

**Establishment of a resource center for hardening of tissue cultured plantlets at Women
Technology Park, Sunderbans, WB**

Final Report

(April, 2008 – March, 2010)

Submitted to

Department of Biotechnology

Govt. of West Bengal

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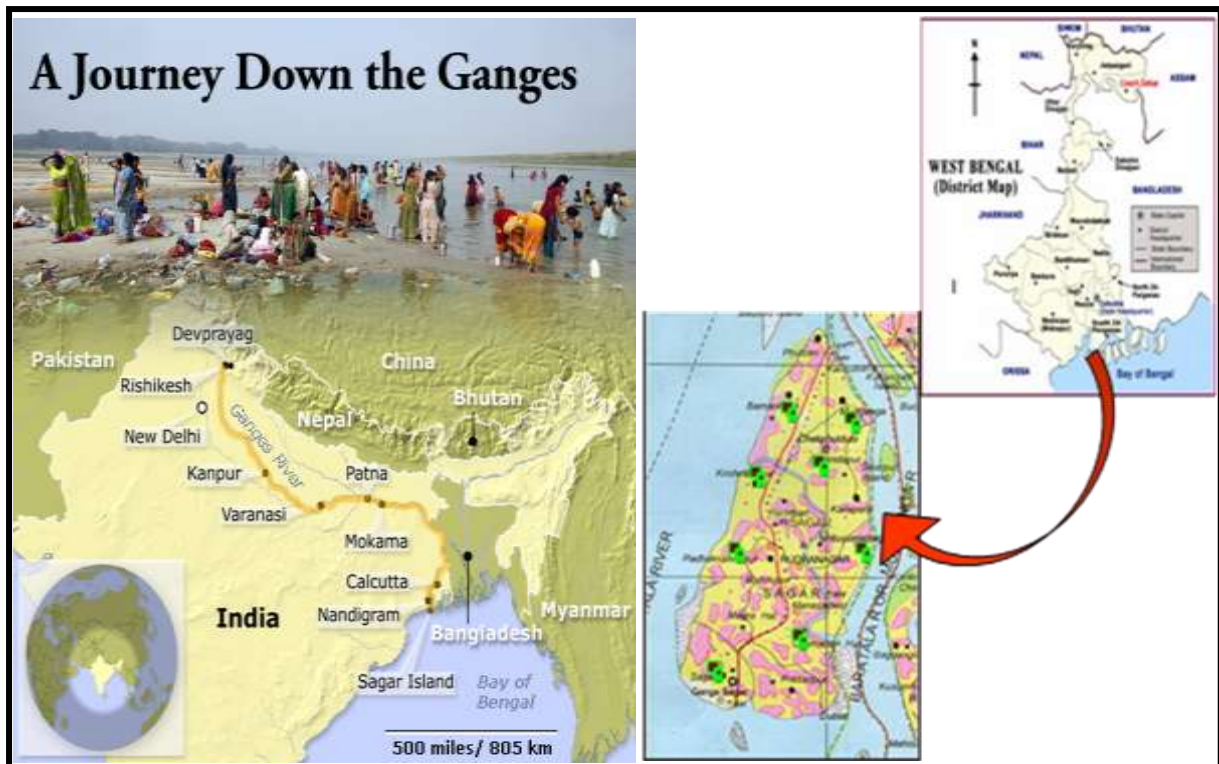
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Sagar Island

Sagar Island, a Sundarban block in S-24 Pgs, has

- a geographical area of 407.8 sq. km
- 8 gram panchayets and 40 villages
- a population of about 1.70 lakhs
- betel vine as a major cash crop grown in about 200 ha area
- about 6945 ha area under aman rice while only 650 ha area under boro
- mung, khesari and lentil grown in about 465 ha area
- 122 Primary, 13 Middle, 13 High, 5 Higher Secondary Schools and only one college without science stream
- a Women Technology Park, established by Vivekananda Institute of Biotechnology with support from DST, Govt. of India in a building provided by SDB, Govt. of W.B.

