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Enhancement of Food and Nutritional Security of Rural Poor through Tuber Crops

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Abstract

The significance of tuber crops as a source of food, nutrition and income for farmers is well known; but these are often overlooked in the debate about improving food security and tackling malnutrition. This study is a sub-component of a Farming System for Nutrition (FSN) underway in Koraput, Odisha and Wardha in the Vidarbha region of Maharashtra, under the research programme on Leveraging Agriculture for Nutrition in South Asia (LANSA). Tuber crops occupy an integral part of the food and agricultural system of communities in these regions but the area under cultivation is very less and it is done in a traditional method. The overall aim was to promote and create awareness of nutrition sensitive agriculture among the tribal poor through introduction of nutrient rich crop varieties both at field and in nutrition gardens followed by their upscale. The study was based on a detailed report of the baseline survey revealing prevalence of anaemia and vitamin A deficiency in these regions. In this context, the study focused on leveraging agriculture for nutrition through a farming system intervention where we introduced orange-fleshed sweet potato (*Ipomoea batatas* L.) (rich in Pro vitamin A) instead of traditional cultivar (white fleshed) in the fields as well as in backyard nutrition gardens. The results of this study will help in the preliminary assessment of a nutrient rich sweet potato variety, its preference for adoption among farmers and as a source to address vitamin A deficiency in the country.

Key words: Tribal poor, nutritional security, vitamin A deficiency, orange-fleshed sweet potato, nutritional garden

Introduction

During last few decades, nutritionists in several developing countries have assembled compelling evidence that many children (especially young ones) and adults lack adequate essential vitamins and minerals in their diets (United Nations, 2012). Further, deficiency in vitamin A is one of the most prevalent problems, particularly in South Asia. The functional consequences of vitamin A deficiency are dramatic: "Severe Vitamin A deficiency has very high fatality rates (60%) but even sub-clinical deficiency is associated with a 23% increase in preschooler mortality in areas with endemic Vitamin A deficiency" (McGuire, 1993). In order to combat Vitamin A deficiency, efforts made in the past few years mainly comprises three approaches. The first approach emphasizes on supplementation programs of distribution of vitamin capsules. However, sustenance was a key issue due to its time bound nature (must be repeated every six months) and financial support from outside donors. The second approach focuses on fortifying common foods with a micronutrient and the third one is to improve dietary quality and quantity through diversification (Mitra, 2012). The later two approaches were food based and could be made sustainable with the inter-sectoral perspectives by providing agricultural and socio economic inputs.

Food based interventions to combat Vitamin A deficiency include animal foods, such as fish oils, liver, milk, eggs and butter, that contain vitamin A in its true form (also called retinol) which can be used directly and easily by the human body; plant foods and vegetables on the other hand do not contain vitamin A as such, but they do contain precursors, or pro-vitamin A – β-carotene and other carotenoids – that the human body can convert to vitamin A. The rural and urban poor in developing countries have

only limited access to vitamin A-rich animal foods. Orange-fleshed sweet potatoes (*Ipomoea batatas* L.) have emerged as one of the most promising plant sources of β-carotene (Hagenimana and Low, 2000; Harvestplus, 2012). A 100-g serving (about half a cup) of boiled roots can supply about 50% of the daily vitamin A requirement of a young child. The present varieties of orange-fleshed sweet potatoes contain 20–30 times more β-carotene than does Golden Rice (Ye et al., 2000).

Again, tuber crops have long served as the principal source of food and nutrition for many of the world's poorest and under nourished population and are generally valued for their stable yields under conditions in which other crops may fail (Anazodo et al., 1989; Scott et al., 2000). Therefore, they find an important place in the dietary habits of small and marginal farmers especially among tribal population of India. Traditionally, the sweet potato varieties grown in tribal parts of India have white flesh and contain no pro-vitamin A. In order to include the orange-fleshed sweet potatoes in cultivation practices as well as in the food systems of tribal poor, this study was carried out as a component of a broad based approach called farming systems for nutrition (FSN). To be specific, FSN aims at promoting and creating awareness of nutrition sensitive agriculture through introduction of nutrient rich crop varieties both at field and in nutrition gardens followed by their upscale.

