

Problem and Prospects of Tuber Crops in North Eastern Region

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The North-Eastern region comprising of states of Arunachal Pradesh, Assam, Manipur , Meghalaya , Mizoram, Nagaland , Sikkim and Tripura has tremendous potential for cultivation of tuber crops like sweet potato, colocasia, cassava (tapioca), dioscorea (yam), *amorphophallus* (Elephant foot yam) etc. With diverse agroclimatic condition, varied soil and high rainfall with wide regional variation, this region is highly suitable for cultivation of tuber crops. The tuber crops provide food and nutritional security to many people of this region. In fact, the tribals of this region are already in the habit of growing these crops, while tapioca, colocasia and dioscorea are common crops grown in the jhum or shifting cultivation fields. Sweet potato and colocasia are grown considerably not only in the hills but also in the plains of Assam and Tripura. In dioscorea, both *Dioscorea alata* and *D. esculenta* are grown mostly in the backyards and the tubers are even collected from the forests. Similarly, different types of *Colocasia*, *Xanthosoma*, *Amorphophallus* are found to grow both in nature and in kitchen gardens of the natives. Most of the tuber crops like sweet potato, colocasia, tapioca, dioscorea are grown as mixed crop with ginger, chilli, brinjal, beans etc. However, sweet potato and colocasia are grown as pure crop in some part of the region. Since these crops do not require much attention or care and no serious disease or insect damages are observed, they get preference as risk aversion crops in this difficult region.

Importance of tuber crops

Tuber crops are mainly consumed as food but quite a sizeable portion is also utilised in industries for producing various other items. Tuber crops form a major part of animal feed in our country. Various items like sago, dextrose, glucose, alcohol etc. are other products made out of cassava in India and other countries. Tamil Nadu utilizes over 75per cent of its total produce of cassava in the production of starch and sago. Cassava chips are utilised as cattle feed and poultry feed. However in north eastern region these tuber crops are consumed as food after boiling/cooking by human and as feed for animals. In this region due to lack of processing units, no value addition or processing is being done.

In colocasia, leaves, young shoots and corms are used for consumption. The root and leaves have a particular flavour that can give an acrid or sharp taste because of calcium oxalate crystals. Fortunately, cooking/drying reduces the acidity. The main cultivars are relatively free from calcium oxalate crystals. Taro has a good range of vitamins and minerals. The corm may be boiled, baked, fried or cooked in curries. The leaves are generally not eaten but traditional communities cook these like any green vegetable.

In sweet potato, the tuberous roots are consumed which are sweet in taste and rich in starch. The tuberous roots or the tubers are important mostly as food item. During storage a part of starch gets converted to sugar. During cooking, due to hydrolysis of starch, sweetness increases. In the N.E. region, sweet potato is consumed mostly after boiling and backing in fire. The sweet potato vines can serve as a nutritive and palatable feed for cattle. The unmarketable and poorly developed tubers can also be utilised as animal feed. For this, the tubers may be chipped and dried and then mixed in the feed.

Cassava is principally used as a food source. Cassava is also used as on-farm feed source. In animal feed industry cassava is one of the most abundantly used feed ingredient in place of cereal grain. A sizeable portion goes into industrial uses or is processed and exported.

Root and tuber crops are also receiving attention because they can be grown on marginal or difficult land. Due to growing population, pressure on land has increased and farmers have to move onto marginal lands with difficult soil, weather or other environmental conditions. Cassava can tolerate drought and high level of aluminum in soils. Taro has always received interest because it can be grown in hydromorphic soils or under flooded conditions.

Uses

Human food

The tuber crops like sweet potato, colocasia, yam, cassava, *amorphophallus* etc. are rich source of carbohydrate but they are poor in protein content. They are also rich in mineral and vitamins. The yellow-orange flesh sweet potato varieties can provide vitamins A and C. However, dioscorea is comparatively rich in protein and amino acids.

