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Achieving Nutritional Security through Nutri-garden in Rural Areas of Nawada District, Bihar

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ABSTRACT

Background: Various nutritional problems such as anaemia, malnutrition, stunting, wasting are prevalent among women and children. Nutri- garden promotes dietary diversification in rural household through easy availability of fresh vegetables and fruits on a daily basis, thereby, can play an important role in achieving nutritional security at household or community level. The objective of the study was to increase the availability of vegetables in rural household and to improve the knowledge of rural farm women regarding layout, technological and nutritional aspect of nutri-garden.

Methods: The study was conducted in the nine villages of Kawakol block of Nawada district. Ten anganwadi centres and three backyard / kitchen garden were selected (that includes 115 respondents) for KVK front line demonstration programme on nutrition security.

Result: An increase in yield of the crops was seen in demonstration unit in comparison to farmers field. This enhances the nutrient availability among rural families. Knowledge of the rural household was also enhanced through various training programmes conducted during the study. The major constraints faced by the farm women in management of nutri-garden were inadequate water supply in some areas and high input cost involved in purchasing low cost quality seed.

Key words: Front line demonstration, Layout, Nutri-garden, Nutrition security.

INTRODUCTION

After independence, food production within India was not sufficient to meet the demand of growing population. With the green revolution, high yielding varieties of cereals was introduced and investment in agricultural productivity alleviated poverty to large extent and promotes food security (Nelson *et al*., 2019). But access to only enough calories and not to nutritionally adequate diet rich in essential nutrients by the poor population results in persistently high rates of malnutrition among children. The most vulnerable population are children under 5 years and pregnant and lactating women as nutritional requirement for essential nutrients such as iron, calcium, vitamin A, zinc *etc*. are high during these periods (Ruel, 201). This can be evidenced by comparing NFHS- 5 with NFHS – 4 data. Children malnutrition can be mainly defined by three indicators namely stunting, wasting and underweight. Analysis indicated that there has been only slight reduction in percentage of wasted, stunted and underweight children from fourth (2015- 16) to fifth round (2019-21) of National Family Health Survey (NFHS) data. Iron deficiency anaemia is most common among Indian population. Anaemia has adverse affect on child health and women of reproductive age (15-49 years) thereby resulting in increased maternal and child death. Public distribution system (PDS), mid-day meal scheme (MMD) and Integrated Child Development Services (ICDS) were started to resolve the issue of malnutrition among women and children in India. But, a significant percentage of the vulnerable population suffers from malnutrition despite the implementation of these programmes.

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In India, nearly 60 per cent of the rural population is agriculture dependent. Still nutritional problem is persistent among population especially among women and children. Availability of nutritious food, diversity in the food and enhancing the purchasing power of the population may results in achieving better nutritional status. Introducing the concept of nutri-garden at household and community level is not a new concept. Kitchen garden concept was there in ancient times also, but over the years, kitchen garden lose their importance and gradually disappeared. Now, linking the kitchen garden with nutrition results in Nutri-garden. With this view, kitchen garden is being introduced among farm women with new name “Nutri-garden” where nutritionally adequate healthy fruits and vegetables should be grown by farm families for meeting their nutritional requirement. According to WHO, every individual should consume at least 400 gm of fresh fruits

and vegetables per day. Considering the various points mentioned above, the study was planned with the objective to increase the availability of vegetables in rural household and to improve the knowledge of rural farm women regarding layout, technological and nutritional aspect of nutri- garden.

