Scoping Study on Future Smart Food in Myanmar and

Selected NUS and preliminary proposed sites option for field survey in Myanmar

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Regional Inception Workshop for Regional TCP

on Creating Enabling Environments for Nutrition-Sensitive Food and Agriculture to Address Malnutrition

in Regional Initiative on Zero Hunger Challenge

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Contents

I. Introduction

a. About Myanmar

- Largest country in mainland Southeast Asia with an area of 676,577 km^2
- 9° 32′, and 28° 31′, N / 92° 10′, and 101° 11′, E.
- Borders with China, Laos, Thailand, India and Bangladesh
- Its length is 2,100 km from north to south
- The population was 51.701 million with 76/km^2 pop density (DOP 2015).

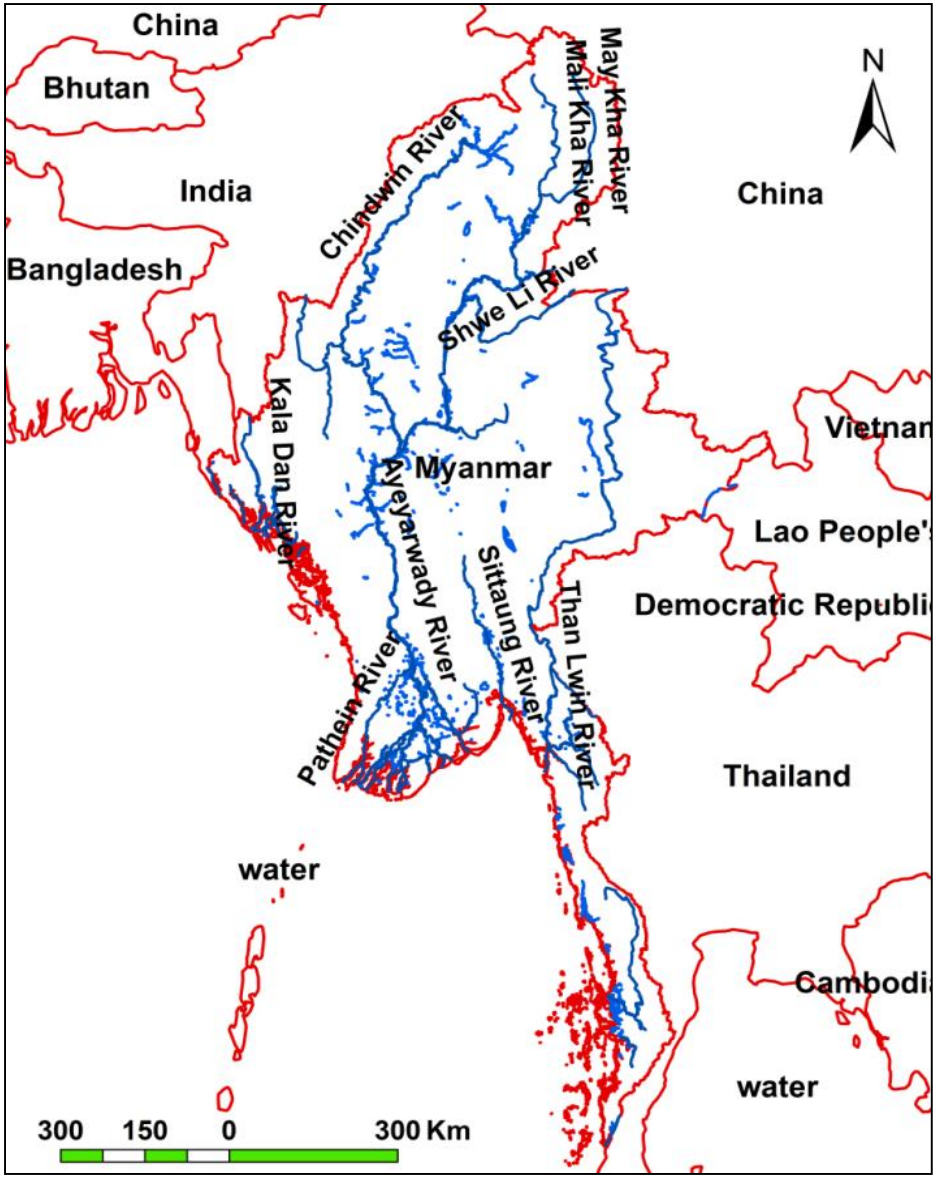


Figure 1. Map of Myanmar

- The **physical geography** of is structurally complex and diverse having the topography of

