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Nutrigarden: A diversified activity for sustainable food and nutrition security

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Abstract
Study was conducted with an objective to introduce nutrigarden at rural families. Five villages of Sidlaghatta taluk, Chikballapur district were selected. To address the identified gap nutrigarden were introduced. It was recorded that the consumption of vegetables which was limited to once a week, increased to daily after the nutrigarden establishment. Thus, it can be concluded that encouraging and establishing nutrigarden a diversified activity which will enhance the consumption of micronutrient rich fruits and vegetables. It also helps in diverting the money spent on purchase of fruits and vegetables towards other food items, thus leading to overall wellbeing.

Keywords: Micronutrient productivity, nutrition garden, nutrition security, diversified activity

Introduction
India, despite being the second-largest producer of fruits and vegetables, faces a significant challenge in improving the consumption of these nutritious foods among its population. This issue arises primarily due to deficiencies in the supply chain, distribution systems, and a lack of awareness regarding the availability of locally sourced produce (Sachdeva *et al.* 2013). Compounding this problem is India's unfortunate status as the second-largest nation with undernourished citizens. Furthermore, an alarming statistic reveals that more than half of Indian women suffer from anaemia, a condition contributing to the high prevalence of low-birth-weight babies. The inadequate and imbalanced diets, coupled with food scarcity, directly contribute to the high incidence of stunting, excess weight gain, and child mortality among those under the age of five.

Addressing the challenge of food security in the face of escalating demand requires a multifaceted approach. One promising solution lies in the concept of nutrition gardens, which play a vital role in enhancing dietary diversity by consistently providing essential micronutrients through a steady supply of fruits and vegetables. These gardens are designed to meet the nutritional needs of families, making them a sustainable model for ensuring food security and promoting dietary diversity to combat malnutrition at both the household and community levels.

The recommended daily allowances for green leafy vegetables, other vegetables, and roots and tubers stand at 100 grams each, as specified by the Indian Council of Medical Research in 2010. Governments and international organizations are increasingly showing interest in bolstering local food production to mitigate the adverse impacts of global food shocks and the volatility of food prices, as highlighted by Galhena *et al.* in 2013 [5]. Consequently, there is a growing focus on nutrigardens as a strategy to enhance household food security and promote better nutrition.

The ongoing issues of both under nutrition and over nutrition have taken a toll on the overall health of the population. To address these persistent nutrition-related problems, scientists have introduced the concept of Nutri-Smart Villages (NSV). This innovative approach, known as 'Nutri Smart Village' (NSV), adopts a multisectoral approach primarily aimed at tackling key nutrition-related challenges, with a special emphasis on combating malnutrition, as discussed by Singh *et al.* in 2020 [13].

Nutri gardening involves cultivating a small plot of land, typically situated near the homestead or within a short walking distance. This practice not only serves as a cost-effective and time-saving endeavour but also offers a healthy, practical, and environmentally friendly hobby that the entire family can engage in (Cheema, K.J., 2011) [2]. Nutri gardening yields fresh fruits and vegetables, thereby reducing the expenses incurred from purchasing these items and

contributing to overall budget savings. Furthermore, nutrigardens contribute to improved nutrition by influencing changes in household food production and the consumption of specific foods and essential micronutrients. They also enhance the overall dietary diversity of rural low-income households, as highlighted by Ruel and Alderman in 2013 [11]. Additionally, while nutrigardens may not directly provide cereals to the family, they indirectly contribute to cereal availability by leveraging the savings generated from not having to purchase fruits and vegetables (Beddington *et al.*, 2012; Njuguna, 2013) [15, 9].

The main aim of nutrigarden concept is micronutrient security among the families. The diversification in dietary intake can be possible as healthy eating practices through scientifically developed nutrigarden. Therefore, sustainability in micronutrient security by establishing the nutri or community gardens is a prime demand to maintain the nutritional status of families with side earning for better livelihood (FAO 2002). Baseline survey of the rural families in the selected villages indicated a gap in intake of micronutrient rich fruits and vegetables which was less than RDA in their daily diet leading to their deficiencies. Hence, to address the identified gap nutritional garden were introduced in purposively selected 25 rural families.

Material and Methods

Present research on Nutrigarden a diversified activity for enhancing micronutrient rich crop productivity was carried out in five villages namely Bodaguru, Thippenahalli, Basavapattana, Yenanguru and Hosapete of Sidlaghatta taluk, Chickballapur district of Karnataka State. A total of 25 farm families were selected purposively to establish nutri garden at their household/ farm field.

