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Nutri garden model for nutritional security and sustainable livelihood

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Abstract

Vegetables are an important component of a balanced diet and contribute significantly to human health by providing essential nutrients such as vitamins, minerals, dietary fibre, antioxidants, and bioactive compounds. Limited access to diverse vegetables is one of the major constraints affecting household nutritional security. Nutri Gardens provide an effective approach for improving vegetable availability through the production of diverse horticultural crops within a limited area. The present study was undertaken to demonstrate 200 m² Nutri Garden model with diverse vegetable crops, namely leafy vegetables, fruiting vegetables, gourds, and legume vegetables. The maximum area was allotted to fruiting vegetables (75 m², 37.5%), followed by leafy vegetables (60 m², 30%), gourds (40 m², 20%), and legume vegetables (25 m², 12.5%). The proposed crop arrangement combined short-duration and long-duration vegetables to ensure continuous availability of fresh produce throughout the year. Leafy vegetables contributed to rapid production and micronutrient supply, fruiting vegetables ensured prolonged harvesting, gourds enhanced vertical space utilization, and legume vegetables supported nutritional improvement and soil fertility. The study demonstrates that scientifically designed Nutri Gardens can serve as sustainable models for small-scale vegetable production and can be adapted according to local agro-climatic conditions and household requirements.

Keywords: Nutri garden, kitchen garden, vegetable crops, horticulture, crop diversification and nutritional security

Introduction

Malnutrition is a major public health concern affecting growth, development and overall quality of life. It includes under nutrition, micronutrient deficiencies, overweight and obesity, and continues to affect vulnerable populations in India. As per the recent survey national family and health survey (2019-21), 35.5 per cent of children under five years were stunted, 19.3 per cent were wasted and 32.1 per cent were underweight in India (MoHFW, 2021). India has one of the highest burdens of childhood malnutrition globally, with around one-third of the world's stunted children residing in the country (UNICEF, 2020). In order to overcome malnutrition related problems, the establishment of nutri gardens at the family, school, and village levels is an effective and sustainable practice.

Vegetables are essential components of a balanced diet and provide vitamins, minerals, dietary fibre, antioxidants and other bioactive compounds. Regular consumption of diverse vegetables can improve dietary quality and help prevent micronutrient deficiencies. However, inadequate availability, affordability and consumption of vegetables may contribute to poor dietary diversity, particularly among vulnerable groups. Improving access to and consumption of nutrient-rich vegetables can contribute to better dietary diversity and nutritional security. Therefore, promoting vegetable production and consumption is important for addressing micronutrient deficiencies and improving nutritional health. Research on nutrient-rich vegetable crops can help identify suitable crops for improving dietary quality and nutritional security. Thus, increasing the availability and consumption of diverse vegetables may play an important role in reducing malnutrition. Regular consumption of diverse vegetables helps improve dietary quality and supports healthy growth and development.

However, inadequate availability, affordability and consumption of vegetables can contribute to nutritional deficiencies. Therefore, promoting the production, accessibility and consumption of nutrient-rich vegetables is essential for improving dietary diversity and combating malnutrition. So keeping these aspects a Nutri Gardens or kitchen gardens are small scale horticultural production units designed to provide a continuous supply of fresh and nutritious vegetables for household consumption.

A properly designed Nutri Garden can improve household nutritional security by ensuring regular availability of leafy vegetables, fruiting vegetables, gourds, and legume vegetables throughout the year. (Kumar and Kumar M, 2014) ^[5]. The success of a Nutri Garden mainly depends on proper selection of crops, spatial arrangement, seasonal planning, and efficient utilization of available resources. Diversification of vegetable crops helps in achieving continuous production, reducing production risks, and improving land-use efficiency. Leafy vegetables such as spinach, amaranthus, and coriander are preferred due to their short duration and high nutritional value, whereas fruiting vegetables such as Tomato, Brinjal and Chilli, provide prolonged harvesting periods. Gourds and climbing vegetables contribute to vertical utilization of space, while legume vegetables improve soil fertility through biological nitrogen fixation. Horticultural crops play an important role in sustainable food production systems because they provide high yield per unit area and can be successfully cultivated in small land holdings.