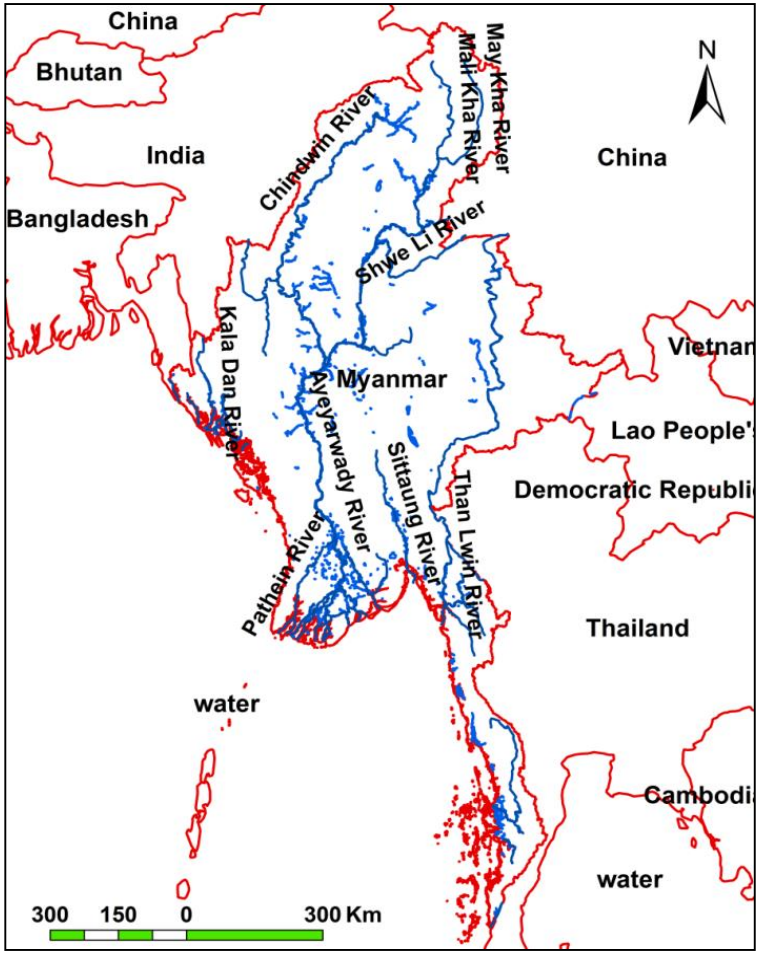
-Steeper mountain ranges,

Hkakaborazi snow-capped mountain 5,881 m appears to be the highest in Myanmar as well as in Southeast Asia

-Upland plateaus and hill valleys in the eastern, northern and northwestern regions

-Central dry zone

-Deltaic region and coastal strip in the south



- **Four major rivers** are formed by the large drainage systems and their wider tributary networks (NBSAP 2011).

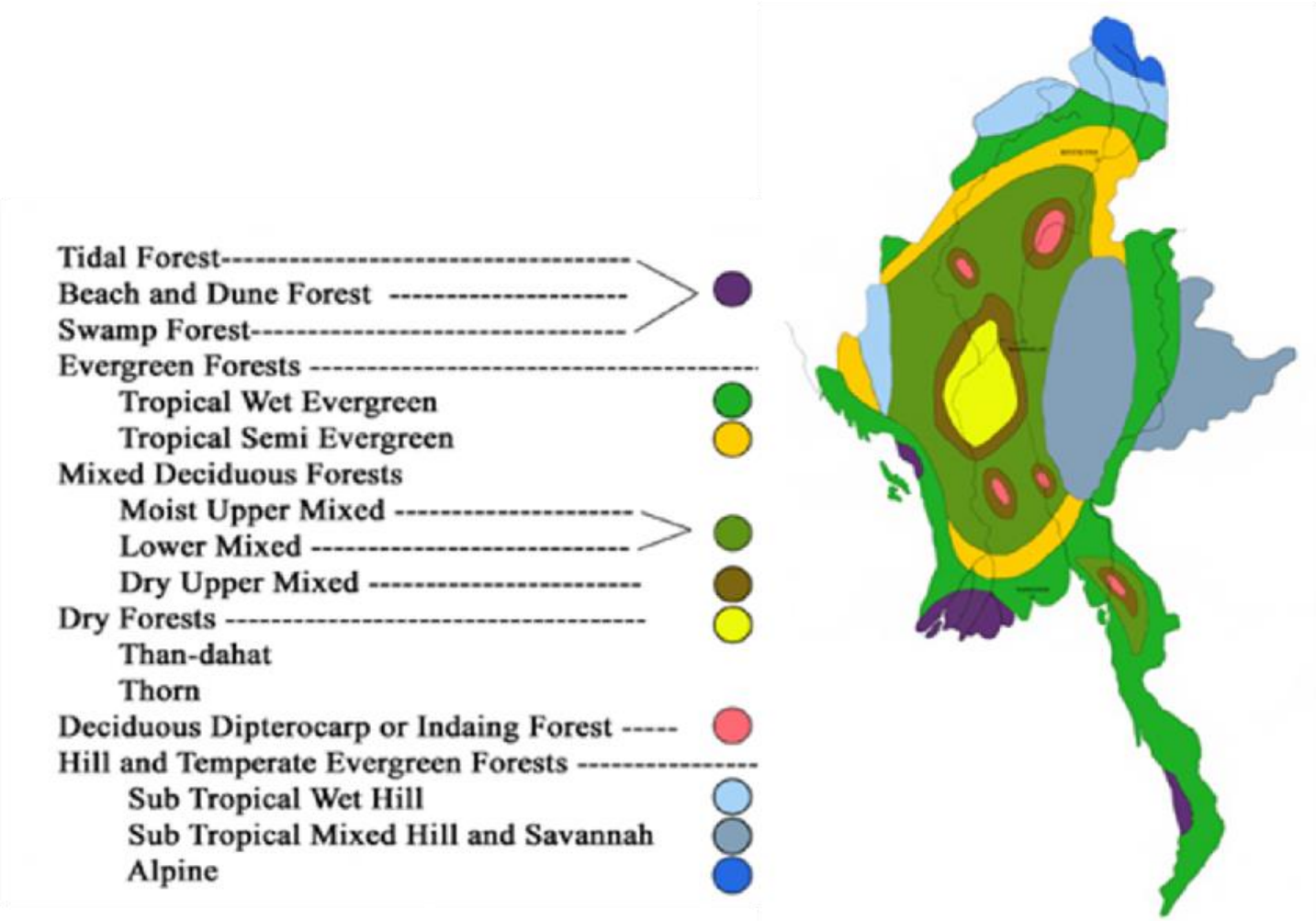


Figure 2. Major vegetation types of Myanmar (Source: NBSAP 2011).

(b) Status of food basket

• Myanmar endowed with numerous agricultural resources and Ayeyarwady delta acts as rice bowl while plain and central dry zone known for production of oil and other produces.

• Coastal strip is appropriate for plantation crops and fruit trees.

• As an agriculture-based country, more than 70% of the Myanmar people are living in rural area and rely on agriculture for their employment, income and livelihoods.

• Myanmar with diverse agro-ecosystems (Table 1) offers high diversity of crops and useful plant species .

• Various crop species and useful wild plant species are important to diversification of food for different nutrients.

• However, a few crops are playing a key role for staple food.

Among them, rice is a national major crop in Myanmar.