A questionnaire was carefully crafted to gather socio demographic information, employing a pretested questionnaire. Subsequently, an assessment was made regarding the frequency of food consumption across various categories, including cereals, pulses, oils, sugars, jaggery, green leafy vegetables, other vegetables, roots and tubers, milk and dairy products, meat, fish, seafood, eggs, fruits, nuts, oilseeds, and dry fruits. The dietary survey of the 25 rural women selected for the study utilized the 24-hour recall method.

To facilitate more accurate recall, standardized cups and vessels were employed to measure food intake. Participants were asked to recall their meal preparations for breakfast, lunch, evening tea, and dinner over a span of three consecutive days, both before and after the intervention. Using the daily quantity of food consumed, nutrient values such as protein, fat, carbohydrates, energy, calcium, iron, zinc, and dietary fiber were computed and compared against the Recommended Dietary Allowance (RDA) of 2020. This comparison aimed to determine whether the dietary intake of food and nutrients met the necessary requirements. The nutrient intake calculations were based on the Indian Food Composition table as provided by Longvah *et al*. in 2017 [7]. To gauge the adequacy or inadequacy of food and nutrient composition, the following formula was employed.

$$\text{Percent nutrient adequacy (\% RDA)} = \frac{\text{Intake of each nutrient}}{\text{Recommended Daily allowances (RDA)}} \times 100$$

Intervention: As per their family size and land availability vegetable seed kits and fruit sapling for both the Kharif and rabi season along with other required inputs such as vermicompost, neem soap, vegetable special, shade net, sprayer, kitchen garden tools and weighing scale were distributed to the selected twenty five rural families. The kit comprised of five to six type green leafy vegetables (Amaranthus, Spinach, Dill, Coriander, and Fenugreek leaves), five other vegetables (Ladies finger, chilly, Tomato, Brinjal and beans), two roots and tubers (Raddish, carrot) and four trailing vegetables (Yard long beans, Ridge guard, bitter guard and bottle gourd). Nutrigarden were periodically monitored and as and when required suitable guidance was provided to the beneficiaries. Additionally capacity building programmes were conducted to create awareness on importance of fruits and vegetables in the daily diet and its impact on their nutritional status and health. The impact of nutrigarden on nutrient intake was assessed after the intervention.

Data analysis: Data was analyzed by calculating Mean, SD and percentage to determine the difference in parameters.

Results and Discussion

Table 1: Socio demographic profile of the respondents

(n=25)

Characters	Category	No.	%
Age	Young (18-35yrs)	5	20
	Middle (36-50yrs)	20	80
	Old(above 50yrs)	2	8
Education	Illiterate	1	4
	Up to Primary School	4	16
	Middle School	18	72
	High School	2	8
	Intermediate	0	0
	Graduation& Above	0	0
Marital Status	Single	0	0
	Married	25	100
	Divorcee	0	0
	Widow	0	0
	Separated	0	0
Occupation	Agriculture	21	84
	Labour	1	4
	Service (Govt./Private)	0	0
	Small Business	1	4
	House wife	2	8
Family Size	Small family (1-4 members)	22	88
	Medium family (5-6 members)	2	8
	Large family (>6 members)	1	4
Family type	Nuclear family	23	92
	Joint family	2	8
	Extended family	0	0
Number of earners in the family	< 2 earners	22	88
	2 – 4 earners	3	12
	> 4 earners	0	0

Table 1 results highlight that a significant portion, specifically 80 percent, of the rural women falls into the middle age category (36-50 years), with the remainder constituting the young age group (20 percent). It is noteworthy that a larger number of respondents were found to be in the middle age group. Additionally, middle-aged rural women tend to shoulder more family responsibilities, displaying efficiency and sensibility in their roles. They often approach their work with a strong sense of commitment and involvement.

Education, as a universally acknowledged catalyst for positive human development, plays a pivotal role in shaping

individuals. This observation is evident from Table 1, where 72.0 percent of the participants possessed middle school education, followed by those with primary school education (16.0 percent) and high school education (8.0 percent). The primary occupation for the majority of respondents is agriculture (84.0 percent), while a smaller percentage is engaged in labour (4.0 percent). When considering family size, the survey found that 88 percent of the respondents belonged to small family groups (1-4 members), followed by 8 percent in the medium family group (5-6 members). As for family structure, 92 percent of the participants reported being part of nuclear families, with the remaining 8 percent in joint families. In terms of earners within the family, the majority (88 percent) had less than two earners, while 12 percent had between 2-4 earners.