Animal feed

Nearly half of the sweet potatoes produced in Asia are used for animal feed. The vines have a lower carbohydrate content but higher in fibre and protein and their principal nutritive value is as a source of vitamins and protein. The content of trypsin inhibitors of the raw sweet potato roots could decrease the protein digestibility in mixed feed. The vines will not produce this effect because they do not contain them in great quantities. This trypsin inhibitor could be destroyed or lowered by preheating raw sweet potato roots. The sweet potato vines can serve as a nutritive and palatable feed for cattle. The unmarketable and poorly developed tubers can also be utilised in animal feed. Cassava chips are utilised as cattle feed and poultry feed. In animal feed industry cassava is one of the most abundantly used feed ingredient in place of cereal grain.

In north eastern region sweet potato and cassava tubers, colocasia corms and petioles are chopped boiled and fed to the pig. However, sweet potato vines and cassava leaves are also fed to the cattles and pig.

Industrial

Sweet potatoes are used in industrial processes to make alcohol and processed products such as noodles, candy, desserts, and flour. A sizeable portion of cassava goes into industrial uses or is processed and exported. Various items like sago, dextrose, glucose, alcohol etc. are other products made out of cassava in India and other countries. Tamil Nadu utilizes over 75 per cent of its total produce of cassava in the production of starch and sago. However, in north eastern region due to lack of processing industries such products are not common.

Medicinal

Amorphophallus campanulatus (elephant-foot yam) is used as a food as well as a medicine. It will not create any gastrointestinal problems. Its various therapeutical application can be seen in diseases like piles, dysentery, gas trouble etc. The cultivated types yam (*dioscorea*) are mainly grown for edible roots however, certain wild types like *D. floribunda*, *D. deltoidea* are grown for their medicinal value. They are good source of corticosteroids e.g. sapogenins and oral contraceptives. The steroidal hormone, cortisone used in rheumatic illness and ophthalmic problems is derived from *D. deltoidea*. The nutritive values of tuber crops are given in Table 1.

Table 1. Nutritive value of tuber crops

Nutrients	Amorphophallus	Colocasia	Dioscorea	Sweet potato	Xanthosoma	Cassava
Moisture (per cent)	74.4	70.3	67.6	72.5	65.2	65.5
Fat (per cent)	0.1	0.1	0.3	-	0.1	0.2
Protein (per cent)	2.0	3.2	2.1	2.2	1.2	2.5
Starch (per cent)	16.6	21.2	19.3	21	27.6	32.4
Energy (Kcal)	75.0	97.0	87.0	-	116.0	135
Vitamin B ₁ (mg)	0.06	0.09	0.05	-	0.03	0.04
Vitamin B ₂ (mg)	0.07	0.03	0.03	-	0.03	0.05
Vitamin C* (mg)	0.0	0.0	13.0	-	13.6	34
β carotene (μg)	260.2	24.0	28.0	-	54.6	-
Calcium (mg)	12.7	31.0	6.2	30	5.9	26
Phosphorus (mg)	67.0	68.0	33.0	49	53.0	32
Magnesium (mg)	47.0	109.0	25.0	24	26.0	-
Sodium (mg)	4.1	1.6	3.5	13	6.6	2
Potassium (mg)	622	356	351	373	530	39.4
Sulphur (mg)	11.8	7.4	17.1	29	7.9	-
Iron (mg)	0.51	0.63	0.69	0.8	0.47	0.9
Copper (mg)	0.18	0.20	0.16	-	0.19	-
Zinc (mg)	1.05	3.6	0.43	-	0.52	-
Manganese (mg)	0.31	0.34	0.07	-	0.17	-
Boron (mg)	0.07	0.09	0.08	-	0.09	-

Source: Tropical Tuber Crops edited by Balagopalan *et. al* (1999)

