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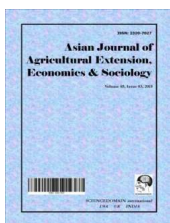
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## **Impact of School Nutrition Garden on the Nutrient Intake of Children**

**Mouneshwari Kammar<sup>1\*</sup>, A. P. Biradar<sup>1</sup>, S. C. Angadi<sup>1</sup> and G. Y. Vidyavathi<sup>1</sup>**

<sup>1</sup>*Krishi Vigyan Kendra, Bagalkot, University of Agricultural Sciences, Dharwad, India.*

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author MK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors APB and SCA managed the analyses of the study. Author GYV managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aims:** The main objective of the study was to assess the impact of school nutrition garden on the micronutrient intake of children, to combat micronutrient deficiency among children and to increase in ability and interest in incorporating healthier foods.

**Sample:** The study was conducted over two year of period at fourteen selected Higher Primary School and High schools of Raichur and Bagalkot taluka covering both public and private schools. The nutrients supplied by the cultivated vegetables were computed using Nutritive Value of Indian Foods [8] using the and were compared with amount of Recommended Dietary Allowance (RDA).

**Study Design:** Cross sectional.

**Place and Duration of Study:** Raichur and Bagalkot district of Karnataka state during 2015-16 and 2016-17.

**Methodology:** Cross sectional design was adopted and schools were selected on the availability of

\*Corresponding author: E-mail: [mrkammar13@gmail.com](mailto:mrkammar13@gmail.com), [manushre@yahoo.com](mailto:manushre@yahoo.com);

the place, water and willingness of teachers to maintain the garden with the help of children even during the summer holidays. Children and teachers were introduced to the concept of nutrition garden through orientation to balanced diet and importance of micronutrients. Other extension methods like celebration of World Environment Day (June 5), group discussion were also carried out to popularize the importance of nutrients. The vegetable seed kits containing eight varieties of vegetables developed by Indian Institute of Horticulture Research (IIHR) containing staple vegetables were distributed. These vegetables were grown in Kharif and Rabi season. Along with the seed kit, perennials like curry leaf, drumstick, fig and lemon were also supplied to the schools. Later each class of the children was allotted a specific vegetable for cultivation.

**Results:** After introduction of nutritional garden, the consumption of fresh vegetables increased in the daily diet which contributed towards the good health.

**Conclusion:** It is inferred from these results that school nutrition garden may be made mandatory for high schools with a provision of school garden kit.

*Keywords:* School nutrition garden; micronutrients; RDA.

## 1. INTRODUCTION

There is anecdotal evidence that school garden programs can enhance students' learning in academic, social, and health-related domains. There has been little rigorous research, however, on the effects of school gardens or on the factors that promote the sustainability of these programs. Garden-based learning is an educational strategy that utilizes school gardens to supplement instruction in a variety of disciplines. School gardens provide an atmosphere that incorporates hands-on activities and strengthens academic, personal, and social skills. The informal and unstructured format of garden learning is flexible enough for all different kinds of learners to benefit – and not just in math and science. Gardening can bring any curriculum category to life – from Language Arts to Lifestyle and Nutrition.

And when the garden is integrated into all subjects at all levels, it can be a very cost-effective hands-on learning tool, especially when compared commercial types of hands-on learning curriculum tools. Moreover, school garden benefits can be expanded to serving the produce grown in the cafeteria, or into entrepreneurship education when students sell their produce at a farmer's market. In addition, school gardens allow children to develop life skills in areas such as nutrition, leadership, and decision making. Benefits of Garden-Based Learning for Children improves knowledge of nutrition, food preferences, and consumption of fruits and vegetables [1,2,3] Integration of multiple subject areas, enhances overall academic achievement provides children with

understanding of agriculture and the environment [4,5] improves life skills, self-esteem, social skills and behavior [6]. Although the 2013 District-Level Household and Facility Survey (DLHS-4) reveals that the maternal mortality rate in Karnataka has dropped from 178 in 2008 to 133 in 2013, Karnataka is still way behind its southern peers on maternal health [7]. Highest numbers of maternal deaths are registered from north Karnataka districts such as Belagavi, Kalaburgi, Yadgir and Raichur. In infant mortality Rate (IMR) the state stands second, only after Andhra Pradesh. Karnataka has registered 133 maternal deaths per lakh when compared to Kerala which has 61 maternal deaths per lakh child births. Thus the child malnutrition is a leading factor for child mortality. With this background, though nutrition garden does directly aim at preventing malnutrition, but it will definitely help to educate the future generation on importance of nutrition. Hence, a demonstration on establishment of school nutrition garden was taken up by KVK Raichur and KVK Bagalkot. This paper examines the impact of nutrition garden established in schools on the nutrient intake of children, per child nutrient requirement of nutrients met by school garden and also economics of vegetable cultivation in the school garden with the following objectives.