• Table 1. Major agro-ecological zones of Myanmar (NBSAP 2011)

Name	Geographical description	Administrative unit	Crop
A. Bago, Kachin River-side Land	Upper Delta, Kachin plain, flat plain along the side of river Ayeyarwady and Sittaung, moderate rainfall (1000 - 2500 mm).	Ayeyarwady, Sagaing, Mandalay, Bago Regions and Kachin State	Rice, pulses, oilseeds, cereals, sugarcane, jute
B. Central Dry Zone	Central dry zone, rainfall less than 1000 mm, high temperature in summer, flat plain, some areas with uneven topography.	Magway, Mandalay, and Sagaing Regions.	Oilseeds, pulses, cotton, other minor crops, irrigated rice
C. Delta and Coastal Lowland	Delta, lowland and mouth of rivers in coastal area, heavy rainfall (>2500 mm)	Ayeyarwady, Yangon, BagoTaninthayiRegions, Mon, Kayin, and Rakhine States	Rice, pulses, oilseeds and Nipa palm, plantation crops
D. Kachin and Coastal Upland	Mountainous, slope land, heavy rainfall (>2500 mm)	Kachin State, Rakhine State, Taninthayi Region, Mon State, Kayin State, Kayah State, Yangon Region and Bago Region.	Orchard, plantation crops, fruit trees and other upland crops
E. North, East and West Hills	Hilly areas, uneven topography, moderate to heavy rainfall, slope land	Kachin, Chin and Shan States	Upland crops, several crop species in shifting cultivation and fruit trees
F. Upper, Lower Myanmar and Shan Plain	Plain, upper and lower parts outside of central dry zone, plateau.	Kachinand Shan State, Sagaing, Bago, Magway, Mandalay and Yangon Regions.	Upland crops, oilseeds, pulses, vegetable and wheat

- Rice is staple food and major crop and Myanmar is surplus in rice.
- Other important food crops are maize, sugarcane, wheat, food legumes, oilseeds, vegetables and fruits.
- In 2014-2015, sown area under various crops was 21.37 million ha (Table 2).
- Net area, and mixed and multiple cropping area were 13.36million ha and 8.01 million ha, respectively.
- So, the cropping intensity percentage for the year 2014-2015 was 159.9%.

Table 2. Sown area of crop group in 2014-2015 FY in Myanmar (DOP 2015)

Sr. no.	Crop group	Sown area (,000 ha)
1	Cereal crop	8357
2	Oilseed crop	3461
3	Pulse crop	4554
4	Industrial crop	1269
5	Culinary crop	350
6	Other	3379
	Total	21370

- Myanmar is one of the major peas and beans exporting countries in the world.
- However, the gap between production and demand is still big that is accounting for hidden hunger in the country.
- Grown area and production of some major crop are shown in Table 3.

Table 3. Sown area and production of some major crops in 2014-2015 FY in Myanmar

Sr. no.	Crop	Sown area ('000 ha)	Production ('000 mt)
1	Paddy	7172	28193
2	Wheat	99	185
3	Maize	459	1721
4	Black gram	1098	1580
5	Green gram	1173	1536
6	Butter bean	64	86
7	Soy bean	151	229
8	Chickpea	378	580
9	Pigeon pea	619	841
10	Garden pea	54	71
11	Groundnut	949	1525
12	Sesame	1581	930
13	Sunflower	484	473
14	Oil palm	153	145
15	Sugarcane	181	11307
16	Chili (dried)	112	123
17	Onion	78	1265
18	Garlic	28	212
19	Potato	37	551

Source: Department of Agricultural Land Management and Statistics, MOALI

- With the increase of population and decrease of cultivable land, food supply in the future may one of the problems to food security and food safety.

- So, intensive cultivation of neglected and underutilized crop species (NUS) is one of the solutions in food insecurity and malnutrition.
- The NUS crops, on the other hand, can be targeted to grow in an adverse climatic condition so that NUS can be considered as future smart food (FSF).

c. Diversity of crop species

• Because of the wide variation in latitude, altitude and climate, Myanmar supports a high diversity of habitats, and is extremely rich in plant species.

•The country is located at the convergence of four major floristic regions: the Indian, Malesian (Sundaic), Sino-Himalayan and Indochinese.

•To date, >18,000 plant species have been recorded in Myanmar.

• However, there are huge research and information gaps for several species.

• Myanmar offers high diversity of crops and useful plant species, >100 species of crops and their wild relatives are being conserved in Myanmar Seed Bank (Table 4)

Table 4. Crop germplasm in Myanmar Seed Bank (March 2016)

Sr. no.	Crop group	No. accession
1	Rice	7729
2	Wild rice	180
3	Legume	1577
4	Cereal	2222
5	Oilseed	797
6	Other	107
	Total	12612

	Short -term Storage	Medium-term Storage
Temperature	10°C	- 5°C
Relative Humidity	30 - 40 %	30 - 40%
Conservation Life	3 - 5 Years	20 - 30 Years
Container	Polyethylene bottle	Alluminium foil
Storage Seed Weight (gm)	300 - 500	40 - 100
Storage Capacity (Accession)	21600	20000

Photo 1. Crop diversity from mixed cropping of traditional shifting cultivation offers a variety of diets (Photo by Minn San Thein)

- However, many species are neglected and still underutilized
- Underutilized species although neglected are potential to source of vitamins, micronutrients, and high nutritional value.
- From standpoint of the rural poor who depend on many of these species for food security, nutrition and incomes, they are seemed to be future smart food.
- So, scoping the availability of FSF, prioritize and identify them with high potential, and map the selected species for further development become important.

II. Situation and gap analysis

a. Hunger and malnutrition

- Hunger, food insecurity and malnutrition are a major problem in many Asian countries including Myanmar.
- Agriculture and nutrition are strongly linked, and crop diversification serving sustainable agriculture also can contribute diversifying diets to reducing hunger and malnutrition.
- Dietary quality in Myanmar remains poor, low on protein and vitamins and with high carbohydrates.
- Most household expenditures are related to food.
- Myanmar entered the global scaling up nutrition movement in 2013.

