 DOI: https://doi.org/10.3126/jiaas.v38i1.73092

CONNECTING VEGETABLE GARDENS IN SCHOOLS AND IN HOMES: A SUSTAINABLE MODEL FOR NUTRITION SECURITY IN NEPAL

Dhruba Raj Bhattarai
National Agricultural Environment Research Centre, Nepal Agricultural Research Council
E-mail: raj01dhruba@gmail.com
https://orcid.org/0000-0001-9455-7819

Abstract

School vegetable gardening is an effective concept to enhance people's inclination towards eating more vegetables. It increases children's knowledge and awareness regarding the importance of vegetables for nutrition in health. School vegetable gardening also contributes to children's physical wellbeing and social skills. Linked with home gardens it can contribute to healthier diets. Based on experiences and evidence of school and home gardening projects this concept paper has been prepared. The purpose is to make an effective contribution to program planning to overcome the extensive problem of micronutrient deficiencies and for boosting immune system of individuals.

Keywords: school garden, home garden, nutrition security, vegetables

Introduction

Vegetables are the richest source of vitamins, minerals and bioactive phytochemicals required for maintaining good human health. However, vegetables consumption in Nepal is suboptimal (Sah *et al.,* 2004; Bhattarai *et al.,* 2017). Various interventions are being undertaken in Nepal to improve the nutritional status of people. For instance, the Ministry of Health and Population has been implementing micronutrient supplementation. This and other programs have produced visible results, but food insecurity and malnutrition remain large problems and much more progress is needed to achieve the Sustainable Development Goal of zero hunger (Government of Nepal, 2020). Recognizing malnutrition as a multidimensional issue which demands an interplay of different sectors including health, agriculture and education in synergistic ways, the government of Nepal has developed a Multi-sectoral Nutrition Planning Framework (Shrimpton *et al*., 2021; Ruducha *et al*., 2021).

Among the agricultural commodities, vegetables are key sources of essential micronutrients required for good health. The nutritional value of vegetables is well recognized as they are a vital source of essential vitamins, minerals, antioxidants, and dietary fiber. However, vegetable intake is very low in Nepal (Bhattarai *et al*, 2021) as well as elsewhere (Kalmpourtzidou *et al*. 2020).

The use of school vegetable gardening as a nutritional education tool is an approach to raise children's awareness about the importance of vegetables in healthy diets and nutrition for their health. Children can gain a more positive attitude towards eating vegetables and healthy eating more generally, which can promote the production and consumption of a diverse range of vegetables by their families and communities. To create such impact, school vegetable gardens are ideally implemented alongside home garden activities to involve parents and communities to increase the household supply of vegetables (FAO, 2010; Bhattarai *et al.*, 2017; Schreinemachers *et al.* 2020).

Vegetables and their health benefits

From time immemorial people have known that vegetables help to protect and recover from numerous ailments. However, during the last few decades because of rigorous scientific

investigation, the association between many plant-based compounds and the reduction of degenerative diseases and improvement of health is better understood. The major health-promoting compounds found in vegetables are vitamins, minerals and trace elements, and phytochemicals (glucosinolates, phenolics, carotenoids, prebiotics) while vegetables are also an important source of dietary fiber and water (Table 1). Naturally occurring phytochemicals have potential to overcome growing problems of non-communicable diseases like cancer, cardiovascular disease, and diabetes alongside many other health promoting functions. Research studies suggest optimal benefits of vegetables at a recommended daily consumption of about 300 grams (125 g leafy vegetables, 100 g root and tuber vegetables, and 75g fruit vegetable) per capita per day. Consumption of a high diversity of vegetables can improve health and well-being (Singh *et al*., 2015).