Materials and Methods

The study was conducted in Koraput District (18.80 to 18.82°N and 82.70 to 82.72°E) of Odisha and in Wardha District (20° 18' to 21° 21' N. and 78° 4' to 79° 15' E) in the Vidarbha region of Maharashtra. These locations were purposefully selected due to their character contrast in agro-climatic and socio-economic condition, size of landholdings, agricultural practices and consumption pattern. Although agro-ecologically the two study intervention locations are different, both of them are characterized by rain-fed farming and high levels of malnutrition. Seven villages from one block of Koraput District (663 households with population of 2,865) and five villages from two blocks of Wardha District (556 households with population of 2,254) were identiûed as core villages for the study. Detailed baseline survey of households was undertaken to understand the socio-economic profile, pattern of agriculture and nutrition status in the project villages through well-structured questionnaires, participatory rural appraisal (PRA) and focus group discussions. About forty two per cent of households in both the regions belonged to Scheduled Tribe.

Results and Discussion

Major food and nutrient consumption pattern

In Koraput, the average consumption of food were comparatively lower than the recommended dietary intake (RDI) except cereals and millets whereas in Wardha, there was higher average consumption of cereals and millets, pulses and legumes, sugar and jaggery than the RDI while that of vegetables, fruits, milk and milk products was found to be much lower than the recommended levels. With regard to the consumption of root and tubers, population that consumed less than 50% of the RDI was found to be 55% and 99% in Koraput and Wardha, respectively (Table 1).

An assessment of intake pattern of nutrients by households revealed that in Koraput, intake of all the nutrients was less than recommended dietary allowance (RDA) except energy, proteins and vitamin C, whereas in Wardha, except iron and thiamine, all the other nutrients consumed are less than the RDA. Further, the intake of micronutrients such as calcium, vitamin A, dietary folate, riboflavin was grossly inadequate in both the study areas (Table 2).

Nutritional status

There was a high level of prevalence of anaemia viz., 75 and 86% in Koraput and Wardha respectively. Higher prevalence of anaemia was seen among women in the age group of 18 to 45 years followed by children (1-5years) in Koraput and by adolescent girls (15 to 17 years) in Wardha. About 35% children in Wardha were found to have subclinical vitamin A deficiency (VAD) while the level was 37% in Koraput (Table 3).

Status of cultivation of root and tubers

Neither Koraput nor Wardha has a record of growing majority of root and tuber crops in their fields. The major source of availability is only open market (Table 4). Local sweet potato and some minor root and tubers like potato, carrot, radish and beetroot etc are found in the market.

Farming systems for nutrition (FSN) intervention through introduction and promotion of orange- fleshed sweet potatoes

As discussed, the aim of FSN initiative is to enable rural families to grow nutritious foods in their fields and in

Table 1 . Average consumption pattern of households in Koraput and Wardha

Types of food groups	*RDI (g/CU/day)	Koraput(n=150)		Wardha(n=161)	
		Avg. intake of food groups (g/CU/day)	Percentage of Population that consume <50% of RDI	Avg. intake of food groups (g/CU/day)	Percentage of Population that consume <50% of RDI
Cereals & millets	375	563.9		323.1	
Pulses & legumes	75	39.4	53.3	57.5	39.1
Green leafy vegetables	100	15.8	89.3	11.2	90.0
Roots & tubers	200	103.1	55.3	28.5	98.8
other vegetables	200	67.6	74.7	32.0	94.4
Nuts & oil Seeds	-	0.9		1.6	
Condiments & spices	-	11.4		15.8	
Fruits	100	2.3	99.3	16.8	93.2
Fish & other sea foods	-	7.6		0.0	
Meat &poultry	-	7.1		5.2	
Milk & milk products	300	4.1	99.3	28.2	97.5
Fats & edible oils	25	12.7		23.9	
Sugar & jaggery	20	12.5		34.5	

Source: Baseline Survey 2014 (n= no. of households surveyed); * RDI: Recommended Dietary Intake as per Dietary Guidelines for Indians, ICMR, 2011; CU: Consumption Unit.

Table 2. Intake of nutrients by households (per CU/day)

Nutrients	RDA* (per CU/day)	Koraput (n= 150)	Wardha (n=161)
Protein (g)	60	56.4	49.8
Visible Fat (g)	25	16.8	29.1
Energy (kcal)	2320	2371.0	1676.0
Calcium (mg)	600	368.3	254.1
Iron (mg)	17	11.6	17.2
Vitamin A (μg)	600	41.2	58.6
Thiamin (mg)	1.2	0.9	1.5
Riboflavin (mg)	1.4	0.6	0.8
Niacin (mg)	16	13.4	14.6
Vitamin C (mg)	40	29.1	19.1
Dietary Folate (μg)	200	36.6	53.0

Source: Baseline Survey 2014 (n= no. of households surveyed); *Recommended Dietary Allowance as per Dietary Guidelines for Indians, ICMR, 2011, CU: Consumption Unit.

Table 3. Prevalence of anaemia and vitamin A deficiency by age and gender.