- Regarding dietary energy supply (DES) during 1990 to 2011, vegetable origin products increased 14% and remain the major DES source.
- Cereals remain the most important source of food energy (50%), but their contribution to overall DES has decreased.
- Products from animal origin for example meat, milk and eggs have increased notably.
- Vegetable oils have also increased 52% and are also significant contributors to DES.
- The diet is rice based contributing 92% of cereals while cereals contributed 52 % to food intake.
- General inflation was correlated with food inflation, and families spent more than 70% of their income on food.

- Food diversity is important for supplying microelements, protein and vitamins.
- According to FAO (2014), Anemia for example is a severe public health issue, in pregnant (71%), and children under five (75%) and in non-pregnant women (45%).
- Stunting and underweight are more than twice as common in the poorest quintile as in the wealthiest.
- Severely high rates of Vitamin A deficiencies (37% of preschoolers) indicate that Vitamin A is lacking in the daily diet.
- Iron (Fe) deficiency is also considerable issue in children and women. Lack of diversity in the food supply can play an important role in malnutrition .

b. Climate change

• There are three seasons in Myanmar; 1)Summer (February-May), 2) Rainy (June-September), 3) Cold (October-January).

• A part from the far north of the country, the climate of Myanmar may practically be classified as tropical monsoonal,

• Seasonally, the temperature ranges

from32’ C and 38’C in dry season,

25’C and 35’C in rainy season and

10’C and 25’C during the cold season.

• Average annual rainfall is as high as 2,500mm in some parts of the country, particularly in coastal regions but as low as 500 mm in the central dry zone.

- As a result of the great variation in rainfall, temperature, complex river systems, and topography, there are several ecosystems in Myanmar, and they are 1) Forest, 2) Mountain, 3) Dry and Sub-humid Land, 4) Estuarine Mangrove, 5) Inland Fresh Water, 6) Grassland, 7) Marine and Coastal, and 8) Small Island Ecosystem.
- Among the ecosystems, forests are considered to be integral for stability of the environment.
- Although nearly half of land area with forest (FAO 2010), most of the forests are degraded.
- Forest cover in 1990 was 58.0% of total land area and it was reduced to 51.5% in 2000, 49.2% in 2005 and 47.0% in 2010. Thus environment is unstable.

- Myanmar is likely to be faced with temperature rising in several areas.
- According to UNFCCC, temperature is going to increase over 1° C in most part of the country within the next 30 years.
- It will have potential effects on agriculture, forestry, biodiversity, water resources, natural disasters and human health.
- In 2008, Cyclone Nargis hit the lower part of Myanmar and over 100, 000 people died in this natural disaster.
- Mangrove forests in the area were also severely affected and biological balance was destroyed

- As a result, rat population significantly increased and the damage of paddy fields by rat infestation aggravated food insecurity in storm-affected villages.
- Duration of rainy period shortened that rainfall pattern can affect the crop productivity by drought in some places
- A wide range of management options can be adopted for adapting agriculture to climatic variability and climate change.
- Crop diversification (inclusive of FSF in cropping patterns) and development of crop varieties tolerant to biotic and abiotic are possible interventions in climate resiliency.

c. Market and economic constraints

- Visions are 1) to attain food security and higher nutrition

2) to double the income of farmers and their socio-economic status, and

3) to improve the quality of agricultural products to compete in international markets.

Myanmar has not well organized marketing system for farm products.

At harvesting the price is generally low by selling at primary market, the primary markets are usually located with 1-10 km from the farm.

- The farm products moved to the market places by different means of transportation.
- There are constraints of procuring farm products and inputs.
- Other constraints are retailer between farmer and consumer, lack of credit system, high transport cost, no storage facilities, lack of market information and unstable price.

d. Cultural relevance

- Some plants and crop species in Myanmar have their value in cultural aspect.
- Among the proposed FSF, specialty rice (*Oryza sativa* L.) local name *Namathalay* with small grain and easy to digest is cultivated in Myanmar for a long time.
- In ancient time, farmers who grew and harvested this rice variety can eat only after the king's feast.
- After that the people can eat and it can be offered the monks.
- This special rice is suitable for aged people because of easy to digest.

- Amla, Burmese gooseberry traditionally is believed that if fruits are broadcasted around house, snakes will be repellent.
- Drum stick for example has many traditional and pharmacological uses (Olson 2002).

III. Scoping and Prioritization FSF

a. Scoping and availability of FSF

•Regarding agricultural importance, nutritional value, economic importance, public acceptance and scope of intervention, the 18 FSF crops (Table 5) have been selected during the workshop on December 2016.

Table 5. List of selected FSF crops in Myanmar

Sr. no	Common name	Scientific name	Group	Adaption	Crop nature
1	Aromatic rice	*Oryza sativa* L.	Cereals	Tropical	Annual
2	Specialty rice (Namathalay)	*Oryza sativa* L.	Cereal	Tropical	Annual
3	Sorghum	*Sorghum bicolor* (L.) Moench.	Cereals	Sub-tropical	Annual
4	Jack	*Artocarpus heterophyllus* Lam.	Fruits	Tropical	Perennial
5	Custard apple	*Annona squamosa* L.	Fruits	Sub-tropical	Perennial
6	Wood apple	*Limonia acidesima/ Ferronia elephantum*	Fruits	Sub-tropical	Perennial
7	Drum stick	*Moringa oleifera* Lam	Fruits	Sub-tropical	Perennial
8	Amla	*Phyllanthus emblica* L.	Fruits	Sub-tropical	Perennial
9	Cowpea	*Vigna unguiculata* (L.) Walp.	Pulses	Sub-tropical	Annual

