DRWA

Technical Bulletin 19

EMPOWERING FARMWOMEN IN ECO-FRIENDLY PEST MANAGEMENT OF VEGETABLES

भाकृअनुप
ICAR

Directorate of Research on Women in Agriculture
(Indian Council of Agricultural Research)
Bhubaneswar-751 003, Odisha, India

Empowering farmwomen in eco-friendly pest management of vegetables

S K Srivastava, B L Attri,
L P Sahoo, M P S Arya,
Geeta Saha and B C Behera

Directorate of Research on Women in Agriculture
(Indian Council of Agricultural Research)
Bhubaneswar - 751 030, Odisha, India

Technical Bulletin 19

Empowering farmwomen in eco-friendly pest management of vegetables

Published by:
Krishna Srinath
Director
Directorate of Research on Women in Agriculture
P.O. Baramunda, Bhubaneswar - 751 003, Odisha, India
Phone: 91-0674 - 2386220, 2386241, Fax: 91-0674 - 2386242
Email: nrcwa@ori.nic.in, director@drwa.org.in
Web: http:// www.drwa.org.in

Authors:
S K Srivastava, B L Attri, L P Sahoo, M P S Arya, Geeta Saha and B C Behera

Printed at:
AB Imaging & Prints Pvt. Ltd.,
62 and 63, Ganga Nagar, Unit-6, Bhubaneswr

S K Srivastava, B L Attri and M P S Arya are Principal Scientist, L P Sahoo is Scientist, Geeta Saha is Technical Officer and B C Behera is Technical Person

PREFACE

Rural poverty is acute throughout India, and especially women who are nearly 60% are hard hit of the billion people living below the poverty line in the developing world. In Asia alone, the number of poor rural women had reached 374 million, more than the total population of Western Europe. Women formed more than half the agricultural workforce and strained every nerve for sustainable agricultural systems. In hilly and tribal areas, women normally use to bear the prime responsibility for all the agricultural operations except ploughing. Feminization in agriculture has kept pace with men movement in urban areas in search of employment. UNDP report indicates that while 67% of the world's work is done by women, only 10% of global income is earned by women and a mere 1% of global property is owned by them. In sub-Saharan Africa, women produced upto 80% of basic foodstuffs both for household consumption and for sale. Women perform 25 to 45% of agricultural field tasks in Colombia and Peru. They constitute 53% of the agricultural labour force in Egypt. Less than 10% of women farmers in India, Nepal and Thailand have their own land. According to a report of FAO, only 15% of the world's agricultural extension agents are women, while in Asia this figure is below 7%. There has been a little effort so far in developing specific technology for farmwomen. This is due to the fact that agricultural research, technical trainings and extension programmes have been primarily targeted at men which has created disparity in social status of men and women. The technological empowerment of women may help to reduce such a gap of social-economic status. The women farmer need technological choice that is economically efficient, as the women farmers are actively engaged in vegetable cultivation as an agricultural labour or cooperator. Because of seasonal and cash crops vegetable cultivation is highly profitable in comparison to other crops and it plays a vital role in maintaining balanced diet. Keeping in increasing demand of vegetables and participation of women in its cultivation, empowering women in eco-friendly vegetable pest management is of paramount importance in the developing nations in general and India in particular.

Authors

Contents

Empowering farmwomen in eco-friendly pest management of vegetables

Women play an important role in agriculture since the inception of mankind. In Stone Age, man was collecting their food by hunting only up to 20%. Rest 80% was managed by the women through root, fruit, and tubers of the plants. They were only women who started cultivating the vegetables/fruits in and around their household from the seeds collected from the forests. The women had enough knowledge of selecting those fruits which have good quality traits so that they can have a better harvest in future. Women farmers are utilizing their maximum time upto an extent of 15 hours for agriculture or allied farm activities therefore, they are being considered as backbone of Indian agriculture. In India, nearly 84% of all economically active women are engaged in agriculture and allied fields. Women are very much involved in production and protection system of agriculture in general and vegetables in particular. India ranks second in the world vegetable production but productivity is less in comparison to other countries. Vegetable cultivation is highly profitable in comparison to other field crops and it plays a vital role in balanced diet of the masses.

Environmental pollution has imposed a serious threat globally, which are mainly due to the growing utilization of chemicals. Soil- the greatest natural resource has also become polluted due to continuous and enormous use of chemical fertilizers and pesticides. The use of insecticides is being done indiscriminately for production of vegetables, which contaminate them largely, especially in the vicinity of big cities. Almost five decades of pesticides use have left us at tragic legacy; severe contamination of our water system, increased cancers, birth defects and other ailments in humans and the emergence of powerful pests which are resistant to chemical pesticides are some of the examples. More than 700 insect species have developed resistance against different chemicals. According to the World Health Organization (WHO) approximately one to two million persons are affected every year because of pesticidal use. While performing different agricultural operation (protection and production) farm women get exposed to a variety of chemical pesticides, which might lead to various adverse effects on women health as well as on soil, water and atmosphere, the three most important natural resources of our planet Earth. The functional (production/protection) agricultural operations not only affect the health of

farmwomen but also reduce the efficiency of their work. Residual effect of DDT have been recorded even in mother's milk which is harmful to newly born babies the future of India and civilization. The researches and technological disseminations were biased so far and women were mostly neglected at this stage. Environmental consciousness has restricted the use of chemical pesticides in Indian agriculture. *Prithvi Sammelan* which was organized under the aegis of UNO at Johansberg in September 2002, attended by 189 countries it was decided to fight with poverty and environmental pollution. Keeping in view the increasing demand of vegetables and participation of women in their cultivation, empowerment of women in eco-friendly vegetable production technologies is of prime importance and the need of the hour. This would be a vital input for planned growth and sustainable development of agriculture in the country.

Keeping above facts in mind a project entitled "*Popularization of eco-friendly pest management technologies for vegetables among farmwomen in homestead lands*" was formulated and conducted at Directorate of Research on Women in Agriculture (formerly National Research Centre for Women in Agriculture) Bhubaneswar, Odisha, under the aegis of ICAR. The major objective of the proposed study was to promote pesticide free production of vegetables, through empowerment of women in the use of eco-friendly pest management technologies, which will be qualitative and provide sound health for human beings, soil and environment of our planet Earth. The specific objective of the study was to generate awareness about health hazards of chemical pesticides and impart trainings on the use of eco-friendly pest management technologies among small and marginal farm families for the improvement of socio-economic status of farmwomen thereby achieving evergreen revolution in long term. Eco-friendly pest management approach has been globally accepted in order to minimize the indiscriminate and injudicious use of chemical pesticides for achieving sustainability in Agriculture. It has become more relevant due to a number of advantages like safety to environment, pesticide-free food commodities and low input based Crop Protection Programme etc. It is an approach for managing pest and disease problems encompassing available methods and techniques of pest control such as cultural, mechanical, biological and chemical in a compatible and scientific manner. Eco-friendly pest management technologies manage the pest population in such a manner that economic loss is avoided and adverse side effects of chemical pesticides are minimized. Therefore, no money is spent on unaffordable chemical pesticides and insecticides and it is quite suitable for resource poor farmwomen. Consumption of

fruits, vegetables and grains grown in eco-friendly system is safe and free from health problems. This will give fillip to exports of chemical and pollution free fruits, vegetables, grains, flowers to foreign countries thereby earning valuable foreign exchange to the country.