Table 1: Bioactive compounds and source vegetables

SN	Bioactive compound	Major source vegetables
1	Vitamins	Green leafy vegetables, carrot, pumpkin, pepper, green peas, beans
2	Minerals and trace elements	Leafy vegetables, broccoli, garlic, onion
3	Glucosinolates	Cabbage, broccoli, turnip, radish, brussels sprout
4	Carotenoids	Carrot, tomato
5	Phenolies	*Anthocyanin:* Red cabbage, purple broccoli, brinjal, rhubarb, radish, black carrot, onion. *Flavonoids:* Onion, lettuce, endive, horse radish, tomato, beans. *Flavones:* Celery, tomato, brinjal, garlic, onion. *Isoflavone:* Soybean, pea, broccoli, asparagus, alfalfa, okra.
6	Polyunsaturated fatty acid	Green leafy vegetables, broccoli, vegetable soybean
7	Dietary fiber	Legumes, onion
8	Thiosulphides	Onion, garlic, leek
9	Saponine	Bitter gourd
10	Phytosterol and stanol	Vegetable soybean and sweet corn

Source: Singh *et al*., 2015

Impact of home gardens

Global literature suggests that there is a positive contribution of home gardens towards enhancing nutrition security for resource poor families in developing countries (Galhena, 2012; Bird *et al,* 2019; Ruel *et al.* 2018). Vegetables grown in home gardens are a good source of micronutrients especially for low-income households for whom vegetables are often unaffordable to buy from the market. It is estimated that 40% of the world's population cannot afford a healthy diet with vegetables being of the most expensive categories of food (Hirvonen *et al.,* 2020). Studies suggest home gardens as a low-cost option to enhance nutritional status of rural people in Nepal (Bhattarai *et al.,* 2021). Studies from other Asian countries also confirm that home gardens are effective to improve the diets of low-income households as in the case of Laos (Suri, 2020), Bangladesh (Baliki *et al.,* 2022), Cambodia (Depenbusch *et al.,* 2022), and India (Murty *et al.,* 2016).

In Nepal and most other countries, women are in charge of home gardens and food preparation, and it is therefore essential to involve them in home garden and nutrition training. The characteristics of a typical home garden are described in Table 2.

Table 2: Typical characteristics of a vegetable home garden

SN	Characteristic	Values
1	Production objective	Family consumption
2	Labour source	Family members
3	Labour requirement	Part-time
4	Harvesting	Daily, weekly, seasonal
5	Space utilization	Horizontal and vertical
6	Garden location	Near to home
7	Gardening Technology	Organic and simple hand tools
8	Input cost	Low, locally available

Source: Galhena *et al.*, 2013; Bhattarai *et al,* 2021

Impact of school vegetable gardens in Nepal

To study the impact of school vegetable gardens, 30 schools were selected randomly from the mid-hill districts (Dolakha & Ramechhap) of Nepal using a randomized control trial (RCT) design. The intervention design is described in Bhattarai *et al.* (2016). Pre- and post-intervention data were collected on a sample of 1275 and 785 schoolchildren for the 2014 and 2015 school years. The results showed a significant increase in children's awareness and preferences about nutrient dense vegetables. After one year of intervention, the study found a significant ($p < 0.01$) increase in children's awareness about fruit and vegetables and their knowledge about food, nutrition and health. Children's stated preferences for eating vegetables (and fruit) also improved. However, these improvements did not translate into significant improvements in fruit and vegetable consumption or nutritional status. The study concluded that to influence children's food decisions, it may be required to work more intensively with parents and to increase the availability of vegetables in children's homes through complementary home gardens.

Table 3: Impact of school gardens on awareness and preference (% of correct answer) of vegetables in hills of Nepal

SN	Indicators	Awareness and preference (increased %)
1	Awareness about vegetables	89.4
2	Preferences to consume vegetables	81.1

Source: Bhattarai *et al.*, 2016; Schreinemachers *et al*, 2016

Combined school and home garden intervention's effects in Nepal

Schreinemachers *et al* (2020) conducted research in Sindhupalchok District of Nepal using a one-year cluster randomized controlled trial with 15 treatment and 15 control schools and a matched sample of 779 schoolchildren (aged 8-12) and their caregivers. The children and their parents were both provided with training in vegetable gardening and nutrition and both school and households were supplied with small packets of vegetable seed. Data were collected from children and parents before and after the intervention during the 2018-2019 school year. For parents, the results show a significant increase in their food and nutrition

