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Potential of Tuber Crops in Achieving Food Security and Improving the Economy of the Tribals of Manipur

Manipur is one of the seven sister states of North East India surrounded by Myanmar in the south-east, Assam in the west, Nagaland in the north and Mizoram in the south. The state lies at a latitude of 23°83'N – 25°68'N and a longitude of 93°03'E – 94°78'E. The total area covered by the state is 22,347 km^2 with an elevation of 790 MSL. Manipur has a central valley dotted with low hills occupying an area of 2.2 lakh ha. which is again surrounded by various layers of mountains with an area of 20.1 lakh ha. The soil cover of Manipur can be broadly classified into two types namely; red ferruginous soil which is seen in the hilly area and Alluvium soil in the valley area. The state receives an annual rainfall of 1500 mm distributed from March to October with a peak during July to September. The temperature ranges from 5^{0}C to 35^{o}C in the valley region while it ranges from 0^{o}C to 30^{o}C in the hilly region.

Agriculture plays an important role in the development of Manipur's economy. It engages about 76% of the total working population. The size of the cultivated area is 9.41% of the total geographical area of the state. Out of the total cultivated area, 52% is confined to the valley. In the valley the mode of agriculture is settled agriculture but in the hills shifting cultivation is common. In Manipur the staple food is rice which is grown in both the hills and plain areas as rainfed crop. The other main crops grown are soybean, ground nut, maize, colocasia, tapioca, brinjal, chilli, bhindi, ginger, turmeric etc. The productivity of the major pre-dominant crop rice, even though higher than the national average is not sustainable economically and environmentally due to the low economic status of the farmers and their inability to invest more. The rainfed areas have degraded naturally leading to the low level of productivity potential. So, the agricultural scenario of the state during the last decade was also not encouraging. During 2011-12 the state recorded the food grain production of 6.5 lakh tones, thereby showing a decreasing trend in subsequent years. The requirement of food grain for human consumption excluding livestock was in the order of 7.6 lakh tones in 2012-13 and 8.7 lakh tones in 2013-14. The production of rice in Manipur for the year 2011-12 was estimated at 6.0 lakh tones as against 2.5 lakh tones in 2012-13.

The tuber crops are important secondary staple food crop of the people living in remote areas and hilly region and are highly potential crops in terms of food, feed and as a resource of income generation. These tuber crops are easily grown in the foot hills, marginal farm areas, swampy lands etc. so, there is scope of increasing the total area and production under food crops. Moreover, climate change projection made up to 2100 for India indicates an overall increase in temperature by 2-4°C compiled with increase in precipitation, especially during monsoon period. The available evidence shows significant drop in the yield of important cereals crops like rice, wheat under climate change condition. Under these circumstances, tuber crops will be an important component of cropping system under vagaries of climate parameters like flood or severe drought. Tuber crops like cassava and white yams are resilient to drought conditions. Sweet potato can tolerate and yield considerably under saline conditions. Taro is tolerant to flood conditions. Elephant foot yam, tannia and arrow root can tolerate shady conditions. These crops are considered as the third most important crop after cereals and grain legumes. Cassava ranks 5th (calorie based) behind maize, rice, wheat and barley. However, in terms of the change (progress or regress) in the recent 30 years (1979-81 mean to 2009-11 mean) cassava ranks 1st in total production, in harvested area and 5th in mean yield per area, indicating that cassava is not only now a major world crop but also the crop for the future (Kazuo, 2013).

The popular tuber crops that are commonly grown in Manipur includes sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), yam (*Dioscorea spp*.), colocasia

(*Colocasia esculenta*) etc. and can be grown in a wide range of elevation starting from >150 msl to >1200 msl. (Table 1.) and are grown under rainfed condition without fertilizer. Sweet potato, cassava and colocasia are grown on commercial scale whereas *Dioscorea* is grown in limited areas and is of less importance. The elephant foot yam is grown as wild and has high acridity and zero edibility. The Indo Mayanmar region is the original place of tuber crops like colocasia and dioscorea so there is a rich diversity of species of these crops in Manipur. The colocasia eddoe type (*Colocasia esculenta* var. *antiquorum*) is mostly grown in hilly areas whereas the dasheen type (*Colocasia esculenta* var. *esculenta*) is commonly grown in valley areas. The tuber crops such as cassava and dioscorea are perennially left as standing crops in the field after maturity and harvesting is done when required by the farmers (Fig. 1).

