

REPORT OF
CONSULTATION FOR
REGENERATION OF AGRICULTURE
AND LIVELIHOOD SYSTEMS IN
AILA AFFECTED AREAS



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1. Introduction

On 25th May cyclone 'AILA' devastated the life and livelihood of the people living in Sunderban deltaic region. People living here mainly depend on agriculture and allied activities for their livelihood. AILA has deprived them of their only source of income. Among the 12 affected districts of West Bengal, the damage in North & South 24 Parganas has been the maximum. Out of the total crop affected area of 2,56,750 ha in all the 12 districts, the share of North 24 Parganas is 55, 600 ha and that of South 24 Parganas is 69, 150 ha. Saline water gushed in through breaches in the river dykes and inundated houses and lands. Under the present conditions, almost 60% of the area in these 2 districts has been rendered uncultivable and not suitable for making seedbed. It has caused a havoc in 5 Blocks (Sandeshkhali-I, II, Minakhan, Hasnabad and Hingalganj) of North 24 Parganas. In Canning II about 1300 bighas of land is under saline water.

600 families in Tambuldaha I and Sarengabad GPs of Canning II block and 2200 families in Bermajur I & II GPs of Sandeshkhali II block lost their houses. They are now residing on the roadside in small makeshift huts or have taken shelter in relief camps and schools.

Only in North 24 Pgs., livestock loss amounts to a whopping 1,17,332. Loss of domestic animals was caused not only by the cyclone, but also by high tide that followed. In Sandeshkhali I & II and Hingalgunj blocks about 70-80 poultry farms got completely shattered.

According to the Government of West Bengal statistics, over 6.77 million people have been affected and 137 killed in North 24 Parganas and South 24 Parganas. The cyclone AILA collapsed more than 500 kilometers of embankments and 926,000 semi permanent houses. In all the affected villages of Sundarbans, there is a high demand for safe drinking water, sanitation facilities, good hygiene practices, access to healthy food, temporary shelters and critical medical facilities. 102 relief camps have been set up in the worst affected districts of South & North 24 Pgs accommodating around 40,000 people.



In most of these villages, the household grain storages that provide year-round food supply for the entire family have got washed away along with the house, resulting in acute food crisis for the ensuing year. In most of these islands, inundation of land by saline water has practically made agriculture impossible in at least the next three years.

In this scenario people are frantically searching for alternative sources of income to maintain their livelihood. The cooperation and assistance from voluntary organizations, clubs, UNICEF, Ramakrishna Mission, Bharat Sevasram Sangha and donor agencies are required to cope with the situation. DRCSC works to achieve food and livelihood security in the villages of Sunderbans and other ecologically vulnerable areas of West Bengal. In a bid to address the grim situation, DRCSC organized a one-day consultation programme for regeneration of agriculture and livelihood system in AILA affected areas on 13th July 2009.



2. Welcome Address



Mr. Anshuman Das, Secretary of DRCSC initiated the day's proceedings with a warm welcome for all the dignitaries present. He, mentioned that different organizations have responded in various ways and capacities to address the situation caused by AILA, but it is nowhere near adequate. DRCSC too, though relief has never been the primary focus of the organization has extended its help of about Rs.50 lakhs supported by KKS, Christian Aid and personal donation to the affected region. It has given the affected people only a short lease of life, but in order to bring about a perceptible change in the present situation, long-term interventions must be undertaken.

The cyclone, once again, proved our inefficient early warning system. At Bangladesh end, there were number of alert messages on Sunday, 24 May 2009 itself. The event, though was unpredicted but was really not very unexpected; as now it is well accepted that due climate changes, frequency and intensity of this kind of extreme events will increase. And Sunderban, is going to be the one of the most climate vulnerable eco region. To protect it and to adapt climate change impacts, it needs solid preparation and long term interventions.

The meet was mainly organized to explore the agricultural possibilities and other livelihood options for people living in the AILA-affected areas. The presence of international agencies, local organizations, and resource persons from the fields of forestry, fishery, livestock & agriculture and the farmers from the South & North 24 Pgs. flared up the expectations of living up to its objective and coming up with truly viable alternatives for the hapless people.

