Assessment of yam cultivar diversity in Yap State, Federated States of Micronesia

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Abstract

Yap is a small island State of the Federated States of Micronesia situated in the Western Pacific. Yam (*Dioscorea* sp.) is one of the two main traditional food crops in Yap that shows a remarkable diversity of cultivars. Exemplary knowledge of women farmers related to its cultivation is such that through a remarkable array of indigenous cultivation practices, they have developed a sustainable system of farming. In order to document yam cultivar diversity, a range of participatory surveys were carried out between 2002 and 2004. The extent of distribution of various cultivars was studied in seven villages. Twenty-three cultivars of *Dioscorea alata* and seven cultivars of *Dioscorea esculenta* were recorded based on farmers' perceptions and IPGRI descriptors. Farmers distinguished yam tubers based on specific morphological traits. Women farmers were reasonably consistent in describing and identifying the cultivars. Linking traditional cultivation practices with modern scientific knowledge could develop strategies to conserve yam cultivars for the benefit of future generations.

Key words

Yam (*Dioscorea* sp.), Cultivar diversity, Traditional knowledge

Introduction

Yap forms part of the geographically far-flung Federated States of Micronesia (FSM). Yap is the westernmost State in the FSM. It includes Yap proper, consisting of four main islands and eight smaller islets dotting the fringing reef, and 15 outer coral islands and atolls. The islands lie in western Pacific Ocean roughly bounded by 6^0 to 10^0 north latitude and 137^0 to 148^0 east longitude, with Yap proper located near the State's western boundary. Subsistence agriculture is the predominant occupation of the island's inhabitants. Although great proportion of the native vegetation of Yap proper has been moved or altered significantly, areas containing a majority of native species still exist. Traditional culture has played an important role in conserving some of these natural parts of the island life on Yap. One of the most important ways in which biodiversity of native and cultivated species has been preserved on Yap is through cultural recognition of various environmental areas where contrasting traditional resource use occurs. Agriculture is characterized by an array of subsistence crop species and the pattern is generally described as tree garden or agroforest. Essentially, a beneficial agroforest or tree garden is one that is well adapted, over the long term, to the natural conditions and cultural need of the society (Merlin, M. *et al*. 1996).

The Yap Island has a subsistence economy and people are dependent on local biological and other natural resources for survival. Yam (*Dioscorea* spp.) is one of the two major tuber crops that have sustained the lives of Yap islanders since time immemorial. It not only provides food but also stands as an important component of prestige economy (offerings during communal feasts associated with funerals, weddings etc.), besides ensuring a biodiversity-based livelihood. Thus, on Yap agrobiodiversity conservation is much more than an ecological and economic issue, it is also social and cultural issue.

While formulating an IPGRI global project to strengthen the scientific basis of *in situ* conservation of agricultural biodiversity, it was suggested that answering four main research questions would provide a scientific basis for designing and planning effective conservation strategies (Jarvis, D. Sthapit, B. & Sears, L. 2000a p.1, Sthapit, B., Rao, R. & Jarvis. D. 2001 p. 138, Sthapit, B. & Jarvis, D. 2003 p. 9). They are (i) what is the extent and distribution of the genetic diversity maintained by farmers over space and over time; (ii) what are the processes used to maintain the genetic diversity on-farm; (iii) who maintains genetic diversity within farming communities, and (iv) what factors influence farmer decision on maintaining traditional cultivars. Based on this concept, a research program was initiated in 2002 to develop a suitable conservation strategy for yam cultivars in Yap. The diversity of yam genetic resources in traditional agroforestry systems of Yap (slash-and-burn) has the recognition of being a threatened resource of greater values. Farmers are the principal custodians of this diversity, while depending on the diverse cultivars for their livelihood. In this article, the author presents a list of yam cultivars identified during surveys and participatory research carried out between 2002 and 2004, the criteria used for identification of the cultivars, principal custodian of the cultivars and the dire need to develop certain policy measures to protect the yam cultivars from threats of changing weather patterns.

Material and Methods

Because of the nature of this survey and the cultural restrictions under which the researcher had to work, very few specimens could be collected for field experimentation. Rather, the growth cycle was mostly followed on farmers' cultivated areas. The survey was carried out between 2002 and 2004 in five municipalities of Yap proper. Table 1 shows details of survey sites. Being a small island, the site characteristics are predominantly similar in all sites. Traditionally, yam cultivation is woman's job (men's involvement is usually limited to preparing beds for planting and erecting trellises) and in the present survey, yam gardens raised by women's groups in different villages of municipality were subjected to in-depth study. Each women's group consists of 10 – 20 members, each in turn possess 5 – 10 different cultivars.