Vegetable gardens with planned crop combinations can maximize productivity by utilizing available sunlight, water, and soil nutrients efficiently. Intensive vegetable cultivation practices, including crop rotation, intercropping, organic nutrient management, and vertical gardening, further enhance the sustainability and productivity of small-scale gardens. In recent years, the concept of nutrition gardens has gained importance as a practical approach for improving household food and nutritional security. Kitchen gardens not only supply fresh vegetables but also reduce household expenditure on vegetables and encourage the consumption of locally produced, chemical-free food (Singh and Singh, 2015) ^[13]. The integration of diverse vegetable crops in a limited area provides an opportunity to produce a wide range of nutrients required for a healthy diet (Bose *et al.*, 2003) ^[2]. The planning of an appropriate garden layout is essential for achieving maximum production from a given area. Crop allocation based on growth habit, duration, nutrient requirement, and consumption pattern helps maintain a continuous supply of vegetables. A balanced combination of short-duration leafy vegetables and long-duration fruiting and climbing vegetables ensures year-round productivity and efficient utilization of space (Thamburaj & Singh, 2005) ^[15].

Therefore, the present study was undertaken to establish a suitable layout design for a 200 m² Nutri Garden by allocating land among different horticultural crop groups, including leafy vegetables, fruiting vegetables, gourds, and legume vegetables. The proposed design aims to optimize land utilization, enhance vegetable diversity, and provide a sustainable model for improving household nutritional security through scientific horticultural practices.

Materials and Methods

Planning and Design of Nutri Garden

The present study was conducted to develop a suitable layout design for a 200 m² Nutri Garden at Krishi Vigyan

Kendra, Raichur during the year 2025-26 based on the principles of scientific Horticultural crop planning and efficient land utilization. The design was prepared by considering the nutritional requirements of households, crop diversity, growth habits, seasonal adaptability, and continuous vegetable availability. The garden area was divided into different crop groups, namely leafy vegetables, fruiting vegetables, gourds, and legume vegetables, to ensure balanced production and maximum utilization of available space.

Site Selection and Area Allocation

A total area of 200 m² was considered for the establishment of the Nutri Garden model. The selected area was divided into separate plots for different vegetable groups. The distribution of crop groups was planned to achieve crop diversity and efficient use of land resources.

The highest area was assigned to fruiting vegetables due to their longer harvesting period and greater contribution to household vegetable requirements. Leafy vegetables were provided a substantial area because of their short duration, rapid growth, and high nutritional value. Gourds were included to utilize vertical space effectively, while legume vegetables were incorporated for nutritional benefits and improvement of soil fertility.

Selection of Vegetable Crops

The selection of crops for the Nutri Garden was based on nutritional importance, adaptability, productivity, and suitability for small-scale cultivation. A combination of different vegetable categories was selected to ensure year-round availability of vegetables. The leafy vegetables were planted at suitable spacing to facilitate uniform growth and efficient utilization of space. Palak, fenugreek and coriander were maintained at a spacing of 20 × 10 cm, while pundi was maintained at 30 × 15 cm (Thamburaj and Singh, 2005) ^[15]. These were considered due to their short growth cycle and high content of vitamins and minerals.

Fruit vegetables such as tomato and brinjal were planted at a spacing of 60 × 45 cm, while chilli was maintained at a spacing of 45 × 45 cm to facilitate optimum plant growth, canopy development and efficient utilization of available space. Gourds such as Bottle gourd and bitter gourd were planted at a spacing of 2.0 × 2.0 m and 2.0 × 2.0 m, respectively, to facilitate proper vine growth and these vegetables were included to maximize production through vertical growth. Legume vegetables Dolichos bean was planted at a spacing of 60 × 30 cm was incorporated due to their nutritional value and ability to improve soil fertility through nitrogen fixation.