Women, in Sagar, are mainly involved with the household, agriculture and fishery. Surprisingly the literacy rate amongst the women in this block is highest within the district. So, a large section of them, are suitable to take up bio-technology based programs.

APPROVED OBJECTIVES

- Training program on field level management of micropropagated banana plantlets.
- Establishing a model hardening unit
- Field level secondary hardening of the plantlets
- At the end of the project period people of the area will have resource cum service center for the relevant technologies.
- In future the center may act as mother center for all horticultural activities in the area.

TARGET AREA

The gram panchayets (G.P) and the villages covered are as follows:

- Ramkarchar G.P
 - Khas Ramkarchar Village
 - Krishnanagar Village
- Rudranagar G.P
 - Kamalpur Village
 - Rudranagar Village

The aim of the project was that the people in the target area would get quality horticultural products including vermi-compost and thus an additional source of income, after the project period.

DETAILED ACTIVITIES & ACHIEVEMENT

Table 1 shows the time schedule of the activities done under this project.

Table 1

Activities	Apr – Jun '08	Jul – Sep '08	Oct – Dec '08	Jan – Mar '09	Apr – Jun '09	Jul – Sep '09	Oct – Dec '09	Jan – Mar '10
Organizing the project Support Structure	█							
Organize Survey to benchmark the initial status of the target area	█							
Selection of field level nodal persons	█			█				
Organizing training for the nodal persons on hardening of micropropagated plantlets and macropropagation of other horticultural plants		█			█			
Quotations for the equipments / low cost hardening unit			█					
Construction of the hardening unit			█					
Conducting experiments on tissue cultured banana plantlets at the hardening stage		█						
Booklet / Training manual preparation for the farmers			█					
Conducting training for the farmers / beneficiaries			█	█	█	█	█	
Follow up programs			█					
Evaluation of the program and documentation				█				

PROFILE OF THE TARGET AREA

Table 2 shows the total population, SC & ST and the number of cultivators and agricultural labourers in the eight GPs of Sagar (Source: Census Report 2001).

Ramkarchar and Rudranagar gram panchayets were selected for this work based on the number of cultivators and agricultural labourers. Tables -3a – 3d show the details of the two gram panchayets.

Based on this data, villages Khas Ramkarchar, Krishnanagar from the Ramkarchar GP and Kamalpur, Rudranagar from the Rudranagar GP were selected for this project work.

Table 2

Gram Panchayet	Population	SC & ST	Cultivators & Agri. labourers
DS I	19588	7915	3463
DSII	18093	4742	3234
Dhablat	26031	6629	3617
Gangasagar	27602	9835	3107
MG I	18261	6324	3117
MG II	18725	6521	3299
Ramkarchar	26984	7193	4487
Rudranagar	25124	2490	3785

Table 3a: Details of Ramkarchar GP

Villages under Ramkarchar GP	Population	SC	ST	Literates	Main workers	Marginal workers	Non workers
Harinbari	4810	918		3381	1213	1130	2467
Khan Saheber Abad	5219	1104	84	3792	1302	821	3096
Khas Ramkarerchhar	6701	1053	194	4657	1486	1891	3324
Krishnanagar	7088	1426		5039	1812	1501	3775
Naraharipur	3166	664		1993	814	379	1973

Table 3b: Details of Ramkarchar GP

Villages under Ramkarchar GP	Cultivators	Agricultural labourers	House hold	Other workers	Male	Female	Sex ratio
Harinbari	425	437	15	336	2506	2304	1:91
Khan Saheber Abad	459	494	22	327	2665	2554	1:95
Khas Ramkarerchhar	596	458	68	364	3441	3260	1:94
Krishnanagar	737	380	24	671	3690	3398	1:92
Naraharipur	309	192	4	309	1620	1546	1:95

Table 3c: Details of Rudranagar GP

Villages under Rudranagar GP	Population	SC	ST	Literates	Main workers	Marginal workers	Non workers
Kamalpur	5595	471		4283	1205	630	3760
Kirtankhali	3293	447		2340	764	528	2001
Manasadwip 2Nd Portion	5340	233	116	4066	838	823	3679
Radha Krishnapur	4463	878	50	3200	1105	952	2406
Rudranagar	6433	485	10	4793	1549	656	4228

