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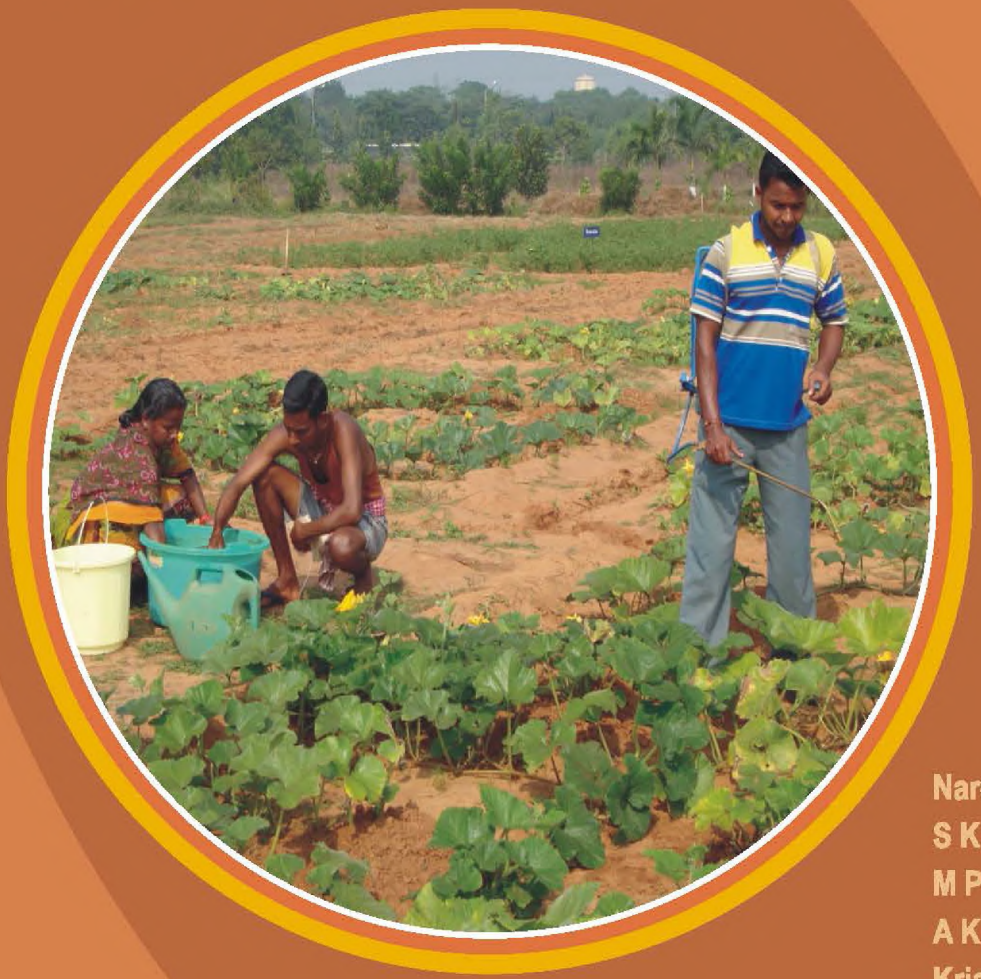
Technical Bulletin 20

Gender friendly organic farming technologies for vegetables



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Preface

Intensive crop production system significantly enhanced the use of high energy inputs as well as greater exploitation of irrigation potentials which indiscriminately affects production and productivity of various crops as well as deterioration of soil health and environments. The sustainability in crop productivity, soil health maintenance and ecosystem conservation are the need of hour which can be thought of with the adoption of organic farming as it offers the most sustainable farming systems with recurring benefits as well as lasting stability in the production.

Vegetable crops have been well advocated in solving the problem of livelihood security of small farmers in general and farmwomen in particular due to their market potential. In India the potential of vegetable is further enhanced with the increased awareness about consumption of chemical- free vegetables. Moreover, suitability of vegetables to grow organically, high market price , traditional method of cultivation and high participation rate of women in vegetable cultivation open new avenue for income generation for farmwomen.

In spite of exponential market growth of organic food (25 folds since 2005), the organic movement in India has long way to go as less than 2% of cultivable land is under organic cultivation. The slow pace of growth is due to the unavailability of information about organic cultivation. Hence, the success of organic farming depends mainly on the efficiency of cultivation technologies adopted to augment the crop, soil and water productivity.

Considering the scope and opportunities of organically grown vegetables efforts were made by the Directorate of Research on Women in Agriculture, Bhubaneswar to develop gender friendly technologies to bridge the gap in organic farming technology and improve the livelihood of farmwomen. This publication briefly deals with the organic farming technologies in vegetables, cost of production, women's participation and certification of produce. I hope that the bulletin will be a worth for researchers, extension functionaries and farming community in obtaining authentic information about various aspects of organic farming technologies.

Bhubaneswar
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Krishna Srinath
Director

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Introduction

Organic farming is becoming increasingly popular worldwide and the global demand for organic products is growing rapidly. It is environment friendly and take into account the health concerns of consumers. Organic farming has relevance as it aims at reducing the costs of production and helps the farmers to get reasonable returns. Organic farming also improves soil health and water holding capacity of the soil, thus making it more productive. The concept of organic agriculture has been perceived differently by different people. To most of them, it implies the use of organic manure and natural methods of plant protection instead of using synthetic fertilizers and pesticides. It is regarded by some as farming involving the integrated use of fertilizers and organic manure as well as chemicals and natural inputs for plant protection. In either case the concept has been understood partially. Organic farming aims at production of quality and safe produce with no chemical residues by eco-friendly production methods and the farming systems that restore and maintain soil fertility.

Only 35% of India's total cultivable area is covered with irrigation facilities and in the remaining 65% of arable land is mainly rain fed where negligible amount of fertilizers are being used. Farmers in these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The north-eastern hill region of India provides considerable scope and opportunity for organic farming due to less utilization of chemical inputs. It is estimated that 18 million hectare of such land is available in the north-east, which can be exploited for organic production. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the worlds organic market.

The report of the Task Force on Organic Farming appointed by the Government of India also observed that in vast areas of the country, where limited amount of chemicals are used, productivity could be exploited as potential areas for organic agriculture. Arresting the decline of soil organic matter is the most potent weapon in fighting against unabated soil degradation and imperilled sustainability of agriculture in tropical regions of India, particularly those under the influence of arid, semiarid and sub-humid climate. Application of organic manure is the only option to improve the soil organic carbon for sustenance of soil fertility and future agricultural productivity. Organic farming of different vegetables is being practiced in various countries of the world. The countries having the largest area under organic farming are Australia, Argentina, Italy, Canada and USA. Some countries namely Sweden, Austria, Switzerland, Finland and Italy have reached a substantial proportion of organic land (Prabu, 2008). Bhattacharya and Chakraborty, (2005) reported that the Indian Agriculture is traditionally organic and farmers were following organic cultivation till the middle of the last century. The per day requirement for organic vegetables is nearly 150 tonnes in the southern states of country, while the average production is

only up to 5 tonnes per day. According to an estimate made by Org Marg 2002 further demand of domestic organic produce in year 2005-06 and 2006-07 was 1457 and 1568 tonnes respectively (Rai and Pandey, 2006). Hence, it is essential that we must increase the production to meet out the demand of local as well as domestic markets.