MATERIALS AND METHODS

A nutri-garden based community level intervention was carried out by Krishi Vigyan Kendra in the nine villages of Kawakol block of Nawada district during the year 2022- 23. The aim was to develop initially nine nutri- smart village on pilot basis and for that purpose, ten anganwadi centres and three backyard / kitchen garden were selected. The whole work was segmented into three parts. Initially, six training programmes were conducted in six villages of kawakol block that were selected under nutri- smart village covering 180 respondents. Training was imparted and pre- and post- evaluation was done for evaluating the change in knowledge of farm women regarding various aspects of nutri- garden. Questionnaire was used for pre - and post- evaluation. Questions were divided into three sections:
a) Importance of nutri-garden; b) Land preparation and layout; c) Knowledge about appropriate sowing methods. In the second phase of the programme, vegetable seeds were distributed to the ten anganwadi workers of the selected anganwadi centres and to the three farm women covering 115 respondents. Vegetable seeds were distributed in Zaid, Kharif and Rabi season. Impact of established nutri- garden in rural household was assessed by calculating the per cent change in the check and demonstration yield during Zaid, *Kharif* and *Rabi* season as well as BCR (benefit to cost ratio) for demonstration and check yield during the three seasons.

$$\text{Demonstration yield} = \frac{\text{Total production of particular crop}}{\text{Total area}}$$

$$\text{Per cent change in the yield} = \frac{\text{Demonstration yield - Check yield}}{\text{check yield}} \times 100$$

•Net return = Gross return - Gross cost

$$\text{BCR (benefit to cost ratio)} = \frac{\text{Net return}}{\text{Gross cost}}$$

Nutrient available in selected vegetable was calculated using Longvah *et al.* (2017). Nutrient availability per vegetable was calculated as:

•Availability of nutrients per veg.= (Nutrient availability in particular vegetable crop per 100 gms) × (total production of particular vegetable [in gms]) / 100

$$\text{Nutrient availability per person} = \frac{\text{Availability of nutrients per veg.}}{\text{Total beneficiaries (}i.e.\text{ 115)}}$$

RESULTS AND DISCUSSION

Nutri- garden was implemented throughout the year during *Rabi*, *Kharif* and *Zaid* season. Vegetables grown during Zaid season consist of green leafy vegetables (GLVs) such as Spinach and amaranthus and other vegetables such as brinjal, beans, bitter gourd, smooth gourd, pumpkin, ridge gourd, cucumber and lady's finger.

Average per unit production with per cent change in the yield between demonstration unit and check unit of vegetables in Zaid, Kharif and Rabi season is presented in Table 1. Results of the study clearly shows more than five per cent increased yield in demonstration unit in comparison to farmer's field for majority of vegetables grown during zaid season. During kharif season, green leafy vegetables (GLVs) such as amaranthus and coriander and other vegetables such as bitter gourd, radish, lady's

Table 1: Per cent change in the yield during *Zaid*, *Kharif* and *Rabi* season.

	Zaid				*Kharif*				*Rabi*			
	Yield (Kg/ Hectare)				Yield (Kg/ Hectare)				Yield (Kg/ Hectare)			
Vegetables	Demo Yield	Check Yield	% change in yield	Vegetables	Demo Yield	Check Yield	% change in yield	Vegetables	Demo Yield	Check Yield	% change in yield	
Spinach	817.74	761.77	7.35	Smooth Gourd	1429.33	1334.23	7.13	Peas	16490.93	14223	15.95	
Brinjal	1056.54	1005.85	5.04	Amaranthus	1310.79	1121.82	16.85	Cauliflower	13221.33	11028	19.89	
Beans	411.28	386.92	6.29	Radish	655.23	508.86	28.76	Radish	8464.33	7280	16.27	
Amaranthus	672.75	631.23	6.58	Lady's Finger	1554.74	1428.46	8.84	Carrot	13266	12295	7.90	
Bitter Gourd	474.15	444.23	6.74	Bitter Gourd	1315.95	1166	12.86	Spinach	10050	8060	24.69	
Smooth Gourd	575.51	553.69	3.94	Pumpkin	2227.49	2087.31	6.72	Pumpkin	26487.33	25010	5.91	
Pumpkin	1616.59	1588.38	1.78	Corriander	498.21	415.4	19.93	Tomato	28586.67	26492	7.91	
Ridge gourd	537.72	508.46	5.75	Brinjal	2099.33	2009.31	4.48	Green chilli	5163.47	4690	10.10	
Cucumber	405.44	373.31	8.61	Tomato	2348.44	2200.77	6.71					
Lady's Finger	685.46	655.08	4.64	Green chilli	409.56	333.63	22.76					

finger, smooth gourd, pumpkin, brinjal, tomato and green chilli were produced in the nutri-garden. During kharif period, increased yield was seen in demonstration unit in comparison to farmer's field for all vegetables. For vegetables such as amaranthus, radish, bitter gourd, coriander and green chilli, 12-22 per cent increased yield was seen in demonstration unit in comparison to check unit. Vegetables such as spinach, peas, cauliflower, radish, carrot, pumpkin, tomato and chillies were produced in rabi season. Higher crop yield was seen in demonstration unit for majority of vegetables.

