Original Research Article

Analysis of Vegetable Nutritional Garden Interventions to Improve Socio-Economic Status, Nutritional and Livelihood Security of Selected Beneficiaries under DST- WOS-B Project of District Moga, Punjab, India

Abstract

Aim: The study was carried out at Punjab Agricultural University, Ludhiana, Punjab to analyze the impact of the vegetable nutritional garden on the nutritional intake and socio-economic status of selected beneficiaries of District Moga, Punjab, India.

Study design: The Survey was conducted to assess the impact of the DST Project from 82 beneficiaries across the two blocks i.e. Village Khosapando and Niddhawala, Village Dagaru and Churchak from November- December 2019 and again August-September, 2021, through a structured questionnaire developed by the Department of Food and Nutrition.

: The data pertaining to the general profile, dietary habits, and socio-economic status of the beneficiaries.

Methodology: The dietary diversity questionnaire includes 12 groups of food like Cereals, Pulses, Green leafy vegetables, Roots, Tubers, Fruits, Vegetables, Milk and Milk products, Egg, Fat, Sugar, Meat and Miscellaneous. The information on respondents' food consumption was collected using (a 24-hour recall).

Results: The results have shown that there was a difference in the nutritional uptake of beneficiaries during the intervention period and before the intervention of the project. Under this project, the area under vegetable cultivation has increased significantly in all selected villages over the period 2019-2022 i.e. area under vegetable production in Village Khosa Pando, Dagru, Chuharchak and Nidhanwala increased by 91.6,100, 93.9, 94.2 percent. Moreover, the per capita income of farmers having landholdings of 0.5 to 1 acre and 0.1 to 0.5 acre has increased by 180 and 62 percent respectively. Furthermore, the consumption of green and leafy vegetables, roots and tubers, and other vegetables by intervention households increased drastically from 61.4, 48, 54 to 97.6, 95.0, and 88.1 respectively after establishing vegetable nutrition gardens.

Keywords: vegetable production, nutrient intake, beneficiaries, Livelihood Security

INTRODUCTION: Vegetables are increasingly considered an essential and cheap source of vitamins and minerals that provide food and nutrition security. Moreover, in developing countries, vegetable cultivation is a promising economic and sustainable approach to alleviating poverty and unemployment in rural areas (Rajasree and Pugalendhi 2021). Vegetable production is a key component of farm diversification strategies to improve dietary choices. In the current era, the importance of the economic and nutritional power of vegetables has not been sufficiently realized. It is crucial to realize the role of horticulture-based interventions in nutritional and livelihood security and income generation. Therefore, this is the right time to invest in vegetable cultivation to generate revenues and create awareness about the importance of consuming vegetables among people through horticulture-based interventions for small landholder farmers and providing healthy diets for all. Various studies have shown that agri-based interventions, such as establishing a vegetable nutrition garden with seasonal vegetable seed kits which contain high-quality vegetable seed can lead to a significant improvement in the nutrition of household members (Schreinemachers *et al*. 2015)

In low-income countries, dietary diversity in the context of vegetable consumption has actually reduced despite the average income increase (Global Panel 2016). Some families remain deprived of certain nutrients due to expensive animal products and vegetarian nature, so, vegetable nutrition gardens are a cheap source of organic and nutritive vegetables (Ali *et al*. 2008). Recommended daily consumption of vegetables is 300g per day per person, but the majority of people are only able to meet about 1/9^{the} of that requirement. Planned vegetable cultivation in a limited area will improve the nutritional requirement and food supply along with a high yield per unit area. India has a wide range of agro-climatic zones which offer a continuous supply of fresh vegetables throughout the year in different parts of the country. It was observed that people with poor economic status find it difficult to consume vegetables on a daily basis as vegetables are relatively expensive per kilocalorie of energy in comparison to other staple diets such as cereals. Therefore, they give priority to consuming energy-rich foods to meet the daily requirement of calories. At this point, giving low priority to consuming vegetables seems understandable and justiciable for the poor rural population (Schreinemachers *et al*. 2018).