knowledge (26%), agricultural knowledge (5%), liking for vegetables (10%) and home garden productivity (15%). For children, the results show no significant effect on food and nutrition knowledge but significant increases in their liking for vegetables (6%), healthy food practices (5%), and vegetable consumption (15-26%, depending on the season). The results therefore indicate that nudging children toward healthier food choices through school gardens requires targeting children as well as their parents. This study showed that such comprehensive intervention design was able to increase children's vegetable consumption by 15-26%, measured in terms of the proportion of meals that included vegetables. These results are indicative of the importance of comprehensive intervention designs (as opposed to school gardens as a standalone intervention) that aim to affect food behavior not just at the individual level, but at a household and community level.

Table 4: Combined school and home garden intervention's effects on children and their caregivers at Sindhupalckwk in Nepal

SN	Indicators	Impact (% increase)
1	Food and nutritional knowledge	26.4%
2	Agricultural knowledge	5.1%
3	Children's liking for vegetables	6.3%
4	Children's food and hygiene practices	5.2%
5	The number vegetable species harvested from the home garden	15.4%
6	The proportion of meals of children that included vegetable	15-26%

Source: Schreinemachers *et al*, 2020

Within one year of the project period significant effects can be seen in the combination model of gardening, that is school and home gardens. Therefore, long term national program on linking school and home gardens will be the good model for overcome nutrition security problem in Nepal.

Suggested model for nutrition security in Nepal

Food systems in Nepal are experiencing a rapid nutrition transition in terms of a shift towards ultra-processed foods high in sugar, fat, salt, low in fiber and low in nutrients other than energy which is indicative of a wider problem of unhealthy eating habits (Pries *et al.,* 2016; Schreinemachers *et al.,* 2021). Research findings suggested that the provision of even small amounts of spending money with school children appears to increase consumption of junk foods.

School gardens have become a widely used approach to influence children's knowledge of and preferences for healthy eating. However, in the case of low-income countries such as Nepal, this needs to be accompanied by interventions that provide households better access to healthy foods as market purchases are unaffordable to many households. The combination of school gardens and home gardens is therefore important.

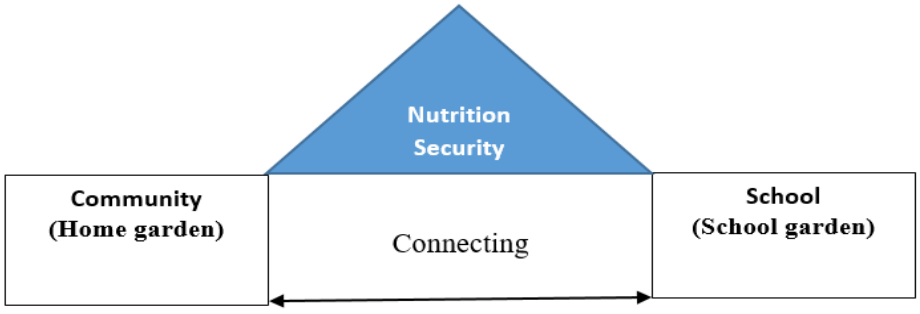

Figure 1: Suggested model for nutrition security in Nepal

Parents in the concerned schools should be provided with training and vegetable seeds for establishing and improving their home gardens. The garden-based training should encompass topics such as garden establishment, crop rotation, compost making, pest management and seed saving. Complementary nutrition training should include topics such as the role of vegetables for family health, the nutritional content of different food items and cooking methods to preserve the nutritional quality of vegetables. In addition to training, parents need to be provided with seeds of different nutrient-dense vegetables for the winter and summer seasons. In each school, one teacher should be identified as focal teacher for the school garden and be provided with training and technical backstopping. The focal teacher can also provide gardening advice to parents (and vice versa) and ideally visit the home gardens on holidays. An additional incentive should be given to the focal teachers for this extra work. The visits of school teachers to parents' homes to observe their garden is expected to create an additional nudge to motivate children and parents to implement their garden well (Table 5).