Since, women's participation in vegetable production is very high than men, the empowerment of women is essential. Women are growing vegetables in homestead with low inputs for their family consumption. Their major participation in vegetable production is in selection of seeds, manure application, nursery management, seedlings treatment, intercultural operations, storage and marketing. Women are economically weak and not able to invest more money for procurement of chemical fertilizers and insecticides and moreover these inputs are not easily accessible for them. Besides these, they are not much aware about the proper application of chemicals as they are exposed to various kinds of health hazards. In spite of several efforts, they are still living in poverty and their role is not visible. They are not getting quality and nutrition rich food as they are suffering from mal nutrition. Research shows that on an average, organic food contains higher levels of vitamin C, good taste and essential minerals such as calcium, magnesium, iron as well as cancer- fighting antioxidants. Presently demand of organic produce is increasing in domestic as well as in international market. Therefore, organic farming of vegetables is an important option where women can become entrepreneur from farmwomen.

Principles of organic farming

- Coexist with, rather than dominate, natural systems.
- Sustain or build soil fertility.
- Minimize pollution and damage to the environment.
- Minimize the use of non-renewable resources.
- Protect and enhance the farm environment with particular regard to conservation and wildlife.
- Consider the wider social and ecological impact of agricultural systems.
- Maintenance or develop valuable existing landscape features and habitats for the production of wildlife with particular regards to endangered species

Benefits of organic farming

- Organic farming technologies helps to prevent environmental degradation and can be used to regenerate degraded areas.
- Organic farming helps to avoid chain reaction in the environment from chemical sprays and dusts.

- Organic grown crops are believed to provide healthier and nutritionally rich food for then those grown with chemical fertilizers.
- Organically grown crops are more resistant to diseases and insects and hence only a few chemical sprays or other protective measurements are required.
- There is an increasing consumer demand for agricultural products which are free of toxic chemical residues.
- In developed countries, consumers are willing to pay more for organic foods. Organically grown produce gaining importance because of high quality, premium price besides being free from toxic residues.
- Organic fertilizers are considered as complete plant food. Organic matter restores the pH of the soil, which may become acidic due to continuous application of chemical fertilizers.
- Organic manures, the principal component of Organic Farming produce optimal conditions in the soil for high yields and good quality crops by providing all the nutrients required by the plant (NPK, secondary and micronutrients), improving growth and physiological activities of plants.
- Most of the organic manures are wastes or by- products which on accumulation may lead to pollution. By way of utilizing them for organic farming, pollution is minimized.
- Organic farming technology is labour intensive in nation, which will also helps in generating more employment in rural areas, that will help in improving economic status of the family.
- As a whole adoption of organic farming provides better and balanced environment, better products and living condition to the human beings (Thapa and Tripathy, 2010).

Organic sources

Organic farming is often understood as a form of agriculture with use of only organic inputs for the supply of nutrients and management of pests and diseases. In fact, it is a specialized form of diversified agriculture, wherein problems of farming are managed using local resources alone. The term organic does not explicitly mean the type of inputs used; rather it refers to the concept of farm as an organism. Often, organic agriculture has been criticized on the grounds that with organic inputs alone, farm productivity and profitability might not be improved because the availability of organic sources is highly restricted. In organic farming the total requirement of nutrients for the crop should be met by use of organic sources like inclusion of legumes in cropping system, green manuring, recycling of crops residues, timely weed control, use of FYM, vermicompost, biofertilizers etc.

The total FYM requirement is higher than its availability so vermitechnology is an alternate method to fulfill the requirement and the whole process ensure side job to the rural people.

Vermitechnology is the application of earthworms in manufacture of useful products, monitoring and maintenance of the environmental quality. It has two prominent components- vermiculture and vermicomposting.

Vermiculture is simple low cost, low energy biotechnology of multiplying earthworms by providing them optimum conditions for rapid multiplication by feeding biodegradable materials available in every house hold, every village, every town/ municipality and all over India. Vermicomposting is the bioconversion of organic waste materials through earthworm consumption.

Properties of vermicompost suitable for organic farming

Physical:

(i) Vermicompost is dark brown/black rich humus like coarse material, it is soft and free from any foul smell, live weed seeds and other contamination.

(ii) Vermicompost has electrically charged particles that improve absorption of plant nutrients. Thus very high direct manurial value at least 8-10 times better than farm yard manure.

(iii) Mucus type substance coated on each particle increases aeration in the soil, excellent water retention properties and improves drainage in heavy soils.

(iv) Contains sufficient moisture (20-30 per cent at the time of packing) to allow macro and micro flora to continuously enhance plant nutrients.

Chemical:

(i)	pH	7.0 to 7.5
(ii)	C: N ratio	12-15: 1
(iii)	Nitrogen	1.75-2.5 per cent (as per chemical analysis) and 5-6 per cent (as per field performance)
(iv)	Available phosphorus	1.55-2.25 per cent (as per chemical analysis) and 4-5 percent (as per field performance)
(v)	Potassium	1.25-2.0 per cent (as per chemical analysis) and 2-3 per cent (as per field performance)
(vi)	Calcium, magnesium, sulphate:	3.0-5.0 times better than farm yard manure
(vii)	Fe, Zn, Mn, Cu	200-700 ppm
(viii)	Co, Mo, B	is also available in soluble form in sufficient quantities

Biological:

(i)	Total bacterial count	More than 10^{10}
(ii)	Actinomycetes, Fungi, Azotobactor, Rhyzobium, Phosphate solubiliser, Nitrobactor	Approximately 10^{2}-10^{6}

(iii)	Gibberellins (GA_3), Auxins (IAA) and Cytokinins	In sufficient quantities
(iv)	Pathogens	Free from all pathogens.

Raw materials

1.	Animal dung	- Cattle dung, sheep dung, goat dung and poultry dropping
2.	Agricultural waste	- Stem, leaves, husk, peels and vegetable wastes.
3.	Forestry waste	- Wood shavings, peels saw-dust, pulp and grasses
4.	Waste paper and cotton cloths	- Decomposable organic waste
5.	Biogas slurry	- After recovering of biogas if not required for agricultural use, may be used for composting.
7.	Industrial waste	- Waste from food processing industries and kitchen wastes

Requirements for vermicomposting

1. **Selection of site for vermibeds:** It is very important to select the composting bed site. It should be selected carefully. A site under shade, in an area on upland or an elevated level to prevent water stagnation in pits during rains is ideal.
2. **Bedding material:** This is the lower most layer of earthworm feed substrate that is required to be vermicomposted. Banana, stems, leaves, peels, sugarcane trash, grasses, husk , waste or discarded cattle feed can be used.
3. **Earthworm culture:** The epigenic type of earthworms (surface dwellers, stay on the surface of the soil) is most suitable for vermicomposting. These are the red coloured, having a minimum length of 3 to 4 inches and weight 0.5 to 1.0 g. Examples of surface dwellers are: *Eisenia foetida, Perionyx excavatus, Eudrila euginae etc.*
4. **Moisture content:** It should be maintained between 30-40%.
5. **Temperature:** Optimum temperature required for vermicomposting is 26-35 °C, however, survival of earthworms is even at lower temperature and up to 48 °C.
6. **pH :** pH of substrate should be between 6.8 to 7.5
7. **Cover of feed substrate:** This is required for reducing moisture loss and also save worms from extra movement. Moist gunny bags also help in conservation of moisture.