Sr. no	Common name	Scientific name	Group	Adaption	Crop nature
10	Green gram	*Vigna radiata* (L.) R. Wilczek.	Pulses	Sub-tropical	Annual
11	Lablab bean	*Dolichos lablab* L.	Pulses	Sub-tropical	Annual
12	Sesame	*Sesamum indicum* L.	Oil seed	Sub-tropical	Annual
13	Groundnut	*Arachis hypogaea* L.	Oil seed	Sub-tropical	Annual
14	Sweet potato	*Ipomoea batatas* (L.) Lam.	Root/Tuber	Sub-tropical	Annual
15	Cassava	*Manihot esculenta* Crantz.	Root/Tuber	Tropical	Annual
16	Elephant's foot yam	*Amorphophalus campanulatus* (Roxb) Bl.exdecne.	Root/Tuber	Tropical	Annual
17	Bottle gourd	*Lagenaria siceraria* (Molina) Standley.	Vegetables	Sub-tropical	Annual
18	Roselle	*Hibiscus sabdariffa* L.	Leafy vegetable	Sub-tropical	Annual

b. Selected NUS and preliminary proposed sites option for field survey in Myanmar

- Among the 18 crop species, 6 species were selected prior with proposed sites in Myanmar

Group	No. of Species	Crop
Cereal	2	Specialty rice and Sorghum
Root and tuber	1	Elephant‘s foot yam
Horticulture	2	Roselle and Drum stick
Other	1	Amla

Cereal

(1) Specialty rice (*Oryza sativa* L.), local name ***Namathalay***

•Specialty rice's grain is considerably small and easy to digest that can be specialty for sick and aged people.
•It has abiotic stress tolerance ability that can be grown in water logged area where modern varieties cannot,
•Less requirement of nitrogen fertilizer means environmentally friendly rice variety.

Photo 2.Specialty rice, *Namathalay*, is an ancient rice variety and easy to digest
(Photo by Minn San Thein)

(2) Sorghum (*Sorghum bicolor*)

•Sorghum as a semiarid crop is important food and forage crop in central dry zone in Myanmar.
•Drought tolerance
•The crop supply feed to draught cattle since limited pasture area in the dry zone.

Photo 3. Sorghum a promising for food, feed, fodder and climate resilient crop
(Photo by Minn San Thein)

Table 6. Nutrient composition (per 100 g of edible fresh weight)

Cereal	Ca (mg)	Fe (mg)	Mg (mg)	P (mg)	K (mg)	Na (mg)	Zn (mg)	Cu (mg)	Vit. E (µg)	Vit. B1 (mg)	Vit. B2 (mg)	Vit. B3 (mg)	Vit. B6 (mg)	Folate (µg)
Specialty rice	19	1.2		105	71	27	0.5	0.1		0.1	0.04	2.6		
Sorghum	13	3.36	165	289	363	2	1.67	NA	0.5	0.332	0.096	3.688	0.443	20

Cereal	Water (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Crude Fibre (g)	Ash (g)
Specialty rice	35.4	11.7	6.8	0.7	79.7	0.6	0.5
Sorghum	12.4	329	10.62	3.5	72.1	6.7	NA

Root and tuber

(3) Elephant`s foot yam (*Amorphophallus campanulatus* Roxb, Bl.exDecne.)

- Myanmar name is *Wa-U*.
- It is an indigenous and widely distributed in the country.
- Wild plants appear in heavy soil, in forest, forest edge and lowland.
- Some edible forms are grown in homestead.
- Over exploitation
- This species is needed to assess germplasm collection, characterization and evaluation.

Table 7.	Protein (g)	Fat (g)	CHO (g)	Crude fibre (g)	Ash (g)
Elephant's foot yam	12.5	0.98	75.2	3.67	4.42

Photo 4. Elephant's foot yam
(Photo by Shinji Watanabe)

Horticulture

(4) Roselle/*Chin Paung* (*Hibiscus sabdariffa*)

- Roselle may be a native of Myanmar as it was mentioned in ancient literature.
- Its cultivation is confined to market gardens near big towns and at homestead in rural area.
- An important vegetable and it can be procured at a cheap price
- Leaves are generally eaten as vegetable and calyx is used in culinary practices and in preparing local jam.
- Its growing area is unknown but it contributes source of vitamin C to both urban and rural people in Myanmar.

Photo 5. Roselle, underutilized leafy vegetable in Myanmar (Photo by Minn San Thein)

Table 8. Nutrient composition (per 100 g of edible fresh weight)

Horticulture	Water (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Ash (g)	Ca (mg)	P (mg)	β-carotene equ. (µg)	**Vit. C (mg)**	Vit. B1 (mg)	Vit. B2 (mg)	Vit. B3 (mg)
Roselle	85.6	57	1.7	0.1	12.4	0.2	9	4	797	**44**	0.11	0.24	4.5

(5) Drum stick (*Moringa oleifera*)

- Common name is Drum stick, it is tree and shrub and fast growing plant with a high fruit production.
- It is of long time cultivating in Myanmar.
- Tender fruits are eaten in curry. Young leaves are traditionally added to soup.
- The leaves have medicinal properties in bring down blood pressure (Watanabe et al. 1999).
- Although cultivated area has not yet been surveyed, it can be found all states and regions in Myanmar.
- The plant is an important food commodity which serves as a natural nourishment for the people of the tropics and sub-tropics (Kenneth Opare- Obuobi, 2012).
- It is rich in both macronutrients and micronutrients which are essential for human nutrition for the daily development of the human body (Anwar et al. 2007).

- Nutritional composition compares satisfactorily with other crops (Table 9) such as beans, cowpea, turnip, cassava leaves, amaranth leaves and pumpkin leaves and even essential nutrients from other non-plant sources (CSIR, 1962; Palmer and Pitman, 1972; Maroyi, 2006).
- In Myanmar, there existed a problem of human health due to malnutrition and it is the best source of micronutrients such as calcium, vitamins, protein, potassium and phosphorus.
- For years, the seeds have been shown to be one of the most effective primary coagulants for water treatment in rural communities.
- Plants are being used all over the world for the cure of countless disease conditions.

