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Improving Household Diet Diversity Through Promotion of Nutrition Gardens in India

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Abstract: This paper describes the introduction of nutrition garden to address household diet diversity in Wardha, Maharashtra and Koraput, Odisha. The study started with a detailed baseline survey and its assessment in 2013-14 along with designing and promotion of nutrition gardens of fruits and vegetables. A seasonal calendar of locally available vegetables was prepared and seed kits/saplings were distributed accordingly. Data on area, types of vegetables grown, number of households participated, production, and utilization was collected regularly through nutrition garden utilization card. Further, awareness programmes on health, balanced diet, hygiene and sanitation were conducted on regular basis at both the project sites. This study examines nutrition garden utilization data of 2015-16 and 2016-17 following two years of intervention and compares it with the baseline. A representative sample size of 190 households was selected at each study site and their change in food consumption (quantity and frequency) was compared between baseline (2014) and endline (2017). Over the period (2015-17), 43 and 28 varieties of plants were found in the nutrition gardens of Koraput and Wardha, respectively as against two or three types of plants generally grown during the baseline (2013-14). The entire produce from nutrition garden was used for household consumption in Wardha while in Koraput, 10-20 per cent was also distributed to neighbours or sold. Monthly per capita consumption of fruits and vegetables, both quantity consumed and frequency of consumption, showed marked increase between baseline and endline. Increased availability of different groups of vegetables also fulfilled the household nutritional requirements.

Keywords: Home Garden, Nutrition Garden, Seasonal Vegetables, Diet Diversity, Nutrition Awareness Programmes

1. Introduction

Food insecurity and malnutrition continue to impose substantial health, economic, and social burden on a large section of people living in developing countries [1]. Lack of resources, religious taboos, limited education and poor socioeconomic conditions are all factors that affect food and nutritional security, particularly at the household (HH) level [2, 3, 4]. Well-fed and food secure households with adequate nutritional status would mean improving what people eat, in terms of quality, quantity, and diversity [5]. This in turn requires efforts related to availability as well as economic access to food supply. In this context, home gardens of fruits and vegetables play an important role in fulfilling dietary and nutritional needs by providing households with direct access to food that can be harvested, prepared and consumed by household members, often on a daily basis [6-10]. They are generally located in a small area near the residence with high diversity of plants. Home gardens are a time-tested local strategy that are widely adopted and practiced by local communities with limited resources and institutional support [11]. However, depending on the food preference of the household, only one or two species of a particular food group is grown in these gardens. Even though they provide some form of nutrition, optimal utilisation of land to grow vegetables that can contribute towards the requirements of a balanced diet as well as address particular nutrition maladies is not considered. The conceptualisation of nutrition garden aims to address this [12, 13]. Nutrition gardens are nothing but home gardens of natural and bio-fortified fruits and vegetables of high nutritive value where the species selection is inclusive of the three vegetable groups *viz.*, green leafy

vegetables, roots and tubers and other vegetables with specific attention to addressing micronutrient (vitamins and minerals) deficiencies, particularly iron and vitamin A. Further in a developing country like India where the diets of particularly pregnant and lactating women and preschool children, are deficient in micronutrients, nutrition gardens can supplement staple-based diets with a significant portion of proteins, vitamins, and minerals, leading to an enriched and balanced diet. Creating awareness on importance of consuming vegetables to address micronutrient deficiencies, accompanied with creating awareness on WASH practices and attention to the health of women and children in particular, is an integral component [14, 15].

This paper attempts to document the impact of household nutrition garden production on food and nutrition security of rural households; a few associated issues and challenges are also discussed.

2. Methodology

2.1. Study Area

A core set of five villages (556 households with population of 2,254) in Wardha district in Vidarbha region of Maharashtra state and seven villages (658 households with population of 2,845) in Koraput district of Odisha state in India were selected for the study. Although agro-ecologically the two study intervention locations are different, both are characterized by rain-fed farming and high levels of undernutrition. In both the field sites farmers were mainly small and marginal land holders (63%) with an average land holding size of 0.80 ha in Koraput and 1.2 ha in Wardha. Farming in their own fields supplemented by wage labour work in other farmer's fields was the primary economic activity.