Thus if a vermibed of 2m x 1m x 0.3m size is used and on an average 4000 adult earthworms are maintained about 400 kg of vermicompost can be obtained every month.

Application of vermicompost: Broadly vermicompost application is done in same manner as conventional farmyard manure. It can be used for flower or garden pots, in vegetable crops and in cereal crops.

Marketing: Marketing of vermicompost is now a potential and flourishing industry due to the growing awareness among the people about the ill effects of chemical fertilizers and the relative benefits of organic farming. In India the cost of vermicompost ranges between Rs. 2000-5000 per tonne. The retail market in urban areas is more promising with sale price vermicompost, in neatly designed and printed packets as high as Rs. 10 per kg.

Role of women in vermicomposting

Presently, vermicomposting is become popular among rural women in villages. Sixteen women Self Help Groups in Satayanagar, Patna, Bharatpur, Shanpur Lowada villages under Debra block in West Midnapur district of West Bengal maintained 16 number of vermicomposting units with the help of State Government and IIT, Kharagpur at different places and each SHG has a 10 number of women. All vermicomposting units have 24 beds at the size of 6.0x2.0x1.5 feet and produced 3.5 q/ bed /cycle and women had taken 5 cycles in a year. Women reported that initially the construction cost was Rs 2 lakh/ unit out of which 50% cost of the unit were contributed by women SHGs and rest were given by Gram Panchayat. Women SHG were produced 360q/ unit vermicompost annually and earned an income of around Rs. 360000/ at sale price of Rs10/q. The sale of earthworms gives the income a further boost. Vermocomposting unit has given an opportunity to un-educated, under- employed women to become income generators and supplement their family income. A man was attended training on vermicomposting from IIT Kharagpur and after that he was sensitized to the women SHGs for vermicompost production. Collection of raw materials is done by men and filling of raw materials in the beds, mixing, turning, watering, cleaning and packing of vermicompost are done by women.

FYM: Another very essential operation in subsistence farming systems is the preparation of farm yard manure (FYM) which is done by women. This is a viable income generating activity for farm women. Paddy straw, dried grasses, dried leaves of maize and other locally available materials are gathered from the field for animal bedding. These materials, when mixed with dung and household organic waste, serve as excellent manure. This practice contributes to waste management and recycling, and provides macro-nutrients and micro-nutrients. The government has encouraged the use of chemicals (fertilizers and pesticides) in the area by making them available to the farmers at highly subsidised rates. However, women believe that artificial fertilizer cannot substitute the moisture retaining capacities of dung and humus and the use of artificial fertilizer alone is harmful. Women are involved in collection, transportation and application of farm yard manure in the field. Swaminathan (1985) mentioned that in the Himalayan region, women carry farm yard manure upto the hill fields over a period of 2-4 weeks while the men later incorporate it in ploughing.

Neem cake: Neem plant is very popular in rural areas. Women can prepare neemcake at home by collecting its seeds and applied into crops so that their expenditure on cost of cultivation will be minimized. Women are involved in collection, cleaning, storage and grinding of neem seeds.

Pest and diseases management

Pest control in organic farming begins by taking right decisions at right time, such as growing crops that are naturally resistant to diseases and pests, or choosing sowing times that prevent pest and

disease outbreaks. Careful management in both time and space of planting not only prevents pests, but also increases population of natural predators that have natural capability to control insects and diseases. Other methods generally employed for the management of pests and diseases are: clean cultivation, improving soil health to resist soil pathogens and promote plant growth; rotating crops; encouraging natural biological agents for control of diseases and insects; using physical barriers for protection from insects, birds and animals; modifying habitat to encourage pollinators and natural enemies of pests and pheromone attractants and trap pests.

Following plants/ botanical pesticides were suitable for control of insect pests under organic farming

Table1 Plants/ botanical pesticides

Plants	Method of preparation	Control of pests
Neem	The leaves or seeds are crushed - 1 kg of ground or crushed seeds or leaves are then put in a cloth bag and soaked in 20 litres of water for 24 hours. Neem can also be absorbed through the plant roots if it is sprayed around the plants.	The chemical absorbed by the plants can kill the sucking insects such as whiteflies and leaf miner.
Chilli (Hot pepper)	Chop 500 g a.i./ha of fresh fruits of chillies. - Mix with 5 litres of water and leave for 24 hours. - Sieve the extract and add an extra 10 litres of water.	Spider and mites. Apply powder around stems of plants to repel ants, cutworms and other soil pests.
Mexican marigold	Cut marigold plant at flowering time. - Chop the plants to fill half 50 litre drum. - Add 20 litres of water cover the drum and allow the contents to decay in water for 5-10 days. - Stir the content in the drum once every two days to fasten decomposition. - After 5-10 days remove the decomposed Mexican marigold particles and sieve the extract. - Dilute the mixture with 10 litres of water and spray.	Ants and termites
Pyrethrum	Boil 1 kg of Pyrethrum flower in 10 litres of water, allow it to cool and sieve. Add 10 litres of water	Aphids
Garlic and Onion	- Crush 2 kg of garlic or onion or both 1 kg each and leave in 20 litres of water for 24 hours. - Sieve and mix with other botanicals.	Antibacterial and anti fungal biopesticides, whitefly, aphid, caterpillar, leafminer

Biocontrol Agents:

Predators: *Chrysoperla carnea*

Brumus suturalis

Menochilus sp.

Coccinella spp

Parasitoid Most common used is an egg parasitoid, *Trichogramma chilonis* which is effective against lepidopterous insect pests.

Needs of organic farming in vegetable crops

- Most of the vegetable crops are taken fresh or processed form for health care; hence any contamination (chemical residue) may lead to various kinds of health hazards
- Most of the vegetable growers in our country are resource poor farmers
- Decrease in land productivity due to ever increasing use of chemical fertilizers
- The ever-increasing cost of production in chemical farming including investments in manufacturing fertilizers, pesticides, irrigation etc despite massive government subsidies is a major cause of concern, which is very low in organic farming.
- High environment and soil pollution
- Organic farming of vegetable crops generates income through International exports or by saving production costs.
- Organic farming also able to secure a place of India on International markets by producing high value vegetable crops.
- Excessive use of chemical fertilizers as well as pesticides not only increases the cost of production but also poses threat to the environment quality, ecological stability and sustainability of production. We have gained quantity but at expense of quality.
- In developing countries like India, especially in low input traditional system, properly managed organic farming system can increase the crop productivity and restore the natural base.