1. To assess the impact of school nutrition garden on the micronutrient intake of children.
2. To combat micronutrient deficiency among children and
3. Increase in ability and interest in incorporating healthier foods.

## 2. MATERIALS AND METHODS

The study was conducted over two year period 2015-16 and 2016-17 in fourteen selected Higher Primary Schools and High schools of Raichur taluka and Bagalkot taluka covering both public and private schools. During 2015-16, a total of six schools from Raichur taluka namely St. Peter English Medium school, Muranpur (private), Govt. Higher Primary school, Puchaldinni, Govt. Higher Primary school Rajalbanda, Govt. Higher Primary school, Aijapur, Govt. Higher Primary school Ganjalli, and during 2016-17 a total of six schools from Raichur taluka namely GHS Singanodi, Morarji Desai Residential school Singanodi, LPS-Midagaldinni, LPS Julmagera, LPS Shakhavadi (Private) HPS Duganur and 2 schools from Bagalkot during 2016-17 i.e., HPS Tulasigeri and HPS Chabbi (Rehabilitation Centre).

In the initial stage, children and teachers were introduced to the concept of nutrition garden through orientation to balanced diet and importance of micronutrients. Along with the seed kit, perennials like curry leaf, drumstick, fig and lemon were also supplied to the schools. Later each class of the children was allotted with a specific vegetable for cultivation. Each school had reserved some area for nutrition garden. Cultivated vegetables were totaled and nutrients contributed by these vegetables were calculated. The nutrient content of the vegetables was assessed using the nutritive value of Indian Foods after enlisting the vegetables and the nutrient contribution of each vegetable per 100 gm [8].

Total month of vegetable garden was eight months.

The average number of children per school was 200 for Lower Primary Schools (LPS) (total strength of five classes from std. 1-5 and average no. of students per High school was again 200 i.e., total strength of 8-10 std. students ranging from 60-80/class). Thus, a total of 1400 children were studying in 14 schools. Vegetables cultivated were used for midday meals in the preparation of curry. The nutrients supplied by the cultivated vegetables were calculated and were compared with Recommended Dietary Allowance (RDA) prescribed by ICMR. Area under nutrition garden, total quantity of the vegetables harvested, per child availability during minimum and maximum production of vegetables was analyzed, yield and

economics of major vegetables cultivated were calculated. The nutrient intake through the vegetables was calculated using Per child availability= Total qty of nutrients/ Total no. of children.

## 3. RESULTS AND DISCUSSION

Table 1 reveals that, each school had its own fixed area reserved for school garden according to the availability. It was interesting to note that, one teacher each from each school (science teacher) were assigned the work of looking after the nutritional garden. There were eco clubs in all the schools which were responsible for the maintenance of greenery in the school. Muranpur school (private school) had reserved maximum area for school garden followed by Morarji Desai school (A residential, govt. school). Rest of the schools had very less area, but intensive cultivation of vegetables throughout year resulted in increased quantity of harvesting of vegetables. They harvested a minimum of 25 kg to 48.5 kg of vegetables. In private school the area allotted was more when compared to govt. schools.

The results implied that, the though there is provision for the supplementation of vegetables from the Govt. (Rs. 1/head/day) which is not sufficient to provide required micronutrients as per the RDA. However, contribution of iron and b-carotene to children was more than other nutrients by the nutrition garden; however they are not meeting the recommended dietary allowances by ICMR. It may be inferred from the results that, nutrition garden can play an important role in combating iron deficiency anemia and vitamin A deficiency. Hence, nutrition garden can supplement the micronutrients to the diet, besides providing knowledge on cultivation of vegetables and perennials.