2.2. Data Collection

The methodology for this study included both quantitative and qualitative components based on household surveys and focus group meetings. Baseline survey was undertaken in 2013-14 to collect data on socioeconomic profile of HHs and their diet, crops cultivated, home gardens, consumption of vegetables and fruits both cultivated and seasonally collected from wild and nutritional status of HH members, using questionnaires, anthropometric and biochemical measurements as well as open ended interviews. Accordingly seed kits/saplings of different groups of locally available seasonal fruits/vegetables were prepared and distributed among the HHs. In order to assess the impact of nutrition garden, an endline survey was conducted in both the study sites in 2017. Endline survey was structured on the lines of the baseline for comparison purpose. A representative sample size of 190 HHs was selected at each study site and data on food consumption and frequency was collected through the survey and for comparison with the baseline (2014).

2.3. Data Analysis

Data about area, plants grown in the nutrition garden, number of harvests, yield and utilization patterns were collected with the help of a "nutrition garden utilization card". The data was collected once a week by trained village volunteers and project staff. Quantitative data analysis was done using SPSS software.

3. Results and Discussion

3.1. Baseline Survey Assessment

The baseline survey revealed high level of undernutrition and micronutrient deficiency [16]. At both the locations, more than 40 per cent of children under age five were underweight (low weight for age), 35 per cent stunted (low height for age) and 27 per cent wasted (low weight for height); about 33 per cent suffered from vitamin A deficiency. 39 per cent adult men and 47 per cent women were undernourished; high levels of anaemia (>60%) prevails among children under five, adolescent girls and women (18-45 years). In this paper, a few aspects of the survey relevant to cultivation and consumption of fruits and vegetables are discussed in detail.

3.1.1. Food Consumption Pattern

The diet of people was largely cereal dominated with consumption of all other food groups being less than the recommended level (Table 1). The average daily consumption of all groups of vegetables and fruits of 75 per cent and more households in Koraput (except in the case of roots and tubers which is at 55%) and 90 per cent and more households in Wardha was well below the recommended daily intake (RDI) by the Indian Council of Medical Research (ICMR).

Table 1. *Average consumption of vegetables and fruits by household (g/CU/day)*

Food groups	Average consumption (g/CU/day)		% of households consuming <50% of RDI		*RDI
	Koraput	Wardha	Koraput	Wardha	
Green leafy vegetables	15.8	11.2	89.3	90.0	100
Roots and Tuber	103.1	28.5	55.3	98.8	200
Other vegetables	67.6	32.0	74.7	94.4	200
Fruits	2.3	1.6	99.3	93.2	100

*Recommended Daily Intake
(Source: FSN Baseline survey 2014)

3.1.2. Traditional Home Gardens: Status and Composition

At both the study sites, the land adjacent to the home was used to grow vegetables primarily for consumption while the crop land far from home was used for cultivation of crops and vegetables for both consumption and commercial purposes. The area of backyard land ranged from 80 to 600 sq m in Koraput and 6.3 to 15.9 sq m in Wardha. Since backyard area was less in Wardha and a large part of the time was spent in the fields, many households used to grow vegetables on a patch in the field itself. However in both the study sites, it was not only the availability of land but also of water and manpower that determined the area that got cultivated; the choice of crop grown was entirely based on the food preference of respective households. Some households were also reported to grow vegetables in fields for commercial purpose (Maliguda [1], Koraput). Further, women were more responsible for cultivation in home gardens while both men and women were in charge of vegetable cultivation in the fields. From the baseline survey, it was also reported that decisions regarding the choice of vegetables to be grown in the home gardens were mainly made by women, while the choices for commercial cultivation or the vegetables to be grown in the fields were decided by men. Men were involved in preparing the land and sometimes fencing while women did the sowing, weeding, and watering. Sometimes children also helped in watering and all of them were involved in plucking and harvesting.