Safety and quality of organically produced food

There is a growing demand for organic foods driven primarily by the consumer's perceptions of the quality and safety of these foods and to the positive environmental impact of organic agriculture practices. It has been demonstrated that organically produced foods have lower levels of pesticides and medicinal and hormonal residues and in many cases lower nitrate contents. Nitrates are significant contaminants of foods, generally associated with intensive use of nitrogen fertilizers. Studies that compared nitrate contents of organic and conventional products found significantly higher nitrates in conventional products. Quality after storage has been reported to be

better in organic produce relative to chemical based produce after comparative tests. 'Organic' in organic agriculture is a labelling term that denotes products that have been produced in accordance with certain predefined parameters and certified by a duly constituted certification agency or authority. The organic label is therefore a process claim rather than a product claim. Organic standard will not exempt producer and processors from compliance with general regularity requirements such as food safety regulation, pesticide registration, general food and nutrition labelling rules, etc.

Impact of organic vegetable production

In intensive farming systems, organic agriculture decreases yield; the range depends on the intensity of external input used before conversion. In the green revolution areas (irrigated lands and well endowed water regions), conversion to organic agriculture usually leads to almost identical yields. In traditional rain fed agriculture (with low external inputs), organic agriculture has shown the potentials to increase yields. A number of studies have shown that under drought conditions, crops in organic agriculture systems produce significantly and sustainably higher yields than comparable conventional agricultural crops, often out-yielding conventional crops by 7-90 per cent. Others have shown that organic systems have less long-term yield variability.

Crop suitability for organic farming

Based on experiments following vegetable crops were found suitable for organic farming.

1. Cow pea: Cow pea (*Vigna unguiculata* L. Walp) var. Utkal Manika was sown at a spacing of 30cm x 60cm from plant to plant and row to row during 4th week of July and different manures such as farmyard manure, neem cake and vermicompost alone and in combinations were applied as different treatment 10 day prior to the seed sowing. Before sowing seeds were treated with

biofertilizer of *Rhizobium* culture @ 25g / kg of seed. For that purpose 100-150 gm jaggery was dissolved in half a litre of water. Boiled the content till a thick solution is obtained then allowed the solution to cool to room temperature. One packet of *rhizobium* was added culture and mixed

thoroughly. Required seed for one acre was mixed with the prepared culture thoroughly so that each seed is coated with a thin film of culture, and spread the treated seed on a non absorbent and cleaned surface under the shade for drying at room temperature. Seed treatment with biofertilizer of *Rhizobium culture was* found cost effective, eco friendly technology and accessible for women. Maximum green pods yield (8.84*t/ hectare*) was recorded with the application of FYM @ 20 *t per hectare* which was at par (8.30 t/ha) with the treatment FYM @10 t per hectare + neem cake @1 t per hectare. Minimum yield of pods (2.41 *t/ ha)* was obtained in the control. Maximum crop residue (8.50 t/ha) was recorded under FYM @ 20 t per hectare followed by FYM @10 t per hectare + vermicompost @ 3 t per hectare. The net return (Rs.23680) and benefit cost ratio (1.50) was also highest with FYM application @ 20 tonnes per hectare *(Table 2)*. Green pods as well as seeds were collected and rest of the plant was added to the soil. Fresh pods were utilized by women for culinary purpose and seeds were used for pulse as well as stored for sowing in next season crop.

Table 2. Effect of different organic manures on yield, fresh weight of biomass of cowpea variety Utkal Manik and estimated income from different treatments

Treatment	Yield (t/ha)	Percent increase in yield over control	Fresh weight of biomass (q/ha)	Cost of Cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Return (Rs/ha)	Benefit cost ratio (BCR)
FYM (20t/ha)	8.84	266.14	85.00	47000	70680	23680	1.50
Neem cake (2t/ha)	4.75	96.64	42.50	47000	37960	-9040	0.81
Vermicompost (6t/ha)	5.08	110.52	50.00	63000	40640	-22360	0.65
FYM (10t/ha)+ Neem cake(1t/ha)	8.30	243.76	48.75	55000	66360	11360	1.21
FYM (10t/ha) + Vermicompost (3t/ha)	6.91	186.49	72.25	47000	55304	8304	1.18
Neem cake (1t/ha)+ Vermicompost (3t/ha)	5.81	140.65	47.50	55000	6456	-8544	0.84
FYM (6.6t/ha)+Neem cake (0.66t/ha)+ Vermicompost (2t/ha)	7.61	215.46	65.00	52334	60896	8562	1.16
Control	2.41	-	26.25	26400	19304	7096	0.73

Cost (Rs/kg): FYM-1.00, neem cake- 10.00, vermicompost- 6.00, cowpea- 8.00, labour-120/day, Man days-225

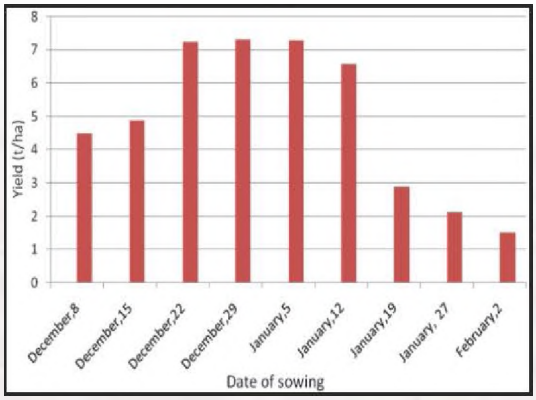
2. Okra: The okra (*Abelmoschus esculentus* L. Moench) cv. Utkal Gaurav was sown at a spacing of 45 cm x 30 cm and different organic manures were applied alone and in combinations in the soil, one weak prior to the seed sowing. The seeds were soaked in water for 8-10 hours and dried in shade for quick and uniform germination. The seeds were covered with mulch after sowing to conserve temperature and moisture. However, the mulch removed after germination to avoid damage by termite, ants to germinating seedlings. Data revealed that maximum yield (2.98 *t / ha*) was recorded under the application of vermicompost @ 6 t per hectare followed by FYM (6.6t/ha) + neem cake (0.66t/ha) + vermicompost (2t/ha) and neem cake (1t /ha) + vermicompost (3t /ha). Based on feedback collected from men and women, taste of green pods of okra as a vegetable was acceptable. As okra is a vegetable suitable for backyard cultivation and the crop yield continues for two months in winter season. It is useful for home consumption and source of income for rural women.