Two most important species of *Dioscorea* under cultivation are *Dioscorea alata* L. and *Dioscorea esculenta* (Lour.) Burk. *D. alata* by far the most accepted and widely used in large scale cultivation, *D. esculenta* mostly limited to few plantings around individual home gardens.

The traditional way of raising yam on Yap is by using bamboo trellises. Forest areas on dry lands are considered best places to prepare yam gardens. In preparation of yam garden, usually upper canopy is cleared, trees may be left standing. Additionally bamboo poles are used for the vines to climb. Typically, a border of stems and logs is formed about the yam plantings and mulch is piled within this area. The mulch buffers rainfall, maintains humidity, and retards weeds. This practice reduces soil erosion and enhances soil structure and fertility.

Each of the gardens was visited at least three times during the growth cycle, followed by a detailed survey while harvesting. The cultivars were mostly identified with the help of descriptions made by women farmers, who generally own different cultivars within a group. Most of the women farmers were consistent in identifying the yams based on tuber characteristics, but were inconsistent on vegetative features. Besides, information about various

cultivars was also collected from at least one available published record (Defngin, F. 1959), Friday market displays from Colonia, Yap or exhibits from Yap Day Festival. Field visit proved helpful for validation of the data gathered from published article and market displays.

Results and Discussion

Farmer-named cultivars

Farmers use names as simpler way of managing and using cultivar diversity. They are useful in terms of distinguishing the variety for planting, managing, using and marketing. Translation of farmer-named cultivars represents first level of farmer descriptor by morphology, use or local adaptation (Jarvis, D. Sthapit, B. & Sears, L. 2000a). Table 2 summarizes the list of recorded yam cultivars based on farmers' descriptions, its scientific name, and traits used to identify the cultivars and additional features used by the investigator. The result suggests that Yapese women farmers have a system of describing and distinguishing cultivars by names. Farmer named cultivar is a practical way of managing agrobiodiversity at the community level which becomes important when farmers have to make day to day decisions in the process of planting, managing, harvesting, utilizing and marketing of the varieties. It was not confirmed, however, whether these cultivars are genetically unique.

Criteria used to identify cultivars

Farmers use many of the morphological features of plants to identify and select their cultivars. These agromorphologic criteria take a wide range of forms and are usually linked to the genetic diversity (Jarvis, D. *et al*. 2000b). Landraces are passed from generation to generation of farmers and are normally distinguished by farmers by agromorphological characteristics (Loutte, D., Charrier, A. & Berthaud, J. 1997, Teshome, A. *et al*. 1997). Yapese farmers use tuber characteristics such as shape, size, color of the outer and inner skin, color of the flesh, presence or absence of hairy roots, and cooking qualities for identification of individual cultivars. Of the 23 cultivars of *D. alata* listed, nine cultivars (for which tubers were available) were further monitored in a semi-experimental plot. Study showed that farmers' descriptions were consistent with that recorded on the field.

Consistency of farmer-named cultivars

Farmers' knowledge about each cultivar was found strongly related to the agromorphological features. Women, especially older women, who happened to be team leaders of the group, were more or less consistent in naming and describing the cultivars based on tuber characteristics. However, on several occasions it was noted that they had difficulty to distinguish the cultivars at vegetative stage. The tuber characteristics are easy to distinguish the cultivars than leaf/stem morphology.

Custodian of yam diversity

Field surveys and visits during market day displays helped to identify custodians of rare and unique yam genetic resources. Women farmers are undoubtedly the custodians of yam diversity on Yap. Since yam cultivation is principally women's job, they possess in depth awareness of various cultivars and the environment in which they grow. Market day displays during harvest season provided an important forum for the recognition of farmers and the diverse cultivars they possess. More importantly, it helped to recognize farmers who maintain greater amounts of

cultivar diversity, their knowledge about various cultivars, area of high cultivar diversity, key custodians who maintain high cultivar diversity and reasons for growing diverse cultivars in terms of use and economic, cultural, breeding, ecological values.

The study found that some farmers maintain a relatively larger number of cultivars than other members of the community. The farmers exclusively depend on their own informal (farmer) system of tuber supply not only in the situation when loss occurs through natural calamities like typhoons but also in normal situations every crop season. This informal system plays an important role in the maintenance of the cultivar diversity on farm.

Use value of yam diversity

The extent and distribution of cultivar diversity is influenced by each farmer's decision, which in turn is dependent on the varied uses of each cultivar. In this study, it was found that cultural importance (exchange during ceremonies) and marketability found superior to cooking quality. Cultivars like *Abya*, *Gabrach*, *Wonbey*, *Rowal*, *Nagbchey*, *Surney* were noted having multiple use values. The yam cultivars that have multiple use values were also found grown individually in many home gardens.