3.2. Introduction of Nutrition Gardens

Based on the baseline survey assessment, discussions with community members and expert advice from scientists, the introduction of nutrition gardens in interested households was started in 2014-15. A seasonal calendar of locally available vegetables was prepared and seed kits comprising seeds of location specific seasonal vegetables from all the three vegetable groups *viz.,* green leafy vegetables, roots and tubers and other vegetables along with seeds of some spices and pulses were prepared and distributed to households with backyard area and having members with incidence of anaemia and/or vitamin A deficiency. Kits were also supplied to other families who were willing to raise nutrition gardens. Saplings of naturally fortified fruits and tree species (e.g. moringa, lemon, amla, papaya, guava, mango) were also given to the selected families. Promotion of different groups of vegetables was emphasized for their nutritional importance. Green leafy vegetables are rich in vitamins and minerals, are easy to grow and can be grown almost throughout the year. Other vegetables like beans, tomatoes and okra are rich sources of vitamin C and minerals. Beans are also rich in proteins. Papaya and mangoes are rich in carotene (pro-vitamin A) and vitamin C and guava in vitamin C. Orange flesh sweet potato (OFSP) was introduced and promoted in order to address Vitamin A deficiency in children. The planting materials, obtained from the Regional Centre of Central Tuber Crops Research Institute (CTCRI), Bhubaneswar, Odisha were multiplied locally and cuttings were made available to interested farmers. Awareness programmes, trainings and workshops were organized in each village at both the project sites with the help of staff members and subject experts in association with panchayat[2] raj members, self help groups, Integrated Child Development Service / Anganwadi centre and ASHA (Accredited Social Health Activist) workers and household members. An annual calendar with pictures for each month selected from a drawing competition in the village schools and related nutrition messages was prepared and distributed. Exposure visits, lectures on specific topics to selected groups like pregnant and lactating and adolescent girls on dietary requirements, exhibition on pulses and food groups, and cooking demonstrations showing preparation of recipes incorporating vegetables like moringa, coriander leaves, Indian spinach (poi), cassava etc, and on hygiene and sanitation were conducted on regular basis.

3.2.1. Nutrition Garden: Diversity, Production and Utilization

i) Diversity in nutrition gardens (2015-17)

Baseline survey reported that in Koraput, 30% of 658 HHs practiced traditional home gardening with limited cultivation of broad bean, tomato, pumpkin, onion, amaranthus, spine, ridge and ivy gourd and brinjal. Growing of cabbage, cauliflower, field bean, bitter gourd, green chillies were done primarily for commercial purpose by households in Maliguda village. Majority of HHs were growing only two (32%) or one (25%) vegetable in their home gardens. Similarly, in Wardha, only 19% of the 556 HHs practiced traditional home gardening with cultivation of few fruit trees and vegetables such as papaya, lemon, guava, beans, brinjal, and bitter gourd. Very limited cultivation of spinach, tomato, radish, carrot, onion and pumpkin was reported. Around 43% of HHs grew only one vegetable, 36% two in their home gardens. However, promotion of nutrition garden coupled with nutrition awareness programmes had a positive impact on the diversity of vegetables cultivated by the HHs (Table 2). In Koraput, majority of HHs (79%) were having four or more types and a mix of vegetables in 2016-17 as against 21% during baseline. Similarly, in Wardha, majority of HHs (45%) were having four or more types and a mix of vegetables in 2016-17 as against 9% during baseline. Further, number of HHs growing three vegetables in the garden was also increased from 12% to 33% in endline.

1Village dominated with 'Mali' or gardener community; known for commercial cultivation of vegetables

2 Local governing body in villages of India

Table 2. *Comparison of number of vegetables grown in nutrition gardens during baseline and endline.*

Number of vegetables grown in home gardens	Percentage of households			
	Koraput (N=189)		Wardha (N=187)	
	Baseline	Endline	Baseline	Endline
One	25	7	43	3
Two	32	7	36	19
Three	22	7	12	33
Four or more	21	79	9	45

During the study period (2015-17), forty three varieties of plants were found in the nutrition gardens of Koraput (Table 3). Of these 17 were other vegetables, 8 were root and tuber varieties, 6 were green leafy vegetables, and 8 were fruit/tree species. Green chilli was the spice grown and the immature seeds of pigeon pea, (a pulse crop) was cooked and consumed as a vegetable. A maximum of 36 vegetables were grown in winter, 33 in rainy season and 26 in summer season.