Table 3: Effect of different organic manures on yield of okra cv. Utkal Gaurav during Rabi season

Treatment	Plant height (cm) 60 days after sowing	Number of fruits/ plant	Yield (t/ha)	Per cent increase in yield over control
FYM (20t/ha)	36.58	9.35	2.10	233.59
Neem cake (2t/ha)	41.25	10.15	2.16	243.15
Vermicompost (6t /ha)	42.46	13.05	2.98	375.16
FYM (10t/ha) + Neem cake(1t/ha)	37.84	8.36	1.88	200.64
FYM (10t/ha) + Vermicompost (3t /ha)	37.81	8.40	2.00	217.68
Neem cake (1t /ha) + Vermicompost (3t /ha)	40.27	9.01	2.27	261.62
FYM(6.6t/ha) + Neem cake (0.66t/ha) + Vermicompost (2t/ha)	38.59	10.27	2.64	320.54
Control	27.46	6.04	1.28	-

Leafy vegetable production technology:

3. Amaranth: Leafy vegetables provide income and food security to the poor farmers especially for women. Among leafy vegetables amaranth (*Amaranthus spp)* popularly known as *chaulai*, is a very nutritive and highly suitable crop for kitchen gardening and commercial cultivation. It could be a very valuable source for combating under nutrition and malnutrition in our country. Local variety of amaranth *(Amaranthus spp)* was sown at a spacing of 30cm x10 cm on different dates to ensure vegetable availability for family consumption round- the -season. FYM @ 5 *t per hectare* + neem cake @ 1 *t per hectare* was applied to the soil one week before seed sowing. Maximum yield (7.29 *t/ ha*) was obtained in the crop sown in the last week of December followed by the crop sown in first week of January (7.28*t/ ha*). Minimum yield (1.50*t/ ha*) was recorded under late sowing (first week of February). Data indicated that second week of December to second week of January is ideal time for maximum production of amaranth. Amaranth is preferred by women due to local demand, high nutritive value and suitability for kitchen gardens. Mostly women cultivate different leafy vegetables including amaranth in their kitchen gardens for household consumption and income generation purpose. It has been observed that self- participation of women in amaranth cultivation was found to be high in operations like selection of seeds, sowing of seeds, watering, weeding, thinning, harvesting, cleaning, washing, bundle making, drying and storage of seeds. In India, though rural women are responsible for feeding their household, yet they have limited access to resources. Cultivation of amaranth leafy vegetable is the option for women for improving their family nutrition and income. Farmwomen used the profit for meeting their very urgent needs like children's education and procurement of other essential items. Women took active part from sowing to harvest and sale of produce. Women found all the activities associated in cultivation of leafy vegetable very comfortable and suitable. They expressed happiness and satisfaction in cultivation of amaranth. There is possibility in collective endeavour in leafy vegetable cultivation. If women join hands they can perform very well.



4. Tomato: Tomato (*Lycopersicon esculentum* Mill.) crop var. BT-10 was raised with the application of three sources of organic manures viz. farmyard manure, neem cake and

vermicompost. FYM, neem cake and vermicompost were incorporated in the soil 10 days prior to the transplanting. Maximum fruit yield (28.18*t/ ha*) was recorded under the application of FYM @ 20 t per hectare followed by the combined application of FYM @ 10 t per hectare + vermicompost @ 3 t per hectare (Table 4).

It can be concluded that application of FYM @ 20 tonnes per hectare may be more economical for tomato in Odisha conditions and can be recommended for adoption by farmwomen (Babu *et. al.*,2010).

Table 4: Effect of organic manure on size, weight, yield and quality fresh biomass of tomato variety BT-10

Treatment	Average fruit weight (g)	Size of fruit (cm)		Yield (t/ha)	TSS	Acidity (%)
		L	W			
FYM (20t/ha)	64.80	4.08	4.82	28.18	3.98	0.39
Neem cake (2t/ha)	48.80	4.15	4.27	20.34	4.01	0.52
Vermicompost (6t /ha)	60.45	4.74	4.82	18.26	4.29	0.48
FYM (10t/ha) + Neem cake(1t/ha)	56.48	5.15	5.22	22.94	5.01	0.61
FYM (10t/ha) + Vermicompost (3t /ha)	50.24	3.80	4.82	24.52	3.89	0.56
Neem cake (1t /ha) + Vermicompost (3t /ha)	50.08	3.93	4.86	23.02	3.52	0.55
FYM(6.6t/ha) + Neem cake (0.66t/ha) + Vermicompost (2t/ha)	51.60	3.96	4.94	23.88	3.75	0.54
Control	43.60	3.92	4.68	8.95	2.41	0.54

5. Pumpkin: Pumpkin (*Cucurbita moschata*) var. Baidyabeti was raised with the application of three sources of organic manures viz. farmyard manure, neem cake and vermicompost. FYM, neem cake and vermicompost were incorporated in the soil 2 weeks prior to the sowing. Seeds were soaked in water overnight before planting to soften their outer shell helping them to sprout more easily. Maximum fruit yield (21.27*t/ha*) was recorded under the application of FYM (6.6t/ha) + neem cake (0.66t/ha) + vermicompost (2t/ha) followed by the application of vermicompost (6t /ha) and FYM (10t/ha) + vermicompost (3t /ha) (Table 5). Fruit quality is the important criterion in the production of pumpkin. The high values of TSS (10.72%) was observed in the application of FYM (10.0t/ha) + Vermicompost (3.0t /ha). Pumpkin occupies a prominent place among vegetables owing to its high productivity, nutritive value, good storability and long period of availability. It is also an important and popular vegetable in Odisha and grown by the poor and marginal farmers including women in their backyard over pundal and thatch houses for home consumption and also for income generation. Participation of women in pumpkin cultivation was found to be high in activities like seed cleaning, grading, sowing, watering, manuring, staking, harvesting and storage of fruits and seeds for sowing in next season crop. It has been observed that women cooked and consumed its young leaves, tender stem and flowers. When the pumpkin attains a deep orange color, it is time for harvesting. Cut it with several inches of stem, so that the pumpkin stays fresh for longer periods of time. Put it in sun for about one week and then stored it in a cool and dry place.

Table 5. Effect of organic manure on yield and yield attributes of pumpkin variety Baidyabeti

Treatment	No. of vine / plant	Fruit set initiation (day)	Fruits/ plant	Avg. fruit weight (g)	Harvesting of fruits (day)	Yield/ plant (kg)	Yield (t/ha)	TSS
FYM (20t/ha)	3.66	74.24	5.60	2.82	133.53	10.35	17.05	10.43
Neem cake (2t/ha)	2.56	76.46	4.25	2.56	125.46	9.38	16.50	10.50
Vermicompost (6t /ha)	3.40	75.62	6.57	3.45	119.27	12.55	18.66	9.45
FYM (10t/ha)+ Neem cake(1t/ha)	3.50	74.16	6.85	3.58	121.28	10.20	16.75	10.12
FYM (10t/ha) + Vermicompost (3t /ha)	3.00	77.58	5.48	3.12	129.20	11.32	17.80	10.72
Neem cake (1t /ha)+ Vermicompost (3t /ha)	3.16	75.65	7.40	2.58	129.45	9.35	15.42	9.35
FYM(6.6t/ha)+ Neem cake (0.66t/ha) + Vermicompost (2t/ha)	4.15	67.55	7.55	3.45	132.48	14.58	21.27	10.50
Control	2.85	82.70	4.26	1.51	142.57	6.35	14.81	10.10

Shelf life of cowpea and tomato:

Shelf life of cowpea was studied and it was found that pods grown with FYM treatment and packed in polyethylene bags recorded minimum physiological loss in weight (41.37 %) after three days of storage under room temperature. Therefore, women can store cowpea in polyethylene bags @ 2% ventilation up to three days (Table 6). Women may grow this crop in their kitchen garden for regular yield and income. Cow pea was harvested in 7 numbers of pickings in over a month. Green pods as well as seeds were harvested and remaining plant parts were added to the soil for improvement of soil fertility. Fresh pods were utilized by women for culinary purpose and seeds were used for cooking as a pulse as well as seed for sowing in the next season crop.

