Journal of Root Crops, 2013, Vol. 39 No. 2, pp. 269-272
Indian Society for Root Crops
ISSN 0378-2409

Food and Nutritional Security Through Root and Tuber Crops Interventions-Impact Assessment in Tribal Regions of India

Root and tuber crops are cheap source of carbohydrates and energy and hence find a special niche in the tribal food habits. Root and tubers play a crucial role in the food and nutritional security of the tribals. The major root and tuber crops grown in tribal areas of Chhattisgarh, Jharkhand and Odisha are sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), taro (*Colocasia esculenta*), yams (*Dioscorea* spp.) and elephant foot yam (*Amorphophallus paeoniifolius*). In Odisha, sweet potato is grown in 43,460 ha and cassava in 60 ha (NHB, 2013). In Chhattisgarh, sweet potato is grown in 3650 ha. Yams, taro and elephant foot yam are mostly grown in backyards and sometimes collected from forests. Hence, the area of cultivation is not available. Arrowroot (*Maranta arundinaceae*), *Curcuma angustifolia* and *Canna edulis* popularly called palua (Odisha) or tikkri (Chhattisgarh) are grown for starch extraction manually. The yield of tuber crops in the present production systems is very low (sweet potato: 8.9 t ha^{-1}, taro: 12.0 t ha^{-1} and greater yam: 18 t ha^{-1}).

Under Tribal Sub Plan (TSP), systematic efforts were undertaken to improve the productivity of root and tuber crops by careful application of improved technologies. Thus the focus was more on outreach programmes complemented with need based research modules, which was undertaken through the production and distribution of seed material, knowledge dissemination, production-processing linkage, capacity and entrepreneurship building (Fig. 1). In this paper, tuber crops technologies demonstrated in the states of Chhattisgarh, Jharkhand and Odisha and their performance are discussed. During the year 2012-2013, the Regional Centre of Central Tuber Crops Research Institute, Bhubaneswar, India, selected three states, Chhattisgarh, Jharkhand and Odisha for demonstrating tuber crops technologies for the livelihood improvement of tribal farmers under the Tribal Sub Plan. Narayanpur district in Chhattisgarh, Deogarh district in Jharkhand and Kandhamal and Koraput districts in Odisha, were selected for the present study. All the three states are comprised of hilly and plateau terrain. All these districts are dominated by tribals. A total of 465 tribal farmers were selected for conducting 665 demonstrations on tuber crops technologies. High yielding varieties were also introduced as technological interventions. Quality planting material of greater yam (var. Orissa Elite) 7400 kg, taro (var. Muktakeshi) 1550 kg, yam bean (var. RM-1) 100 kg, sweet potato (var. ST14 and Kishan) 110000 vine cuttings and cassava (var. Sree Jaya, Sree Vijaya and Vellayani Hraswa) 40000 setts were used for the demonstrations (Table 1). The area covered in all the three states together were 3.7 ha under greater yam, 1.24 ha under taro, 8 ha under yam bean, 2.2 ha under sweet potato and 4 ha under cassava (Table 2). The recommended package of practices was duly followed for all the crops. The yield at harvest was recorded. Economic analysis was done as per the prevailing market rate of inputs and output.

The yields of tuber crops are presented in Table 3. Greater yam var. Orissa Elite produced the highest tuber yield of 22.9 t ha^{-1} (Fig. 2) compared to the other crops/

Table 1. Quantity of planting material of tuber crops distributed to the tribal farmers

District	Greater yam (kg)	Sweet potato (No. of vine cuttings)	Yam bean (kg)	Cassava (setts)	Taro (kg)
Kandhamal	2000	35000	25	5000	-
Koraput	-	45000	25	12500	50
Narayanpur	3400	5000	25	12500	1300
Deogarh	2000	25000	25	10000	200
Total	7400	110000	100	40000	1550