Vegetables are a good source of antioxidants that reduce the incidence of cardiovascular diseases. Evidence suggested that horticulture-based nutrition interventions like establishing vegetable nutrition gardens offer a potentially sustainable approach to mitigating multiple nutritional deficiencies (Jones et al. 2005). Studies conducted on food consumption

suggest that cereal-based diets are much more prevalent among rural people due to the cheapest source of energy (Kaur 2005). In addition to this, any change in nutrient intake can lead to malnutrition with its serious consequences (Singh *et al*. 2014). Macro and micronutrient deficiencies among the elderly population are public health problems in most developing countries, partly due to a monotonous, cereal-based diet that lacks diversity. A study conducted in Zimbabwe found that vegetable nutrition gardens have a positive impact on livelihood as they provide steady incomes and curb diet-related diseases along with cheap vegetables thereby mitigating the daily food cost and also protecting the environment (Nyasha *et al*.; 2014 and Mohsin *et al.* 2017).

Access to variety contributes to dietary diversity in China was studied by Liu *et al*. (2014). It was observed that a higher cost of access negatively affects the individual's ability to diversify her diet in terms of both the total counts and the balancing of varieties consumed. In rural communities where consumers have been limited in their ability to diversify food baskets by high electricity and transportation costs, infrastructure development and modernization may effectively improve nutritional balance. Increasing the availability and consumption of nutrient-rich foods through a household's own production is considered to be a sustainable approach because the process empowers household members, particularly women, to take ultimate responsibility for the quality of the diet of the households through their own production and improved nutritional knowledge.

Dietary diversity has been universally identified as a key element of high-quality diets (Rathnayake *et al.* 2012). However, lack of dietary diversity is a major nutritional concern among deprived people from low-income countries. Changing from a monotonous diet to one with varied food types has been shown to improve energy and nutrient intake in people from developing countries (Jayawardena *et al.* 2013). Mushroom cultivation and production is common, particularly in Europe, America, and Asia to reduce vulnerability to poverty and strengthens livelihoods through income generation and nutritious source of food (Rachna *et al.* 2013). So, mushroom production was one of the components of the project to improve the overall nutritional quality of the diet and dietary diversity. Therefore, diversity in the diet is important to meet the requirements for energy and other essential nutrients, especially for those who are at risk of nutrition deficiencies. Therefore, there is a need to implement agriculture-based interventions for the nutritional and livelihood security of poor people.

To fill this gap, baseline data has been collected from 87 beneficiaries across the 02 blocks containing 04 villages i.e. Khosa Pando, Chuhar Chakk, Nidhan wala, Dagru under Block

Moga II and Dharm kot in Moga district of Punjab in May, Aug 2020 and July, August 2021 through a structured questionnaire developed by the Department of Food and nutrition college of Community Science, PAU. Seasonal vegetable kits developed by the Department of Vegetables Sciences, PAU Ludhiana were provided to selected beneficiaries to cultivate green leafy vegetables (Amaranthus, Indian spinach, Coriander, Spinach, Leaves of Pumpkin, and Cauliflower), roots and tubers (Sweet Potato, Radish, Onion, Carrot, Potato and Beetroot) and other vegetables including mushrooms (Ridge gourd, Pumpkin, Cowpea, Lady's finger, Tomato, Beans, French bean, Cucumber, Bitter gourd, Ivy gourd, Pointed gourd, Brinjal, Cauliflower, Cabbage, Spring onion, Ridge gourd, Chilli, Peas, and Mushroom) that are rich in vitamins and minerals, easy to grow and can be grown almost throughout the year. The objectives of this project are as follows

1. Detailed survey for baseline data on present socio-economic status, land holding, cropping preference of selected small and marginal farmers/ farm women and educating them regarding the harmful effects of indiscriminate use of pesticides and fertilizers on human health.
2. To train/skill up the selected farmers/ farm women for the establishment of PAU vegetable nutritional garden in front and backyards by advocating resistant/tolerant varieties along with scientific and eco-friendly methods to improve dietary diversity with button mushroom for their empowerment, nutritional, and livelihood security.
3. To enhance the regular income of selected farmer/ farm women by entrepreneurship development and formation of SHGs through off-season vegetables and multi-rack mushroom production.

This paper will undertake the impact of PAU Vegetable Nutritional Garden on human health, nutrient intake, dietary diversity, and income generation of selected beneficiaries of the Moga district.

