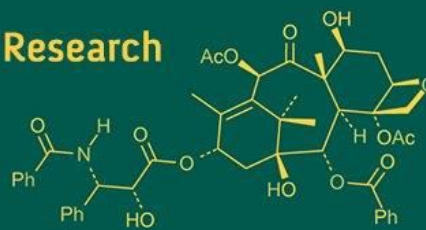


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Women-led nutrition gardens as a strategy for strengthening household food and nutritional security

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Abstract

Women play a pivotal role in managing household food systems, particularly in rural settings where access to diverse and nutrient-rich foods is often constrained. The present study evaluated the effectiveness of women-managed nutrition gardens in improving household food availability and nutritional security through an intervention-based approach. A comparative assessment conducted before and after the intervention revealed a substantial increase in vegetable availability, rising from 153.62 g/day to 330.60 g/day per capita. Several crops, including cabbage, cauliflower, knolkhol, brinjal, spinach and French bean, recorded yields exceeding expected levels, reflecting efficient crop management practices adopted by participating women. Nutritional analysis indicated significant improvements in the availability of essential nutrients, with protein, iron, calcium, beta-carotene, vitamin C and folic acid reaching 8.45%, 73.15%, 41.43%, 311.58%, 118.45% and 57.42% of the recommended dietary allowance (RDA), respectively. Furthermore, overall vegetable availability reached 82.65% of the level recommended by the Indian Council of Medical Research. The findings demonstrate that women-led nutrition gardens are an effective, sustainable and scalable intervention for improving dietary diversity and addressing micronutrient deficiencies in rural households.

Keywords: Nutrition-garden, food security, women empowerment, dietary diversity, micronutrients

Introduction

Ensuring household food and nutritional security remains a persistent challenge in many developing regions, particularly in rural areas where access to a diverse diet is limited. Inadequate consumption of fruits and vegetables often leads to deficiencies of essential micronutrients such as iron, vitamin A and calcium, which are critical for maintaining overall health (ICMR, 2020) [5]. In India, despite improvements in agricultural production, dietary diversity among rural populations continues to remain suboptimal. In this context, nutrition-sensitive agricultural interventions have gained increasing attention as a means to improve household nutrition. Among these, nutrition gardens—small-scale, diversified cropping systems established within household premises—offer a practical and sustainable solution (Singh *et al.*, 2018) [9]. These gardens enable year-round production of a variety of vegetables and fruits, thereby enhancing access to fresh, nutrient-rich foods at the household level (Pradhan *et al.*, 2018) [8].

The concept of nutrition gardens extends beyond food production and incorporates principles of sustainability, resource efficiency and dietary diversification. By including a wide range of crops such as leafy vegetables, roots and tubers, legumes and fruit crops, these systems contribute to improved intake of essential nutrients (Kammar *et al.*, 2018) [6]. Women play a central role in household nutrition management and agricultural activities. Their involvement in nutrition garden interventions has been shown to positively influence food availability, dietary practices and overall family health (Borthakur *et al.*, 2023) [4]. Strengthening women's participation in such initiatives is therefore critical for achieving improved nutritional outcomes (Borthakur and Borthakur, 2025) [3].

In Assam, although agro-climatic conditions are favourable for diverse crop production, the intake of vegetables remains below recommended levels. Recognizing this gap, Krishi Vigyan Kendras (KVKs) have promoted nutrition gardens among rural households through frontline demonstrations. The present study was undertaken to assess the impact of women-led nutrition gardens on vegetable availability, consumption patterns and nutrient intake in rural areas of Assam.

Materials and Methods

Study Area

The study was conducted in NARI village adopted by Krishi Vigyan Kendra, Golaghat. All total of 50 numbers of nutrition garden was developed and nutritional assessment was conducted.

Intervention Design

A standardized nutrition garden layout developed by Assam Agricultural University, Jorhat (2020-21) was effectively implemented in all 50 numbers of households. The model emphasized year-round production of diverse crops, including leafy vegetables, roots and tubers and fruits. This layout aims to develop self-sufficiency in food and nutrition.

Distribution of Inputs

Selected households were provided with quality seeds, planting materials, and vermicompost. For *kharif* season, the vegetables selected for the garden included amaranthus, okra, bottle gourd, sponge gourd, bitter gourd, brinjal, tomato, cow pea, spinach and radish whereas in *rabi* season, they were provided seeds/planting material of coriander, fenugreek, spinach, radish, carrot, beet root, cauliflower, cabbage, tomato, brinjal, chilli and green pea. Average yield of all the crops has been recorded.

Data Collection and Analysis

Baseline (pre-intervention) and endline (post-intervention) data were collected through structured interviews. Nutrient availability was estimated using the Indian Food Composition Tables (Longvah *et al.*, 2017) [7] and compared with Recommended Dietary Allowances (ICMR, 2020) [5]. Statistical analysis was performed using paired t-test to assess the significance of differences between pre-and post-intervention values.