Table 3. *Diversity of crops available across seasons in nutrition gardens in Koraput (2015-17).*

Groups	Details		
Fruit/tree species	**Moringa, papaya, lemon, amla, mango, banana, guava, pomegranate**		
***Seasonal vegetables**	**Rainy (n=187)**	**Winter (n=215)**	**Summer (n=194)**
Leafy vegetables	Amaranthus, Indian spinach, coriander, spinach, leaves of pumpkin, barada, moringa	Amaranthus, Indian spinach, coriander, spinach, leaves of pumpkin, barada, moringa, leaves of cauliflower	Amaranthus, Indian spinach, coriander, spinach, leaves of pumpkin, leaves of cauliflower
Roots and tubers	Orange flesh sweet potato (OFSP), yam, tapioca, radish	OFSP, colocasia, onion, yam, radish, carrot	Colocasia, onion, yam, potato, radish, carrot
Other vegetables	Ridge gourd, pumpkin, snake gourd, cow pea, lady's finger, tomato, dolichos bean, french bean, cucumber, bitter gourd, spine gourd, ivy gourd, pointed gourd, brinjal	Ridge gourd, pumpkin, snake gourd, cow pea, lady's finger, tomato, dolichos bean, french bean, cucumber, cluster bean, bitter gourd, spine gourd, ivy gourd, cauliflower, cabbage, spring onion, brinjal	Ridge gourd, pumpkin, cow pea, lady's finger, tomato, dolichos bean, french bean, cluster bean, bitter gourd, spine gourd, ivy gourd, brinjal
Spices	Chilli	Chilli	Chilli,
Pulses	Pea, pigeon pea	Pea, pigeon pea	Pea

*Seasons: Rainy (June-September); Winter (October-February); Summer (March-June).
Indian spinach: poi in Odia
Scientific names are given in Appendix

Similarly, twenty eight varieties of plants were found in the nutrition gardens of Wardha during the study period (2015-17) (Table 4). There were 10 types of plants under other vegetables, 4 roots and tubers, 8 green leafy vegetables, and 5 fruit/tree species. Green chilli was the spice grown. A maximum of 21 vegetables were grown in winter followed by 16 types in rainy, and 13 in summer season.

Table 4. *Diversity of crops available across seasons in nutrition gardens in Wardha (2015-17).*

Groups	Details		
Fruit/tree species	**Moringa, guava, custard apple, curry leaves, lemon**		
Seasonal vegetables	**Rainy (n=230)**	**Winter (n=246)**	**Summer (n=204)**
Leafy vegetables	Rajgira, chaulai, shepu,	Rajgira, chaulai, shepu, green sorrel, coriander, spinach, fenugreek, spring onion	Coriander, spring onion, spinach, fenugreek
Roots and tubers	-	Carrot, radish, beet root, OFSP	Radish, carrot, beet root, OFSP, onion
Other vegetables	Cowpea, cluster bean, beans, lady's finger, bitter gourd, cucumber, ridge gourd, brinjal	Tomato, cabbage, cowpea, lady's finger, bitter gourd, brinjal, tomato	Brinjal, tomato
Spices	Chilli	Chilli	Chilli

Scientific names are given in Appendix

ii) Average production and utilization of vegetables across seasons (2015-17)

Out of 658 households across the seven study villages in Koraput, 187, 215 and 194 households had nutrition gardens during rainy, winter, and summer seasons, respectively. During rainy season, out of 187 household nutrition gardens, 50-60 per cent had amaranthus and pumpkin. Among leafy vegetables, amaranthus and Indian spinach were preferred among the households irrespective of season. With regard to roots and tubers, around 20 per cent of households grew yam, tapioca, colocasia, carrot, radish; OFSP was grown by 3-5 per cent of the households in the nutrition garden as most of the households grew it in the main field. Banana, guava, and moringa were the dominant species of tree/fruits.

The mean quantities of vegetables produced, consumed, distributed and sold per household during each season are presented in Figure 1. For most of the vegetables, household consumption was between 80-90 per cent with the remaining

being distributed among neighbours and sold. However, due to local market demand, some vegetables like cabbage, cauliflower, radish, coriander, pumpkin, beans etc were primarily sold. Further, in resource poor families, income takes priority over reasoning of nutrition and health [14]. Total produce per household was highest in winter as the availability of space in the backyard area was more which otherwise was occupied by maize and pigeon pea during rainy season, leaving little space for growing of the vegetables.