MATERIAL AND METHODS:

Location, time, and respondents:

For this study, 3 surveys were conducted i.e. one survey was conducted to collect the baseline data of selected beneficiaries to collect information about their dietary food habits before the implementation of the project during March- April 2019, and the remaining two surveys were conducted in different season in a whole year i.e. summer season (April to September) and winter season (November to March) 2020-2021 from 87 farmers across the 02 block containing 04 villages i.e. i.e. Khosa Pando, Chuhar Chakk, Nidhan wala, Dagru under Block Moga II and Dharm kot in Moga district of Punjab, India.

In the selected villages, the total land holding of all farmers ranges from 0.16 acres to 10 acres whereas land under vegetable production ranges from 0.18 acres to 01 acres. However, the area under vegetable production has increased under the influence of this project. Current research has also utilized, Mobile phones, Video calls, and WhatsApp groups for precise and on-the-spot solutions for updates and feedback messages from beneficiaries due to COVID -19 Pandemic. The nutritional survey was conducted to analyze the nutritional status and dietary patterns of rural households. Methods used for the nutritional survey were the '24-Hour Recall Method' and 'Food Frequency Questionnaire' developed by the Department of Food and Nutrition. The dietary diversity questionnaire includes 12 groups of food like Cereals, Pulses, Green leafy vegetables, Roots,Tubers, Fruits, vegetables, Milk and milk products, Egg, Fat, Sugar, Meat, and Miscellaneous. From each village, about 20 households were selected for the survey on the basis of land availability for the Vegetable Nutritional Garden.

Under this project, **06** awareness camps and **08** training camps were organized for mass mobilizations about horticulture-based interventions of the current project to solve their problems including good Vegetable Practices like the use of PAU vegetable Trap, Yellow Sticky Traps, and Plant Extracts to minimize the use of chemical pesticides for better health and wellness. In addition to this, **09** Field visits/Demonstrations for the "Learning by Doing" exercise for better rapport with beneficiaries and **02** Hands-on pieces of training for skill /entrepreneurship development of selected beneficiaries were organized in every village. Statistical analysis was done using Mean and standard error was calculated for various parameters. T-test was used to assess the significant difference between various parameters.

RESULTS AND DISCUSSION:

The average daily food intake before and after the implementation of horticulture interventions is given in table 1. The percent adequacy of various foods in comparison with suggested values of selected beneficiaries (Pasricha and Thimmayamma 2010) is shown in Fig 1. These horticulture interventions simultaneously address vegetable availability, access, demand, and utilization and help to achieve the target of consuming the recommended intake levels of 400 g per day. This sustainable and economical approach is effective at increasing vegetable consumption among poor rural farms holds vulnerable to micronutrient deficiencies (DFID, 2014; Galhena *et al*. 2013; Olney *et al*. 2009; Schreinemachers *et al.* 2016).

The most commonly used cereals among all the respondents were wheat and wheat products (cracked wheat, refined wheat, semolina, etc.) and rice. The average daily intake of cereals among selected beneficiaries was around 292 g with a percent adequacy of 83% before interventions. No significant difference was found in the cereal intake before and after the interventions. The mean intake of cereals in 3 income groups was 252.2, 249.3, and 264.0 g day-1 with percent adequacy of 76.4, 75.5 and 80.0 in low (LIG), middle (MIG), and high (HIG) income groups, respectively (Singla *et al*., 2017) . However, the intake of pulses and legumes increased marginally. Similar findings on the diet and nutritional status of women have been reported by Rao *et al*. (2010). Furthermore, the consumption of green and leafy vegetables, roots and tubers, and other vegetables by intervention households increased drastically from 61.4, 48, 54 to 97.6, 95.0, and 88.1 respectively after establishing vegetable nutrition gardens.

Rethi *et al*. (2020) noticed the same results that 76.2 percent of women have started consuming vegetables on the daily basis to fulfill their nutritional requirements after introducing horticulture interventions. A Study conducted by Talukder *et al*. (2010) that with the establishment of nutrition garden volume and variety of vegetables produce inclined to three to four times approximately and the same results have been found in our study. Akrofi *et al.* 2010 reported the contribution of food items from the vegetable nutrition garden to the DDS (6.8) was significantly higher in HIV-positive (14.9%) than in HIV-negative households (9.1%) that don't have a vegetable nutrition garden in their home and have DDS 6.0. The results of K. Chayal *et al*., (2013) line with our results where production of vegetables at the household level increased by 169.27 percent leading to an increase of 85.66 % in vegetable consumption and money-saving. However, non-significant differences were observed in other food types such as fruits, sugars, milk and milk products, and fats and oils.