In Manipur there is a problem of food scarcity especially in the hilly regions and the only crop that supplies carbohydrates or energy at the time of scarcity is tuber

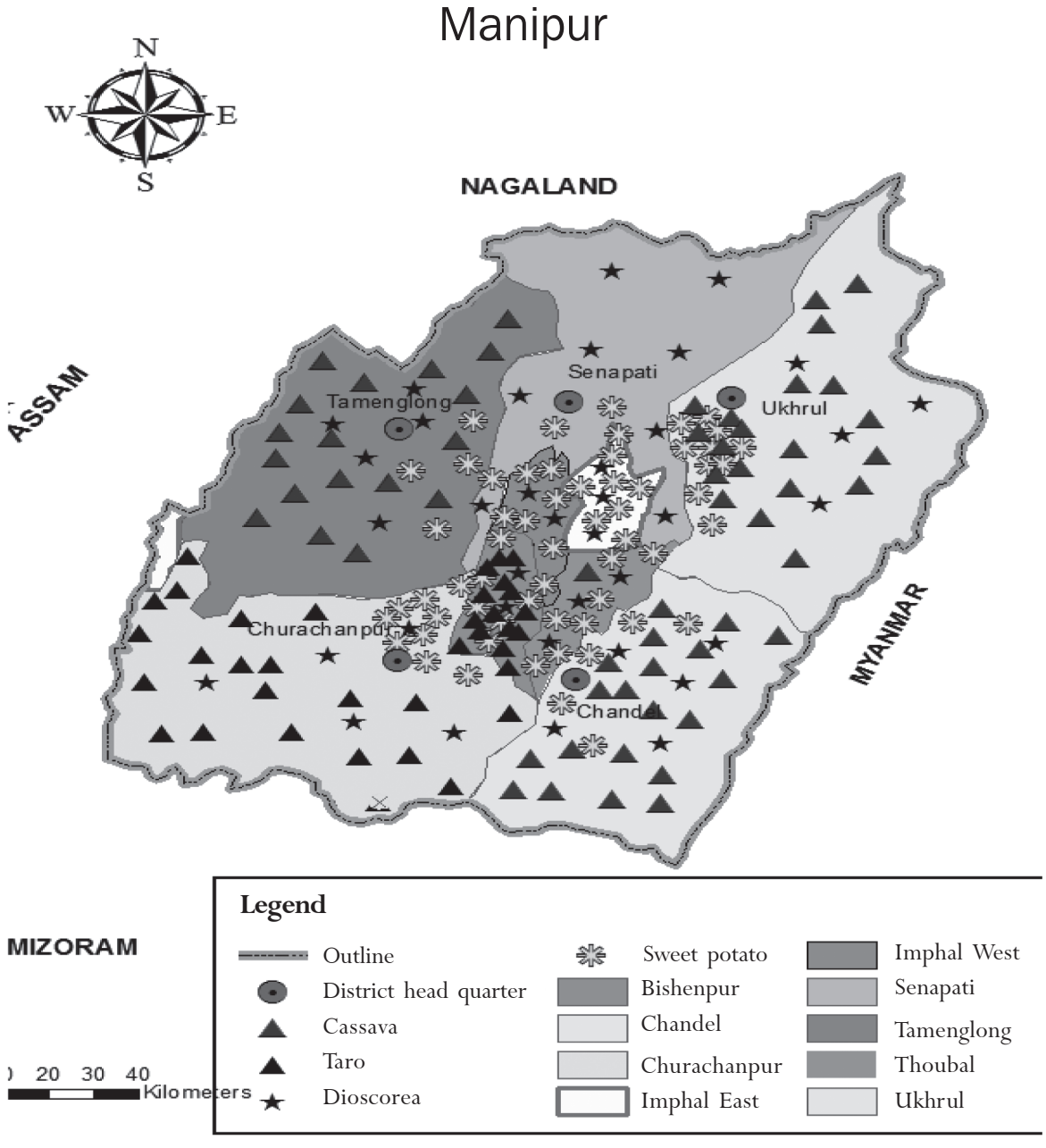

Fig. 1. Tuber crops distribution in the different districts of Manipur

Table1. Percentage distribution of area at different elevation in Manipur along with suitable tuber crops

Sl. No.	Elevation	Area (%)	Tuber crops grown
1	< 150 M	5.29	Colocasia, Alocasia, swamp taro, sweet potato
2	150 – 300 M	1.38	Colocasia, Alocasia, swamp taro, sweet potato
3	300 – 600 M	12.49	Cassava, sweet potato, *Dioscorea*, Colocasia
4	600- 1200 M	53.47	Cassava, sweet potato, *Dioscorea*, Colocasia
5	> 1200 M	17.34	Cassava, sweet potato, *Dioscorea*, Colocasia

Table 2. Main characteristics of tuber crops

Characteristics	Cassava	Sweet potato	Tannia	Taro	Yam
Growth period (months)	9-24	3-7	9-12	6-18	8-11
Annual or perennial plant	per.	Ann.	Per.	Per.	Ann.
Optimal rainfall (cm)	100-150	50-75	140-200	250	115
Optimal temperature (0^0C)	25-20	15-18	13-29	21-27	30
Drought resistant	Yes	No	No	No	Yes
Optimal pH	5-6	5.5-6.0	5.5-6.5	5.5-6.5	n.a.
Fertility requirement	Low	High	High	High	High
Organic matter requirement	Low	High	High	High	High
Growable on swampy/ water logged soil	No	No	No	Yes	No
Planting material	Stem cutting	Vine cutting/ tuber	Corms/cormels	Corms/cormels	Tubers
Storage time in ground	Long	Short	Long	Moderate	Long
Postharvest storage life	Short	Long	Long	Variable	Long

Source: Kay (1973)

crop. People in the hilly region grow one or the other tuber crop on a larger scale to solve the problem of food scarcity to some extent. These crops show highest rate of dry matter production per day per unit area among all the crops (Table 3.)