Technological gaps in crop protection measures among farmwomen of Odisha

Survey conducted in twenty villages of Khurda, Puri, Cuttack and Jagatsinghpur districts of Odisha revealed the technological gaps in crop protection technologies (Table -1) and depicted through bar diagram. (Fig.1) Farmwomen were having good knowledge of seed storage of vegetables but there was a vast gap in the knowledge of seed treatment and use of bio-pesticides, which varied from 78.4 to 95.2%. Overall, technological gaps among farmwomen in vegetable protection technology were found 52.6% in Odisha. Gaps identified during the study were helpful for further formulation of training programmes. A total number of 556 farm women were trained through 19 training programmes on different aspects of eco-friendly pest management techniques. During survey various eco-friendly pest management technologies and ITKs related to vegetable cultivation were collected from different sources which have been presented in Table-2.

Table-1 : Evaluation of technological knowledge gap in crop protection among the farm women of Odisha

Sl. No	Different aspects of crop protection technology	No. of farm women interviewed	Maximum score	Average score obtained	Difference in score	Technological gap in knowledge (%)	Rank
1.	Seed treatment	200	12.5	2.7	9.8	78.4	II
2.	Nursery protection	200	12.5	8.8	3.7	29.6	VI
3.	Preparation of spray solution	200	12.5	8.3	4.2	33.6	V
4.	Pesticidal hazards	200	12.5	9.3	3.2	25.6	VII
5.	Waiting period	200	12.5	4.9	7.6	60.8	IV
6.	Bio pesticide	200	12.5	0.6	11.9	95.2	I
7.	Botanical pesticide	200	12.5	3.2	9.3	74.4	III
8.	Seed storage	200	12.5	9.6	2.9	23.2	VIII
		Total	100	47.4	52..6	52..6	

Sl. No.	Name of the eco-friendly pest management technologies	Crop	Pest	Source
4.	Spraying of Kochilla (*Strychnos nuxvomica*) seed powder with water	Brinjal and Tomato	Fruit and shoot borer and *Helicoverpa*	KVK, Bhanjnagar
5.	In inter-cropping of cabbage+ tomato (1:1), tomato seedlings should be transplanted before 30 days transplanting of cabbage	Cabbage	Diamond back moth	CHES, Aiginia, Bhubaneswar
6.	Inter cropping of cabbage+ mustard (25:2). First line of mustard 15 days before and second line 25 days after the transplanting of cabbage	Cabbage	Diamond back moth, Leaf webber, Web worm and Aphids	CHES, Aiginia, Bhubaneswar
7.	Inter cropping of Cabbage with French bean	Cabbage and French bean	Aphid	CIPMC, Bhubaneswar
8.	Soaking of neem seed powder overnight and application of its extract	Cabbage	Diamond back moth	CHES, Aiginia, Bhubaneswar
9.	Soil application of Neem cake @ 250 kg/ha	Cabbage	Diamond back moth	CIPMC, Bhubaneswar
10.	Boiling stem of Tomato in water and its spray	Cabbage	Diamond back moth	CHES, Aiginia, Bhubaneswar
11.	Early harvesting	Cabbage	Cabbage worm, Cabbage weevil	CIPMC, Bhubaneswar
12.	Spraying of Insect growth regulator Juvenile or molting hormone Teflubenzuron @ 45 g a.i./ha. and Flufenoxuron @ 20 g a.i./ha	Cabbage	Diamond back moth	CIPMC, Bhubaneswar

Sl. No.	Name of the eco-friendly pest management technologies	Crop	Pest	Source
13.	Spraying of Neem soap and Pongamia soap @ 1%	Tomato and Cabbage	Tomato Fruit Borer *Helicoverpa armigera* and Diamond back moth	CHES, Aiginia, Bhubaneswar
14.	Use of light traps	Tomato	Tomato fruit borer	OUAT, Bhubaneswar
15.	Inter-cropping of tomato with marigold (16:1). 40 days old seedlings of marigold should be transplanted with tomato	Tomato	Fruit borer	CHES, Aiginia, Bhubaneswar
16.	Inter-cropping of tomato with Rajma	Tomato	Bacterial wilt	CIPMC, Bhubaneswar
17.	Inter-planting with beans	Tomato	Serpentine leaf miner	CIPMC, Bhubaneswar
18.	Six release of *Trichogramma brasilensis* @ 40,000/ha at weekly intervals with the first release coinciding with 50% flowering along with 3-4 application of Ha NPV @ 250 larval equivalents/ ha. The first spray should coincide with flowering	Tomato	Tomato fruit borer	CIPMC, Bhubaneswar
19.	Spraying of cattle urine +dung extract (cattle urine 12.5 litre + dung 12.5 kg+water 12.5 liter+ 375 gm lime, after fermentation for four days, stock solution thus obtained is made to 80 litre will be sufficient for one acre) preferably after 3.30 P.M.	Tomato	To repel *Helicoverpa* moths	CIPMC, Bhubaneswar

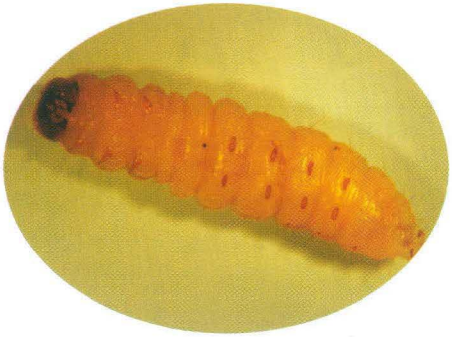
Sl. No.	Name of the eco-friendly pest management technologies	Crop	Pest	Source
20.	Spraying of green chilli+garlic extract @ 7.5kg chilli extracted in water(4 kg chilli should be drenched in 8 litres of water for overnight) +1.25 Kg garlic extracted in kerosene (750 gm pounded garlic made to soak in 200 ml of kerosene for overnight)+100 gm dissolved detergent, for one hectare.	Tomato	Repel *Helicoverpa* to lay eggs	CIPMC, Bhubaneswar
21.	Spraying of 10% Doob Ghas (*Cynodon dactylon*) extract (20 Kg Doob Ghas + 50 litres water—heat at 60°C for 1 hour, sieve, dissolve it in 200 litres of water and spray.	Tomato	Spotted dry virus	CIPMC, Bhubaneswar
22.	Release of poultry birds early in the morning	Tomato and French bean	Fruit borer	Mahulia village Nayagarh, (Odisha)
23.	Spraying of Bael (*Aegle marmelos*) leaves extract	Tomato and Onion	Blight	CIPMC, Bhubaneswar
24.	Extracts form *Beta vulgaris* and *Cascuta* extracts	Cucumber and Tomato	Cucumber mosaic virus and Tomato bushy stunt	Inventory of Indigenous Technical Knowledge in Agriculture, Document -1
25.	Use of Pheromone trap	Brinjal, Tomato and Cabbage	Adult insects of Brinjal shoot and fruit borer, *Helicoverpa* and Diamond back moth	CIPMC, Bhubaneswar