Results and Discussion

Effect of Nutrition Garden on Vegetable Production, Purchase and Consumption

Fruits and vegetables production offers a significant opportunity to address micronutrient deficiencies and improve overall nutritional security. Inadequate production often leads to reduced consumption, which in turn contributes to a range of micronutrient-related health problems, including energy imbalance. Therefore, it is essential to promote appropriate preventive measures aimed at enhancing the production of fruits and vegetables, particularly among rural households, to ensure increased availability and consumption.

The introduction of nutrition gardens resulted in a significant enhancement in household vegetable production. This increase can be attributed to the adoption of improved cultivation practices and efficient management of garden resources by women participants. (Table 1). The annual household vegetable production increased markedly from 152.62 kg before intervention to 505.14 kg after intervention, reflecting a 231.01% increase. This substantial rise clearly indicates the effectiveness of the scientifically designed nutrition garden layout and active participation of women in crop management practices. The high t-value (5.32**) confirms that the increase was statistically significant at 1% level.

Table 1: Per unit production, purchase and consumption status of vegetables before and after intervention

Particulars	Before intervention	After intervention	% change	t statistic
Production	152.62	505.14	231.01	5.32**
Purchase	82.66	29.80	63.95	5.76**
Consumption	227.18	360.4	58.64	4.31**

** Significant at 1% level of significance

Correspondingly, household consumption of vegetables increased markedly, indicating that the additional production was primarily utilized for improving dietary intake rather than commercial sale. Vegetable consumption increased from 227.18 kg to 360.40 kg per annum, registering a 58.64% increase. In contrast, vegetable purchase declined significantly from 82.66 kg to 29.80 kg, showing a 63.95% reduction, which highlights the economic benefits of nutrition gardens by reducing household expenditure on vegetables.

These findings strongly support earlier studies, which reported that nutrition garden interventions significantly enhance production and consumption while reducing market dependency (Singh *et al.*, 2018; Sudhakar Rao, 2020) [9, 10]. The results also align with findings of Borthakur *et al.* (2021) [1], who observed substantial improvements in vegetable availability and household nutrition following similar interventions in Assam.

Seasonal and Crop-wise Performance of Nutrition Gardens

Crop-wise analysis revealed that several vegetables performed beyond expected yield levels. Seasonal trends indicated higher productivity during winter months, consistent with observations reported in earlier studies (Kammar *et al.*, 2018) [6]. The analysis of crop-wise performance (Fig. 1) revealed that most of the crops performed satisfactorily, with several crops such as cabbage, cauliflower, knolkhol, brinjal, spinach and French bean producing yields higher than expected levels. This can be attributed to:

- Adoption of improved varieties
- Adoption of proper and timely agronomic practices
- Effective utilization of organic inputs such as vermicompost
- Active involvement of women in routine crop management

Seasonal analysis indicated that maximum production was recorded during the winter season, particularly for leafy vegetables, roots and tubers and cole crops. This reflects better suitability of climatic conditions for vegetable cultivation during rabi season in Assam. Importantly, 90-95% of the produce was utilized for household consumption, indicating that nutrition gardens primarily served their intended purpose of improving dietary intake rather than commercial production.

Per-capita availability of nutrients before and after establishment of Nutrition Garden

The results indicated that a substantial increase of household diet diversity through promotion of nutrition gardens and nutritional needs of the households were significantly met through the year round production of nutrition garden (Fig. 1). The availability increased from 153.62 g/day to 330.60

g/day, which is more than double the baseline level. Despite this improvement, the intake reached 82.65% of the ICMR recommended level (400 g/day), indicating that while nutrition gardens substantially improve availability, there is still scope for further enhancement through diversification and inclusion of fruit crops.

The availability of green leafy vegetables exceeded recommended levels, roots and tubers reached 73.67% and

other vegetables reached 76.16% of recommended levels. This diversification across vegetable groups is particularly important, as it ensures a balanced intake of micronutrients. These findings are consistent with studies by Kammar *et al.* (2018) [6], who reported improved dietary diversity and vegetable consumption following nutrition garden interventions. The results also align with findings of Borthakur *et al.* (2021) [1] and Borthakur *et al.* (2023) [4].