Policy Implications

Federated States of Micronesia is signatory to several international treaties including Convention on Biological Diversity (CBD), UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Montreal Protocol, UN Convention on the Law of the Seas etc. The FSM ratified the CBD in 1994 and prepared National Strategy and Action Plan report in 2002 as a prerequisite to the CBD. Agrobiodiversity emerges as one of the key themes of nation's NBSAP report. Although conservation and sustainable use of agrobiodiversity is one of the objectives therein, the threats for the genetic resource base induced by extreme weather patterns do not find a place in the NBSAP document. If this small island nation were to protect its genetic resources for its future generation, immediate conservation steps need to be implemented at the State level depending upon the target species. Thus, in the State of Yap, yam genetic resources call for immediate conservation plans owing to its vulnerability to extreme weather events and deadly anthracnose epidemic present in the nearby island of Pohnpei in the FSM. Defngin (1959) reported 34 yam cultivars belonging to two species of *Dioscorea* namely, *D. alata* and *D. esculenta* from Yap. This study, however, revealed not more than 30 cultivars. Whether the cultivars became extinct or not is a matter of debate, however, experience from one of the worst typhoons (typhoon Sudal) in the history of Yap points to the fact that farmers have lost at least some of the invaluable cultivars due to saltwater intrusion, and powerful winds that destroyed yam trellises.

Policies needed

(i) Government should give priority to protect its vulnerable genetic resources of food and agriculture from genetic erosion induced by extreme weather patterns

(ii) Appropriate conservation strategies (*in-situ*, *ex-situ* or integrated) be initiated at the national level and State level to protect the genetic resources for food and agriculture from erosion induced by extreme weather patterns

National legislation developed and passed to support FSM commitments under all major international environment conventions – Climate Change, Biodiversity, Desertification, Transport of Hazardous Wastes etc.

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Table 1: General features of the study sites

Study areas	Maap	Gagil	Dalipebinaw	Tomil	Weloy
Latitude	$9^0$34_00_N to $9^0$36_30_N	$9^0$32_30_N to $9^0$34_00_N	$9^0$30_00_N to 9^0 31_10_N	$9^0$30_30_N to 9^0 32_10_N	$9^0$31_10_N to $9^0$32_30_N
Longitude	138^0 10_ 30_E to $138^0$11_00_E	$138^0$09_10_E to $138^0$10_30_E	$138^0$06_30_E to $138^0$07_30_E	$138^0$10_30_E to $138^0$11_30_E	$138^0$06_30_E to $138^0$07_00_E
Population[1]	592	734	645	1,023	1,197
Topography of the study site	Forested area, Home gardens	Forested area Agroforests	Savannah, Home gardens	Forested area Agroforests	Home gardens, grassland
Mean annual precipitation[2]	10.86 inches	--	--	--	--
Mean annual temperature[3]	80 ^{0}F	--	--	--	--
Soil type and taxonomic class[4]	Weloy: Clayey skeletal, mixed, isohyperthermic Typic Argiudolls	Yap: Clayey mixed, isohyperthermic, Tropepticeutrothox	Rumung-Weloy: Clayey skeletal, mixed, isohyperthermicLithic Tropudalfs	Yap: Clayey mixed, isohyperthermic, Tropepticeutrothox	Rumung-Weloy: Clayey skeletal, mixed, isohyperthermicLithic Tropudalfs
No. of yam cultivars recorded	24	23	21	27	22

[1]Yap State (2002)
[2] No data available for individual sites
[3] No data available for individual sites
[4]After Smith (1983)