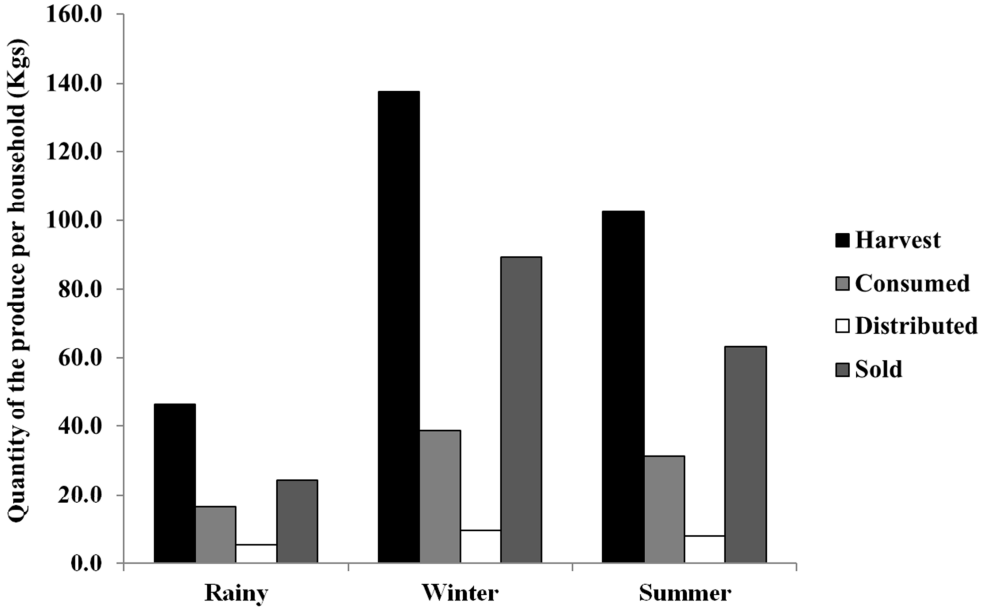

Figure 1. *Production and utilization from nutrition garden per household in Koraput across seasons (2015-17).*

In Wardha, out of 556 households across the five study villages, 246, 230 and 204 households had nutrition gardens during winter, rainy and summer seasons, respectively. During rainy season, out of 230 household nutrition gardens, 91 per cent had grown ladies finger. Further, cluster bean and cowpea was grown by 74 and 60 per cent of the households. Among leafy vegetables, rajgira (Amaranthus) and moringa leaves were preferred during rainy whereas spinach, coriander, fenugreek leaves were the popular choice in winter. With regard to roots and tubers, around 30 per cent of households grew beet, carrot, radish in winter; OFSP was grown by only 7 per cent of the households mainly because it was newly introduced in the area. Around 90 per cent of the households had curry leaf tree in their gardens followed by custard apple (30%).

The entire produce from nutrition garden was used for household consumption. From Figure 2 it was found that maximum production per household as well as all the three groups of vegetables i.e. green leafy vegetables, roots and tubers and other vegetables was in winter. Quantities of vegetables produced per household were lowest in summer mainly due to water scarcity.

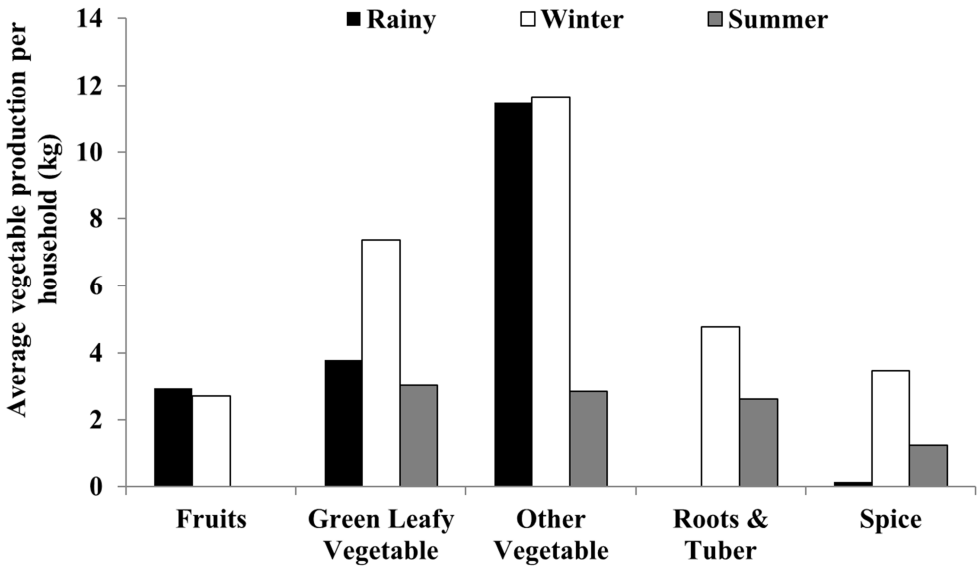

Figure 2. *Produce from nutrition garden per household in Wardha across seasons (2015-17).*