Table 3d: Details of Rudranagar GP

Villages under Rudranagar GP	Cultivators	Agricultural labourers	House hold	Other workers	Male	Female	Sex ratio
Kamalpur	485	424	51	245	2855	2740	1:95
Kirtankhali	418	177	6	163	1697	1596	1:94
Manasadwip 2Nd Portion	418	197	7	216	2800	2540	1:90
Radha Krishnapur	396	347	8	354	2336	2127	1:91
Rudranagar	433	500	46	570	3318	3115	1:93

SURVEY OF THE TARGET AREA

The survey conducted in two of the villages helped us to understand the need, as shown in Table 4 below.

Table 4

Name of GP	Name of Village	Required point of interventions
Ramkarchar	Krishnanagar	<ul style="list-style-type: none"> ➤ Banana technology ➤ Vermicompost production ➤ Biofertilizer (awareness and trials) ➤ Pisciculture (not to be taken up under this project)
Rudranagar	Rudranagar	<ul style="list-style-type: none"> ➤ Banana technology ➤ Nursery technology ➤ Soil testing ➤ Biofertilizer (awareness and trials) ➤ Pisciculture (not to be taken up under this project)

Table 5 shows the cropping pattern in these two villages (data as obtained through the survey).

Table 5

Month	Vill: Krishnanagar (Ramkarchar GP)	Vill: Rudranagar (Rudranagar GP)
Apr-May	Sesame, Boro paddy(harvest)	Boro paddy, chilly, sunflower, onion cucumber (harvest), Brinjal, Ridge gourd (sow)
May-Jun		Sesame (harvest)
Jun-Jul	Aman paddy (sow)	
Jul-Aug	80% farmers cultivate Betel vine (each have 2-3 Boroj in average)	Aman paddy (sow), Brinjal, ridge gourd (harvest)
Aug-Sept		Betel vine (60-70% farmers)
Sep-Oct		
Oct-Nov	Mustard (sow)	Mustard, radish, bitter gourd, tomato (sow)
Nov-Dec	Aman paddy (harvest)	Potato (sow), Radish (harvest)
Dec-Jan	Chilli, Ridge gourd, Mustard Cucumber, Mung, Sesame, Ladies finger, Bitter gourd (sow)	Aman paddy (harvest) Chilly (sow)
Jan-Feb	Boro paddy, Sunflower (sow) Mustard (harvest)	Sunflower, Ladies finger, Chilly, Beans Mustard, Sesame, Water melon, Mung, Boro paddy (sow), Potato(harvest)
Feb-Mar	Ridge gourd, Bitter gourd Ladies finger, Cucumber (harvest)	Bitter Gourd (harvest)
Mar-Apr	Chilli, Mung, Sunflower (harvest)	Sun flower, Mung, Mustard, Ladies finger, Onion, Beans (harvest)

This has helped us to design a training schedule for the farmers depending on the seasonal requirement.

It has also helped to understand the demand for the seedlings of various crops, soil testing, vermicompost, biofertilizers and biocontrol agents.

SELECTION OF FIELD LEVEL NODAL PERSONS & ORGANIZING TRAINING

To reach the farmers, we selected field level nodal persons (**Table 6**) – the entrepreneurs, and have trained them on the relevant aspects. Sixteen nodal persons have been trained on aspects of banana technology, macropropagation (nursery) and vermi- technology (**Fig.1a – 1e**).

After the training the interested entrepreneurs are given the facility of incubation in the institute, where they can take up the work.