Benefit to cost ratio (BCR) for demonstration and check yield during *Zaid*, *Kharif* and *Rabi* season are presented in Table 2, Table 3 and Table 4 respectively. Benefit to cost ratio (BCR) ranges between 0.05 to 1.06 for demonstration unit and between 0.08 to 0.28 for check unit i.e. farmer's field during Zaid season. BCR ratio for demonstration yield was higher for vegetables such as spinach, brinjal, beans, bitter gourd, pumpkin, ridge gourd, cucumber and lady's finger in comparison to check yield. Benefit to cost ratio (BCR) for *kharif* crop ranges between 0.05 to 2.58 for demonstration unit and between 0.03 to 1.18 for check

Table 2: BCR for demonstration and check yield during *Zaid* season.

	Economics of demonstration (Rs./ ha)				Economics of check (Rs./ha)			
	Gross cost	Gross return	Net return	BCR	Gross cost	Gross return	Net return	BCR
Spinach	390.77	489.23	98.46	0.25	400	472	72	0.18
Brinjal	390.77	482.31	91.54	0.23	395	430	35	0.09
Beans	390.77	447.69	56.92	0.15	378	420	42	0.11
Amaranthus	390.77	408.62	17.85	0.05	360	390	30	0.08
Bitter Gourd	390.77	484.62	93.85	0.24	400	445	45	0.11
Smooth Gourd	390.77	415.38	24.61	0.06	370	410	40	0.11
Pumpkin	390.77	805.38	414.61	1.06	400	510	110	0.28
Ridge gourd	390.77	473.08	82.31	0.21	410	450	40	0.10
Cucumber	390.77	429.23	38.46	0.10	400	430	30	0.08
Lady's Finger	390.77	507.69	116.92	0.30	380	428	48	0.13

Table 3: BCR for demonstration and check yield during *Kharif* season.

	Economics of demonstration (Rs./ ha)				Economics of check (Rs./ ha)			
	Gross cost	Gross return	Net return	BCR	Gross cost	Gross return	Net return	BCR
Smooth Gourd	425.77	941.54	515.77	1.21	380	580	200	0.53
Amaranthus	425.77	694.15	268.38	0.63	390	520	130	0.33
Radish	425.77	446.15	20.38	0.05	360	430	70	0.19
Lady's Finger	425.77	1027.69	601.92	1.41	410	680	270	0.66
Bitter Gourd	425.77	1352.31	926.54	2.18	385	840	455	1.18
Pumpkin	425.77	1107.69	681.92	1.60	390	810	420	1.08
Corriander	425.77	452.31	26.54	0.06	360	370	10	0.03
Brinjal	425.77	1038.46	612.69	1.44	420	910	490	1.17
Tomato	425.77	1523.08	1097.31	2.58	380	830	450	1.18
Green chilli	425.77	473.85	48.08	0.11	350	360	10	0.03

Table 4: BCR for demonstration and check yield during *Rabi* season.