iii) Impact of nutrition garden on household food consumption and frequency

Baseline (2013-14) monthly per capita consumption (grams (g) per person per month) of fruits and vegetables as well as their frequency (percentage of households) was compared to that of 2017-18 to see if there was any change after two years of promotion of nutrition garden in the study area (Tables 5 & 6).

As frequency of all the items consumed under the food groups was different, it was decided to derive the monthly consumption and appropriate conversions were done for each household (n= 189 for Koraput and 187 for Wardha). The monthly quantity consumed for each household was then divided by number of respective HH members and an average was taken to get the monthly per capita consumption (g per person per month).

Comparison of data during start and end of the study in both Koraput and Wardha showed a significant improvement in the consumption quantity of fruits and vegetables ($P < 0.001$). In Koraput, the monthly per capita consumption of green leafy vegetables, other vegetables, roots and tubers and fruits increased from 1554g to 3352g, 3078g to 6568g, 2459g to 2900g, and 2299g to 3334g, respectively. A similar pattern was seen in Wardha (Table 5). The quantum increase in consumption of roots and tubers and fruits in Wardha may be attributed to distribution of tree saplings (moringa, papaya, lemon, curry leaves, guava) coupled with conduction of different nutrition awareness programmes such as lectures on importance of dietary diversity, consuming different fruits and vegetables and recipe demonstration activities.

In Koraput, there was paradigm shift of household food frequency under green leafy vegetables and other vegetables from once in a week in 2013-14 to daily or twice/thrice in a week in 2016-17. Households consuming green leafy vegetables daily and twice/thrice a week increased from 0 to 4% and 17% to 46% respectively. Items under other vegetables were consumed by 50% (daily) and 48% (twice/thrice a week) of the HHs during 2016-17 as against 6% and 76% in 2013-14, respectively (Table 6). Similarly, in Wardha, majority of HHs were consuming either daily or twice/thrice a week as against once/twice a week. Table 6 also indicated that at both the study sites, frequency of consumption of roots and tubers did not show much change and all the HHs had included fruits in their diet. Increased availability and greater understanding of nutrition awareness programmes among the HHs might have contributed towards all these positive shifts in the food frequency pattern.

Table 5. *Comparison of monthly per capita consumption of fruits and vegetables (g per person per month).*

Food groups	Food consumption (g per person per month)			
	Koraput (N=189)		Wardha (N=187)	
	2013-14	2016-17	2013-14	2016-17
Green leafy vegetables	1553.69	3352.34***	1367.73	2206.82***
Other vegetables	3077.85	6567.73***	2333.58	5070.14***
Roots and tubers	2459.44	2899.86***	939.56	1473.73***
Fruits	2299.20	3333.79***	296.25	2429.51***

***$P < 0.001$, by paired t test

Table 6. *Comparison of frequency of consumption of various food groups (Percentage of households N = 189 in Koraput and 187 in Wardha).*

Food groups	Study site	Study period	Daily	Twice / Thrice	once a week	Fortnight	Once a month	Occasionally	Never
Green leafy vegetables	Koraput	2013-14	0.0	16.9	63.0	20.1			
		2016-17	3.7	45.8	37.4	13.1			
	Wardha	2013-14	15.0	84.5	0.5				
		2016-17	38.4	60.0	1.6				
Other vegetables	Koraput	2013-14	6.4	76.2	16.4	1.0			
		2016-17	49.5	47.9	1.6	1.0			
	Wardha	2013-14	96.8	2.1	1.1				
		2016-17	91.0	9.0	0.0				
Roots and tubers	Koraput	2013-14	97.4	2.1	0.0	0.5			
		2016-17	82.1	17.9	0.0				
	Wardha	2013-14	99.5	0.5					
		2016-17	99.0	1.0					
Fruits	Koraput	2013-14	0.5	27.0	43.9	28.0	0.0	0.0	0.6
		2016-17	4.7	33.7	37.4	8.4	1.1	14.7	0.0
	Wardha	2013-14	0.0	1.6	10.7	16.6	48.7	13.8	8.6
		2016-17	15.3	39.0	39.5	6.2	0.0	0.0	0.0