Increase in ability and interest in incorporating healthier foods into family diets and guiding children in early childhood to make healthier choices; positive changes in shopping patterns reflecting healthy and local foods. [9,10]. Increase in access to fruits and vegetables increased in planning and preparing meals at home [11-13].

Results presented in Table 3. revealed that, after introduction of nutritional garden, the consumption of fresh vegetables increased in the daily diet which contributed towards the good health. Researches indicate that, using school

**Table 1. Area reserved by each school to nutrition garden and quantity of vegetables harvested**

Sl. no.	Name of the school	Area under kitchen garden (Gunta)	Harvested veg./ day (g)	Sl. no.	Name of the school	Area under kitchen garden (Gunta)	Harvested veg./ day (g)
1	Aijapur	2	250-3500	8	GHS Singanodi	4	1500
2	Muranpur	10	6000-15000	9	Morarji Desai Residential school Singanodi	10	3000
3	Puchaldinni	5	1500-4000	10	LPS-Midagaldinni	5	500
4	Ganjalli	1	250-5000	11	LPS Julmagera	6	2000
5	Rajalabanda	1	150-1500	12	LPS Shakhavadi (Private)	2	350
6	Julamgera	4	400-3000	13	HPS Duganur	4	1500
7	HPS Tulasigeri	5	5000	14	HPS Chabbi (RC)	5	2500

**Table 2. Additional nutrient intake by children through nutrition garden**

Each kg veg contributes	Approx. qty provided by each kg of vegetable	Total qty of nutrients with min. production of vegetables	Total qty of nutrients with max. production of vegetables	Contribution of nutrients
Protein(g)	4.9	1225	17150	0.88-12.25
Fat	2.0	12000	30000	8.57-21.43
CHO(g)	0.40	600	1600	0.43-1.14
Fe (mg)	10	2500	50000	1.79-35.71
Ca(mg)	0.40	60	600	0.04-0.43
B-carotene(µg)	5000	2000000	15000000	1428.57-10714

garden produce in school foodservice programs has been suggested as a means to improve the nutritional quality of food served at school lunch, integrate foodservice with nutrition education, and possibly reduce the cost of school lunches. [14,15]. The GOK has been assisting the schools with the Mid Day Meals programme, where in all the children in Primary, and higher primary are getting free meals in the afternoon. In that meal, Rs. 1.08 has been spent towards purchase of fresh vegetables. This amount is insufficient to meet the one third requirements of micronutrients for children. Hence, there is need to revise the amount reserved for the purchase of vegetables.

A good deal has been written and discussed about tendencies and benefits of school gardens. The study reported here documents many of the claims that have been made about these gardens and, it is hoped, will serve to contribute to an understanding of experiential learning and gardening participation. School gardens appear to be predominantly used by most schools to

enhance academic instruction through teaching subjects such as science, environmental studies, nutrition, language arts, and math. This indicates that the garden is being used to teach some of the core academic subjects, possibly with the incorporation of core curriculum standards [16]. Through a structured garden program, integration into the school curriculum, and monitoring progress, students and school administration can benefit from the changes in student attitudes and academic efficacy [17].

**Table 3. Yield and economics of selected vegetables grown at Nutrition garden**

Particulars	Demo
Yield (kg/300 sq.ft) Tomato	60
Yield (kg/300 sq.ft) Bell paper	14.2
Yield (kg/300 sq.ft) Brinjal	46.0
Yield (kg/240 sq.ft) Leafy vegetables	10
Cost of cultivation(Rs.)	540
Gross income (Rs/1200 sq.ft)	1904
Net Income (Rs/ 1200 Sq.ft)	1364

## 4. CONCLUSION

It is implied by these results that, benefits of nutri-gardens at school assures children a continuous supply of fresh, organic vegetables and inculcation of knowledge of agriculture. It is inferred from these results that school nutrition garden may be made mandatory for high schools with a provision of school garden kit. School nutrition garden may be made mandatory for high schools with the ensured support from community.

School food gardens had positive effects in particular on children described as “non-academic” or exhibiting “learning difficulties” and challenging behaviors. The space for education was described by teachers as “transformed” for children with complex needs [18].

Using school garden produce in school foodservice programs has been suggested as a means to improve the nutritional quality of food served at school lunch, integrate foodservice with nutrition education, and possibly reduce the cost of school lunches [14]. However there is a need for detailed clinical studies to analyze the impact of nutrition garden in combating deficiencies.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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