Sl. No.	Name of the eco-friendly pest management technologies	Crop	Pest	Source
26.	Inter-cropping of okra and chilli with marigold & chilli with Ramdana (*Amaranthus*)	Okra and Chilli	Mosaic and Root knot nematode	CIPMC, Bhubaneswar
27.	Spraying of Pongamia, Mahua and Sesame seed extract	Okra	White fly	CIPMC, Bhubaneswar
28.	Spraying of Neem kernel extract or *Melia* Kernel Extract @ 10%	Okra	*Earias vitella*	CIPMC, Bhubaneswar
29.	Seed treatment with *Trichoderma viridae* @ 2g /100 g of seeds	Okra	Color rot disease	CIPMC, Bhubaneswar
30.	Spraying of NSKE 5%, Neem Oil, Garlic extract	Chilli	Flower gall midge	CIPMC, Bhubaneswar
31.	Early sowing (Emergence of insect takes place in February and by that time vines of cucurbits increased in size, so there is no harm by the insect)	Pumpkin family	Red pumpkin beetle	CIPMC, Bhubaneswar
32.	Spraying of Leaf extract of Lantana (*Lantana camara*) and Tulsi *(Ocimum bacilinum)*	Potato, Bean, Brinjal, Tomato, Chilli and Onion etc.	Leaf miner	CIPMC, Bhubaneswar
33.	Scattering a 2 cm layer of dried, powdered leaves of *Cannabis* over piles of potatoes protected them from the tuber moth upto 120 days	Potato	*Phthorimaea operculella*	Inventory of Indigenous Technical Knowledge in Agriculture, Document 1

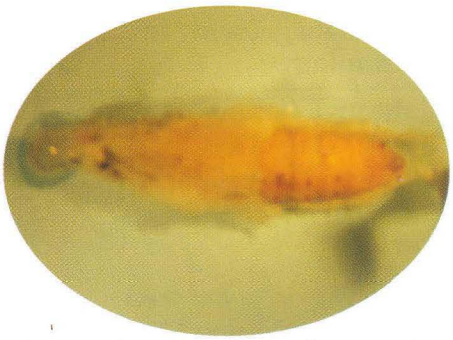
Sl. No.	Name of the eco-friendly pest management technologies	Crop	Pest	Source
34.	Spraying of neem oil 0.03% @ 2.5 lit./ha	All vegetables	Fruit borer and other insects	CHES, Aiginia, Bhubaneswar
35.	Spraying of 1 kg *bael* leaf with 10 litres of water or cow dung slurry 1 kg in 10 litres of water	All vegetables	Bacterial blight	Koraput, Odisha
36.	Broadcasting of 4-5 kg sugar/acre. Ants are attracted to sugar particles and thereafter they feed on the larval form of the pests	All vegetables	Larval form of various pest	Koraput, Odisha
37.	Application of Kochilla leaf (*Strychnos nuxvomica*) + Karanj leaf + Neem leaf + cow dung in the form of compost	All vegetables	Different insect pests	Chawalia village, Erasama, Jagatsinghpur (Odisha)
38.	Putting of old fishing net in the periphery of vegetable field	All vegetables	Non insect pest- Poultry folks	Chawalia village, Erasama, Jagatsinghpur (Odisha)
39.	Planting of Marigold (locally called Kusum) in the periphery of vegetable field or intercrop with Okra and Brinjal	All vegetables	Different insect pests	Chawalia village, Erasama, Jagatsinghpur (Odisha)
40.	Keeping the seed after sun drying in earthen pots sealed with mud and cow dung	All vegetable seeds	Storage pest	Aastarang village Distt. Puri

Sl. No.	Name of the eco-friendly pest management technology	Crop	Pest	Source
41.	Root dip of nursery of vegetables with water solution of Aesfoetida (*Heengu*) powder + Turmeric powder @ 0.1 g and 1g respectively /litre of water	All vegetables	Fungal diseases of vegetables	Village Papda handi, Distt. Navrangpur (Odisha)
42.	Mixing of cement with the seed of vegetables and keeping in polyethylene bag / Glass bottles/ Tin containers	All vegetable seeds	Storage pest	Village Andharwa and Balbhadrapur Block Bhubaneswar Distt- Khurda
43.	Keeping dry sand in container and thereafter-vegetable seeds followed by tightening the lid of the container	All vegetable seeds	Storage pest	Village-Balbhadrapur and Saripur, Block-Balipatna, Distt-Khurda
44.	Spraying of Holy water of Lord Shiva temple which contains Curd, Milk, Ghee, Honey and Basil leaves	All vegetables	Different insect pests in vegetables	Smt. Nayana Behera and Smt. Lata Mani Behera at Village – Hansapara, Block - Neemapara, Distt. Puri (Odisha)
45.	Mixing of ash with the seed of vegetables and keeping in Polyethylenebag/ Glass bottles/ Tin containers	All vegetable seeds	Storage pest	Village-Dahijang, Block - Neemapara, Distt. Puri (Odisha)

