Ecological and Economic security through Organic Vegetable Cultivation in the Raised Bed Model: A case study of Akshayakalpa organics in Tiptur, India

Abstract

This paper explores the potential role of organic vegetable production technologies in ensuring ecological and economical security for farmers. In the current scenario, the survival of farmers, especially small and marginal farmers is challenged by several problems such as low land holding, decreased subsidies for inputs, high labor cost, high input cost, less market rate, increased cost of living and increased awareness about health benefits of organic vegetable consumption among economically middle and high strata of society leads to more demand for organic vegetables. Under these conditions, diversification of the cropping system with high-value crops like vegetables can be the best option for the farmers. In this context, modern technologies and practices are needed for higher and more sustainable production and productivity of vegetables and to maintain a good ecology in the farm.The raised bed is one of the technologies in which beds are raised with a stone border and this model has several advantages for small and marginal farmers. The vegetables are grown organically in one acre of area. The average yield per month is 903.69 KG, the average gross revenue generated per month is Rs.53,783.25/- and average total expenditure per month is Rs. 21,584.35. The Average Air temperature for three months within the farm, outside of the farm (open area) and outside of the farm (shade area) is 27.49°C, 29.22°Cand 28.54°C respectively. The Average soil temperature for three months within the farm, outside the farm (open area) and outside the farm (shade area) is 23.48°C, 25.54°Cand 24.20°C respectively. The Average Relative Humidity for three months within the farm, outside the farm (open area) and outside the farm (shade area) is 60.42 %, 52.38 %and54.15 % respectively. Due to buffer zone microclimate has been created inside the farm. The temperature and RH difference can be noticed within and outside of the farm. This system requires a smaller amount of labor and less water when compared to conventional farming. With all its advantages the farmer can be assured of economic and ecological security.

Key words: Buffer Zone, Ecological Security, Economic security,Organic farming and Raised bed.

Introduction:

As per Ministry of Agriculture and Farmers welfare, Government of India, during 2020-21, India produced 200.445 million metric tons of vegetables. The area under cultivation of vegetables was10.859 million hectares.Organic vegetable growing could be more productive and rewarding than growing with fertilizers or chemicals (Pimpini et al., 2005). Vegetable crops aids for food and nutritional security. They are found to be rich in vitamins, fibre, minerals and contain a good quantity of carbohydrates and proteins. Demands for vegetables are found not only in local markets but also in domestic and international markets. Before Independence, vegetable production was around only 15 MT and now it is found to be 184.39 MT during 2018-2019 (NHB, 2018). Though India is the second largest vegetable producing country in the world next to China, it is found that productivity of some vegetable crops isless than the world's average productivity. It is recommended by Indian Council of Medical Research (ICMR) that 300 g/head/day of vegetable should be consumed in routine diet. The demand for vegetables keeps on increasing. Therefore, to feed the increasing population, productivity or vertical expansion should be increased. Strategies should be planned such that vegetable production must be higher with less use of land, water, energy, and resources. Organic vegetable cultivation imparts long lasting stability for production by enhancing soil health. It fetches 10 to 50% premium price over conventional production and has faster marketing rate (Ashely et al.,2007; Smukler et al., 2008)

Therefore, there is an urgent need for more environmentally benign strategies to be adopted in intensive vegetable production. Hence Akshayakalpa organics started to work on organic vegetable cultivation. Raised bed was the new practice adopted by Akshayakalpa. Without chemical inputs vegetables are grown since from 2017.This production model also includes buffer zone, according to the USDA organic regulations, a buffer zone is "an area located between a certified production operation or portion of a production operation and an adjacent land area that is not maintained under organic management. A buffer zone must be sufficient in size orother features (e.g., windbreaks or a diversion ditch) to prevent contact by prohibited substances applied to adjacent land areas." In Akshayakalpa banana, curry leaves, papaya, drumstick, citrus etc has been grown in buffer zone which gives the additional revenue.