* Values are expressed in mg/100 g fresh weight

Diversity of tuber crops in NEH region

The north eastern region is considered to be the richest reservoir of genetic variability of tuber crops i.e. colocasia, *dioscorea* etc. These crops are an integral part of dietary system of tribals of the region and are grown abundantly in their **jhum** land or kitchen garden as mixed cropping. The considerable diversity has been reported in several states like Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

Alocasia occurs in wild in humid tracts being more common. Much diversity occurs in shoot/leaf thickness, shape, colour & size of corm. Local types have more raphides-calcium oxalate content, good cooking quality and better taste. However, in colocasia and xanthosoma wild types vary in leaf size, petiole lengths etc. and possess both green and pigmented forms. More variability in respect of Kalla Kachu, Ban kachu, Ahu-kachu, Dukh kachu, Mukhi, Panch mukhi, Man kachu, Jal kachu, etc.

In *dioscorea* about 28 species and 25 varieties has been reported from NE region mainly in the Garo hills (Sharma and Hore, 1995). The major species found in the region are *D. alata*, *D. esculenta*, *D. bulbifera*, *D. pentaphylla*, *D. hamiltonii*, *D. cylindrical*, *D. sativa*, *D. oppositifolia* and *D. deltoidea* and *D. floribunda*. *Dioscorea* is the crop which is mainly grown by tribal farmers in their **jhum** field.

In sweet potato mainly two types are available in the region i.e. red and white. In tapioca both sweet types and bitter are only available. Tapioca and sweet potato have been introduced long back in this region and they are well acclimatized.

Status of tuber crops in NE Region

The north eastern region has tremendous potential for cultivation of tuber crops. The colocasia, alocasia, xanthosoma and *amorphophallus* are common aroids grown in the region. Total area under sweet potato is 17 thousand hectare with a production of 70.7 thousand tonnes and productivity of 4.16 t/ha. Assam has highest area (9.4 thousand ha.) under sweet potato with an average production of 36.2 thousand tones where as Meghalaya has 5.2 thousand hectare area with total production of 17 thousand tones (Table 2). The total area under cassava in whole north eastern region is 7.8 thousand ha with total production of 55.6 thousand tones and productivity is 7.13 t/ha against the national productivity of 25.28 t/ha.. In cassava maximum area is under Meghalaya (4.0 thousand hectare) followed by Assam (2.5 thousand ha). In case of colocasia the area under Mizoram is 0.30 thousand ha with total production of 1.85 thousand tonnes and productivity is 6.11 t/ha. in Nagaland the total area under colocasia is 2.84 thousand ha with total production of 24.95 thousand tonnes and productivity is 8.8 t/ha. The area, production and productivity in other north eastern states is not available because the cultivation of these tuber crops is limited to kitchen/backyard in mixed cropping system.

Table 2. State wise area, production and productivity of tuber crops in north eastern region

State		Sweet potato	Colocasia	Tapioca
Assam	A	9.4	-	2.5
	P	32.6	-	11.7
	Y	3.47	-	4.68
Meghalaya	A	5.22	-	4.11
	P	17.39	-	21.88
	Y	3.4	-	5.3
Mizoram	A	0.27	0.30	0.11

	P	1.6	1.85	0.96
	Y	5.92	6.11	8.64
Nagaland	A	0.36	2.84	2.84
	P	5.76	24.95	14.22
	Y	16.0	8.8	5.01
Tripura	A	1.3	-	0.5
	P	11.5	-	2.2
	Y	8.85	-	4.4
NE Region	A	16.55	-	10.06
	P	68.85	-	50.96
	Y	4.16	-	5.07
India	A	120.6	-	264.3
	P	1048.1	-	6681.9
	Y	8.69	-	25.28

A= Area in thousand hectare, P= Production in thousand tonne, Y= Yield in t/ha

In case of colocasia Mukhi and Panch mukhi are commonly grown in Assam and Garo hills of Meghalaya. Man kachu and Jal kach types of *Alocasia* are grown in Assam. Apart from this other local types are also cultivated in different areas available with farmers. In *Amorphophallus* local types and Gajendra are generally grown but at limited scale. In sweet potato mostly white and red skinned local types are cultivated in most of the states. Local types of cassava i.e. sweet and bitter types are available but sweet types are normally grown by farmers of Meghalaya, Mizoram, Nagaland, Tripura and Manipur. In yam generally local types are grown in the **jhum** field and kitchen garden. Varieties identified/recommended for different north eastern states have been presented in Table 3.