Sl. No.	Name of the eco-friendly pest management technology	Crop	Pest	Source
46.	Putting Bitter guard (*Karella*) seed in Cow dung and its pasting on the wall inside the house	All vegetable seeds	Storage pest and for vigourous germination	Dahijang village,Block - Neemapara, Distt. Puri (Odisha)
47.	Spraying of Neem seed kernel suspension 5%	All vegetables	Oviposition deterrent,Ovicide , Antifeedant and Insect growth regulator	CIPMC, Bhubaneswar
48.	Spraying of Tobacco leaf decoction @ 5 kg/ha prepared from tobacco dust	All vegetables	Sucking pests and *Helicoverpa*	CIPMC, Bhubaneswar
49.	Spraying of *Jatropha curcas* (*Baigava, Ratanjot*) leaf extract	All vegetables	Sucking pest	KVK Bhanjnagar
50.	Spraying of Cow milk with water	Kitchen garden	Sucking and borer pest	NGO, Gram Vikash, Berhampur (Odisha)
51.	Application of Mahua (*Madhuca longifolia* Koen) cake in seed beds	All vegetables	Nursery pests	NGO, AFPRO, Ranchi (Jharkhand)
52.	Dusting of wood ash @ 20 kg/acre with hand or duster early in the morning	All vegetables	Nursery pest	CIPMC, Bhubaneswar
53.	Crop rotation with cereals; jowar/maize	French bean	Pod borer	CIPMC, Bhubaneswar
54.	Erection of Bird parches @ 50 number /ha to attract local predatory birds, which in turn feed on insects pest	All vegetables	Various insects	CIPMC, Bhubaneswar



Ventral view of *Leucinodes orbonalis*



Leucinodes orbonalis inside puparia

Damaged plant in later stage
by *Leucinodes orbonalis*

Damaged symptoms
by *Leucinodes orbonalis*

Validation trials with the participation of farmwomen:

Fifteen participatory validation trials five each on Tomato, Brinjal and Cabbage were conducted in Jaganathpur and Khamang Sasan village of Odisha to empower farmwomen in eco-friendly pest management, as per details given below:

Methodology for validation trials

Farmwomen were trained to grow nursery in raised bed having a height of 10.0 to 12.0cm from field. Seeds were soaked in water for 6-8 hours; shade dried and treated with bavistin @2.0 gm per kg. of seed. Neem shield was mixed in nursery bed @ 30gm/m^2. One cm deep line was drawn 5cm apart across the length of the nursery bed. Seeds were sown in these lines in proper moisture conditions, followed by covering of

seeds with a thin layer of dry compost (FYM) and paddy straw. In order to keep the bed moist, it was irrigated regularly. Paddy straw was removed just after the germination of seeds. Protective spraying of Neem oil @0.03% along with bavistin 3gm /lit was given at ten days interval to protect the nursery from pests and diseases. Root zone of seedlings was kept in a solution containing 2ml neem oil, 2.5gm bavistin and 1 litre water for 1 hour before transplanting. Seedlings of each variety in each crop were transplanted in conventional and eco-friendly system for the comparison of results.

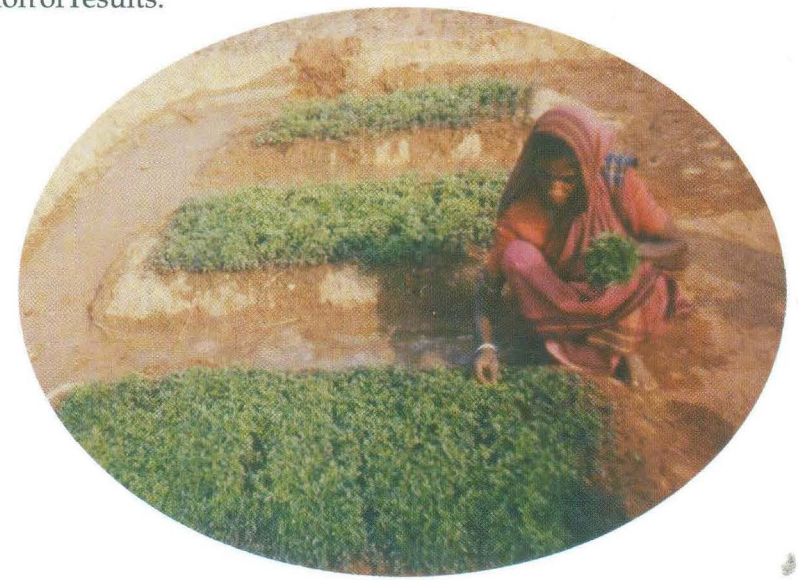
Training of farmwomen

Farmwomen scientist interaction and training

Preparation of main field for validation trials

Chemical fertilizers NPK @ 200:100:100 kg / ha for brinjal and tomato and 210:250:250kg/ha for cabbage were used in main field. 400 m^2 net area was prepared for the experiment. Each variety was transplanted in 100 m^2 area and subdivided into two plots for conventional system and eco-friendly methods. Neem Shield was used @2.5kg/50 m^2 in eco-friendly methods only. In the case of Brinjal and Tomato 25% N, 50%P, 50%K was applied in the field at the time of last ploughing, another 25% N was applied 30 to 40 days after transplanting. Remaining 50%N, 50%P and 50%K was applied in field after 100 days of transplanting. Full dose of Neem Shield was applied in the eco-friendly plot at the time of last preparation before transplanting in all three crops. In case of cabbage 50%N, 100%P and 100%K was applied at the time of last

ploughing before transplanting. Remaining 50% N was applied after 30 and 45 days of transplanting respectively. There were four main plot treatments of varieties and two sub plot treatment *viz.*, conventional method and eco-friendly method with an area of 50 m^2 each. 4 varieties each of brinjal, tomato and cabbage were transplanted in these subplots in separate participatory trials followed by other treatments *viz.*, installation of pheromone trap with heli lure (for tomato), DBM lure (for cabbage) and Lucin lure (for brinjal) and spraying of Neem oil (Azadirachtin) @5.00% at weekly interval in standing crop. Lure was changed at every 15 days interval. Experiment was laid out on fields of 15 farmwomen (5 each for brinjal, tomato and cabbage) in participatory mode. Total fruit yield of brinjal and tomato and total head yield of cabbage was recorded in conventional and eco-friendly method. Finally, cost benefit ratio was calculated for the interpretation of results.



Farmwomen uprooting the healthy seedling for main field

Details about Neem shield and Neem oil

Neem Shield

It is 100% organic manure made out of Neem, Karanj, Kusum, Til, Mustard etc. It is helpful to rejuvenate the soil by correcting the effect of prolong use of chemical

fertilizer and pesticides. It is ready to use and free from problems of composting. It is powerful than cow dung, FYM, oil cake, bone and leather meal. It contains balanced proportion of macro, micro nutrients and trace elements. It makes vegetables full of natural colour, taste, aroma, nutrition and free from chemical residue. Its natural quality increases plants resistance capacity from attack of mites, termites, insect-pests, nematodes, ants, bacteria and fungus. It does not contaminate/pollute ground water sources. It was applied @30gm/m^2/fortnight for vegetables.