	Age and gender		Wardha Koraput	
	n	%	*n*	%
Anaemia				
1-5 years children (Hb <11 g/dL)	90	83	272	69
12-14 years adolescent girls (Hb <12 g/dL)	52	81	121	60
15-17 years adolescent girls (Hb <12 g/dL)	37	84	77	62
NPNL women (18-45 years) (Hb <12 g/dL)	355	86	483	62
Pregnant women (18-45 years) (Hb <11 g/dL)	13	62	38	55
Lactating women (18-45 years) (Hb <12 g/dL)	20	75	47	75
Vitamin A Deficiency(VAD)				
1-5 years children (Blood Vit. A <20μg/dL)	94	35	272	37

Source: Baseline Survey 2014; NPNL: Non-Pregnant Non-Lactating; n: Number examined.

their back yard nutri-garden for their own consumption to get adequate nutrition. As a part of this approach, initial planting material of sweet potato (white and orange-fleshed), was obtained from the Central Tuber Crops Research Institute (CTCRI), and multiplied in both the study areas (Table 5) and in four months, it was made available for growing in fields, household and community nutrition gardens.

In Koraput, areas under sweet potato cultivation by households varied from 122 to 2254 m^2 with an average

Table 4. Household consumption of root and tubers

Particulars	Wardha (n=556) (%)	Koraput (n=658) (%)
Home Grown	0.4	9.0
Purchase from Market	99.6	83.0
Purchase from others	-	8.0

Source: Baseline Survey 2014; n= no. of households

of 490 m^2 (Table 6). Both the area and production of white and orange -fleshed sweet potatoes were reported to be same but the amount of additional nutrients were in terms of â carotene and vitamin C accounted from 143-540 mg and 1035-1487 mg per 100g of the raw produce, respectively. Furthermore, as the households preferred the orange- fleshed ones for consumption, it may help in alleviating vitamin A deficiency to some extent. Also, the additional income from selling the produce will

Table 5. Details of planting material (cuttings) of sweet potato

Crop	Variety/species	Koraput		Wardha	
		Cuttings received for multiplication in 2013 and 2014	Cuttings made available for distribution	Cuttings received for multiplication in January 2015	Cuttings made available for distribution
Sweet potato	*ST-13	250	—	71	50
	*ST-14	200	1000	40	200
	Kishan	130	2000	60	200
	*Kamala Sundari	—	2000	-	200

*Orange-fleshed sweet potato varieties; planting material (cuttings of roots and stems/stumps) received from Regional Centre, ICAR-CTCRI, Bhubaneswar

Table 6. Area, production and consumption of sweet potato

	Koraput		Wardha
No. of farmers/ households (practising the intervention)	22		30
Minimum area	122 m^2		
Maximum area (m^2)	2452 m^2		-
Average area (m^2)	490 m^2		6-10 m^2 (nutrition garden)
	White- fleshed	Orange-fleshed	Both white and orange-fleshed varieties
Significant attribute	-	Rich in pro-vitamin A (β carotene)	
Varieties	Kishan	ST-14, Kamala Sundari	ST-13, ST-14 and Kishan
Area	5387 (m^2)	5387 (m^2)	
Total production	5550 (kg)	5546 (kg)	295 kg (9.8 kg per household)
*Additional nutrients	-	β carotene: 143 – 540 mg/ 100g Vitamin C: 1035-1487 mg/100g	β carotene and vitamin C in case of orange-fleshed sweet potatoes
Consumption	-	10% of the total production per household	100%
Sale @ Rs. 7 kg^{-1}	100%	90%	-

*Additional nutrients i.e. β carotene and vitamin C content of orange-fleshed sweet potatoes of these varieties were calculated as given by per Mitra, 2012 (β carotene: 2.58-9.74 mg/100g and vitamin C: 18.66 to 26.82 mg/ 100g) .

increase the household income. In Wardha, the intervention is mainly confined to nutrition gardens primarily focusing on household consumption.

In Wardha, the cultivation of both white and orange-fleshed sweet potatoes was a part of promotion of nutrient sensitive agriculture therefore mainly confined to nutrition gardens.

Conclusion

The production and distribution of planting materials among resource poor farmers could increase the availability of orange-fleshed sweet potatoes as they are willing to cultivate sweet potato on their own farmland and backyard nutrition garden. In addition to the promotion of orange-fleshed sweet potato in household diets, educating the farmers on the importance of vitamin A in the diet could improve their comsumption the vitamin A status. Considering these preliminary study results, this intervention can be viewed as a prospect to increase vitamin A in the dietary intake of the tribal poor.

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