The concept of “Horticulture for sustainable development" by the United Nations, prioritize ending poverty as one of the most important Sustainable Development Goal (SDGs) by creating employment opportunities in the horticulture sector. The production and sale of fruit and vegetables, especially on a small scale, is an effective tool for rural poverty alleviation and meeting the recommended nutritional requirements among farmers having small landholding. (Jaenicke and Virchow 2018)

Growing and selling market-oriented vegetables at a commercial scale not only enable small-scale farmers to reduce poverty but also help the farmers to become agricultural entrepreneurs throughout the whole food value chain (Maertens 2009; McCulloch and Ota 2002). However, extension services by KVKs are mandatory to make the farmers aware of the production, storage, transportation, and marketing.

Weinberger and Lumpkin (2005) noticed that farmers involved in the production of vegetables often earn higher incomes than those engaged in the production of cereal crops alone. Under the influence of this project, the per capita income of farmers having landholding of 0.5 to 1 acre and 0.1 to 0.5 acre has increased by 180 and 62 percent respectively. Dubey *et al*. (2017) found the same impact of vegetable production on an increase in per capita income of selected beneficiaries after interventions. In another study, Dubey *et al*. (2021) noticed that agriculture and dairy occupation contributes to high total and per capita income among different groups of landholders.

Before the project, farmers used to cultivate only 5 to 6 vegetables but during the project, they were guided to grow 21 types of seasonal vegetables which ultimately led to an increase in food diversity. In rural areas, sometimes the sale of extra vegetables and mushrooms from home gardens is the only source to earn livelihood for farm women. Therefore, farm women were trained to generate income from mushroom production on a commercial level along with the consumption at home Table 3. The mushroom farming enterprises have a significant impact on mushroom farmers to raise the income of the farming community, creating additional employment opportunities, and provide sustainability to the existing cropping system. Mushroom farming is transforming farmers into full-scale entrepreneurs by diversifying toward mushroom spawn production, mushroom processing, and mushroom trade, improving farming health and education, and supporting the local economy (Kaur 2019). Ali (2005) conducted research on

vegetable nutrition gardens where mushroom cultivation and bee-keeping are included in the garden contributing to the share of proteins and other nutrients available for the family.
Allagbé *et al*. (2014) noticed that market-oriented vegetable farming provides a nutritional and balanced diet to the rural population along with enhanced farmers' household income and living standards In Benin.

Under this project, the area under vegetable cultivation has increased significantly in all selected villages over the period 2019-2022 i.e. area under vegetable production in Village Khosa Pando, Dagru, Chuharchak and Nidhanwala increased by 91.6,100, 93.9, 94.2 percent. Sunny and Sanjay 2012 reported that the area under vegetable cultivation had almost doubled whereas the production had increased by three times over the period 1985–86 through 2010–11 in India. During the period 1990–91 to 2005–06, the increase in production of vegetables in Punjab was found to be due to the effect of the area but during 2005–06 to 2010–11, the effect of productivity was higher. Sidhu *et al.* (2010) reported that the growing of vegetable crops at the household level not only helps to enhance the quantity and quality of food intake but also contributes to a decrease in the area under paddy wheat rotation besides reducing family expenditure.

Kundu and Tapan (2020) conducted a survey in belts of the south 24 Parganas district of West Bengal and observed a significant increase in the annual per capita consumption of vegetables. In the Madan Nonglakhiat village, farmers were provided with seasonal vegetable seeds, seedlings, a package of practices, and popularized technology for three years by KVK Ri-Bhoi. Consequently, the yield has increased from 12 to 64 percent in vegetables and 341 percent in spices (Islam *et al*. 2021). Dubey *et al.* 2017 reported a 59.42, 59.43, and 57.28 percent increase in consumption of different vegetables like green leafy vegetables, roots, tubers, and other vegetables respectively. Similarly, vegetable consumption in villages Khosa Pando, Chuharchak, Nidhanwala, and Dagru inclined by 58.6, 71.3, 80.0, and 78.2 percent respectively under this project.