Frequency of food consumption by rural women were recorded during study period and depicted in Table 2. Before intervention Majority of the rural women consume cereals (100%), pulses (97.5%), oil (100%), sugar and jaggery (100%), milk (97.5%), curd and buttermilk (60%) with the frequency of daily basis whereas green leafy vegetables (2%), other vegetables (55%), roots and tubers (24.5%), nuts and oilseeds (13%) were consume weekly twice. It was interesting to note that majority of rural women consume weekly three time meat (46%) and egg (35%) whereas fish and sea foods were consume rarely. After the nutri garden establishment frequency of food consumption on green leafy vegetables other vegetables, roots and tubers was changed from weekly once to daily. Nutrigarden activity can not only save our money and time but also can provide a healthy, useful and environment friendly hobby for whole family (Cheema. K.J, 2011) [2]. It supply fresh fruits and vegetables and save the amount that expended from family budget in its purchases.

During the study period, the nutrient intake of rural women was carefully documented, and the average nutrient intake was compared to the recommended dietary allowances for rural women, as outlined in Table 3. The mean nutrient intake revealed that energy (1630 Kcal) and protein (44.20 g) were in line with the recommended values, while iron (14.80 mg), zinc (7.40 mg), and dietary fiber (17.60 g) fell short of the recommended levels. On the other hand, rural women were found to consume more fat (28.70 g), carbohydrates (297 g), and calcium (1020.90 mg) compared to the recommended amounts, surpassing the RDA. The mean percentage adequacy for fat, carbohydrates, and calcium was 143.5 percent, 297 percent, and 102.09 percent, respectively. However, the adequacy for fiber, iron, and zinc stood at 54.79 percent, 50.91 percent, and 56.34 percent, respectively, all falling below the recommended values. Following the implementation of the nutrigarden intervention, the percentage adequacy of iron, zinc, and dietary fiber experienced significant improvements, rising from 51.03 percent, 56.06 percent, and 70.4 percent to 94.83 percent, 93.94 percent, and 110.80 percent, respectively.

Calcium plays a pivotal role in essential physiological processes such as robust muscle contractions, maintaining bone structure, and facilitating nerve signaling. In our study, it was observed that the dietary calcium intake among all rural women was notably high. This can be attributed to their consumption of non-vegetarian meals and their staple diet, which prominently features finger millet, a calcium-rich grain commonly consumed in the region.

Similar findings were reported by Gangavath and Ashlesha (2019) [4] in their study of 100 randomly selected rural women from Madirala village in the Kothagudam district. Their results revealed that 68 percent of the women had a normal BMI, but their mean intake of energy, protein, carbohydrates, fats, fiber, iron, and calcium (1271 Kcal, 41 g, 205 g, 27.8 g, 23 g, 7 mg, and 315 mg, respectively) did not meet the recommended dietary allowances. The study indicated that, except for fat and fiber, all other nutrients fell short of meeting the RDA. The primary reasons for this inadequacy were attributed to a lack of nutrition awareness, limited purchasing power, and the unavailability of essential food items at their households, all contributing to insufficient intake of both the quantity and quality of protein, dietary fiber, iron, and zinc.

These findings align with those of Ravi and Ravindra (2017) [10], who also noted that the mean calcium consumption (757.45 mg) among the study participants exceeded the recommended dietary allowances.

Table 2: Frequency of Food Consumption

Foods	Before								After							
	Daily (%)	Weekly (%)			Monthly (%)			Rare (%)	Daily (%)	Weekly (%)			Monthly (%)			Rare (%)
		Thrice	Twice	Once	Thrice	Twice	Once			Thrice	Twice	Once	Thrice	Twice	Once	
Cereals/Millets	100	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Pulses	97.5	0	1.5	1.0	0	0	0	0	98.5	0	1	0.5	0	0	0	0
Oil	100	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Sugar and jaggery	100	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Green leafy vegetables	2	31	38.5	25	0.5	1.0	2.0	0	100	0	0	0	0	0	0	0
Other vegetables	55	1.0	28	15.5	0	0	0	0	100	0	0	0	0	0	0	0
Roots and tubers	24.5	9.5	46	17.5	0	0.5	0	1.0	100	0	0	0	0	0	0	0
Milk	97.5	0.5	0	0	0	0	0	2.0	98.5	1	0.5	0	0	0	0	0
Curd & butter milk	60.0	2.5	4.5	4.5	0.5	0	0	28.0	65.0	2.0	3	2.0	1.0	0	0	27
Milk products	23.0	5.5	4.5	1.0	1.5	5.0	3.0	56.5	40.0	3.5	4.0	2.0	1.5	2.0	1.5	45.5
Meat	0	46.0	12.0	4.0	4.0	23.0	6.5	4.0	0	45	12	7.0	4.0	23.0	6.0	3.0
Fish and sea foods	0.5	4.5	0.5	0	14.0	6.5	0.5	73.5	0.5	3.0	2.5	2.0	12.0	7.0	1.0	72
Egg	5.5	35.0	18.5	14.0	3.5	11.0	2.0	10.0	45.0	17	9	7	5	4	6	7
Fruits	28.0	19.0	17.5	19.0	1.0	5.0	5.0	5.5	39.0	21.0	15.5	13.0	3.0	3.0	2.5	3.0
Nuts and oil seeds	13	20.5	27	15.0	3.0	7.5	1.0	12.5	15	22.5	30	12.0	2.5	6.5	2.0	9.5
Dry fruits	7.5	3.5	3.0	3.5	7.0	1.5	2.5	70.5	16	4.5	2.0	2.5	5.0	2.5	1.5	66
Any other: honey, herbs, health foods	1.5	1.0	1.0	1.5	4.0	0	1.0	90.0	8.5	3	3	2.5	6	0	2.5	75