Table 6: Field Level Nodal Persons – the entrepreneurs

S.NO.	Name of nodal persons	Village and GP
1	Sonali Santra	Krishnanagar, Ramkarchar
2	Sheuli Jana	Chapatala, MG-I
3	Tanusree Jana	Purushattampur, Dhablat
4	Asima Das	Khasramkarchar, Ramkarchar
5	Ranu Majhi	Khansaabad, Ramkarchar
6.	Purnima Sahoo	Krishnanagar, Ramkarchar
7.	Debashree Panda	Krishnanagar,Ramkarchar
8.	Mamata Maity	Khas Ramkarchar,Ramkarchar
9.	Ganga Rani Mondal	Khas Ranmkarchar,Ramkarchar
10.	Sutanusree Manna	Kamalpur , Rudranagar
11.	Kajal Khanra	Kamalpur, Rudranagar
12.	Sandhya Raut	Rudrnagar, Rudranagar
13.	Sumita Karmakar	Rudranagar,Rudranagar
14.	Tapasi Das	Khas Ramkarchar, Ramkarchar
15.	Kabita Pal	Krishna Nagar, Ramkarchar
16.	Monimala Das	Kamalpur, Rudranagar



Fig.1a. Training on hardening of tissue cultured banana plantlets



Fig.1b. Training on vermishash production



Fig.1c. Hardening unit facility at Women Technology Park, Sagar



Fig.1d. Visit of the Expert Committee from the Dept. of Biotech, Govt. of W.B. at the Hardening unit facility at Women Technology Park, Sagar



Fig.1e. Training on Vermi technology at Women Technology Park, Sagar

Table 7 depicts the number and duration of training programmes conducted for the field level nodal persons during the project period.

Table 7

Training	Apr-Jun'08	Jul-Sep'08	Oct – Dec'08	Jan-Mar'09	Apr-Jun'09	Jul-Sep'09	Oct-Dec'10	Jan-Mar'10
Vermi Technology	■	■	■	■		■	■	
Macropropagation		■		■		■		
Banana Technology		■			■		■	

The components of training on Vermitechnology include earthworm biology, vermiculture and production of vermicompost, vermiwash and vermimeal. Macropropagation techniques that are taught during the training are methods of cutting, layering, grafting and budding. Banana technology includes hardening of tissue cultured banana plantlets (primary as well as secondary hardening), training of farmers on cultivation and management of banana crop in the field, food products from banana fruit, banana fibre extraction and product making.

Case Studies of Few Entrepreneurs:

Name: Smt Kabita Pal

Address: Krishnanagar

Educational Qualification: MA; Age: 24 yrs

Got trained in production of bio-pesticides

Presently engaged in agricultural services with an annual income of Rs.30, 000-40,000/-

Got selected as an entrepreneur under MSME best idea incubation program

Name: Ms. Sonali Santra

Address: Krishnanagar Gram panchayet: Ramkarchar

Educational Qualification: Graduate; Age: 22 yrs

Trained in Micro-propagation/ macro-propagation, bio-pesticide, apiculture, banana fiber extraction

Presently under training cum incubation

Got selected under MSME best idea incubation program

Income at present: Rs.25000/--30,000/-per annum

Name: Ms. Asima Das

Address: Vill+PO: Khasramkarchar Gram panchayet:

Age: 24yrs; Educational qualification: Graduate

Trained in Micro-propagation/ macro-propagation, bio-pesticide, apiculture, banana fiber extraction

Presently is under training cum incubation.

Income at present: Rs.25,000-30,000/- annually

CONDUCTING EXPERIMENTS

Experiments were conducted on tissue cultured banana plantlets at the primary and secondary stage to standardize the hardening conditions that gives the optimum survivability rate.

The plantlets from the culture bottles, after being taken out, are treated with fungicide before they are potted for primary hardening to prevent loss from root rotting. Bavistin (0.1%) alone or in combination with Dithane M45 is usually used for this purpose. The biofungicide *Trichoderma viride*, which is produced in the institute's laboratory, was used and its effect on the percent survivability of the plantlets was compared with that of the former. It was observed that the latter treatment gave a better result.

Various potting mixtures were used and comparative studies were made; the best results on survivability (85%) were achieved with plain cocopeat used as the potting mixture. Hence, training on cocopeat production also has been included in the module on hardening (**Fig. 2a - 2b**).