Neem oil

It was used as preventive dosage against various insects, pests, fungus bacteria, mites attack. 5ml neem oil and 0.5gm of home detergent (Nirma Washing powder) was mixed with one litre water. This liquid was sprayed every 10 days interval with conventional sprayers on plants. It does not leave harmful chemical residue. Neem oil has tendency to gets thicker during winter. Bottle of neem oil was kept in lukewarm water before preparation of spray solution. Neem oil acts as preventive against various insect-pests, fungus, bacteria and mites of vegetables, fruits, flowers and foliage. Neem oil can also be used as Mosquito repellent. Put 3 drops of Neem oil every day on used mosquito mat and put the mat on bulb/lantern/machine. It is sufficient for 10 cubic foot of room for 8 hours. It is also effective against lice and dandruff. Mix 10ml Neem oil with 100ml coconut oil. Apply the mixture on scalp and hair twice a week. Moreover, massage pure Neem oil once a week on pets, or spray 10ml Neem oil with a pinch of detergent powder and 1 liter water against ticks and lice in pets.

Neem oil treated brinjal field

Brinjal (*Solanum melongena*)

Following observations were recorded during the study. Average yield data of five participatory trials of Brinjal and Cost Benefit Ratio of Brinjal have been presented in Table 3 and Table 6, respectively. The brinjal crop is attacked by a number of insect . Some of important insect found during the study were shoot and fruit borer(*Leucinodes orbonalis*) and lady bird beetle.

Green Star Long

Plants are spineless upright and fruits are oval shaped, green-white striped. Average weight of the fruit was 180gm. This was found resistant to bacterial wilt.

BB 44

Plants are spineless, bushy, 4 to 5 fruits born in cluster. Fruits are whitish green and oval shaped. Average weight of the fruit was 63g. This was found resistant to bacterial wilt and root knot nematode. This was preferred by farmwomen because of its suitability during transportation.

Green Star

Plants are upright spineless and fruits are oval, dark green with white stripes. Eight to ten fruits are born in cluster. Average weight of fruit was 75gm. This was found resistant to bacterial wilt and root knot nematode. This variety gave maximum yield among all four tested varieties of Brinjal followed by Green Star Long.

Chandrika

Plants are little spiny, bushy, fruits are round, dark green, white striped. Average weight of fruit was 195gm. This was found resistant to bacterial wilt and root knot nematode. This variety gave lowest yield among all four tested varieties of Brinjal.

Cost benefit ratio

Although, yield was less in eco-friendly method but at the same time cost of inputs was also less, therefore, cost benefit ratio in eco-friendly method was higher (2.95). Yield

was more in conventional method but at the same time, cost of inputs was more due to frequent application of pesticides. Therefore, Cost Benefit Ratio was less (1.83) in conventional method. Eco-friendly method was found cost effective. Therefore, it is quite suitable for resource poor farmwomen with health security as an additional benefit.

Training of farmwomen on eco-friendly pest management technology

Installation of pheromone trap in brinjal field

Cabbage (*Brassica oleracea* var. *capitata*)

Following observations were recorded during the study. Average yield data of five participatory trials of Cabbage and Cost Benefit Ratio of Cabbage have been presented in Table 4 and Table 7, respectively. Cabbage maggot, Green cabbage worm, Cabbage lopper and Aphid are the important insect of cabbage were found during the study.

Priya (Hybrid)

Growth and maturity is uniform. Maturity was observed in 60-65 days after transplanting. Heads were of 1.0 to 1.250 kg in weight, round in size and very compact.

Green Samrat (Hybrid)

Maturity was observed in 70 to 75 days after transplanting. Heads were of 2.000 to 2.750 kg in weight, round in size and compact. This has been found tolerant to black rot and Fusarium wilt. This variety gave maximum yield among all four tested varieties of Cabbage followed by Gold Star.

Green Diamond (Improved)

Maturity was observed in 50-55 days after transplanting. Heads were of 1.000 to 1.150 kg in weight, round in size and compact.

Gold Star (Hybrid)

Maturity was observed in 60-65 days after transplanting. This was preferred by farmwomen because heads were very solid and don't burst even after several days of maturity. Dark green colour leaves have a protected layer. Heads were of 1.100 to 1.400kg in weight and round in size.

Cost benefit ratio

Although, yield was less in eco-friendly method but at the same time cost of inputs was also less, therefore, cost benefit ratio in eco-friendly method was higher (12.03). Yield was more in conventional method but at the same time, cost of inputs was more due to frequent application of pesticides. Therefore, Cost Benefit Ratio was less (10.92) in conventional method. Eco-friendly method was found cost effective. Therefore, it is quite suitable for resource poor farmwomen with health security as an additional benefit.

Installation of pheromone trap in cabbage field

Tomato (*Lycopersicon esculentum*)

Following observations were recorded during the study. Average yield data of five participatory trials of Tomato and Cost Benefit Ratio of Tomato are presented in table 5 and Table 8, respectively. Tomatoes are subject to attack by a large number of insect pests from the time plants first emerge in the seed bed until harvest. The major insect were found as tomato fruit worm and lady bird beetle.

Utkal Deepti (BT-2)

Fruits are round shape with an average weight of 65gm. This has been found resistant to bacterial wilt and root knot nematode and tolerant to Fusarium and Verticilium wilt.

Kumari (BT-10)

Fruits are globe shaped with an average weight of 90gm. This has been found resistant to bacterial wilt, root knot nematode and tolerant to Fusarium and Verticilium wilt. This was preferred by farmwomen due to good keeping quality. This variety gave maximum yield among all four tested varieties of Tomato followed by Samaleswari.

Jyoti

Fruits are globe shaped with an average weight of 90gm. This has been found resistant to bacterial wilt, Fusarium wilt and root knot nematode.

Samaleswari

Fruits are egg shaped with an average weight of 70gm. This has been found resistant to bacterial wilt, Fusarium wilt and root knot nematode.

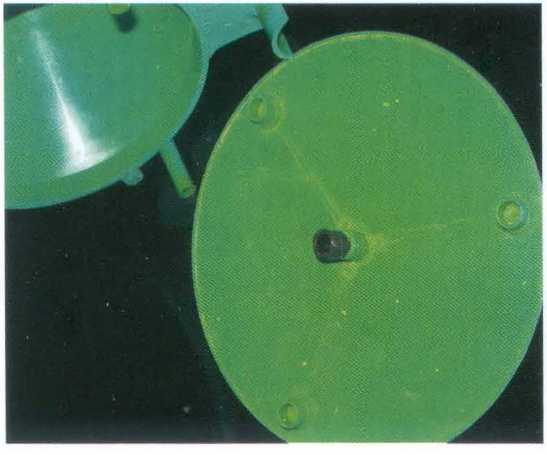
Cost benefit ratio

Although, yield was less in eco-friendly method but at the same time cost of inputs was also less, therefore, cost benefit ratio in eco-friendly method was higher (4.78). Yield was more in conventional method but at the same time, cost of inputs was more due to frequent application of pesticides. Therefore, Cost Benefit Ratio was less (4.53) in conventional method. Eco-friendly method was found cost effective. Therefore, it is quite suitable for resource poor farmwomen with health security as an additional benefit.