3.2.2. Nutrient Contribution from Household Nutrition Gardens

Fruits and vegetables are important sources of vitamins and minerals in the diet. Vegetables are much easier and cheaper to produce as well as a source of many nutrients. In this study, nutritional values of different fruits and vegetables grown in household nutrition gardens across the three seasons were calculated with the help of nutritional value index (Table 7). The results indicated that a substantial

proportion of the nutritional needs of the households can be met through a year round maintenance of nutrition gardens. A similar finding on contribution of vegetables from community nutrition garden at Wardha towards nutrition equivalence was also reported by [13].

Table 7. *Nutrient equivalence made available to each household at the study sites through nutrition garden produce (2015-17).*

Nutrient	Rainy	Winter	Summer
Koraput	n= 187	n= 215	n= 194
Energy (kcal)	180.8	182.4	177.2
Protein (g)	9.0	9.5	9.4
Fat (g)	2.1	2.1	2.0
Calcium (mg)	196.8	237.7	201.7
Iron (mg)	3.6	6.2	3.2
Vitamin A (µg)	334.1	365.6	358.3
Vitamin C (mg)	111.2	86.3	113.0
Folic acid (µg)	51.5	61.1	62.9
Wardha	n= 230	n= 246	n= 204
Energy (kcal)	5.8	85.9	73.5
Protein (g)	3.4	3.9	3.1
Fat (g)	0.4	0.7	0.7
Calcium (mg)	104.8	131.8	151.1
Iron (mg)	2.4	5.6	6.4
Carotene (µg)	193.5	273.1	366.1
Vitamin C (mg)	40.1	48.7	35.3
Folic acid (µg)	30.0	32.9	20.2

3.3. Problems and Prospects of Nutrition Garden

While there are benefits of nutrition gardens in terms of food and nutrition security, there are some major constraints to their productivity and sustainability. The key constraint identified in both the study areas was access to water particularly in summer. Cultural sensitivity and lack of knowledge on importance of consuming particular fruits and vegetables were other factors. Specific to Wardha, access to seed and planting materials, small size of backyard area and unavailability of labour during peak cotton growing season (rainy) were reported to be other major issues.

As water availability in summer is a key constraint to grow vegetables in summer, HHs are encouraged to plant them around the washing area and use waste water for watering. In order to make HHs realise the importance of different food groups and importance of having a balance diet, several nutrition awareness programmes, trainings, workshops and lectures are being conducted on regular basis in each village at both the project sites. Apart from these, programme staffs are in touch with all the participating HHs and provide suggestions and guidance accordingly. Further, for sustainability of the programme, selected individuals from the community in the core study villages have been trained on understanding nutrition and linking agriculture to nutrition to be Community Hunger Fighters (CHF). The idea is that they will be the champions to take forward and generate greater awareness on nutrition sensitive agriculture at the ground level.

For better access to seeds and planting materials, community seed banks managed by groups of women have been initiated in the study villages in Wardha to ensure availability of vegetable seeds for upcoming seasons. They have been trained to maintain registers to record seed collection and distribution. In Koraput, retaining vegetable seeds for next season is a part of the local culture. Several exposure visits and trainings on seed collection and safe seed storage have been conducted at both the study sites.

Households having no land or very less backyard land area in Wardha approached the panchayat to lease common land to establish community nutrition garden. These are maintained by groups of 7-10 women and are in operation in three villages. The produce is shared by the group and the surplus is given to neighbours, relatives or to the village school for inclusion in the mid day meal (MDM).