Consuming vegetables supports food safety issues, as vegetables contain various vitamins and micro-nutrient. In relation to food security, high valued vegetables are expected to indirectly support household food security, since the sale of such vegetables could be traded for food. Other vegetables are obviously expected to directly support household food security through substitution or supplementation of staple foods. Smallholding farmers do not grow high valued vegetable alone.

In this paper, we explore the potential roles of vegetable production and improved production technologies in ensuring ecological and economic security to farmers. This articleanalyzesthe potential impacts of raised bed model on productivity and ecological benefits.

Material and methods:

The study was conducted at a place called Kodihalli, which is located near Tiptur, Tumkur district of Karnataka. One acre of land was selected,and Totally52 beds were raised. The beds are with the dimension of 70*4*1 feet. Out of 4000 sq.mt area only 1200 sq. mt of area is used for crop production, rest of the area is used for walking path and creating buffer zone.The fertile soil was used to raise the bed. Planting materials was initially burrowed fromprogressive farmers and local nurseries.The crops include leafy vegetables (Coriander, Mint, Amaranthus, Spinach and Dil), Flower vegetables (Cabbage and Cauliflower), Root, Rhizomes and Tubers (Potato, Yam, Carrot, Radish, Beetroot, Zinger, Turmeric), Fruit vegetables (Chilly, Tomato, Brinjal, Bhendi), seed vegetables (beans and its varieties)

Descriptive research design has been employed; the primary data has been collected by researcher. The data on expenditure, revenue and production has been documented for each month. Soil test reports,microclimate parametersi.e., Air temperature, Soil temperature and RHhave been recorded for each month. These readings were recorded two times a day during the morning and evening with the thermometer. Using descriptive statistics, the data has beenanalyzed with statistical tools such as frequency and percentage. The results have been summarized below.

Results and discussion:

The data revealed that 903.69 kg of vegetable production can be seen every month. This model is generating total revenue of Rs. 53,783.25 per month and with the expenditure of Rs. 21,584.35.

Table 1: Table representing the production, productivity, and profit of Raised bed model.

Month/Year	Crop Production per Ac (in KG)	Gross Revenue in Rs (per Month)	Total Expenses in Rs (Per month)	Diff in Rs. Per Month
Jan-19	773.70	50,000.00	22733	27,267.00
Feb-19	953.95	56,479.00	23400	33,079.00
Mar-19	779.50	44,881.00	22800	22,081.00
Apr-19	559.70	32,761.00	22767	9,994.00
May-19	678.64	32,506.00	20966	11,540.00
Jun-19	782.90	36,699.00	22053	14,646.00
Jul-19	672.23	35,734.00	23753	11,981.00
Aug-19	520.78	34,121.00	22163	11,958.00
Sep-19	744.03	29,344.00	22863	6,481.00
Oct-19	739.70	39,217.00	22053	17,164.00
Nov-19	746.58	48,899.00	17764	31,135.00
Dec-19	845.35	38,152.00	21936	16,216.00
Jan-20	928.12	40,933.00	22134	18,799.00
Feb-20	821.95	48,572.00	22134	26,438.00
Mar-20	929.80	37,990.00	22163	15,827.00
Apr-20	996.80	59,253.00	22832	36,421.00
May-20	977.95	56,590.00	22163	34,427.00
Jun-20	928.12	54,334.00	17932	36,402.00
Jul-20	865.02	48,430.00	22744	25,686.00
Aug-20	774.50	69,706.00	22733	46,973.00
Sep-20	991.50	43,933.00	17933	26,000.00
Oct-20	940.83	78,857.00	22600	56,257.00
Nov-20	770.79	65,399.00	17402	47,997.00
Dec-20	559.79	36,536.00	17966	18,570.00
Jan-21	1,480.60	28,737.00	17933	10,804.00
Feb-21	981.90	65,067.00	17942	47,125.00
Mar-21	1,260.22	53,928.00	20811	33,117.00
Apr-21	1,495.96	66,387.00	22823	43,564.00
May-21	1,497.00	81,672.00	19701	61,971.00
Jun-21	593.58	63,088.00	17400	45,688.00
Jul-21	901.06	42,711.00	20482	22,229.00