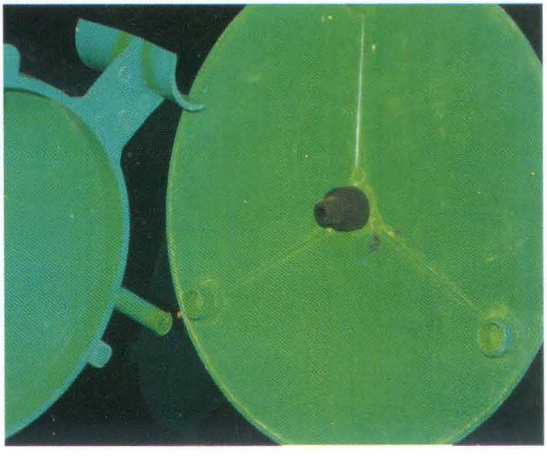
Farmwomen observing pest incidence in tomato field

Table- 3 : Average yield of five participatory trials of Brinjal

Sl. No.	Name of the variety	Yield q/ha						
	Eco-friendly method	**I**	**II**	**III**	**IV**	**V**	**Total**	**Av.**
1.	Green star long	106.42	110.34	118.26	130.06	131.22	596.30	119.26
2.	BB-44	100.30	106.24	109.24	110.14	120.16	546.08	109.22
3.	Green star	122.74	123.60	128.82	141.82	143.14	660.12	132.02
4.	Chandrika	90.32	91.54	97.86	90.20	101.34	471.26	94.25
	Conventional method							
5.	Green star long	146.72	140.22	152.06	155.10	157.62	751.72	150.34
6.	BB-44	132.54	130.32	141.70	142.12	146.30	692.98	138.59
7.	Green star	158.50	151.62	161.34	169.04	166.12	806.62	161.32
8.	Chandrika	123.46	126.60	132.62	130.30	139.22	652.20	130.44
	Total	**981.00**	**980.48**	**1041.90**	**1068.78**	**1105.12**	**5177.28**	
	C.D.at 5 %							4.840



Wrong placement of pheromone lure



Right placement of pheromone lure

Conventional methods of spraying

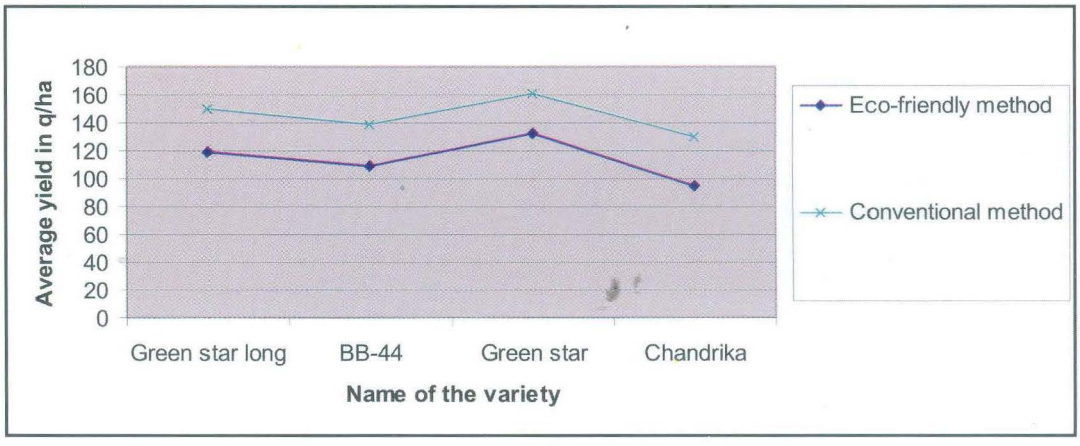


Figure-2: Comparison of eco-friendly v/s conventional method on the yield of different varieties of Brinjal

Table-4 : Average yield of five participatory trials of Cabbage

Sl. No.	Name of the variety	Yield q/ha						
	Eco-friendly method	**I**	**II**	**III**	**IV**	**V**	**Total**	**Av.**
1.	Pirya	471.10	418.20	408.90	467.02	492.10	2257.32	451.46
2.	Green Samrat	640.12	649.00	609.20	646.18	669.04	3213.54	642.70
3.	Green Diamond	406.90	390.16	451.06	457.12	439.02	2144.26	428.85
4.	Gold Star	488.80	481.10	476.70	507.20	516.10	2469.90	493.98
	Conventional method							
5.	Pirya	480.10	430.12	420.45	480.24	500.04	2310.95	462.19
6.	Green Samrat	651.20	660.20	620.18	661.80	680.16	3273.54	654.70
7.	Green Diamond	450.16	421.60	400.12	460.50	460.10	2192.48	438.49
8.	Gold Star	500.40	491.90	490.60	521.50	530.07	2534.47	506.89
	Total	**4120.90**	**3959.02**	**3816.31**	**4195.5**	**4304.73**	**20396.46**	
	C.D.at 5 %							15.09

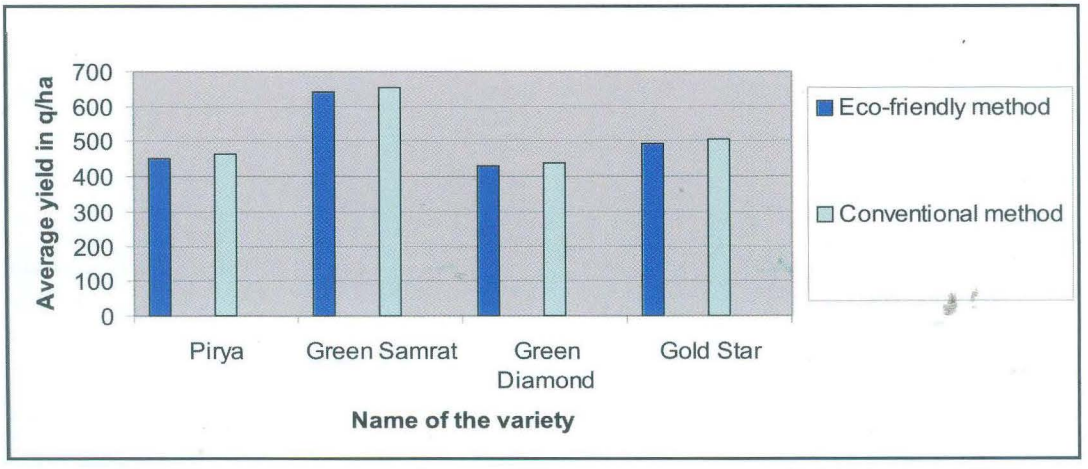


Figure-3: Comparison of eco-friendly v/s conventional method on the yield of different varieties of Cabbage