Initiatives were undertaken to establish nutrition garden within the premises of the village school in four villages of Koraput and three villages in Wardha. The gardens help ensure a regular supply of fresh vegetables for inclusion in the MDM. The gardens are maintained primarily by the MDM cook and village volunteers. They also serve the educational purpose of making children aware of the nutrient content of different vegetables and the importance of consuming them. This knowledge carried by them to their homes will have positive spill over effect. The involvement of the teachers is another plus and the overall response has been encouraging. ICDS centres in two of the villages in Koraput have also started maintaining nutrition gardens. Genetic garden, one each at Koraput and Wardha have also been developed where each plant has been labelled and its use for addressing different nutritional deficiencies highlighted. The model will serve as an educational tool for creating nutrition awareness to promote nutrition security among different stakeholders besides also multiplying and providing planting material for cultivation.

Sharing of study results at different public and private stakeholder platforms has also created a huge demand from HHs within the intervention villages and neighbouring villages. In 2017-18, Kharif (rainy season), 578 HHs in Koraput and 354 HHs in Wardha were practising nutrition garden.

4. Conclusion

Promotion of nutrition gardens has increased availability of and access to different groups of vegetables; most of which are being consumed by the households. Over a short period of two years, significant increase in the quantity and frequency of consumption of fruits and vegetables and huge demand generation from HHs suggests a positive trend as well as well acceptance of the approach in the study area. The improved dietary diversity has the potential to help improve nutrition outcomes in the area and other neighbouring areas. It will also help in conserving crop diversity including some indigenous species as well as strengthen family relationships through sharing of nutrition garden produce with neighbours and relatives. It was evident from the study that provision of seeds and technical advice and nutrition awareness increased the production and

consumption of both traditional and non-traditional micronutrient rich vegetables. The combination of agricultural training with nutrition awareness programmes provides knowledge on the importance of food and nutrition, as well as practical guidance on how to grow and prepare nutritious foods. To summarise, nutrition gardens are proving to be a cost effective approach to make micronutrient rich foods accessible to the entire household and contribute to improve the quality of diets. However, for scale up and sustainability, support by way of seed kits and agricultural advice from government extension officers is required.

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Appendix

Table A1. *Scientific names of fruits and vegetables grown in nutrition gardens of Koraput and Wardha.*

Tree/fruit/vegetable species	Scientific name	Tree/fruit/vegetable species	Scientific name
Amaranthus	*Amaranthus oleraceus*, *Amaranthus gangeticus*	Ivy gourd	*Coccinia grandis*
Amla	*Phyllanthus emblica*	Jackfruit	*Artocarpus heterophyllus*
Banana	*Musa sp*	Lady's finger	*Abelmoschus esculentus*
Barada	*Bauhinia variegata*	Lime	*Citrus aurantifolia*
Beans	*Vigna unguiculata ssp. Sesquipedalis*	Mango	*Mangifera indica*
Beet root	*Beta vulgaris*	Moringa	*Moringa oleifera*
Bitter gourd	*Momordica charantia*	Onion	*Allium cepa*
Brinjal	*Solanum melongena*	Orange flesh sweet potato (OFSP)	*Ipomoea batatas*
Cabbage	*Brassica oleracea var. capitata*	Papaya	*Carica papaya*
Carrot	*Daucus carota*	Pea	*Pisum sativum*
Cauliflower	*Brassica oleracea var. botrytis*	Pigeon pea	*Cajanus cajan*
Chilli	*Capsicum annum*	Pointed gourd	*Trichosanthes dioica*
Colocasia	*Colocasia antiguorum*	Pomegranate	*Punica granatum*
Coriander leaves	*Coriandrum sativum*	Potato	*Solanum tuberosum*
Cowpea	*Vigna unguiculata*	Pumpkin	*Cucurbita maxima*
Cucumber	*Cucumis sativus*	Radish	*Raphanus sativus*
Curry leaves	*Murraya koenigii*	Ridge gourd	*Luffa acutangula*
Custard apple	*Annona squamosa*	Shepu	*Peucedanum graveolens*
Dolichos bean	*Lablab purpureus*	Snake gourd	*Trichosanthes cucumerina*
Fenugreek	*Trigonella foenumgraecum*	Spinach	*Spinacea oleracea*
French bean	*Phaseolus vulgaris*	Spine gourd	*Momordica dioica*
Garlic	*Allium sativum*	Spring onion	*Allium fistulosum*
Green sorrel	*Rumex acetosa*	Tapioca	*Manihot esculenta*
Guava	*Psidium guajava*	Tomato	*Solanum lycopersicum*
Indian spinach	*Basella alba*	Yam	*Dioscorea alata*

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