Aug-21	907.36	51,639.00	17400	34,239.00
Sep-21	1202.75	65,997.00	19702	46,295.00
Oct-21	726.45	75,388.00	21920	53,468.00
Nov-21	542.84	60,072.00	25014	35,058.00
Dec-21	726.35	40,279.00	25348	14,931.00
Jan-22	964	60,669.00	17650	43,019.00
Feb-22	1006	72,523.78	19954	52,569.78
Mar-22	1085.5	69,797.00	21120	48,677.00
Apr-22	1184.7	75,884.00	33618	42,266.00
May-22	1151.2	85,215.60	22656	62,559.60
Jun-22	965.3	72,952.00	22667	50,285.00
Jul-22	773.70	61,347.50	27999	33,348.50
Average	*903.69*	*53,783.25*	*21,584.35*	*32,198.90*

Initially the production will be less because the land will be in conversion process. As the year passes the yield also increases. In general, 10 per cent of grading loss can be observed in vegetable cultivation. After deducting all the grading losses an average of 903.69 kg of yield and Rs. 53,783.25/- of total revenue can be seen per month. However, the increase in revenue also depends on the market price of the vegetables. Sometimes the increase in market price of some of the vegetables like tomato, onion, leavy vegetables etc brings the higher revenue. This model incurs the monthly expenditures of Rs. 21,584.35/- per month. the expenditure includes all the total input cost, management cost and two labour cost.

In raised bed organic vegetable farming the production and productivity increase over the days because the soil fertility and soil productivity also increase over a period.The decrease in the expenditure cost and increase in the revenue makes the farmers to get good profit margin. Hence the farmers are economically secured with this model.

Table 2: Soil test reports

Test.no.	**Year**	**pH (6.3-8.3)**	**EC (<1)**	**OC (0.5-0.75)**	**Cu (0.2-2.0 ppm)**	**Zn (0.6-1.2 ppm)**	**Fe (4.5-9.0 ppm)**	**Mn (2.0-4.0 ppm)**	**N (280-560 KG/Ha**	**P_2O_5 (22.5-55 kg/ha**	**K (144-336 Kg/ha)**
1	2022	6.07	0.370	**0.53**	1.371	0.382	2.976	3.494	273.4	20.84	289.49
2	2021	7.62	0.285	**0.5**	0.835	0.344	5.612	5.278	294.78	21.76	327.4
3	2020	7.92	0.31	**0.56**	1.148	0.562	3.66	3.601	323.01	23.5	367.72
4	2019	7.90	0.330	**0.59**	1.12	1.04	13.20	11.92	269.7	34.12	371.6
5	2018	7.00	0.25	**0.49**	0.41	1.00	3.18	0.46	231.4	12.06	202.80

Soil test will be conducted every year. The table illustrate that all the soil parameters are found to be within the range. Mainly Organic Carbon (OC) is maintained above 0.5. The neutral soil pH (6.5-7.5) is maintained. Electric conductivity (EC) is found to be within the limits (<1) all this is due to the use of Cow dung slurry, Manure, Compost, Vermicompost, Jeevamruta (Made out of cow dung, cow urine, dicot flour, jaggery and handful of soil).

Even for pest control Dashaprani (Natural herbicide made out of any 10 following plant leaves -Neem leaves and twigs cut into smaller pieces, Karanj/Ponga leaves, Gliricidia leaves, Custard Apple Leaves, Lantana leaves, Tumbe(Leucas) leaves, Parthenium leaves, Adhatoda leaves, Neem Leaves, Castor Leaves, Dhatura leaves, Vitex Leaves, Krishna Thulasi stem, leaves, cut into small pieces. Marigold root, branch, stem, flower, leaves.cut into small pieces. Erukam leaves, Ganneru leaves, Mango leaves, Papaya leaves, Hibiscus leaves, Murungai leaves) used instead of pesticides. The status of major and micronutrients in soil help us to manage the nutrient requirements of the soil.