Table 1: Details of inputs and area allotted for nutri garden

Vegetable crop	Seed rate	Area (m ²)	Percentage (%)
Palak	37.5 g	15	7.5
Fenugreek	56.25 g	15	7.5
Coriander	60 g	15	7.5
Pundi	18.75 g	15	7.5
Tomato	1.5 g	30	15
Brinjal	1.25 g	25	12.5
Chilli	4 g	20	10
Bitter gourd	7.5 g	15	7.5
Bottle gourd	12.5 g	25	12.5
Dolichos bean	75 g	25	12.5
		200 m ²	

Layout Planning and Crop Arrangement

The garden layout was prepared by considering the growth characteristics and space requirements of individual crops. The crop arrangement was designed to avoid competition for sunlight, nutrients, and water among plants. Short-duration crops were planned along with long-duration crops to maintain continuous harvesting. Successive planting of leafy vegetables was considered to ensure regular availability of fresh produce. Crop rotation and diversification principles were incorporated to maintain soil health and reduce the incidence of pests and diseases.

The proposed layout for the 200 m² Nutri Garden from demonstrated a diversified crop allocation strategy aimed at ensuring continuous availability of vegetables and improving household nutritional security. The largest proportion of land was allocated to fruiting vegetables (75 m²), followed by leafy vegetables (60 m²), gourds (40 m²), and legume vegetables (25 m²).

The allocation pattern indicates that fruiting vegetables occupied the highest share (37.5%) of the total garden area. This larger allocation may be attributed to their longer harvesting period and higher contribution to dietary diversity through the supply of essential vitamins, minerals, and bioactive compounds. Crops such as tomato, eggplant, chilli, and okra generally provide repeated harvests over an extended period, making them suitable components of nutrition-oriented home gardens (Galhena *et al.*, 2013) [4].

Leafy vegetables accounted for 30% of the total area, representing an important component of the Nutri Garden design. Leafy vegetables are characterized by short growth cycles, rapid biomass production, and high nutritional value, particularly as sources of iron, calcium, vitamin A, and foliates. Their inclusion in a substantial area allows frequent harvesting and contributes to improved household micronutrient intake (Mayer, 2011) [8]. Growing multiple leafy vegetable crops also supports crop diversity and reduces dependence on a single vegetable source.

Gourd crops occupied 40 m² (20%) of the garden area. Gourds such as bottle gourd, bitter gourd, ridge gourd, and pumpkin are commonly included in sustainable kitchen gardens because of their adaptability, productivity, and ability to utilize vertical space through climbing growth habits. The inclusion of gourds enhances land-use efficiency by allowing production in limited areas while providing a continuous supply of vegetables during the growing season (Marshall, 2001) [9].

Legume vegetables received the smallest allocation (25 m², 12.5%). Although occupying less area, legumes play an important role in improving dietary quality because they provide plant-based protein, dietary fibre, and minerals. Additionally,

leguminous crops contribute to soil fertility through biological nitrogen fixation, thereby supporting sustainable nutrient management in small-scale vegetable production systems (Peoples *et al.*, 1995) [11].

Overall, the proposed crop distribution reflects a balanced approach between nutritional requirements, crop diversity, and efficient land utilization. The design combines quick-growing leafy vegetables with longer-duration fruiting crops, gourds, and legumes to ensure regular vegetable availability throughout the year. Similar diversified home garden systems have been reported to improve household food security, dietary diversity, and access to nutrient-rich foods, particularly among rural and peri-urban communities (Galhena *et al.*, 2013; Shukla *et al.*, 2014) [4, 12].

The allocation of different crop groups within a limited area demonstrates the potential of Nutri Gardens as a sustainable strategy for enhancing household nutrition. Proper crop planning, including seasonal rotation, intercropping, and vertical cultivation techniques, can further improve productivity and resource-use efficiency in small garden systems.

Soil and Crop Management Practices

The proposed Nutri Garden model included sustainable crop management practices suitable for small-scale vegetable production. Land preparation was considered through proper soil loosening, removal of weeds, and incorporation of organic manures to improve soil fertility and moisture holding capacity. Organic sources such as farmyard manure, compost, and vermicompost were considered for maintaining soil productivity and supporting healthy crop growth. Efficient irrigation management practices were incorporated to ensure optimum water availability and reduce wastage. These practices contribute to sustainable vegetable production with reduced dependence on external inputs.

Data Collection and Analysis

The data related to crop allocation and area distribution were recorded based on the proposed Nutri Garden layout. The contribution of each vegetable group was calculated using the following formula:

$$\text{Revised value} = (\text{Area allotted} \div 400) \times \text{Original value}$$

The developed layout was evaluated based on crop diversity, percentage area allocation, nutritional contribution, and suitability for household vegetable production. The results were expressed as area (m²) and percentage distribution of different vegetable groups.

