Proceedings of the 2nd Annual UPWARD International Conference. Los Banos, Philippines Pp.113-119.

Dayo, H. F., J. D. Labios and A. M. Wagan. 1998. Rootcrop Agriculture in Batanes: Diversity and transformation of an island food system. In: Prain, G. and C. P. Bagalanon. 1998. Conservation and change: Farmer management of agricultural biodiversity in the contextof development. UPWARD, Los Banos, Laguna. Pp.14-44.

Fang-asan, M. L. D., R. P. Mula, B. T. Gayao, J. M. Sim and C. H. M. Brady. 1998. The Dynamics of Sweetpotato Variety maintenance and Planting Material Management in Bayyo, Mountain Province. In Prain, G. and C. P. Bagalanon. Conservation and change: Farmer management of agricultural biodiversity in the context of development. UPWARD, Los Banos, Laguna. Pp. 80-120.

Fu, X. and L. Soete. 2011. The Role of ForeignTechnologyandIndigenousInnovation in the Emerging Economies: Technological Change and Catching-up. World Development 39 (7):1204–1212, 2011 Elsevier Ltd. www. elsevier.com/locate/worlddev.doi:10.1016/j. worlddev. 2010.05.009

Horton, D. 1988. Underground Crops. Long-term Trends in Production of Roots and Tubers. Winrock International. Morrtton. AK. USA.

Kimber, A. J. 1972. The sweet potato in subsistence Agriculture. Papua New Guinea Agricultural Journal, 23: 80-102.

Lancaster, P. A. and D. G. Coursey. 1984. Traditional post-harvest technology of perishable tropical staples. FAO Agricultural Services Bulletin No. 59. FAO, Rome. P.51.

NGO Association for Agriculture Research in Asia-Pacific. 2009. Retrieved on June 2015 from naarap.blogspot.com/2009/10/ importance-of-indigenoustraditional.html.

Northern Philippines Rootcrop Research and Training Enter. 1990. Rapid Rural Appraisal on Sweetpotato Producing Areas in Bayyo, Bontoc, Mountain Province. Benguet State University, La Trinidad, Benguet.

Sano, E., M. L. D. Fang-asan, B. Gayao and E. Alupias. 1991. Sweetpotato as a buffer in crises situations: the case of Amlimay, Buguias during the 1990 earthquake crises in Benguet. In UPWARD. 1991. Sweet Potato Cultures of Asia and South Pacific.Pp.120-125.

Scott, G. J., R. Best, M. Rosegrant and M. Bokanga. 2000. Roots and tubers in the global food system: A vision statement to the year 2020. A co-publication of the International Potato Center(CIP), Centro Internacional de Agricultura Tropical (CIAT), International Food Policy Research Institute (IFPRI), International Institute of Tropical Agriculture (IITA), and International Plant Genetic Resources Institute (IPGRI). Lima, Peru: International Potato Center. P. 111.

Scott, G., S. Wiersema and P. Ferguson (eds.). 1992. Product Development for Root and tuber.

Crops. VCL. I-Asia. Proceedings of the International Workshop, held April 22-May 1, 1991 at Visayas State College of Agriculture (VISCA), Baybay, Leyte, Philippines, sponsored by the International Potato Center (CIP), the Centro Internacional de Agricultura Tropical

(CIAT), and the International Institute for Tropical Agriculture (IITA). CIP, Lima, Peru. P. 384.

Solimen, J., B. Gayao and G. Prain.1998. Community-based Knowledge Systems in Sweetpotato Genetic Resources Management among Four Ethno-linguistic Groups in Northern Philippines. In Prain, G. and C. P. Bagalanon. Conservation and change: Farmer management of agricultural biodiversity in the context of development. UPWARD, Los Banos, Laguna. Pp. 120-186.

Soni, K. 2007. Indigenous knowledge and Importance. Retrieved on June 2015 from www. iimahd.ernet.in/users/anilg/files/ Articles/cine_report_Kailash.doc.

Tansey, G. and T. Rajotte (eds). 2008. The Future Control of Food: A Guide to International Negotiations and Rules on Intellectual Property, Biodiversity, and Food Security. The Quaker International affairs Programme. Earthscan.UK and USA.

Thiagarajan, S. 2008. Importance of indigenous technology. Retrieved on Oct. 12, 2008 from www.thehindu.com/.../importance... indigenous-technology/article14457...June 2015.

Verdonk, I. 1991. The Role of Sweetpotato in the Philippine Diet. In UPWARD. 1991. Sweet Potato Cultures of Asia and South Pacific. Proceedings of the 2nd Annual UPWARD International Conference. Los Banos, Philippines. Pp.429-439.