Table 2: List of yam cultivars recorded from Yap

No	Cultivar name	Yapese name	Botanical name	Tuber characteristics	Additional features for identification	Remarks
1	Rowal	Duo'g	*D. alata*	Tuber has the shape of a durian fruit, so it is also called durian yam; there are two types of *Rowal* – white flesh and red flesh	Vines and leaves are green in color	
2	Wonbey	Duo'g	*D. alata*	There are three types of tuber: white flesh, purple flesh and with purple color only in the central portion of the corm	The vine is dark puplish. Leaves are dark green	This is considered as a prestige yam and is used for offerings
3	Abya	Duo'g	*D. alata*	There is a brownish tinge between tuber skin and flesh; tuber is usually large		The variety is said to come from an island in the South Pacific called by the Yapese, *Abya*
4	Surney	Duo'g	*D. alata*	Grows in different shapes; one farmer reported change in shapes with soil characteristics (not scientifically confirmed)	The vines have soft thorns.	This variety is said to have originated in a place called *Surney*
5	Tinyan	Duo'g	*D. alata*	Tuber is long usually with a swollen middle portion. Flesh is white in color.		Cooked tuber tastes same as cultivar *Purpala*
6	Ponape	Duo'g	*D. alata*	Long and slender tuber, white flesh		Yapese believe this cultivar was brought from Pohnpei
7	Alien	Duo'g	*D. alata*	Long, slender and branched tuber		One women group named it as alien because it is somewhat rare looks dissimilar to any other familiar varieties
8	Ngabchey	Duo'g	*D. alata*	The most common cultivated variety; inner skin is deep purplish; a second type is with white flesh; tuber branches and grows in big size	The vines and leaves are purplish when sprouting; vines have thin, red tinged veins; matures leaves have red veins on the bottom side	Very common and found in almost every Yapese garden

9	Samaw	Duo'g	*D. alata*	Somewhat rectangular in shape; flesh white colored		Not a common cultivar; seen with only one farmer
10	Pa'aw	Duo'g	*D. alata*	Grows to big size and in various shape; thick hairy roots all around		*Pa'aw* literally means 'hairy' because the tuber is covered with fine roots all around; not a common cultivar
11	Gabrach	Duo'g	*D. alata*	Long and thick round tuber; while colored flesh; cooked tuber is hard		Highly priced, exchanged during ceremonies
12	Sarere	Duo'g	*D. alata*	Tuber is long and slender; tuber is red	Wine is purplish	*Sarere* in Yapese means 'insistent'; because if it grows beneath a tree, will refuse to give way to tree roots and will twist itself around them
13	Defrow	Duo'g	*D. alata*	Somewhat dorsi-ventrally flattened and triangle shaped; flesh dull colored, with pinkish lines inside	Wine is green	This yam is believed to have brought in by a man named Defrow who lived in Maap, Tomil Municipality
14	Dugyeb	Duo'g	*D. alata*	Long and flattened and usually more than one tuber forms in group		
15	Komey	Duo'g	*D. alata*	Several medium sized, oval shaped tubers grow from one plant		When cooked, the tuber expands like rice
16	Ishobing	Duo'g	*D. alata*	Tuber is bottle-shaped, with white flesh		
17	Tenmen	Duo'g	*D. alata*	Tuber is slender and long; flesh becomes very hard after cooking	Young leaves and shoots are purplish red	According to a legend, this was brought to Yap by 'Giliwaay and his chickens'
18	Gamed	Duo'g	*D. alata*	Tuber generally grows above the ground		*Gamed* literally means lazy; Yapese call it lazy because it does not grow without

						assistance; as the tuber grows above the ground, farmer must pile soil around it
19	Warabrab	Duo'g	*D. alata*	Round, rough skin and hairy, tuber flesh is white		
20	Dol	Duo'g	*D. alata*	Flesh is fibrous; becomes loose and watery after cooking		It's a sort of famine food
21	Dolyol	Duo'g	*D. alata*	More tubers form in clusters; tubers are hairy	Leaves are light green in color	
22	Parpala	Duo'g	*D. alata*	Tuber is long, with thin skin and white flesh; grows in a twisted manner		
23	Fiin Tugrow	Duo'g	*D. alata*	Tuber is somewhat elongated and flattened; flesh is white		
24	Yu rech	Dal	*D. esculenta*	Medium sized, fusiform shaped tubers; with light colored skin, few hairs on the skin	Very starchy tuber	
25	Yu Uchub	Dal	*D. esculenta*	Medium size tuber with one end rounded and other, pointed; smooth skin	Shaped like coconut, tuber is large	Tuber forms in bunches like coconut, one bottom side of the tube is somewhat flat
26	Nguy	Dal	*D. esculenta*	Tubers form in clusters, light skinned, with hairs all around		
27	Wangun	Dal	*D. esculenta*	Smooth skinned, medium size and elongated to oval with both ends rounded		
28	Moros	Dal	*D. esculenta*	Small to medium, top shaped tubers, with		*Moros* means New Guinea, might have

				hairs on the outer skin		come from New Guinea
29	Yu ban	Dal	*D. esculenta*	Grows in clusters and attain very big size		There is a small projection at one end of the tuber just like the aerial roots of mangroves, hence the name *ban*
30	Chugum but	Dal	*D. esculenta*	Big and long tubers, brown skin very hairy all around	The hair carries dirt, about _ to 1 _ thick around the tuber	Meaning of this kind of yam is taking dirt