Shelf life of tomato fruits was studied and it was found that unpacked fruits recorded minimum physiological loss in weight (4.82 %) under zero energy cool chamber as compared to 10.36% under ambient temperature after 6 days of storage (Table 7).

Table 6. Effect of organic manures on physiological loss of weight (%) on storage of cowpea variety Utkal Manik at ambient temperature

Treatment	Physiological loss of weight (%) (PLW) Days					
	1		2		3	
	Open	Polyethylene	Open	Polyethylene	Open	Polyethylene
FYM (20t/ha)	16.90	13.79	30.99	25.86	46.48	41.37
Neem cake (2t/ha)	17.24	14.29	34.48	28.57	56.90	48.21
Vermicompost (6t/ha)	17.86	16.07	37.50	28.57	60.71	48.21
FYM (10t/ha) + Neem cake(1t/ha)	19.23	15.22	32.69	34.78	53.84	50.00
FYM (10t/ha) + Vermicompost (3t/ha)	25.00	23.08	40.00	38.46	65.00	58.97
Neem cake (1t/ha) + Vermicompost (3t/ha)	18.75	20.45	34.09	31.25	61.36	56.25
FYM(6.6t/ha) + Neem cake (0.66t/ha) + Vermicompost (2t/ha)	17.03	15.00	34.15	32.50	58.54	57.50
Control	19.44	14.29	33.33	25.71	58.33	42.86

Table 7. Effect of packing materials and storage environment on weight loss in tomato variety BT-10

Storage condition and packing material	Physiological loss of weight (%) Days of storage							
	1	2	3	4	5	6	7	8
Room temperature								
Polyethylene bags	1.56	4.81	5.67	6.67	7.43	7.79	8.14	9.45
Paper bags	1.47	4.60	5.36	6.35	7.18	7.56	7.95	9.39
Open condition	1.82	5.16	6.70	7.56	8.32	10.36	-	-
Zero Energy Cool Chamber								
Polyethylene bags	0.39	1.56	2.24	3.17	3.46	4.16	4.47	5.46
Paper bags	0.52	1.40	2.06	2.70	3.30	4.28	4.75	6.30
Open condition	0.65	1.86	2.50	2.95	3.80	4.82	5.22	7.78

Plant protection practices adopted during study period suitable for women

Soil treatment with bio fungicide:

Bio fungicide *Trichoderma viride* @ 10 kg per hectare mixed with 100 kg of FYM and applied at the time of transplanting was found effective in improving the yield of tomato.

Seed treatment with Trichoderma:

One kg seed of cowpea variety Utkal Manika was treated in the slurry of 10g of Trichoderma and one litre of cow dung before sowing.

Seedling root dip treatment:

Thirty days old seedlings of tomato variety BT-10 were treated in the solution of 10g of *Trichoderma* in one litre of water for 10 minutes before planting for control of wilt problem.

Application of pudina leaf powder for management of ant:

Application of pudina (Mint) leaf powder @10 g/ 20 m^2 around the field of amaranth at the sowing time was effective in repelling ant. Application of broken rice locally known as *khuddi in Odisha* @ 150g/ 100m^2 mixed with amaranthus seed at the time of sowing was also found effective in reducing seed damage in filed by ants. This practice can be adopted by the farmwomen in backyard kitchen garden.

Seedling treatment in solution of asafoetida (Ferula asafoetida) and turmeric powder:

Thirty days old seedlings of tomato variety BT-10 were treated with the solution of asafoetida @ 0.01per cent (1 g) + turmeric powder @ 0.1 per cent (10 g) in 10 litre of water for 1-2 hours and transplanted in the well prepared field to control of wilt problem. As asafoetida and turmeric powder are easily available. This treatment is found suitable for small and marginal farmers.

Nursery treatment with bio fertilizer:

Raised nursery beds were prepared for ensuring drainage to avoid damping off and were covered with polyethylene sheets of 0.45 mm thickness for three weeks during June for soil solarization to reduce soil borne insects and diseases such as bacterial wilt. Three kg FYM enriched with 250 g of *Trichoderma viride* mixed in soil in nursery beds was found beneficial for tomato seedlings. Infected seedlings were rouged out at regular intervals. Nursery raising with the incorporation of above treatment can be taken up by women for income generation.

Planting marigold as trap crop for management of fruit borer *Helicoverpa armigera* in tomato:

Among eco-friendly pest management practices, planting of marigold as a trap crop in tomato was promising to protect *Helicoverpa armigera* infestation. Women can also use marigold flowers for income generation. Flower cultivation was taken up by women mainly for home consumption and worship. Tomato planted with marigold was not required any spray until harvest for the management of fruit borer.

Use of pheromone traps and water traps for management of fruit borer:

Among eco-friendly pest management practices, use of pheromone traps and water traps @ 10 per hectare was effective in mitigating borer menace in cowpea, okra, tomato (Srivastava *et. al.*, 2012). Both pheromone traps and water traps are easily available, easy to handle, cost effective and a women friendly pest management practice.

Spray of neem seed kernel extract (NSKE) solution for control of insect pests in vegetables :

Spray of NSKE solution @ 5% at 15 days interval was effective against red pumpkin beetle, leaf minor, fruit borer in pumpkin, amaranth, okra and tomato (Srivastava *et.al.*, 2010)

.

Use of earthen pot trap for management of termite:

Earthen pot termite trap with maize cobs (after removal of grains) placed @16per hectare was effective in termite control in cowpea and okra at early stages. Women can use earthen pot termite traps for management of termite in their crops as the materials used in these traps are easily available.

Application of neem cake in gunny bag through irrigation channel for management of termite in vegetables:

Application of neem cake in gunny bag through irrigation channel was found effective in termite control in cowpea, okra and tomato at early stage. This practice was cost effective and eco-friendly and can be adopted by women. Soil fertility was

also improved by this technique. These techniques are economically viable, easily available and free to any type of health hazards, need to be popularized among farmers and farmwomen for organic production of vegetables.

Vegetable cultivation in cropping system mode

In addition to vegetables, various other crops including cereals, oil seeds, and legumes can be grown successfully. While 3-4 months are sufficient for vegetable cultivation, other crops could be cultivated during rest of months. In general, vegetable such as tomato (var. BT.10) is transplanted in the second week of November and harvested by the second week of February. Thereafter, short duration varieties of Rabi ground nut are cultivated in the same field. After harvesting of Rabi ground nut (June), cow pea is sown by mid of July and harvested by the second week of October and the field is prepared for the subsequent crop of tomato. Hence, cultivation of three crops per year is possible in the field.