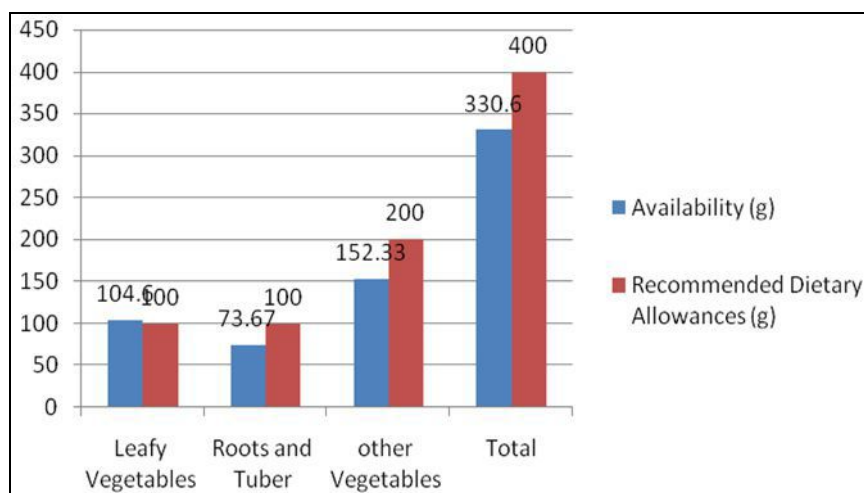


Fig 1: Availability of vegetables for consumption after intervention from nutrition garden

Impact on Nutrient Availability

The most significant outcome of the intervention was the improvement in per capita nutrient availability (Table 2). All major nutrients showed statistically significant increases.

- Iron availability increased from 34.18% to 73.15% of RDA, indicating strong potential to address iron deficiency anaemia

- Calcium increased from 13.94% to 41.43%, contributing to improved bone health
- Beta-carotene showed a remarkable increase from 49.22% to 311.58%, highlighting enhanced intake of vitamin A precursors
- Vitamin C increased from 70.26% to 118.45%, exceeding recommended levels
- Folic acid increased from 20.84% to 57.42%, supporting improved maternal and child health

Table 2: Availability of nutrients and % RDA from nutrition garden produce before and after intervention

Nutrients		Before intervention	After intervention	t statistic
Protein	Average	2.78	3.711	5.057**
	%RDA	6.33	8.45	
Iron	Average	3.76	8.047	10.543**
	%RDA	34.18	73.15	
Calcium	Average	111.5	331.5	5.711**
	%RDA	13.94	41.43	
B-Carotene	Average	1231	7790	5.867**
	%RDA	49.22	311.58	
Vitamin C	Mean	45.67	76.99	5.854**
	%RDA	70.26	118.45	
Folic Acid	Average	52.11	143.5	6.752**
	%RDA	20.84	57.42	

** Significant at 1% level of significance

The high t-values for all nutrients indicate statistically significant improvements, confirming the effectiveness of the intervention. The substantial increase in micronutrient availability can be attributed to inclusion of diverse crops (leafy vegetables, roots, legumes), year-round availability of vegetables and improved awareness among women regarding nutrition. These findings corroborate earlier studies that demonstrated nutrition gardens as an effective strategy to combat micronutrient deficiencies and improve dietary quality (Pradhan *et al.*, 2018; Borthakur *et al.*, 2023) [8, 4].

Role of Women in Enhancing Nutritional Security

The success of the intervention can be largely attributed to the active involvement of women in planning, cultivation, and utilization of nutrition gardens. Women ensured, proper crop selection and seasonal planning, efficient utilization of produce for household consumption and adoption of improved cultivation practices. This supports the concept that women are central to nutrition-sensitive agriculture, as highlighted by Borthakur and Borthakur (2025) [3], who emphasized the importance of women's knowledge and participation in improving household nutrition outcomes.

Major constraints perceived during development of Nutrition garden

Major constraints faced by rural women in the state of Assam in establishing nutrition garden have also been recorded during pre survey as well as conduction of training on nutritional gardening. They were as followed:

Input constraints: Major input constrains perceived from the respondents was unavailability of quality seed and planting materials followed by high price of quality seed and difficulty in seedling production. Irrigation is another important constrain.

Technical constraints: Major technical constraints identified were lack of knowledge about recommended seed rate and varieties, identification of major insect pests and diseases, unaware of organic disease and pest management, crop rotation and lack of knowledge and awareness on nutritional aspects and health benefits of fruits and vegetables.

Socio-cultural constraints: Engagement of farm women in household and other farm activities which leads to lesser involvement of women also a major constraint to make nutrition garden a successful task. Similar result was also reported by Sudhakarrrao, 2020 ^[10].

General constraints: Least importance on scientific layout of the garden and lesser priority to nutrition gardening than other farm activities was also a major constraint recorded during the study. This might be due to the reason that monetary returns of other farm activities were higher whereas nutrition garden produce is mainly to be consumed at home.

Conclusion

The study demonstrates that women-led nutrition gardens are an effective intervention for improving household food and nutritional security in rural areas. The significant increase in vegetable production, consumption and nutrient availability highlights their potential in addressing dietary deficiencies and reducing dependence on market sources. Beyond improving food availability, nutrition gardens contribute to dietary diversification, economic savings and empowerment of women. However, to maximize their impact, there is a need for sustained institutional support in terms of input supply, technical guidance and capacity building. Integration of nutrition gardens into agricultural extension and rural development programmes can play a crucial role in achieving long-term nutritional security and sustainable livelihoods in rural communities.

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