Table 5: Components for connecting school and home gardens

SN	Component	Values
1	School garden	Train the teachers on how to establish and manage the school garden for the cultivation of nutrient-dense vegetables
2	School garden curriculum or action plan	To teach school children about gardening, nutrition and WASH The teaching emphasis learning by doing, regularly conduct in the school garden.
3	Promotional activities	The activities include poster display and the distribution of booklets about nutritious food and hand washing Provide small packets of seed to replicate the vegetable garden at home and to share the lessons learned with their family members
4	Training to parent (mostly the mothers) through school gardening program	Training on vegetable gardening and nutrition (nutritional content of different food items, and cooking methods to preserve the nutritional quality of vegetables)
5	Visits of school garden focal teachers to parents' home	To create an additional nudge to motivate children and parents to implement their garden effectively

The school garden helps children to realize the importance of nutrient-dense vegetables and promotes a liking for them. If vegetables are available within their households, it is likely

that vegetable consumption at home inclines towards nutrient dense vegetables. Increased availability of vegetables can be promoted by motivating children to establish their own vegetable garden at home together with their parents and family members.

CONCLUSION

We can improve the health of people of our country through the integration of school gardens and home gardens in rural communities. Promoting school and home gardening to improve dietary diversity especially among children will defiantly contribute to good nutrition status in rural communities of Nepal. Furthermore, necessary evidence required for scaling school and home gardening programs at a larger level is available. School gardens linked to complementary lessons in agriculture, food, nutrition and promotional activities for children and parents have the potential to address malnutrition problem in Nepal. It has immense potential to increase children's awareness and knowledge about sustainable agriculture and sanitation. So, practical intervention of school vegetable gardening, nutrition & sanitation along with home gardening activities is necessary and should be practiced in all schools and communities of Nepal.

REFERENCES

Baliki, G., Schreinemachers, P., Brück, T. & Uddin, N.M., 2022. Impacts of a home garden intervention in Bangladesh after one, three and six years. *Agriculture & Food Security* 11, 48.

Bhattarai, D. R., Piya S., Bhattarai, D., Poudel, B. & Dahal, K.M. 2021. Impact of home garden interventions on household access to vegetables for nutrition security in Kavreplanchok district of Nepal. *Hort Int J Med.* 2021;5(5):187–190. DOI: 10.15406/hij.2021.05.00228

Bhattarai, D. R., Subedi, G. D. & Schreinemachers P. 2016. School Vegetable Gardening: Concept, Curriculum & Action. Khumaltar, Lalitpur, Nepal: Government of Nepal, Nepal Agricultural Research Council (NARC).

Bhattarai, D. R., Subedi, G. D., Acharya, T. P., Schreinemachers, P., Yang, R., Luther, G., Dhungana, G., Poudyal, K. P. & Kashichwa, N. K. 2016. ""Effect of school vegetable gardening on knowledge, preference and consumption of vegetables in Nepal.""*International Journal of Horticulture* 5 (20):1-7.

Bhattarai, D. R., Subedi, G. D., Gautam, I. P., Kashichhawa, N. K., Dhungana, U. & Shrestha, A. 2017. Better Nutrition for School Children in Nepal through School Gardens and Health Interventions: *Policy Brief:* Nepal Agricultural Research Council (NARC), Lalitpur, Nepal.

Depenbusch, L., Schreinemachers, P., Brown, S. & Roothaert, R. 2022. Impact and distributional effects of a home garden and nutrition intervention in Cambodia. *Food Security* 14, 865-881.

Ebert, A. W. 2020. The Role of Vegetable Genetic Resources in Nutrition Security and Vegetable Breeding. *Plants,* 9, 736; doi:10.3390/plants9060736

FAO, 2010. A new deal for school vegetable gardens. Food and Agriculture Organization of the United Nations, Rome. www.fao.org/docrep / 013/i1689e/

Galhena, D. H., Freed, R. & Maredia, K. M. 2013. Home gardens: a promising approach to enhance household food security and wellbeing. *Agriculture & Food Security* 2013, 2:8 http://www.agricultureandfoodsecurity.com/content/2/1/8

Government of Nepal, 2020. Nepal's Sustainable Development Goals Progress Assessment Report 2016–2019. Government of Nepal, National Planning Commission, Kathmandu.

https://www.undp.org/sites/g/files/zskgke326/files/migration/np/UNDP-NP-SDG-Progress-Report.pdf

Hirvonen, K., Bai, Y., Headey, D. & Masters, W.A. 2020. Affordability of the EAT-Lancet reference diet: a global analysis. *The Lancet Global Health* 8, e59-e66.