Conclusion: The literature summarized in an earlier section of this, agrees that horticulture-based agricultural programs are a sustainable approach and contribute to improving livelihoods and nutritional security, diet quality, social status, economic performance, self-employment, and women’s empowerment of district Moga of Punjab. There is **a paradigm shift in the mindset of beneficiaries of the Aspirational district of Moga** and it's not only selected beneficiaries

but also their close relatives and friends w.r.t. the importance of vegetables in their daily diet as well as for commerce.

- **86** families adopted PAU Vegetable Nutritional Garden for nutritional and livelihood security and the saving of their hard-earned money by growing PAU Vegetables Nutritional Garden was worth **Rs.1500/-to 1700/**- per month per family.
- **13** beneficiaries have adopted improved vegetable varieties developed by PAU for commercial cultivation for a regular income of approx. **Rs.25,000**/ 0.125 Acre to **Rs.3,50,000**/Acre/year.
- About **three times increase in yearly income** by selling of vegetable varieties of PAU ie. Pea (Pb. Ageta), Green and dried Chilli (CH-27), Coriander (Pb. Sugandh), Okra (Pb. Suhawani), Onion (Pb. Naroya),Garlic (PG-18),Palak (Pb. Green) Mentha ,Kasuri Menthi (Kasuri Supreme), Radish(Pb.Safed Mooli-2), Bottle gourd (Pb. Komal), Sponge gourd (Pb. Nikhar), Carrot (Pb.Black Beauty) as compare to Rice-wheat cropping system prevailing in Moga district of Punjab.
- **11** families have adopted the production of multi-rack button mushrooms and earned approx. **Rs.9400** to **84,000**/season for their livelihood security and empowerment.
- **57** beneficiaries have produced button mushrooms for their nutritional and livelihood securities.
- Moreover, training of eligible households in a rural areas in establishing vegetable nutrition gardens significantly increased the per capita supply of vegetables by 16.5 g/day, most of which was consumed within the own household. It also led to an increased diversity of vegetables in the households' diets

Such interventions will help to achieve the target of malnutrition-free India by 2022 under the National Nutrition Mission or POSHAN Abhiyaan by Govt. of India.

Consent

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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Table 1: Food Intake of Selected Beneficiaries

FOOD TYPE	BEFORE	AFTER	P- value	Suggested intake
Cereals	292±7.64	294 ±6.54	0.8531[NS]	350 [a]
Pulses and legumes	42.29 ± 0.892	46.36 ± 0.652	0.0003***	50 [a]
Green leafy vegetable	30.74 ± 1.868	49.84 ± 0.652	0.0003***	50 [a]
Roots and tubers	55.00 ± 0.629	95.00 ± 0.629	0.0001***	100 [a]
Other vegetable	92.24 ± 6.759	142.24 ± 11.759	0.0006***	150 [a]
Fruits	105.4 ±11.213	108.88 ± 10.956	0.8244[NS]	200 [a]
Milk and milk products	431.83±19.462	516.73± 20.58	0.0001***	300 [ab]
Sugar	32.49 ± 1.243	32.43 ± 1.240	0.1815[NS]	20 [ab]
Fats and Oils	39.82 ± 1.719	41.15 ± 1.424	0.4001[NS]	25 [ab]
Meat and poultry	173.25±6.884	170± 9.02	0.1081[NS]	----

[a] Pasricha and Thimmayamma (2010)
[b] ICMR (2010)
[NS] Non significant; *Significant at 10%; *** Significant at 1%