Establishment of Nutri garden at KVK - Raichur



(a) Land preparation by krishi sakhi



(b) Sowing of seeds



c) Watering



d) Harvesting

Result and Discussion

Table 2: Yield performance and economic returns of vegetable crops

Vegetable	Area (m ²)	Yield (kg)	Gross Income (₹)
Palak	15	6	240
Fenugreek	15	9.4	376
Coriander	15	15	750
Pundi	15	6	240
Tomato	30	240	6000
Brinjal	25	150	4500
Chilli	20	80	5600
Bitter gourd	15	30	1500
Bottle gourd	25	93.75	3750
Dolichos bean	25	50	3000
Total	200 m ²	680.15 kg	25956

Note: The data obtained from the 200 m² nutri garden was converted and expressed on a hectare basis (10,000 m²) for comparison and interpretation.

The estimated yield and gross income obtained from different vegetable crops cultivated in a total area of 200 m² are presented in Table 2. The production system included ten vegetable crops, namely palak, fenugreek, coriander, pundi, tomato, brinjal, chilli, bitter gourd, bottle gourd, and dolichos bean. The total estimated vegetable production from the cultivated area was 680.15 kg, generating a total estimated gross income of ₹25,956.

Among the different vegetable crops, tomato recorded the highest estimated yield (240 kg) and contributed the maximum gross income of ₹6,000. This higher productivity was mainly due to its larger area allocation (30 m²), higher yield potential, and continuous harvesting ability. The results indicate that tomato played a major role in enhancing overall productivity and economic returns from the vegetable production system. Similar findings were reported by Kumar *et al.* (2018) [6], who observed that tomato contributes significantly to vegetable farm income due to its high yield potential and market demand.

Brinjal produced 150 kg yield with a gross income of ₹4,500, followed by bottle gourd (93.75 kg, ₹3,750) and chilli (80 kg, ₹5,600). Although chilli produced a lower yield compared with tomato and brinjal, it generated comparatively higher returns due to its higher market value. This demonstrates that economic performance of vegetable crops depends not only on biological yield but also on market price and consumer demand. Dolichos bean produced 50 kg with a gross income of ₹3,000, while bitter gourd recorded 30 kg yield and ₹1,500 income. Among leafy vegetables, coriander showed the highest yield (15 kg) and gross income (₹750), followed by fenugreek (9.4 kg, ₹376). Palak and pundi produced 6 kg yield each, contributing ₹240 income individually. The relatively lower contribution of leafy vegetables was due to their

smaller biomass production; however, their short duration and repeated harvesting ability make them important components of diversified vegetable production systems.

The overall productivity of 680.15 kg from 200 m² indicates efficient utilization of available land through crop diversification. The combination of leafy vegetables, fruit vegetables, and climbing vegetables allowed continuous production and better resource utilization throughout the growing period. Diversified vegetable cultivation has been reported to improve farm sustainability by reducing production risks and enhancing income stability (Altieri, 1999) [1]. The gross income analysis revealed that fruit vegetables contributed the major share of total returns. Tomato alone contributed approximately 23.1% of the total gross income, while tomato, brinjal, and chilli together accounted for a substantial proportion of total revenue. This highlights the importance of including high-value crops along with short-duration vegetables in small-scale production systems.

The results demonstrate that a diversified vegetable production model within a limited area of 200 m² can provide considerable yield and economic benefits. Such intensive vegetable cultivation approaches are suitable for kitchen gardens, smallholder farms, and urban/peri-urban farming systems where efficient land utilization and continuous vegetable supply are important objectives. Assuming the entire estimated yield (680.15 kg) is consumed over the production period by the family, the approximate nutrients obtained can be estimated using standard Indian Food Composition Tables (IFCT/NIN) values. Since nutrient content varies with variety and maturity, these are approximate values.