Fig.2a: Coconut husk kept soaked in water in tank before cocopeat production



Fig.2b: Training on Cocopeat production

Initially the low cost hardening unit comprised of planting the plantlets taken out from the culture bottles on the net pot containing cocopeat as the potting mixture and covering it with transparent poly bags in the primary stage. Later in the secondary stage, these are planted in the soil in a tray and kept exposed without any covering (Fig.3).



Fig.3. Tissue cultured banana plantlets at the primary hardening stage (covered with polybags on the right side) and the secondary hardening stage (plantlets on the plastic tray on the left side)

Further work on this aspect carried out showed that plants at the primary hardening stage achieve almost 100% survivability, if covered with an aquarium glass, instead of polybags (Fig.4).



Fig.4: Tissue cultured banana plantlets covered with an aquarium glass during hardening

Covering with the aquarium glass enhanced the survival rate as well as the growth of the plantlets.

Table 8 shows the number of banana plantlets hardened in the unit during the project period.

Table 8

S.No.	Time Period	No. of plantlets hardened
01.	November'08	1779
02.	December'08	1356
03.	January'09	2465
04.	February'09	5969
05.	March'09	4894
06.	April'09	2689
07.	May'09	3206
08.	June'09	1881
09.	July,09	905
10.	August'09	950
11.	September'09	947
12.	October'09	1667
13.	November'09	2437
14.	December'09	1074
15.	January'10	1982
16.	February'10	2072
17.	March'10	1594

Vermiwash has a positive effect on the rooting of the banana plantlets at the hardening stage. Vermiwash at a concentration of 60% gave the best results when the percent increase in length of the plantlets and the average number of new roots were recorded.

Vermiwash at this concentration also enhances the rooting of cuttings in chrysanthemums (**Fig.5a-5b**)



Fig.5a: Chrysanthemum cuttings (control) – roots are smaller, less in number



Fig.5b: Chrysanthemum cuttings (treated with 60%vermiwash) – profuse rooting, longer in size

Banana fibre extraction is one of the components in the banana technology. Banana fibre is extracted from banana pseudostem. The pseudostem is peeled. The fibres are extracted through hand extraction knife (Fig.6a-6c). The extracted fibres are sun-dried which whitens it.



Fig.6a. Peeling of banana pseudostem



Fig.6b. Extraction of fibre from banana pseudostem



Fig.6c. Banana fibre

Banana fibre extracted by the trainees at the resource centre is used for product making as shown in Fig.7 below.



Fig.7. Product making from banana fibre

TRAINING FOR THE FARMERS

Farmer trainings are conducted at the resource centre as well as off campus. The training on cultivation and management of banana crop in the field is conducted along with the supply of banana plantlets to the farmers (Fig 8a-8b). In addition plant clinics are organized where the experts try to solve the problems faced by the farmers especially regarding the pest and disease management (Fig 8c).



Fig.8a. Farmers training program on cultivation of banana in the village Krishnanagar, Ramkarchar GP.



Fig.8b. Supply of banana plantlets to farmers after the training program



Fig.8c. Plant clinic for the farmers at the resource center, WTP, Sagar

During this period 150 farmers were supplied with the banana plantlets, the names of few of the farmers are as given below:

S.No	Name of the farmer	Gram Panchayet	Variety	Results
1	Atulkrishna Bhunia	Gangasagar	<i>Robusta</i>	He has earned Rs.108/- more per plant than the normal varieties cultivated previously.
2	Ranjit Bhunia	Gangasagar	Red banana	Fruiting yet to occur
3	Rabindranath Maity	Muriganga I	<i>Robusta</i>	Fruiting awaited
4	Prajapati Das	Muriganga I	<i>Robusta</i>	Fruiting yet to occur
5	Khokan Mandal	Gangasagar	<i>Robusta</i>	Fruiting yet to occur
6	Amitava Maity	Muriganga I	<i>Robusta, Grandnaine</i>	Fruiting yet to occur
7	Niranjal Mandal	Gangasagar	<i>Robusta</i>	Fruiting yet to occur
8	Bishweshware Maity and Balai Jana	Krishnanagar	<i>Robusta</i>	They have used neem in its management; they could reduce the cost 5-10% than that of the previous practice. But the product as well as yield was better.