Table -5 : Average yield of 5 participatory trials of Tomato

Sl. No.	Name of the variety	Yield q/ha						
	Eco-friendly method	**I**	**II**	**III**	**IV**	**V**	**Total**	**Av.**
1.	Utkal Deepti (BT-2)	513.20	472.20	487.20	579.20	577.20	2629.00	525.80
2.	Kumari (BT-10)	554.40	508.20	524.40	613.40	607.00	2807.40	561.48
3.	Jyoti	507.00	457.40	464.20	546.40	539.40	2514.4	502.88
4.	Samaleswari	528.80	481.40	501.10	593.20	586.60	2691.10	538.22
	Conventional method							
5.	Utkal Deepti (BT-2)	526.20	489.20	504.40	586.00	591.20	2697.20	539.40
6.	Kumari (BT-10)	561.00	523.00	541.20	636.30	623.20	2884.70	576.94
7.	Jyoti	516.20	471.00	483.60	563.00	554.20	2588.00	517.60
8.	Samaleswari	537.60	505.20	519.40	607.00	606.40	2775.60	555.12
	Total	**4244.40**	**3907.60**	**4025.50**	**4724.50**	**4685.20**	**21587.20**	
	C.D.at 5 %							7.681

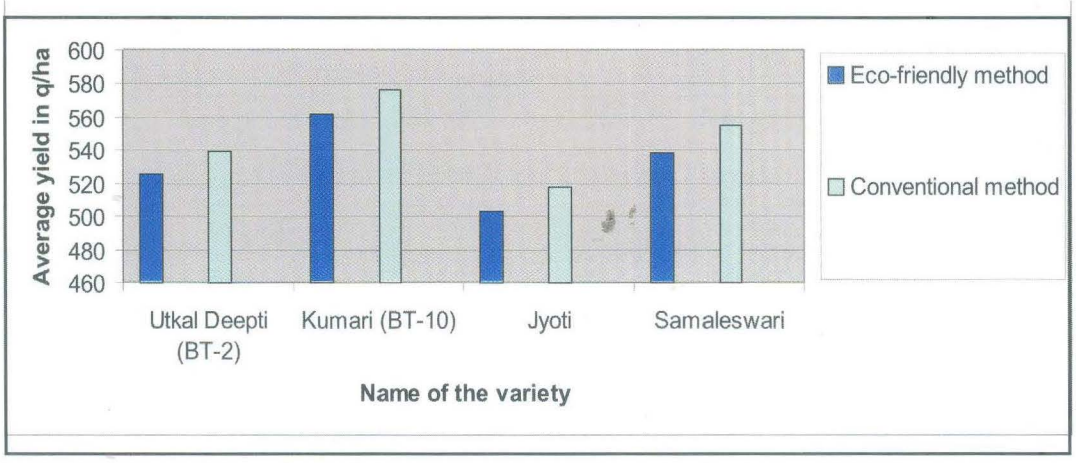


Figure-4 : Comparison of eco-friendly v/s conventional method on the yield of different varieties of Tomato

Table -6 : Cost benefit ratio of Brinjal (Average of 5 trials)

Items	Rate	Rs./ha	
		Eco-friendly method	Conventional method
Cost			
Pheromone trap	12 trap/ha @ Rs.25/- each	300.00	-
Lucin lure	120 lure / ha @ Rs. 11.00 each	1320.00	-
Neem shield	5q/ha @ Rs.2640/q	13200.00	-
Monocrotophos	2.50 lit/ha @Rs.280/lit. 10 spray	-	9800.00
Quinalphos	2.50 lit/ha @Rs.360/lit.10 spray	-	11800.00
Endosulfan	2.50 lit/ha @Rs.260/lit. 10 spray	-	9300.00
Neem oil	2.50lit./ha @Rs.1.60/litre12 spray	8160.00	-
Sevin 50% W.P.	2.0kg./ha@Rs.360/kg. 10 spray	-	10000.00
Total cost		**22980.00**	**40900.00**
Yield and returns			
Marketable yield (q/ha)		113.68	145.17
Gross return @Rs.8.00/kg.		90944.00	116136.00
Net return		67964.00	75236.00
Cost benefit ratio		2.95 and	1.83
		health security.	

4 Labour/ha for spraying @Rs.70/labourers = Rs.280/- for one spray

Table - 7: Cost benefit ratio of Cabbage (Average of 5 trials)

Items	Rate	Rs./ha	
		Eco-friendly methods	Conventional methods
Cost			
Pheromone trap	12 trap/ha @ Rs.25/- each	300.00	-
DBM lure	84 lure / ha @ Rs. 13.00 each	1092.00	-
Neem shield	5 q/ha@ Rs. 2640/q	13200.00	-

Items	Rate	Rs./ha	
		Eco-friendly methods	Conventional methods
Monocrotophos	2.50 lit/ha @Rs.280/lit. 7 spray	-	6860.00
Quinalphos	2.5 lit/ha @ Rs.360/lit7 spray	-	8260.00
Endosulfan	2.5 lit/ha @ Rs.260/lit7 spray	-	6510.00
Neem oil	2.5 lit./ha @ Rs.160/lit7 spray	4760.00	-
Total cost		**19352.00**	**21630.00**
Yield and returns			
Marketable yield (q/ha)		504.24	515.56
Gross return@ Rs.5.00/kg.		252120.00	257780.00
Net return		232768.00	236150.00
Cost benefit ratio		**12.03 and health security.**	**10.92**

4 Labour/ha for spraying @Rs.70/labourers = Rs.280/- for one spray

Table-8: Cost benefit ratio of Tomato (Average of 5 trials)

Items	Rate	Rs./ha	
		Eco-friendly methods	Conventional methods
Cost			
Pheromone trap -	12 trap/ha @Rs.25/- each	300.00	-
Heli lure	120 lure / ha @ Rs. 11.00 each	1320.00	-
Neem shield	5Q/ha @ Rs.2640/Q	13200.00	-
Monocrotophos	2.50 lit/ha @Rs.280/lit. 8 spray	-	7840.00
Quinalphos	2.50 lit/ha @ Rs.360/lit 8 spray	-	9440.00

Endosulfan	2.50 lit/ha @Rs.260/lit. 8 spray	-	7440.00
Neem oil	2.50 lit/ha @ Rs.160/lit 12 spray	8160.00	-
Total cost		**22980.00**	**24720.00**
Yield and returns			
Marketable yield (q/ha)		532.09	547.27
Gross return @ Rs.2.50/kg.		133022.50	136817.50
Net return		110042.50	112097.50
Cost benefit ratio		**4.78 and health security.**	**4.53**