- In spite of the numerous benefits, the plant has been less interested in doing research in Myanmar.
- Information on this plant is still rare in Myanmar.
- It is important for conservation and utilization of its germplasm.
- In Myanmar, *M*. *oleifera* can be found everywhere and other species of *Moringa* are rare to find out.
- It grows well in the humid tropics or hot dry lands, survives destitute soil, and has the ability to tolerate drought.
- It also grows under wide range of rainfall from 250 mm to over 3000 mm and a pH range of 5 - 9 (Palada and Changl 2003).
- Every part of the plant is useful with the leaves, flowers, immature pods and roots being edible for both man and farm animal.
- Propagation is either by seeds or cuttings, and there are marvelous opportunities for sustainable agriculture and to promote it as a cash crop (Saini et al. 2012).

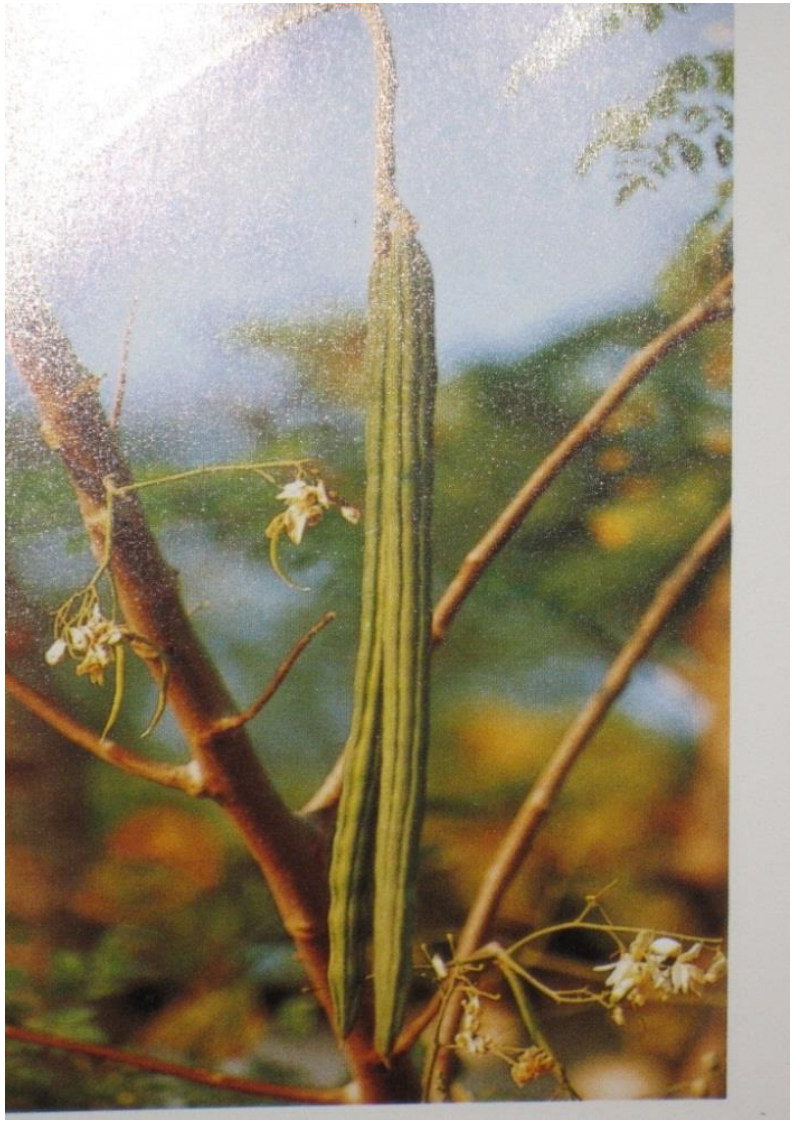


Photo 6. Drum stick for food and medicinal purposes (Photo by Shinji Watanabe)

Table 9. Nutrient composition of Drum stick(per 100 g of edible fresh weight)

Material status	Moisture (%)	Calories (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fibre (g)
Pod	86.8	26	2.5	0.1	3.7	4.8
Fresh leaves	75.0	92	6.7	1.7	13.4	0.9
Dried leaves	7.5	205	**27.1**	2.3	38.2	19.2

Source: (http://www.edlagman.com/moringa/moringa-fresh-leaf-vsdried-leaf.pdf)

Other

(6) Amla/Burmese gooseberry, *Zee Phyu*

(*Phyllanthus emblica (or) Emblica officinalis*)

- Fruit is one of the richest sources of natural ascorbic acid (Thu et al 2015) that is a good source of vitamin C for rural poor.
- In Thailand Emblic myrobalan fruits are traditional used as an expectorant, antipyretic, diuretic, antidiarrheal and antiscurvy (Subhadrabanbhu 2001).
- It is rarely cultivated in orchard garden and homestead that still remains as wild plant species.
- However, the species habitat in the tropical forest is threatened due to deforestation by many reasons.
- So, pilot demonstration of growing in homestead or establishing orchard garden is needed.