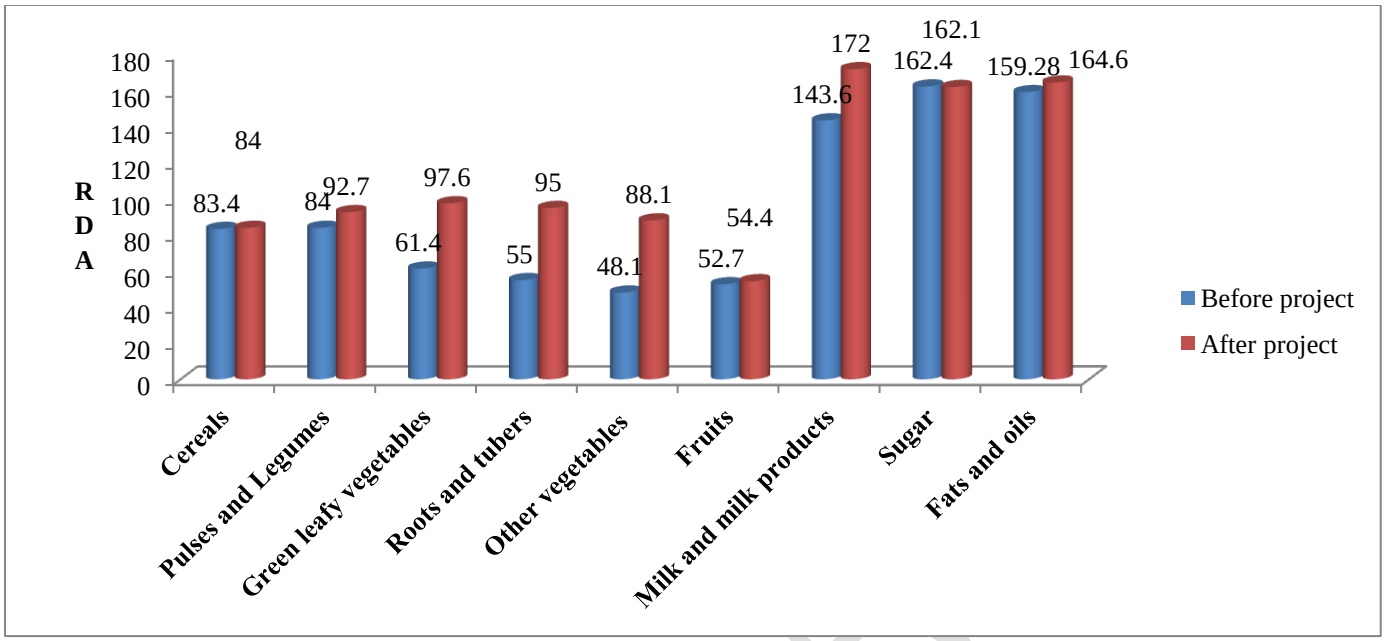

Fig 1: Percent Adequacy of Food Intake of Selected Beneficiaries Before and After Interventions

Table 2: Economic Status of Small Land Lolders

Income Per Year (Rs)	Vegetables Cultivated	Group I Landholding (0.5 Acre to 1 Acre)	Group II Landholding (0.1 Acre to 0.5 Acre)
Per capita income before intervention of the project	Okra, Bottle gourd, Toria, Palak Radish Pea, Metha, Onion, Potato, Garlic, Chili	Rs 1,25,000/-	Rs 55,000/-
Per capita income after intervention of the project	-do-	Rs 3,50,100	Rs 89,450
Yield (Qtl)	-	259.75	33.32
Percent increase in income	-	180	62

Table3: PAU Button Mushroom for Income Generation and Livelihood Security of Selected Farm Women

Mushroom bags (No.)	Yield (Kg)	Income (Rs)
45	81.0	9,315

90	157.5	18,055
350	735.0	84,525
56	100.8	12,342
45	76.5	8,797
35	56.0	6,440
48	86.4	9,936
75	157.5	17,250
62	117.80	13,547
75	129.0	14,835
65	117.0	13,455