4 Labour/ha for spraying @Rs.70/labourers = Rs.280/- for one spray

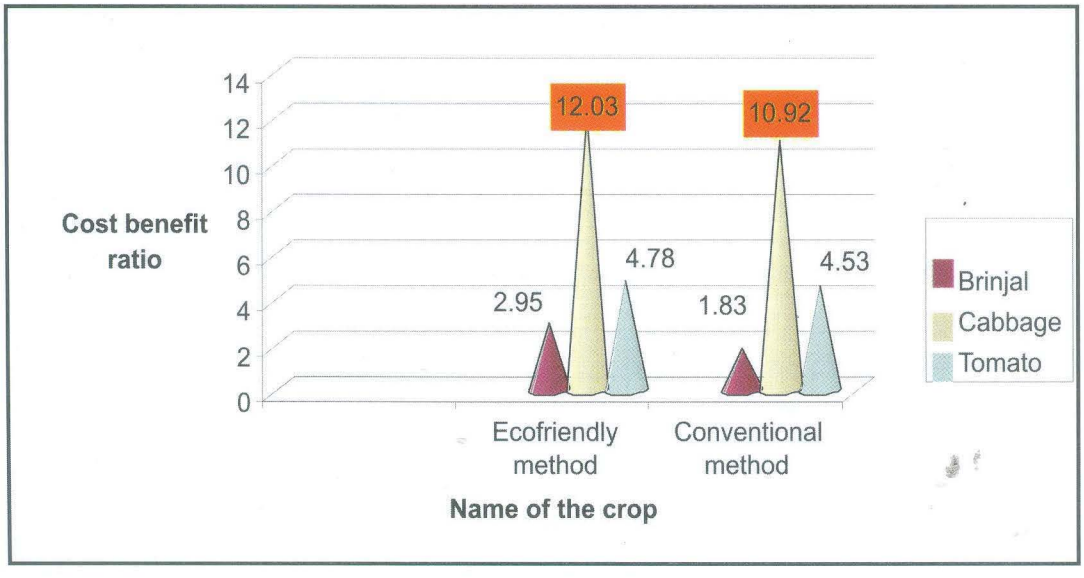


Figure-5: Cost benefit ratio of eco-friendly method v/s conventional method

Impact of the study

1. Farmwomen became experts in identifying insect-pests and timely application of pesticides in the areas covered under the project.
2. Technical knowledge of farmwomen was found to increased.
3. Eco-friendly pest management approaches were applicable to various situations and contexts.
4. Farmwomen/farmers of neighboring villages showed interest in eco-friendly pest management and assisted in popularising these gender friendly technologies.
5. Women preferred eco-friendly pest management as there was reduction in health hazards and work load due to preparation of less number of spray solutions.
6. Women showed positive response in decision making based on what they had learned.
7. Availability of quality food in the farm families and in the local market.
8. Use of pheromone Trap and botanicals were found as new technology by most of the farmwomen.
9. Farmwomen perceived that indiscriminate use of pesticides lead to health hazards.
10. Farmwomen gained knowledge that application of neem shield improves soil moisture retention and required less number of irrigation.
11. Farmwomen perceived that eco-friendly pest management reduced the frequent application of pesticides.

Secrets for the success

All strategies were designed by keeping in mind the socio-economic status of the farmwomen with a message that - spray when necessary. All critical inputs were provided as a part of the strategy. The strategies/demonstrations were taken to only those farmwomen/villages where farmwomen responded during training programmes. During training programme it was stated that projects would work with farmwomen to solve their pest management problems, if they were in need of help. Emphasis was made on making the best of all available options with farmwomen thereby leading to an overall reduction in insecticide use and avoidance of superfluous sprays. Frequent interaction with farmwomen in selected villages from field preparation to harvesting was vital for the transfer of technology. Farmwomen were educated on the identification and scouting of harmful and beneficial insects, and harmful effects of pesticides. They were encouraged to take all decisions of pest management, pesticide application after a total assessment of the pests and damage status. Farmwomen were trained for the seed treatment and proper placement of lures in the Pheromone traps. During the entire training programme farmwomen were taught that increased pesticide usage inevitably leads to higher levels of cancer and other diseases in the human population.

About Directorate of Research on Women in Agriculture, Bhubaneswar

Vision:

Emerge as a leading centre for gender research and serve as a catalyst for gender mainstreaming and women empowerment in agriculture to realize enhanced productivity and sustainability of agriculture.

Mission:

Generate and disseminate knowledge to promote gender sensitive decision making for enhancing efficiency and effectiveness of women in agriculture.

Mandate:

Carrying out basic, strategic and applied research to identify gender issues and test appropriateness of available farm-technologies/ programmes/policies with women perspective. To do training and consultancy for promoting gender mainstreaming in research and extension for empowerment of farmwomen and capacity building of scientists, planners and policy makers to respond to the needs of the farm women.

Objectives:

- Undertake studies to assess farm technologies, programmes, institutions and policies with gender perspective.
- Understand the dynamics of gender role in different agro-ecological and production systems and its linkages with agricultural development.
- Identify and understand drudgery related issues and other constraints among farmwomen and suggest measures for increasing their work efficiency.
- Create and maintain a database on gender in agriculture to meet information needs of stakeholders.

- Develop gender sensitive science & technology based models and institutional innovations for sustainable livelihood security and empowerment of women.
- Capacity building of R & D professionals for addressing gender issues in agriculture.
- Documentation and dissemination of gender based knowledge among the stakeholders.

Functions:

- Development of gender information system, analysis of farming system models from gender perspectives.
- To test the appropriateness of available farm technologies for suitability to women.
- Impact assessment of programmes and policies in gender perspectives.
- Addressing the issues of , drudgery, livelihood, food and nutritional security of farm women through appropriate technologies, innovations and policies.
- Capacity building of various stakeholders through development of gender sensitive appropriate training modules, income generation technologies and organising need based training programmes.

For any information please write to:

The Director
Directorate of Research on Women in Agriculture
P.O. Baramunda, Bhubaneswar - 751 003, Odisha, India
Phone : 91-0674- 2386220, 2386241, Fax: 91-0674 - 2386242
Email : nrcwa@ori.nic.in, director@drwa.org.in
Web : http:// www.drwa.org.in

DRWA,Bhubaneswa

Directorate of Research on Women in Agriculture
Bhubaneswar 751 003, Orissa, India
Phone : +91-674-2386220, Fax : +91-674-2386242
email:nrcwa@nic.in,web:http://www.drwa.org.in