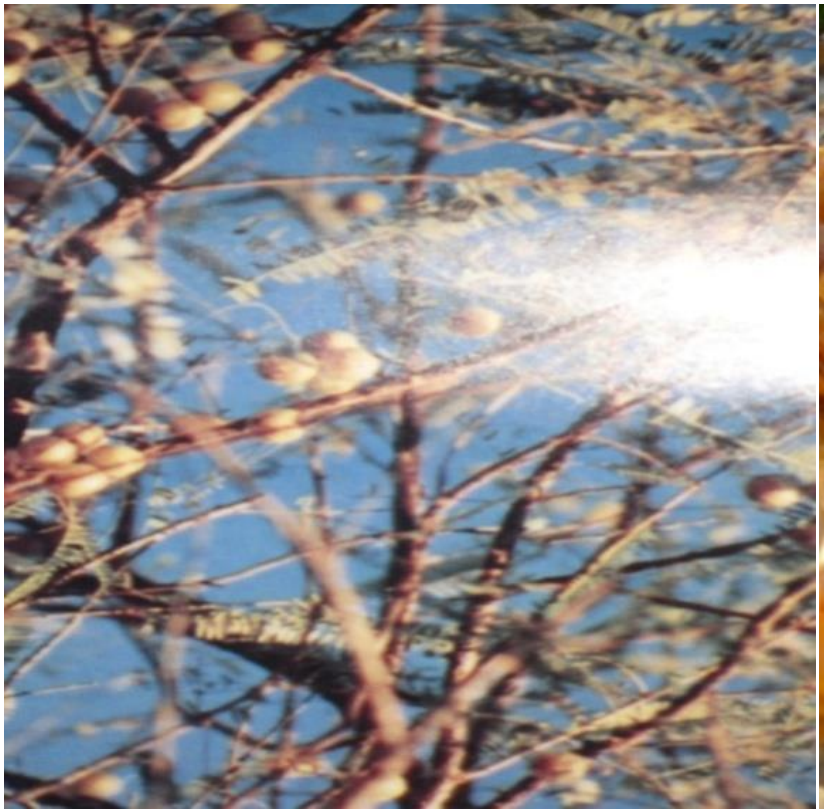



Photo 7. Amla / Burmese gooseberry, *Zee Phyu*
(Photo by Shinji Watanabe and Minn San Thein)

Table 10. Nutrient composition (per 100 g of edible fresh weight)

Other	Water (g)	Energy (kcal)	Protein (g)	Fat (g)	CHO (g)	Crude Fibre (g)	Ash (g)	Ca (mg)	Fe (mg)	P (mg)	β-carotene equ. (µg)	**Vit. C (mg)**	Vit. B1 (mg)	Vit. B3 (mg)
Amla	82.2	66	0.38	0.1	14.82	2.1	0.4	18	0.5	4	21	**243**	0.02	0.8

Table 11. Characteristics of 6 selected NUS

Character FSF	Specialty rice	Sorghum	Elephant's foot yam	Roselle	Drum stick	Amla
Season	Rainy	Rainy and post-monsoon	Naturally collected during post-monsoon	Year round	Year round	Perennial
Edible /useful part	Grain	grain and whole plant	Tuber, stem of some types	Leaf and fruit	Immature fruits, leaves, bark, root	Fruits
Abiotic stress tolerance	Water logged, low nitrogen tolerance	Drought, heat	Semi-Shade	Heat,	Drought, wide range of rainfall,	Semi-Shade
Biotic stress tolerance	-	Incidence of insect pests and diseases are low	-	-	Susceptible to stem borer	-
Adaptability to stress prone ecosystem	Unfavorable rainfed	Dry area	Grow well under forest -	Well established across the country	Can stand in dry area	Grow well under forest
Sown area	unknown-	235,000 ha	unknown	unknown	unknown	unknown
production	-	243000 mt				
Average yield (t/ha)	1.0	1.03				

Character FSF	Specialty rice	Sorghum	Elephant's foot yam	Roselle	Drum stick	Amla
Crop duration (days)	150-175	150-180				
Over all acceptance	High	High	High	High	High	High
Consider cropping pattern	Rice-pulses	Mixed cropping with pea and bean	-	-	Home stead	-
Nutrition	carbohydrate,	protein	Carbohydrate	Vitamins C and B-3	Protein and microelements	Vitamin C
Climate resilience	Unfavorable rainfed, requires less N_2	Tolerance to drought	Less biotic stress problems	Heat	Wide range of adaptation	Tolerance to drought
Marketing	Promising	-	Yes, Cash crop	Year round market	Yes	Yes
Available genetic diversity	Medium	High	?	High	?	?
Cultural relevance	Medium	-	-	-	High	Medium

Character FSF	Specialty rice	Sorghum	Elephant's foot yam	Roselle	Drum stick	Amla
Marketing	Promising	-	Yes, Cash crop	Year round market	Yes	Yes
Available genetic diversity	Medium	High	-	High	-	-
Cultural relevance	Medium	-	-	-	High	Medium
Health benefit	Easy to digest that suitable to aged people	-	Medium	Medium	Very high	high
Ecological adaptability	Rainfed lowland	Dry zone and most regions	All forest	All over the country	All over the country	All over the country
Photoperiod sensitivity	Sensitive to day-length	Not applicable		Sensitive to day-length	-	-
Processing	-	-	Making food liked Tophu	Local jam	-	Traditional medicine
Export potential	-	Low	High	Low	Export Seeds to China	Low
Caution	-	-.	Some are itchy types	-	-	Eating too much may cause constipation

Table 12. Selected NUS and preliminary proposed sites for field survey in Myanmar

Crop	Possible intervention	State/Region, District, Township
1) Specialty rice	1) Evaluation of conserved germplasm and reintroduction to farmers, and market improvement	1) Nay Pyi Taw (Yezin) and Sagaing (Shwebo)
2) Sorghum	2) Participatory varietal selection	2) Mandalay (Myin Chan and Nyaung U)
3) Elephant's foot yam	3) Germplasm collection and identifying promising genotypes	3) Collecting sites : Chin, Kachin Tanintharyi
4) Roselle	4) Varietal improvement	4) Nay Pyi Taw (Yezin)
5) Drum stick	5) Incorporating the crop into homestead and improving processing, value added, etc.	5) Mon (Mawlamyine)
6) Amla	6) Pilot establishment of orchard	6) Shan (Pin Laung)