Table 3: Mean and percent adequacy of nutrient intake of rural women

Nutrients	Before			After		
	RDA	Mean intake	% adequacy	RDA	Mean intake	% adequacy
Protein (g)	45.7	44.20	96.72	45.7	44.70	97.81
Fat (g)	20	28.70	143.5	20	29.1	145.5
CHO (g)	100	297	297	100	330	330
Energy (Kcal)	1660	1630	98.2	1660	1700	102.40
Calcium (mg)	1000	1020.9	102.09	1000	1048	104.80
Iron (mg)	29.0	14.80	51.03	29.0	27.50	94.83
Zinc (mg)	13.2	7.40	56.06	13.2	12.40	93.94
Dietary fibre (g)	25	17.60	70.4	25	27.70	110.80

Table 4: Per capita availability of vegetables before and after nutrigarden intervention

(n=25)

Village	Before		After		% Increase
	Per capita availability	% adequacy	Per capita availability	% adequacy	
Bodhguru	193.07	64.35	353.021	117.67	82.84
Thippenahalli	161.64	53.88	389.76	129.92	114.12
Hospete	157.53	52.51	318.21	106.07	102
Basavapattana	191.78	63.92	317.30	105.76	65.45
Yennanguru	182.64	60.88	322.87	107.62	76.77

Per capita availability and percent adequacy of vegetables at five adopted villages were depicted in the table 4. Before the establishment of nutrigarden per capita availability of five villages Bodhguru, Thippenahalli, Hospete, Basavapattana and Yennanguru found that 193.07, 161.64, 157.53, 191.78 and 182.64 gm/day respectively. But after the establishment of nutrigarden per capita availability was improved in all five villages 353.02, 389.76, 318.21, 317.30 and 322.87 gm/day. Before nutrigarden establishment percent adequacy was not met RDA which was below 100 but after the nutrigarden establishment percent adequacy was met RDA in all five villages which was found to be above 100. After the intervention highest per capita availability was observed in thippenahalli (129.92) followed by Bodhguru (117.67). Percent increase was found higher in thippenahalli (114.12) followed by Hospete (102). Least percent increase was observed in yennanguru (65.45) followed by basavapattana (76.77) village.

Table 5: Vegetable production and consumption pattern of nutrigarden (kg/per year)

(n=25)

Si. No.	Adopted villages	Production/year	Consumption/year	Distribution to others/year
1.	Bodhguru	2516.00	2190.50	325.50
2.	Thippenahalli	2946.25	2703.00	243.25
3.	Hospete	2220.20	1823.00	397.20
4.	Basavapattana	1650.45	1450.55	199.90
5.	Yennanguru	1721.25	1520.75	200.50
Total		11054.15	9687.80	1366.35

Mean vegetable production and consumption pattern of nutrigardens were depicted in table 5. Highest production was observed in Thippenahalli village 2946.25 kg/year followed by Bodhguru 2516.00 kg/year Consumption also found highest in Thippenahalli and Bodhguru 2703.00 and 2190.50 kg/year. Total production and consumption of vegetables found that 11054.15 kg and 9687.80 kg/year. Rural women are not purchasing any vegetables in the market after the establishment of nutrigarden. All family members consuming fresh and chemical free vegetables all round the year.

Conclusion

The establishment of a nutri garden in a village can have numerous benefits for the community. Nutri gardens provide a sustainable and accessible source of nutritious food, promoting better health and reducing malnutrition. Thus, it can be concluded that encouraging and establishing nutrigarden a diversified activity which will enhance the consumption of micronutrient rich fruits and vegetables and sustain the same throughout the year. It also helps in diverting the money spent on purchase of fruits and vegetables towards other food items, thus leading to overall wellbeing.

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Conflict of Interest: No

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