	Economics of demonstration (Rs./ ha)				Economics of check (Rs./ ha)			
	Gross cost	Gross return	Net return	BCR	Gross cost	Gross return	Net return	BCR
Peas	450	1042.31	592.31	1.32	390	850	460	1.18
Cauliflower	450	565.38	115.38	0.26	410	450	40	0.10
Radish	450	452.31	2.31	0.01	425	430	5	0.01
Carrot	450	676.92	226.92	0.50	345	510	165	0.48
Spinach	450	553.85	103.85	0.23	360	385	25	0.07
Pumpkin	450	1029.23	579.23	1.29	410	878	468	1.14
Tomato	450	1430.77	980.77	2.18	380	1110	730	1.92
Green chilli	450	484.62	34.62	0.08	365	385	20	0.05

unit. In comparison to check yield, BCR ratio for demonstration yield was higher for all vegetables except for the radish during kharif season. Huge difference was seen in the crop yield between demonstration unit and check unit for majority of vegetables during *rabi* season. Benefit to cost ratio (BCR) ranges from 0.01 for radish to 2.18 for tomatoes in demonstration unit. BCR ratio for check unit lies between 0.01 - 1.92. In comparison to check yield, BCR ratio for demonstration yield was higher for all vegetables except for the radish during rabi season.

Higher crop yield during the three seasons in demonstration unit in comparison to check unit for majority of vegetables can be attributed to use of vermicompost in proper amount (Islam *et al.,* 2021), regular monitoring of demonstration unit by nutrition and agriculture scientist and timely spray of the insecticides and pesticides as per the need. Vermicompost enhances the nutrient content of the soil resulting in higher growth and productivity in the demo unit of the farmer's field.

Training

Nutri-gardens have gained prominence as a valuable source of nutrition at household level. Integrating training on nutri-garden practices can significantly contribute to better performance and well-being of individuals. This holistic approach not only addresses nutritional needs but also brings change in the attitude of the people and helps the family to carry out the work more efficiently and effectively through improved knowledge and skill.

Pre- evaluation, then training followed by post-evaluation is assessment tools that helps in evaluating the learning outcomes, knowledge gaps, and behaviour changes of trainees before and after the training. Data on changes in the knowledge of participants before and after training on various aspects of kitchen gardening is presented in Table 5. Before training was imparted to farm women, only 8% women had knowledge that nutri- garden can help in women empowerment; only 16% had knowledge that home grown vegetables are free from harmful pesticides and insecticides; whereas only 19% had knowledge that vegetables grown in nutri-garden are free from artificial colours. After training, knowledge of the farm women was enhanced that can be evidenced from the fact that more than 90% of the women had gained knowledge on various aspects of importance of nutri-garden.

Knowledge of the farm women was evaluated about nutri- garden land preparation and layout through pre-evaluation questionnaire. None of the women had knowledge that the preferred shape for nutri-garden should be square or rectangle; neither had they any idea regarding vermicompost preparation method and its beneficial impact on the farmer's field. Only 7% had idea that vermicompost should be used in nutri- garden and 16% of farm women knows that Nutri- garden area should have availability of sunlight throughout the day. Improvement in the knowledge of farm women was noticed post training as nearly 80% of

Table 5: Pre- and post-training knowledge of farm women regarding various aspects of nutri- garden.

Particulars	Knowledge of the farm women (N= 180)			
	Before training		After training	
A. Importance of nutri-garden	n	%	n	%
Nutri-garden helps in easy availability of fresh vegetables at home	90	50	170	94.44
Availability of vegetables free from harmful pesticides and insecticides	28	15.56	165	91.67
Availability of vegetables free from artificial colours	35	19.44	168	93.33
Nutri - garden veggies serve as source of income for family	45	25	180	100
Nutri – garden helps in women empowerment	15	8.33	165	91.67
B. Land preparation and layout				
Space: Nutri- garden area should have availability of sunlight throughout the day.	29	16.11	174	96.67
Preferred shape for nutri-garden is square or rectangle	0	0	167	92.78
Vermicompost should be used in nutri- garden.	12	6.67	158	87.78
Importance of use of vermicompost in the in the field	0	0	143	79.44
C. Knowledge about appropriate sowing method				
1) By seed				
Radish	45	25	155	86.11
Spinach	53	29.44	148	82.22
Bittergourd	57	31.67	164	91.11
2) By planting				
Tomato	46	25.55	165	91.67
Brinjal	50	27.78	165	91.67
Chilli	42	23.33	157	87.22

Table 6: Availability of nutrients from nutri- garden.