In second cropping system amaranthus is sown in the second week of December and harvested by the last week of January. Thereafter, moong var. K 851 is grown in the same field. After harvesting of moong (June), rice (var. Udayagiri) is sown by mid of July and harvested by the second week of November and the field is prepared for the next crop of Amaranthus.

In third cropping system okra (var. Utkal Gaurav) was sown in the month of March and harvested in the month of June. Thereafter, dhaincha (*Sesbania aculeate*) is taken in the same field for green manuring purpose. After turning of dhaincha in the field in the month of August, Pumpkin (var. Baidyabeti) is sown by mid of September and harvested in the month of January and the field is prepared for the subsequent crop of okra.

Green manure (*Dhaincha)* in okra based cropping system

Rabi ground nut cultivation in cowpea based cropping system

Moong (left) and rice (right) cultivation in amaranthus based cropping system

Cost of cultivation under organic production system

Cost of cultivation under organic production system has been worked out and the net return (Rs. /ha) are given below:

1. Okra, followed by pumpkin and green manure (*Dhaincha*) Rs. 58800/-
2. Cowpea, followed by tomato and rabi ground nut Rs. 124190/-
3. Amaranthus, followed by moong and rice Rs. 37760/-

The details of economics of each method of vegetable cultivation is depicted in Table 8-10.

Table 8. Economics analysis of okra cultivation in organic methods

Name of the items	Rate per unit (Rs./ha)	Total cost (Rs)
Inputs cost (Rs/ha)		
Ploughing and planking of the field (twice)	2000.00	4000.00
Seed (10kg)	300.00	3000.00
Manure (15 t)	1000.00	1500.00
Biofertilizer (Azotobactor 5 kg)	40.00	200.00
Plant protection measures	5000.00	5000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	5000.00	5000.00
Harvesting of crop	6000.00	6000.00
Miscellaneous	5000.00	5000.00
Total cost of input		47700.00
Output		
Average yield (65q)	1000.00	65000.00
Net income		17300.00

Table 8.1 Okra followed by pumpkin and green manure (*Dhaincha*)

Name of the items	Rate per unit (Rs./ha)	Total cost (Rs)
Total input cost of okra		47700.00
Pumpkin		
Ploughing and planking of the field (twice)	2000.00	4000.00
Lay out, pit making (30 mandays)	150.00	4500.00
Pit filling with FYM (20 mandays)	150.00	3000.00
Seed (5 kg)	1000.00	5000.00

Manure (5 t)	1000.00	5000.00
Irrigation	5000.00	5000.00
Plant protection measures	3000.00	3000.00
Weeding (twice) 30 mandays	150.00	4500.00
Harvesting	4500.00	4500.00
Miscellaneous	4000.00	4000.00
Sub total		**42500.00**
Total input cost (Rs/ha)		**90200.00**
Output(s)		
Okra		**65000.00**
Pumpkin		
Yield 210 q	400.00	84000.00
Green manure (Dhaincha)	-	0.0
Total output		**149000.00**
Net return (Rs./ha)		**58800.00**

Table 9. Economics analysis of cowpea cultivation in organic methods

Name of the items	**Rate per unit (Rs./ha)**	**Total cost (Rs)**
Inputs cost (Rs/ha)		
Ploughing and planking of the field (twice)	2000.00	4000.00
Seed (12kg)	600.00	7200.00
Manure (15 t)	1000.00	15000.00
Biofertilizer (*Rhizobium* 250 g)	10.00	10.00
Plant protection measures	3000.00	3000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	3000.00	3000.00
Harvesting of crop	5000.00	5000.00
Miscellaneous	3000.00	3000.00
Total cost of input		44710.00
Output		
Average yield (85q)	800.00	68000.00
Net income		23290.00

Table 9.1 Cowpea followed by tomato and rabi ground nut

Name of the items	**Rate per unit (Rs./ha)**	**Total cost (Rs)**
Total input cost of cowpea		**44710.00**
Tomato crop		
Ploughing and planking of the field (twice)	2000.00	4000.00
Layout and bunds making (5 mandays)	150.00	750.00
Seed (400g)	400.00	1600.00
Nursery bed preparation and seed sowing (5mandays)	150.00	750.00
Nursery management for 1 month (5 mandays)	150.00	750.00
Seedlings planting (20 mandays)	150.00	3000.00
Manure (15 t)	1000.00	15000.00
Plant protection measures	3000.00	3000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	4000.00	4000.00
Harvesting of crop	5000.00	5000.00
Miscellaneous	4000.00	4000.00
Total input cost of tomato crop		**56350.00**
Rabi ground nut crop		
Ploughing and planking of the field (twice)	2000.00	4000.00
Layout and bunds making (5 mandays)	150.00	750.00
Manure (10 t)	1000.00	10000.00
Seed (100 kg)	90.00	9000.00
Shelling of pods, seed treatment and sowing (20 mandays)	150.00	3000.00
Weeding and earthing up (30 mandays)	150.00	4500.00
Irrigation	4000.00	4000.00
Plant protection measures	3000.00	3000.00
Harvesting and removal of pods from plants (50 mandays)	150.00	7500.00
Miscellaneous	4000.00	4000.00
Total input cost of rabi ground nut crop		**49750.00**
Total input cost of all three crops		**140810.00**
Output(s)		
Cowpea	-	**68000.00**
Tomato		
Yield-220 q	600.00	132000.00
Rabi ground nut		
Yield- 26 q	2500.00	65000.00
Total outputs of all three crops (Rs /ha)-		**265000.00**
Net return (Rs/ha)		**124190.00**

Table 10. Economics analysis of amaranthus cultivation in organic methods

Name of the items	Rate per unit (Rs./ha)	Total cost (Rs)
Inputs cost (Rs/ha)		
Ploughing and planking of the field (twice)	2000.00	4000.00
Bunds and bed preparation (10 mandays)	150.00	1500.00
Manure (10 t)	1000.00	10000.00
Seed cost (10 kg)	400.00	4000.00
Seed treatment, seed sowing and initial watering (10 mandays)	150.00	1500.00
Plant protection measures	3000.00	3000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	3000.00	3000.00
Uprooting, washing & packing	10000.00	10000.00
Miscellaneous	3000.00	3000.00
Total cost of input		**44500.00**
Output		
Average yield (220q)	300.00	66000.00
Net Return (Rs./ha)	-	21500.00