We have chalked out a detailed list of seasonal activities (**Table 9**) that will be taken up at the horticultural resource center, throughout the year, so that training and providing services as well as products can be taken up in future accordingly.

Table 9: List of seasonal activities (in addition to the hardening of tissue cultured plantlets) at the horticultural resource centre

Month	Vegetables (potato included)	Fruits	Flowers	Paddy, spices and other work, if any
January	<p>Summer vegetable cultivation (okra, cowpea, chili, brinjal, cucurbits, tubercrops viz., elephant foot yam, colocasia, sweet potato)</p> <p>Off season vegetables (Spinach, Radish)</p> <p>Seed production and storage of potato tubers</p>	<p>Pest and disease management of mango, litchi, guava</p>	<p>Dahlia cutting for mother plants (for tubers)</p> <p>Rose budding</p> <p>Rose rootstock cutting</p>	
February	<p>Seed collection, storage in brinjal, tomato, chilli</p>	<p>Budding, grafting in mango, guava, citrus, custard apple, bel</p> <p>Cutting in grapes</p> <p>Seed sowing in papaya</p>	<p>Budding in China rose</p> <p>Cutting in bougainvillea,</p> <p>Separation in chrysanthemums</p>	<p>Polypacks to be ready for nursery plantlets (potting mixture)</p>
Month	Vegetables (potato included)	Fruits	Flowers	Paddy, spices and other work, if any
March	<p>Nursery for brinjal, chilli</p> <p>Seed collection and storage</p>	<p>Papaya cultivation</p>	<p>Mother plant maintenance of Chrysanthemum</p> <p>Collection of bulb of gladiolus</p> <p>Collection of Dahlia tubers</p>	<p>Crop management in jute</p> <p>Potting mixture preparation continued</p>

			Seed collection in Cosmos, Zinnia, Gilaria	
April	Seed sowing of rainy season vegetables	Papaya cultivation technology Pest and disease problems in fruits Budding in Jujuba		Preparation of potting mixture
May	Okra cultivation	Fruit harvesting, Marketing (packaging, transportation) Post harvesting technology		
Month	Vegetables (potato included)	Fruits	Flowers	Paddy, spices and other work, if any
June		Propagation (cutting, grafting, layering)	Propagation (cutting, grafting, layering)	Aman paddy seed bed Ginger, turmeric cultivation
July	Rainy season vegetables, sak alu, Early cabbage, cauliflower, tomato - seed sowing	Planting of fruit crops - coconut, sapota, mango) Propagation of fruits	Propagation	
August	Transplanting cabbage, knolkhol, brinjal, early tomato		Cultivation of gladiolus, Dahlia, Gloriosa, chrysanthemum and other annuals	

September	Cultivation of all winter vegetables (carrot, beet, radish, sweet potato)		Post harvest treatment for flowers - harvesting, shelf life, packaging, mktg Cultivation of aster	
Month	Vegetables (potato included)	Fruits	Flowers	Paddy, spices and other work, if any
October	Sowing of beans, peas			Winter pulses (Chola, Matar, Masur, Khesari) Oil seeds (Mustard, Sunflower, Groundnut)
November	Potato cultivation Onion cultivation Garlic cultivation		Cutting of rose stock Budding in rose can be started Breeding in gladiolus	Paddy seed bed (boro)
December	Management of winter vegetables		Rose budding	

CASE STUDIES

Technological intervention; Vermicompost, Bio-pesticides (*Trichoderma viridi*, *Pseudomonas fluorescense*), Liquid *Azotobacter*, Phosphate solubilising bacteria, NKAЕ (Neem kernel aqueous extract) and tissue cultured banana plantlets

1. Name of the farmer: Sk. Motlep

Gram Panchayet: Krishnanagar

Crop: Betel vine;

He used chemical fertilizer and pesticide costing Rs.15000/ for 1000 plants before the technical intervention. But afterwards he has used (this year) chemical fertilizer costing Rs. 6500/-and Vermicompost along with bio-fertilizer (liquid *Azotobactor*) as well as bio-pesticide (*Trichoderma viridi*) costing Rs.4000/-, thus his saving is for Rs.4500/- for each 1000 plants.