Nutrients	Per capita availability of nutrients		
	Zaid	*Kharif*	*Rabi*
Protein (g)	221.25	384.38	347.06
Iron (mg)	212.17	333.93	149.88
Calcium (mg)	8072.01	13026.24	4710.11
Beta- carotene (mcg)	179695.2	294246.5	134636.19
Vitamin C (mg)	2934.76	6633.46	4577.17

the women had knowledge on all aspects of nutri- garden land preparation and layout.

Through training, farm women gained knowledge about appropriate sowing method of vegetables. 25% of the farm women had low level of knowledge about appropriate sowing method of vegetables before training. After training with KVK, majority of respondents (>82%) got knowledge that radish, spinach, bittergourd like vegetables are grown by seed sowing method whereas seeds of transplanted crops like tomato, chilli, brinjal should be sown in nursery beds one month in advance and after one month of sowing, seedlings are removed from nursery and transplanted in the nutri- garden beds.

Training program enhances the awareness of farm women regarding various nutritional aspects and economic benefits of nutri-garden. Farm women understanding the nutritional benefits of the crops they grow, increases the likely of these fresh and nutrient-rich foods to be incorporated in their family's daily meals. This can lead to improved dietary practices and overall better health outcomes.

Nutrient availability

Average per capita availability of nutrients from vegetables grown in zaid, kharif and rabi season are presented in Table 6. One of the primary objectives to develop nutri- smart village having nutri- garden is to ensure nutritionally adequate diet at the household level. By comparing the NFHS - 4 data with NFHS - 5 data regarding nutritional status of the children under 5 years, it can be seen that although stunting, wasting and underweight percentage decline from 2015-16 to 2019-21 but the percentage of occurrence of disease in the population is still high. Protein and micronutrient deficiency among children results in PEM. Establishment of nutri-garden under front line demonstration ensures approximately 221.25 gms, 384.38 gms and 347.06 gms of per capita availability of protein during *Zaid*, *Kharif* and *Rabi* season, respectively. WHO recognized anaemia as global health problem resulting in several health consequences (World Health Organization, 2004). Prevalence of anaemia among children under 5 years, pregnant and lactating women increases from 2016 to 2021 (GOI, 2021). Despite of multifactorial pathophysiology of anaemia, iron deficiency anaemia is most prevalent (Warner and Kamran, 2022). Ascorbic acid is reported to be a potent enhancer of iron absorption (Milman, 2020). Ascorbic acid facilitates iron absorption in small intestine. Increased per capita availability of iron and ascorbic acid was also seen with the establishment of nutri- garden ensuring approximately 212.17 mg, 333.93 mg and 149.88 mg of iron and 2934.76 mg, 6633.46 mg and 4577.17 mg of ascorbic acid per capita availability during *Zaid*, *kharif* and *rabi* season, respectively.

According to the WHO, millions of children suffer from vitamin A deficiency in developing countries (Wiseman *et al.,* 2017). *β*-carotene is the precursor for vitamin A (Krinsky and Johnson, 2005). Food-based approaches and supplementation are the ways for combating vitamin A deficiency in the population. Sustainable food-based approaches through nutri-garden can be portrayed as effective method for combating vitamin A deficiency in long term. Per capita availability of beta carotene after establishment of nutri-garden under NARI project was approximately 179695.2 mcg, 294246.5 mcg and 134636.19 mcg during *Zaid*, *kharif* and *rabi* season, respectively. Both calcium and vitamin D deficiency is highly prevalent in India resulting in rickets in children; osteoporosis and osteomalacia in adults. Per capita availability of calcium was also found to be enhanced among study population with the establishment of the nutri- garden.

CONCLUSION

Nutri-garden is highly beneficial in achieving nutritional security at household level by increasing the vegetable intake. Training on nutri-gardens offers a multifaceted approach to enhancing the performance of farm women. By addressing nutritional, physical and mental well-being, nutri-garden practices contribute to a holistic approach to development. Integrating training programs along with the establishment of nutri-garden in farm families can lead to healthier environment by increasing production and intake with use of appropriate technical know-how.

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Conflict of interest

The authors report no conflict of interest.

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