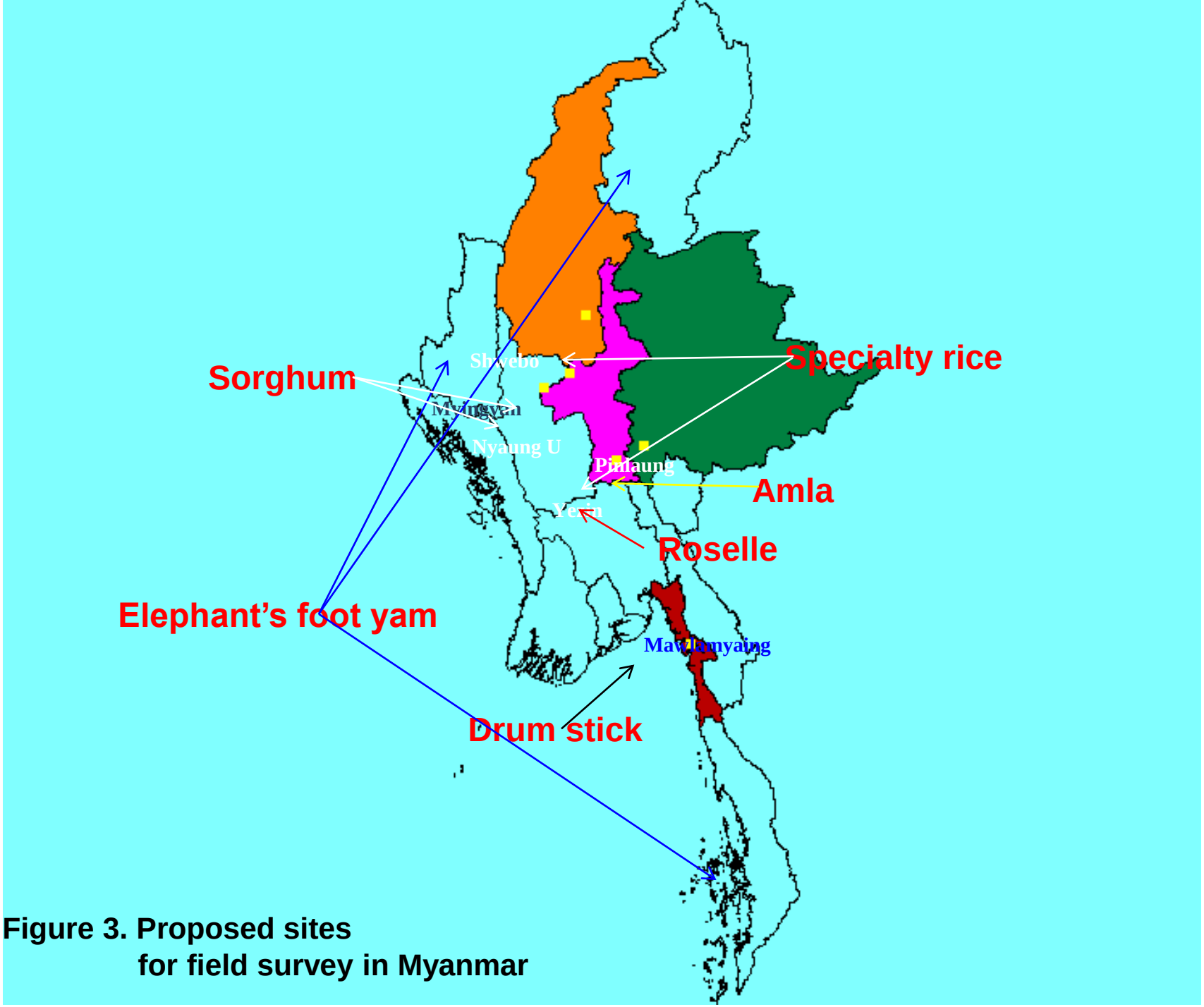


Figure 3. Proposed sites for field survey in Myanmar

c. Prioritization analysis

Cereal

- Rice is a national crop and staple food in Myanmar.
- However, *Namathalay*, **specialty rice** is paid not much attention.
- It has been grown for a long time, and suitable for sick and aged people since it has an easily digest feature.

Nowadays, there is a little acreage, and just recently some of the farmers and rice growers requested the Myanmar Seed Bank to reintroduce the elite accession that premium price can be expected

- Low nitrogen tolerance

- There are a variety of cereal crops in Myanmar, and some of them are maize, wheat, sorghum, minor cereals like pearl millet, fox tail millet, finger millet, little millet and job's tear.
- Among them, **sorghum** become as an important crop for climate adaptation, cropping pattern, both for food and feed in the dry zones of Myanmar.
- So, it could be considered as future promising species.
- Although sorghum is one of the promising crops for future climate change resiliency, varietal mixture, degradation by out-crossing and negative effect of mutation may occur in the existing varieties.
- Therefore, outstanding varieties can be expected by farmers' participatory varietal selection approach.

- **Roots and tuber**
- Potato, cassava, sweet potato, taro, yam, winged bean (for root) are grown in Myanmar.
- **Elephant's foot yam** is a rich source of starch, vitamins and minerals.
- It is collected from natural forest and domestic consumed of processed food and exported as raw tuber.
- By over exploitation, this yam may become endangered species.
- Therefore, domestication, germplasm collection, identification of elite genotypes for cultivation as FSF become essential.

Horticulture

- **Roselle** is one of the local vegetables with unknown acreage and grown in kitchen gardens that contributes source of vitamin C to both urban and rural people in Myanmar.
- Being a selection for FSF in Myanmar, **Drum stick** serves for food and medicinal values and it can be tolerant to abiotic stresses such as drought, heat, poor soil fertility, etc.
- It also can be grown easily by seed or stem cutting.
- However, it can be found only few of the homesteads in rural area in Myanmar, and processing technology for value added products will be benefitted.

Other

- As Myanmar people knew an **Amla** is a poor man's Vitamin C source, it is frequently collected from the natural forest, and rarely cultivated in orchard garden or homestead that still remains as wild plant species.
- However, the species habitat in the tropical forest is threatened due to deforestation by many reasons. Therefore germplasm collection and maintaining by field conservation, establishment of Amla orchard garden are urgently needed.

- **IV. Conclusion**
- Dietary quality in Myanmar remains poor, low on protein and vitamins and with high carbohydrates.
- Most household expenditures are related to food.
- Poor diet quality has contributed to high level of stunting and underweight along with high level of anemia , iodine and vitamin A deficiencies.
- In addition, a lack of diversity in the food supply has play a role in malnutrition.

- Myanmar is rich in useful plant species and crops.
- Prioritizing NUS can supply diversification in diet and reduce hunger and malnutrition.
- The NUS on the other hand is also important for agriculture, climate resiliency, culture, socio-economic, etc.
- Thus, the NUS can be a smart food in the future.

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