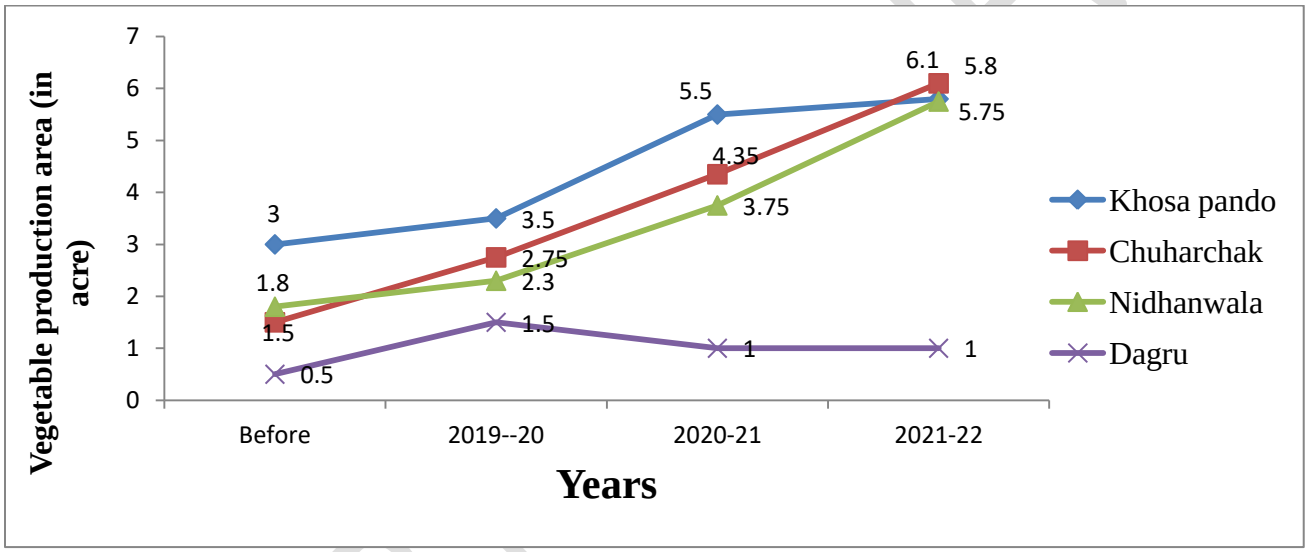

Fig 2: Increase in Areas under Vegetable Production Before and After Intervention of Project in Selected Villages of District Moga

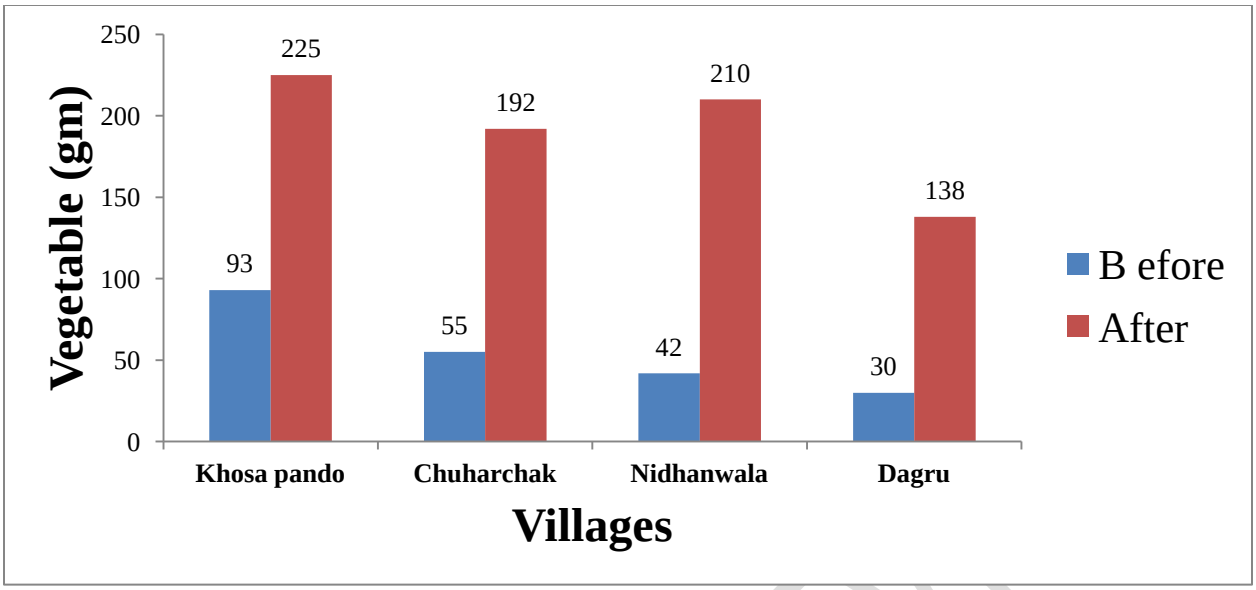

Figure 3: Daily Consumption of Vegetables per Person Before and After Establishing Vegetable Nutritional Garden under DST WOS-B Project of Selected Villages