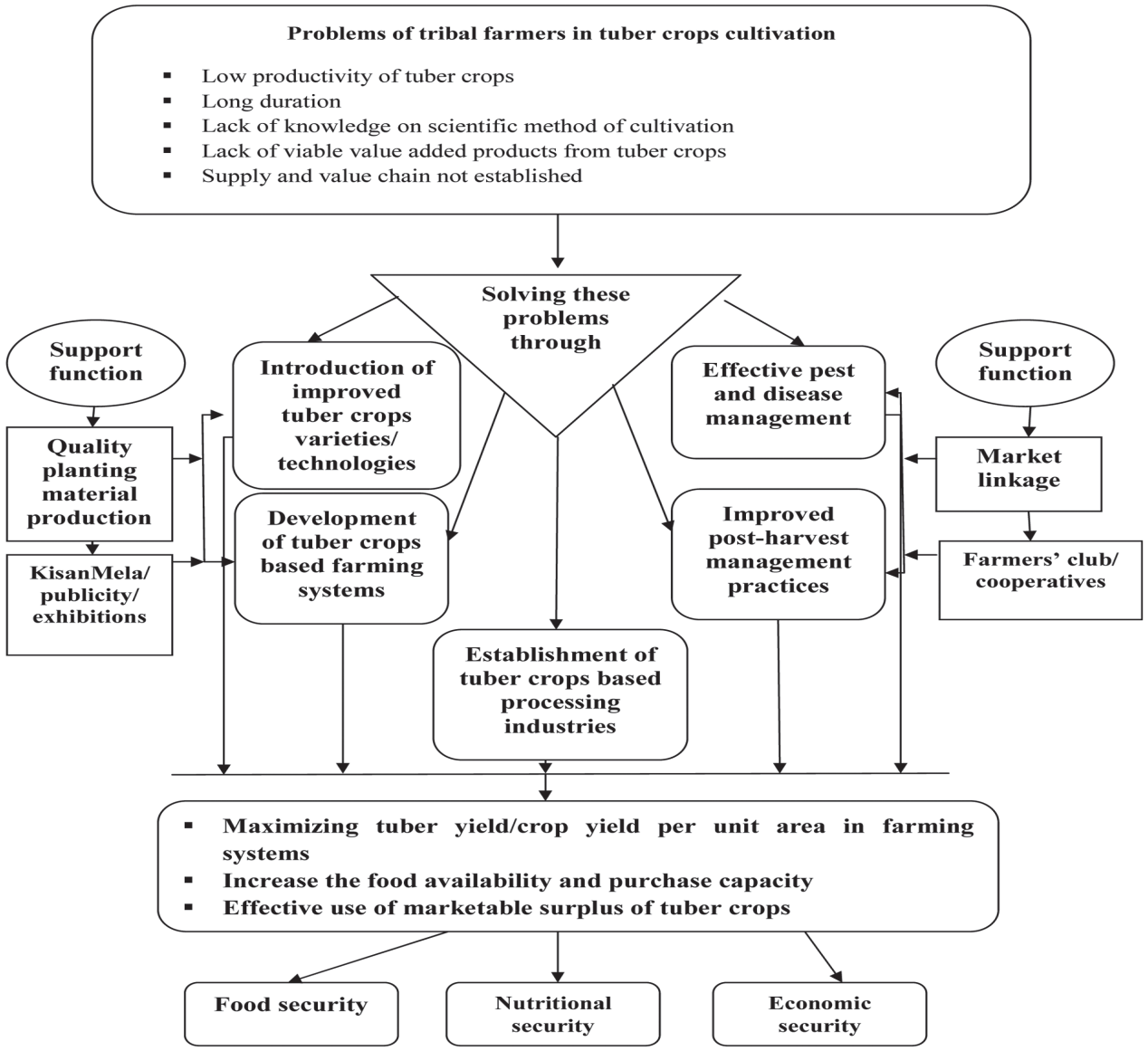

Fig. 1. Tuber crops based research module for livelihood improvement

interventions. This may be due to the suitability of this crop to climatic conditions of these states, varietal attributes and long duration of the crop compared to other crops. It is documented that yield has a direct relation with the duration of the crop (Nedunchezhiyan and Byju, 2005; Lenka and Nedunchezhiyan, 2013). The cassava varieties, Sree Jaya, Sree Vijaya and Vellayani Hraswa were the next good performers (18.3 t ha^{-1}). Short duration crops like sweet potato and yam bean produced lower yield. Taro, yam bean and sweet potato