Table 3. Top food crops in terms of dry matter/ha and edible energy production mj/ha/day

Dry matter production		Energy production	
Crop	t/ha	Crop	mj/ha/day
Cassava	3.0	Potato	216
Yam	2.4	Yam	182
Sweet potato	2.1	Maize	159
Rice	1.9	Cabbage	156
Carrot	1.7	Sweet potato	152
Cabbage	1.6	Rice	151
Bananas	1.5	Wheat	135
Wheat	1.3	Cassava	121
Maize	1.3	Egg plant	120

Source: Horton et al., 1984

Besides being a good source of carbohydrate tuber crops are also good source of minerals and vitamins. Cassava and sweet potato provide ascorbic acid (Vitamin C) deficiency of which causes scurvy – bleeding gums and mucus membranes and susceptibility to infections such as common cold. Orange fleshed sweet potato (Fig. 2) is a rich source of vitamin A and deficiency of this vitamin causes inability to see in twilight, sensitivity to bright light, foamy white patches on the conjunctive softening of the cornea, eventually leading to blindness and frequent respiratory infections. Besides, sweet potato is rich in anti-oxidant, nutrients like β-carotene ascorbic acid (Vitamin C) and tocoferol (Vitamin E) which can prevent coronary disorder and cancer. Cassava, sweet potato, taro, yam and elephant foot yam also provide Vitamin B complex (Thiamine – B_1 and Riboflavin – B_2) deficiency of which causes loss of appetite, cracks at the corner of the mouth, cracked lips, glossy tongue and ulcers in the oral cavity. Tuber crops also provide minerals such as calcium, phosphorous and iron (Table 4.). The recommended

Table 4. Nutritional values of tuber crops per 100 g edible portion

Crop	Energy Kcal	Protein (g)	Fat (g)	CHO (g)	Vit. A 1μg	Vit.B (mg)	Ribo-flavin (mg)	Vit. C (mg)	Ca	P	Fe
Cassava	157	0.7	0.2	38.1	-	0.05	0.01	25	50	40	0.9
Sweet potato	144	1.7	0.4	26.3	8800	0.10	0.06	24	32	47	0.7
Taro	97	3.0	0.1	21.1	40	0.09	0.03	0	40	140	1.7
Yam	102	1.5	0.2	24.0	-	0.10	0.01	5-6	12	35	0.8
Elephant foot yam	79	1.2	0.1	18.4	429	0.06	0.07	0.1-0.5	50	34	0.6

Fig.2. Orange-fleshed sweet potato

dietary allowance which is possibly met by root and tuber crops is @500 gram per capita per day. Moreover, these crops are easily available and affordable to the poor people and their requirements of nutrition can be fulfilled easily. These crops can also be used to improve human nutrition indirectly while contributing to a more productive livestock sector.

Tuber crops can be good source of income if processed, when use as feed and also as industrial raw materials. These crops can be consumed as raw or can be processed into different food products like wafers, noodles, jam, pickles, sago, chips, wine, bakery products from flour and other fermented products. The processed products can be prepared in small scale local production units as well as large scale. Local production is also very important because it is the more stable way of improving livelihoods, of increasing food security and contributing to long term and broad based economic growth in developing countries.

In the hilly regions one of the main crops grown is tuber crop.Tuber crops like cassava and yam remains in the field for years because of the difficulty in transporting the huge mass in the hilly tract where no proper roads lead to the urban market. In such conditions, processing of the tuber crops in small scale will help the growers to generate income and will encourage to increase the area and total production under tuber crops. Tuber crops are also used as animal feed in many countries. The leaves, vines, foliage and roots are used in the fresh, dried, sliced and cooked forms, feed for different livestock like cattle, poultry and pigs. In the hilly state like Manipur pig rearing is a common occupation but feed is a problem because of the high cost of feed and availability. Including tuber crops in piggery feed saves the capital input in rearing the pigs as tuber crops are easily available. The tuber crops can replace up to 40% of the conventional pig feed has showed no variation in the weight of the pig reared under conventional feed and thereby increased profit to pig farming up to 4-6 times (Dhaneswar, 2012). Tuber crop products like starch and flour are important industrial raw materials for making textiles, paper, glue, plywood, and pharmaceuticals like glucose, mannitol, sorbitol, dextrin and monosodium glutamate. In Manipur, the processed product of tuber crops is very limited and it is still consumed either as fresh or cooked.

It can be summarised that root and tuber crops are highly potential crops in terms of food, feed and as a resource of income generation. Including these crops in the integrated farming system will

provide additional income. Providing the knowledge of processing technology by giving short term training courses to the tuber crop growers will help to enhance their income. The challenge in both the technological (development of new productive, environmentally sustainable production system) and political (policies that do not discriminate rural area and agriculture) areas will have to be confronted at this juncture by policy makers, researchers, processors and the community members to implement policies to make effective use of the tuber crops to generate more income resulting in the economic development of the state.

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