Table 10.1 Amaranthus followed by moong and rice

Name of the items	Rate per unit (Rs./ha)	Total cost (Rs)
Total inputs cost of amaranthus		
Moong		44500.00
Ploughing and planking of the field (twice)	2000.00	4000.00
Cleaning field and bunds (5 mandays)	150.00	750.00
Manure (5 t)	1000.00	5000.00
Seed (25g)	60.00	1500.00
Seed treatment and seed sowing(4 mandays)	150.00	600.00
Biofertilizer (*Rhizobium* 1 kg)	40.00	40.00
Plant protection measures	3000.00	3000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	5000.00	5000.00
Harvesting, drying, threshing, winnowing and bagging	150.00	4500.00
(30 manadays)		
Miscellaneous	4000.00	4000.00
Total input cost of moong		**32890.00**
Rice crop		
Ploughing and planking of the field (twice)	**2000.00**	**4000.00**
Cleaning field and bunds (5 mandays)	150.00	750.00
Manure (10 t)	1000.00	10000.00

Seed (75kg)	20.00	1500.00
Seed treatment and seed sowing(4 mandays)	150.00	600.00
Plant protection measures	2000.00	2000.00
Weeding (twice) 30 mandays	150.00	4500.00
Irrigation	3000.00	3000.00
Harvesting, bundling (30 mandays),	150.00	4500.00
Threshing, winnowing and bagging (20 manadays)	150.00	3000.00
Miscellaneous	3000.00	3000.00
Total input cost of rice crop		**36850.00**
Total input cost of all three crops		**114240.00**
Output(s)		
Amaranthus		**21500.00**
Moong		
Yield 10 q	4000.00	40000.00
Rice		
Seed yield- 18 q	2000.00	36000.00
Straw yield 5t	2000.00	10000.00
Sub- total of rice		**46000.00**
Total outputs of all three crops (Rs /ha)		**152000.00**
Net return (Rs/ha)		**37760.00**

Certification of produce

Market support and certification of organic produce is very important so as to enable cultivators to get higher price for their produce. For this certification of the produce is very important. As to date no direct marketing for organic agriculture is being promoted by Government. Whatever, marketing is being done is through private intervention or by NGOs who are in contract with the farmers producing organic food. There is need to promote marketing of organic produce for which some space in the mandies need to be reserved for sale of organic produce. To give greater authenticity of the produce, some logo or certificate needs to be issued by competent agency for giving greater push to sale organic produce.

Market potential of organic produce

Presently, demand of organic produce in the domestic market and international markets is increasing many folds. Vegetables are marketed mainly in fresh form. Since, most of the vegetables are highly perishable in nature and cannot be retained for longer period after harvest. Therefore, these are not marketed to distant markets. Tomato, chillies, beans, cabbage, cucumbers, leafy vegetables and tuber crops are cultivated by the farmwomen in tribal areas. The production of organic vegetables in Odisha is mainly confined to tribal districts. Women sell their vegetables in small quantity at farm. It has been observed that women also sell their vegetable produce on the road side in the local market at scattered way during morning and evening hours. Village merchant generally collect the produce from farmers and market them either to commission agent or whole seller in the assembling market of Bhubaneswar, Keonjhar and

Behrampur. Women are selling vegetables (tuber crops) in tribal fair and exhibitions organized by State Government time to time at Bhubaneswar and other places in Odisha.

Involvement of women in organic farming

Manure application: The involvement of women is seen in land preparation activities such as stubble collection, land leveling and manure application. Their participation is more than 60 percent in stubble collection and in manure application.

Gender difference in cropping system: It has been observed that men mostly preferred cultivation of vegetable crops for commercial purpose. They preferred cropping of single crop depending on their expertise and market demand but women mostly preferred two or more crops to be grown at a time which helps in natural biocontrol of various insect and pests. Number of crops grown by women in the backyard was more than 15 in many cases which includes fruits, vegetables, flowers, plantation crops, medicinal plants etc.

Selection of seeds and varieties: Women preferred local and indigenous seeds and varieties of crops. Most of the local seeds and varieties of crops are suitable for cultivation under organic farming system.

Seeds and seedling treatment: Seed treatment of vegetable crops such as tomato, cowpea, and okra with bio fertilizer was mostly taken up by women. Moreover, seedling treatment of vegetables such as tomato in solution of asafoetida (*Ferula asafoetida*) and turmeric powder before planting are done by women to control wilt disease and these practices are suitable under organic farming system. Asafoetida (*Ferula asafoetida*) and turmeric powder are easily accessible for women.

Intercultural operations: Among various intercultural operations such as weeding, earthing up, thinning, staking etc, weeding required highest man days. The weeding operation is predominantly done by women and their participation in these activities varies from 80- 95 percent in different vegetables. Weeding and mulching of crops with locally available materials are performed by women. These are very important operations for organic farming.

Plant protection: Vegetables are infested by various insects and pests during cropping period. Various botanical pesticides are used to control insects and pests under organic farming system. These pesticides are being prepared from locally available plants. Women can involve in preparation of botanical pesticides without health hazards.

Post harvest operations: The participation of women in post harvest operation is much more then men. More than 60 per cent of cleaning, grading and storing of vegetables are primarily performed by women. Since most of the responsibility of storage of produce at home level is done by women. Shelf life of organically grown produce is more than produce grown with chemical fertilizers and pesticides. Organic produce can help women in storage of produce at home due to better shelf life as compared to in organically grown produce.

Issues

- The research for Organic farming in vegetable crops must be on a system basis. It must be integrated one and must not be looking at in isolation.
- The task of research would be to produce technologies, which can not only increase more food but also more jobs and more incomes.
- The research for organic farming should be focused on developing technologies which may attract the vegetable growers to adopt them, keeping in view of the requirements of small holdings of resource poor small and marginal farmers.
- The research should be in a holistic manner with long-term evaluation of different organic substrates.
- Identification of suitable cover crop in a given cropping system.
- Identification of soil improving crops under major agro-climatic zone.
- Evaluation of soil conservation practices of disease management, change in the habitat for beneficial insects and suitability of trap crops in organic culture and identification of nematode repellant cover crops especially from various vegetable crops should be given due emphasis.
- Development of techniques for modifying fertilizer recommendations for new crop rotations using different cover crops and full proof technology for transformation of traditionally used chemicals inputs farm into a successful organic farm.
- Developing suitable varieties for organic farming.
- Suitable packages of technologies are to be developed for organically grown vegetables.
- Large scale multiplication of bio-fertilizers, vermicompost, bio-control agents and distribution to the farmers at reasonable prices.
- There should be proper research efforts for production and commercialization of biopesticides and extension services to educate the farmers to use them.
- Organic foods are proved superior in terms of health and safety, but there is no scientific evidence to prove their superiority in terms of taste and nutrition, as most of the studies are often inconclusive. Therefore, strategy should be made for proper evaluation of quality parameters and packaging of organic foods ((Thapa and Tripathy, 2010).
- Efforts should be made to select suitable cropping systems or more precisely, farming systems specific to those agro climatic zones having higher productivity under Organic Farming. The Government should provide them adequate infrastructure facilities to make the Organic Farming, a profitable enterprise.
- There is need for marketing research for organically produce for export potential. There should be proper planning for marketing of organically grown fruits and vegetables that should help farmers to get a better price for their produce.
- There should be incentives to the growers who produce organic vegetables.
- Extension scientists must develop strategy to create interest in small and marginal farmers to adopt organic farming technologies for growing vegetable crops.

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