Table 3. Tuber crop varieties identified/recommended for different north eastern states

Sweet potato (*Ipomoea batatas*)

Place	Variety	Yield (t/ha)
Basar, Arunachal Pradesh	71-OP-219	24.34
	71-OP-217	20.86
	H-633	19.00
Barapani, Meghalaya	Sree Bhadra	37.50
	Sonipat-2	35.80
	H-42	35.20
Tripura	Cross-4	25.30
	V-35	23.90

Colocasia (*Colocasia esculenta*)

Place	Variety	Yield (t/ha)
Basar, Arunachal Pradesh	Kandyam C	32.70
Barapani, Meghalaya	ML-1	20.5
	ML-9	20.0
	Kadina Local	20.0
Mizoram	MZ-2	-
	MZ-3	-

Manipur	MR-5	-
Assam	AS-2	-
Tripura	293	23.2
	TR Local	21.6

Cassava (*Manihot esculenta*)

Place	Variety	Yield (t/ha)
Barapani, Meghalaya	H-1687	30.0
	H-312	34.0
Basar, Arunachal Pradesh	H-312	26.8
	H-2304	24.7
Manipur	H-1687	-
	H-165	-
Nagaland	H-1687	27.5
	Local	25.1
Tripura	H-1687	41.0
	H-3641	39.5
	H-43	36.0

Prospect in North eastern region

Strength

- Soil and climatic conditions are highly favourable
- Rich biodiversity of tuber crops in the region
- Tuber crops are already integral part of food of tribals of the region
- These crops requires less care
- Can be grown on marginal land

Major weaknesses or problems of tuber crops

Vegetative propagation is probably the most important single limitation because:

- High cost of planting materials
- It requires more labours for handling
- Digging on hill slopes causes heavy soil erosion
- It can not be stored for a longer period
- Lack of processing and value addition
- Tuber crops are generally consumed by tribals or poor people

Constraints

Production constraints

- Germplasm conservation for root and tuber crops is difficult because of heavy dependence on vegetative propagation and non-availability of planting materials of improved varieties
- In case of colocasia disease like Phytophthora blight and corm borer insect and in sweet potato, weevil and rat

Constraints in human diet

- Low protein content in most of the tuber crops
- Presence of cyanogenic glycosides in cassava, which on hydrolysis yields HCN
- Presence of calcium oxalate in colocasia and amorphophallus
- Presence of trypsin inhibitor in sweet potato, which reduces the protein digestibility in mixed feed

Processing constraints

- No industry for making sago, alcohol, chips, flour, etc. of cassava in NE Region
- No industry for starch extraction in tuber crops in NE Region

Thrust area

- Identification of short duration, high yielding varieties suitable for inter cropping
- Identification of varieties having high carotene content in sweet potato etc.
- Identification of varieties having low calcium oxalate content in colocasia, *Amorphophallus* and low HCN content in cassava
- Identification of yam varieties with high diosgenin content for industrial uses
- Identification of colocasia varieties resistant/tolerant to *phytophthora* blight
- There is need to establish processing unit for chips, flour etc. in cassava and extraction of starch from cassava, diosgenin from yam
- Standardization of cassava, sweet potato, as feed concentrate along with good supplements. There is also need to prepare, silo from leaves, vines/stem of these tuber crops
- Mixed/inter cropping of tuber crops with legume vegetable like French bean (pole type) and cowpea should be advocated
- Need more research work on standardization of package of practices for cultivation in different cropping systems
- There is need for standardization of post harvest handling and processing

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