The yield is more or less same, the quality of the product (i.e. the leaf) is better, so it is getting preference in the market while the input cost is reduced.

Crop: Brinjal

Area of land: 2 kattah

Before technical intervention the cost was Rs. 3000/-for chemical fertilizer and pesticides.

After intervention, this year chemicals was replaced partially by vermi-compost, *Azotobactor*, and *Trichoderma viridi*, and the total input cost came down to Rs.2100/-.

The yield is same, quality is better while the input cost is reduced.

2. Name of the farmer: Sri Kripasindhu Panja

Gram Panchayet: Khasramkarchar

Crop: Betel vine

He used chemical fertilizer and pesticide before the intervention costing Rs.12, 000/- for 1000 betel vine plantlets; but after the intervention he has replaced chemical fertilizer partially with vermi-compost and for pest management he has used *Trichoderma viridi* and *Pseudomonas fluroscence*; the total cost is Rs.9000/-, thus his saving is Rs.3000/- for 1000 plants, while the production is same but with better quality.

Crop:Potato

Before intervention he has spend Rs.480/ per kattah for chemical fertilizer and pesticides. This year, after intervention, though chemical fertilizer is not replaced completely but partially thus the cost came down, Rs. 120/- less per kattah. The storage quality of potato is better. The product is for self consumption and in the island there is no cold storage facility, hence, it is very important for the farmers of the area.

3. Name of the farmer: Sri Sambhu ram Das

Gram panchayet: Krishnagar

Crop: Betel vine.

Before the training and follow up work he has spend Rs. 14000/- for chemical fertilizer and pesticides for 1000 plants on an average in the previous year; this year he has replaced partially the chemical fertilizer with vermi-compost, liquid *Azotobactor* and phosphate solubilizing bacteria, he has used only neem (NKAE) . But the cost of cultivation was 20% less in comparison to the previous practice.

Crop: Ladies finger;

Last year before training, he has spend Rs. 425/-per kattah for chemical fertilizer; this year he has used less chemical fertilizer of Rs.245/-.Instead of chemical fertilizer and pesticide he has used neem (NKAE),vermi-compost ,liquid *Azotobactor* and phosphate solubilizing organisms of Rs. 95/- per kattah. His saving was Rs.1700/- per bigha.

4. Name of the farmer: Sri Ranjit Nath

Gram Panchayet: Krishnagar

Crop:Betel vine

Before the training he has spend Rs. 12000/- for 1000 plants for chemical fertilizer and pesticides but after the training he has used vermi-compost and replaced the chemical fertilizer partially. For pest control he has used *Trichoderma viridi* and *Pseudomonus fluorescense*, he is able to save Rs.2800/- for 1000 plants.

5. Name of the farmer: Sri Pradip Pradhan

Gram Panchayet: Khas Ramkarchar

Crop:Betel vine

He has spend Rs.10, 500/- for 1000 plants before he attended the training; but after the training has adopted only *Trichoderma viridi* and *Pseudomonus flurescence* and with this only he could save Rs.1500/- for 1000 plants.

Crop:Ridge gourd,

Last year he has spend Rs.1050/- for 100 plants, but this year he is able to reduce the cost Rs.150 for 100 plants by adopting *Trichoderma viridi* and *Pseudomonus flurescence*.

FUTURE PLAN

In the target area, the resource centre will be providing services and products related to horticulture at the doorstep of the farmers and the grass root level people. It will be incubating the trainees – the rural women – the entrepreneurs to work and stand on their own – individually or in groups. Thus, this work has just been initiated and has long way to go before we reach the ultimate goal.

-O-