Kalmpourtzidou, A., Eilander, A. & Talsma, E.F. 2020. Global Vegetable Intake and Supply Compared to Recommendations: A Systematic Review. *Nutrients* 12. https://doi.org/10.3390/nu12061558

Murty, P.V.V.S., Rao, M.V. & Bamji, M.S. 2016. Impact of Enriching the Diet of Women and Children Through Health and Nutrition Education, Introduction of Homestead Gardens and Backyard Poultry in Rural India. Agricultural Research 5, 210-217. Bird, F.A., Pradhan, A., Bhavani, R.V., Dangour, A.D., 2019. Interventions in agriculture for nutrition outcomes: A systematic review focused on South Asia. *Food Policy* 82, 39-49.

Pries, A.M., Huffman, S.L., Adhikary, I., Upreti, S.R., Dhungel, S., Champeny, M. & Zehner, E. 2016. High consumption of commercial food products among children less than 24 months of age and product promotion in Kathmandu Valley, Nepal. Matern Child Nutr 12 Suppl 2, 22-37.

Ruducha, J., Bhatia, A., Carlyn, M. & Torlesse, H. 2021. Multisectoral nutrition planning in Nepal: Evidence from anorganizational network analysis. *Matern Child Nutr*.2020;e13112.wileyonlinelibrary.com/journal/mcn1of12 https://doi.org/10.1111/mcn.131122022;18(S1):e13112.

Ruel, M.T., Quisumbing, A.R. & Balagamwala, M. 2018. Nutrition-sensitive agriculture: What have we learned so far? *Global Food Security* 17, 128-153.

Sah, R. P., Bhurtyal, P. R. & Maharjan, B. B. 2004. Horticultural Research in Nepal; An overview and future direction. Proceeding of the fourth national workshop on horticulture. Nepal Agricultural Research Council, Khumaltar, Lalitpur, Nepal.

Schreinemachers, P., Bhattarai, D. R., Subedi, G. D., Acharaya, T. P., Chen H, Yang R., Kashichhawa, N. K., Dhungana, U., Luther, G. & Mecozzi, M. 2016. School Gardening in Nepal: Evaluating Outcomes and Impact. *Journal of Development Effectiveness* http://dx.doi.org/10.1080/19439342.2017.1311356

Schreinemachers, P., Ghassan, B., Manandhar, R., Bhattarai, D. R., Gautam, I. P., Ghimire, P. L., Subedi, B. P. & Brück, T. 2020. Nudging children toward healthier food choices: An experiment combining school and home gardens. Global Food Security. *Global Food Security* 26 (2020) 100454.

Schreinemachers, P., Shrestha, R.M., Gole, B., Bhattarai, D.R., Ghimire, P.L., Subedi, B.P., Brück, T., Baliki, G., Gautam, I.P. & Blake, C.E. 2021. Drivers of Food Choice among Children and Caregivers in Post-earthquake Nepal. *Ecology of Food and Nutrition* 60, 826-846.

Shrimpton, R., Crum, J., Basnet, S., Mebrahtu, S. & Dahal, P. 2014. Documenting the process of developing the Nepal Multi-sector Nutrition Plan and identifying its strengths and weaknesses: Report of a research project. Kathmandu, Nepal: UNICEF/European Union

Singh, N., Roy, S., Karmakar, P., Chaurasia, S. N. S., Gupta, S. & Singh, B. 2015. E-manual on improved production technologies in vegetable crops. ICAR-Indian Institute of Vegetable Research. Varanasi, India

Suri, S. 2020. Nutrition Gardens: A Sustainable Model for Food Security and Diversity. ORF Issue Brief No. 369, June 2020.