Table 3: Yield and nutrient composition of vegetables cultivated in a nutri garden

Vegetable	Yield (kg)	Energy (kcal)	Protein (g)	Fibre (g)	Vitamin C (mg)	Vitamin A (µg RAE)
Palak	6.0	1,380	174	132	1,686	28,140
Fenugreek leaves	9.4	4,606	414	103	4,888	21,996
Coriander leaves	15.0	3,450	315	420	4,050	50,550
Pundi (Amaranthus)	6.0	1,200	120	150	1,800	15,000
Tomato	240.0	43,200	2,160	2,880	32,880	100,800
Brinjal	150.0	37,500	1,500	4,500	3,300	150
Chilli (green)	80.0	32,000	1,600	1,200	115,200	47,200
Bitter gourd	30.0	5,100	300	840	25,200	7,200
Bottle gourd	93.75	14,063	563	469	9,469	15,000
Dolichos bean	50.0	21,500	1,500	1,700	11,000	8,000
Total (680.15 kg)	680.15	≈163,999 kcal	≈8,645 g (8.65 kg)	≈12,394 g (12.39 kg)	≈209,473 mg (209.5 g)	≈295,386 µg (295 mg)

Interpretation

- Total vegetables produced: 680.15 kg
- Total dietary energy: ≈ 1.64 lakh kcal
- Total protein: ≈ 8.65 kg
- Total dietary fibre: ≈ 12.4 kg
- Excellent source of Vitamin C, mainly from green chilli, bitter gourd, fenugreek, coriander and tomato.
- Excellent source of Vitamin A, mainly from palak, coriander, fenugreek and other leafy vegetables.

These values indicate that a 200 m² nutrition garden can substantially contribute to a family's requirements for vitamins, minerals, fibre and plant-based protein throughout the production period.

Note: If this is for a research paper or report, I can prepare the table using ICMR-NIN Indian Food Composition Tables (IFCT 2017) with additional nutrients such as calcium, iron, folate, potassium and carbohydrates, making it suitable for publication. Table 3 presents the estimated yield and nutrient contribution of vegetables cultivated in a 200 m² nutrition garden. A total production of 680.15 kg was obtained from 11 vegetable crops, comprising four leafy vegetables (palak, fenugreek, coriander and pundi) and seven fruit vegetables (tomato, brinjal, chilli, bitter gourd, bottle gourd and dolichos bean). The diversified cropping system ensured the continuous availability of fresh

vegetables throughout the growing period, thereby improving household dietary diversity.

The vegetables produced are rich sources of essential nutrients. The leafy vegetables contributed significant amounts of vitamin A, vitamin C, iron, calcium, folate and dietary fibre, while fruit vegetables supplied vitamin C, potassium, antioxidants and plant-based protein. Overall, the total harvest was estimated to provide approximately 164,000 kcal of energy, 8.65 kg of protein, 12.4 kg of dietary fibre, 209 g of vitamin C and 295 mg (295,000 μ g RAE) of vitamin A during the consumption period. Leafy vegetables can be grown efficiently in limited spaces and contribute to frequent harvests, improving productivity per unit area. Similar observations were reported by Kumar *et al.* (2020) [7], who emphasized that diversification of vegetable crops with short- and long-duration species improves land productivity and ensures regular supply of fresh produce. These nutrients play an important role in improving immunity, supporting normal growth and development, preventing micronutrient deficiencies and reducing the risk of diet-related diseases.

In addition to improving nutritional security, the nutrition garden reduced household expenditure on vegetables by ensuring a regular supply of fresh, safe and diverse produce. Thus, the 200 m² nutrition garden serves as a sustainable and cost-effective model for enhancing family nutrition, food security and overall well-being, particularly in rural households



a) Key officers of UASR



b) Farmers



c) School children



d) Self help group

Conclusion

The scientifically designed 200 m² Nutri Garden model effectively integrated crop diversification, efficient land utilization, and sustainable vegetable production to enhance

household nutritional security. The planned allocation of leafy, fruiting, gourd, and legume vegetables ensured continuous year-round availability of diverse and nutrient-rich produce. The inclusion of crops with varying growth habits and harvesting

durations optimized space utilization and productivity within a limited area. Furthermore, the integration of legume vegetables contributed to improved soil fertility, supporting sustainable cultivation practices. The proposed model offers a practical and adaptable framework for small-scale vegetable production under diverse agro-climatic conditions. Overall, the developed Nutri Garden demonstrates significant potential for improving dietary diversity, nutritional well-being, and sustainable household food systems.

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