Organic agriculture is a system of soilmanagement and food production that represents natural ecosystems to maximize the recital of renewable resources, enhance valuable organism populations, and maintain/improve the soil fertility. It is based on minimal use of off-farm inputs and does not utilize synthetic pesticides, herbicides or fertilizers and genetically modified organisms. Simultaneously, organic livestock production also requires considerable pastureland and prohibits the use of synthetic foodstuff, growth hormones and antibiotics. Organic farming has great potential to improve carbon storage (Pimentel et al. 2005). Niggli et al. (2009) estimated the global average sequestration potential of organic farming is about 0.9 – 2.4 Gt Co2/year, which is equivalent to an average sequestration potential of 200-400 kg C/ha/Year for all crop lands. The organic farming can produce two to eight times as much soil carbon per unit of biomass carbon input then conventional non-organic farming systems. The long-term adoption of organic production practices significantly increases the soil organic carbon and carbon stock and reduces the bulk density as compared to inorganically managed field.

Farming practices are known to exert strong control oversoil organic carbon (SOC) content because they affect bothinput and turnover rates of soil organic matter (SOM).Whether practices lead to either an increase or adecrease in SOM content has implications for environmental policy, with respect to soil carbon sequestration. Measures that offset some of the anthropogenicCO2 emissions could mitigate global warming (Lal 2004).Soil carbon sequestration is a key measure in agricultureand may counterbalance large proportions of agriculturallyinduced emissions of methane and nitrous oxide (UNFCCC2008).

Table 3: Climatic data

Area	Soil Temp℃	Air Temp ℃	RH (%)	Light
Raised bed model	23.48	27.49	60.42	High
Open Area	25.54	29.22	52.38	High
Shadow Area (tree cover)	24.20	28.54	54.15	High

Throughout the year, there are 162.5 rainfall days, and 711mm of precipitation is accumulated in this area (Tiptur)

The temperature and RH difference was recorded with in the farm, and outside the farm (open area and tree cover/shade area).

The soil temperature in the farm is 23.48 whereas, in open area it is 25.54 and in tree cover area it is 24.20 respectively. the air temperature in the farm is 27.49 whereas, in open area is

29.22 and in tree cover area 28.54 respectively. The relative humidity inside the farm is 60.42 % whereas, in open area it is 52.38% and in shade area it is 54.15%.

In real sense it refers to a comprehensive approach towards improvementof both health of underlying productivity of the soil and plant leading to the enrichment of thesurroundingecology,whichisapre-requisitecriterionforsustainableagriculture(Barik and Narayan, 2017).AccordingtoIFOAM,"Organicagricultureisaproductionsystemthatsustainsthehealth ofsoils,ecosystemsand people". It relies on ecological processes, biodiversity and cycles adapted to local conditions,ratherthantheuseofinputswithadverseeffects.Themajorobjectivityoforganicfarmingresidesondevelopmentofaself-sustainablefarmingsysteminharmonywithnaturewhichdeliversecologicallyandeconomicallysustainablepurefoodwithenrichmentofsurroundingbiodiversityanditsentirecomponents. The temperature difference which can noticed here is due to the organic farming practices and maintenance of buffer zone and tree cover around the farm.

This model always maintains the good ecosystem in the farm and ensures the ecological security to the farmers.

Conclusion:

This study is focused on ensuring ecological and economic security for small and marginal farmers. The average profit of Rs. 32,198.90per month ensures economic stability and security to the farmers. The soil parameters such as pH, EC and OC have been improved from year to year. The buffer zone has created the microclimate inside the farm. The temperature (Soil & Air) and RH difference can be noticed. This climate and edaphic factors improvement ensures the ecological security to the farmers. Hence from this study it can be concluded that organic vegetable production in raised bed technology ensures both economic and ecological security to the small and marginal farmers.

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