Table 2. Area covered by the tuber crops interventions

District	Greater yam (ha)	Sweet potato (ha)	Yam bean (ha)	Cassava (ha)	Taro (ha)
Kandhamal	1.0	0.7	2.0	0.50	-
Koraput	-	0.9	2.0	1.25	0.04
Narayanpur	1.7	0.1	2.0	1.25	1.04
Deogarh	1.0	0.5	2.0	1.00	0.16
Total	3.7	2.2	8.0	4.00	1.24

Fig. 2. Women farmers with the harvested tubers of greater yam var. Orissa Elite

produced lower yields (13.1, 12.5 and 12.4 t ha^{-1} respectively). In general, the introduced improved varieties of tuber crops produced higher yield than local cultivars, especially sweet potato, taro and greater yam. The higher productivity of these crops increased the overall farm production. The availability of roots and tubers for household consumption and sale was found to increase. Household food and nutritional security was enhanced through increased availability, accessibility and utilization of nutritionally rich roots and tubers.

Cultivation of greater yam proved to be the most profitable (₹ 2,19,000 ha^{-1}) (Table 3). Taro (var. Muktakeshi) was also a feasible proposition (₹ 1,16,000 ha^{-1}). Yam bean (var. RM-1) generated net return of ₹ 79, 500 ha^{-1}. Net return from sweet potato (₹ 35,000 ha^{-1}) and cassava (₹ 54, 000 ha^{-1}) were lower. This was due to the low market price for tubers. Variation in returns due to market price of the commodity has been already reported (Nedunchezhiyan, 2011; Pandey et al., 2013). Higher B:C ratio of 2.76 was recorded with greater yam and yam bean. This was due to higher yield in greater yam and lower cost of cultivation in yam bean. Taro (var. Muktakeshi) intervention generated B:C ratio of 2.44. Due to the lower market price of tubers, sweet potato resulted in lower B:C ratio (2.30). Higher net returns from various tuber crops interventions resulted in higher farm income. The enhanced farm income due to higher productivity of high yielding varieties enabled tribal farmers to purchase additional livelihood needs. Thus the livelihood security of the tribal farmers improved through tuber crops interventions.

Thus the study indicated that in the hilly plateau regions of Chhattisgarh, Jharkhand and Odisha states of India, the cultivation of high yielding varieties of tuber crops like greater yam, yam bean, sweet potato, cassava and taro hold great promise. Root and tuber crops play significant role in the improvement of livelihood security and income of tribal farmers.

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Table 3. Yield and income from tuber crops interventions

Crop	Number of demonstrations	Average demonstration area (m^2)	Average tuber yield (t ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	Benefit: cost ratio
Greater yam (var.Orissa Elite)	148	200	22.9	343500	219000	2.76
Sweet potato (var. ST14 and Kishan)	55	400	12.4	62000	35000	2.30
Taro (var. Muktakeshi)	62	200	13.1	196500	116000	2.44
Yam bean (var. RM-1)	200	400	12.5	124500	79500	2.76
Cassava (var. Sree Jaya, Sree Vijaya and Vellayani Hraswa	200	200	18.3	91500	54000	2.44

Farm gate sale price: Yam: ₹15 kg^{-1}; Sweet potato: ₹ 5 kg^{-1}; Taro: ₹ 15 kg^{-1}; Yam bean: ₹ 10 kg^{-1}; Cassava: ₹ 5 kg^{-1}

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Received: 5 July 2013; Accepted: 25 December 2013

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