3. Sessions

3.1 Session I

3.1.1 Video Clipping on AILA

The session began with the screening of a snippet on AILA. It captured the devastations caused by AILA in the Hingalgunj Block of North 24 Pgs. along with glimpses of the local people's experience from the day the cyclone came and the sufferings that followed. It also tried to make a need assessment of the entire situation and tried to hint at some possible intervention measures.



3.1.2 Experience sharing by farmers and workers

The farmers & workers of Sustainable Food and Livelihood Security Network Project from North & South 24 Pgs. shared their experiences of facing, absorbing and fighting the devastations caused by AILA and the disastrous impact it had on their food and livelihood situation. They also suggested some ways and means of addressing the all-encompassing problem with inputs from the knowledge they had inherited through generations.

Nishambhu Mondal, a farmer nurtured by Swanirvar, one of the long-time partners of DRCS operating mainly in North 24 Pgs – shared his experience of the aftermath of AILA. The saline water that entered through breaches in the river dykes has stagnated causing the salt to settle in the fields. The green fields have turned brownish black. Vegetables in the homestead gardens have got ruined, fish in the ponds have been killed. The people are now very much worried about their future.

Hiranmoy Biswas of Janakalyan Samity from Shridharkathi, North 24 Pgs. shared that after the disaster people are now migrating to Andaman, Bangalore, Gujarat etc. in search of livelihood. Women are coming to cities in search of work. He described how river water with high velocity and waves as high as 5 ft lashed on the ground drowning, devastating livestock, fish, humans and properties. There is no scope for income in their village. The market is totally damaged.

Narayan Chandra Bachhar, a resource farmer and a worker of Swanirvar of North 24 Pgs. informed that in Baduria Block about 3500 bighas of land with crops were damaged. Entire crop of jute and sesame are lying prostrate on the ground submerged in saline water. The soil has become saline which is evident from the white patches all over. In fear of losing their only means of livelihood, the farmers cannot leave their land and go elsewhere to earn their living nor do they have the option of cultivating it.





Sukdev Mondal, a farmer of Indraprastha Srijan Welfare Society (ISWS) from Ramganga Block, South 24 Pgs. shared that paddy varieties that can tolerate 50% salinity can be cultivated in such extreme saline conditions. Vegetables can be cultivated in sacks and earthen pots using fresh water from a nearby source. Plants with low and medium root depths must be selected for this purpose. A good rain can wash out the salinity of the land

Animesh Bera, a worker of ISWS from South 24 Pgs. informed about the outbreak of different water borne diseases. Application of lime and bleaching powder is not producing desired results. People are being compelled to sell their cattle and other domestic animals due to unavailability of fodder, fresh water etc. The farmers are migrating to places – near and far – in search of work.

Matin a volunteer from Swanirvar, North 24 Pgs. commented that the basic needs at the moment are getting fulfilled by the relief materials supplied but the availability of such materials in the future is something to be pondered upon. He queried about the regeneration of the salinated lands, which he thought was the most important issue to be discussed.

Prabhanjan Mondal a farmer from Gosaba, South 24 Pgs. told that 2000 kg of rice, 3 quintals of chili, 20-22 kg of fish got washed away in the lashing waves. People from nearby areas took shelter in his house. Local Police Station, Block Office helped at that time. He donated Rs.10,000/- for relief work at Kumirmari.

Dilip Naskar from Bagmari Netaji Sangha, South 24 Pgs. informed that saline water remains stagnant in the affected blocks and after evaporation leaves a layer of salt. He shared that seedbed for indigenous paddy cultivation should be raised in high places.



Suggestions that emerged from the sharing are:

- 2 – 3 heavy showers can wash away the salt from the land surface thereby reducing its saline concentration.
- Salinity tolerant indigenous paddy varieties like 'Talmugur', 'Getki', 'Kanasol', 'Bhunri' etc. can be cultivated. The seedbeds for these varieties should be raised in higher places of the village where saline water could not reach.
- Vegetables like yam, sponge gourd, pumpkin etc. can be grown in earthen pots, sacks with fresh soil and compost. Vegetables can be grown on raised beds with fresh soil from unaffected places in the village. Plants with low or medium root depths should be selected for this purpose.

3.1.3 First hand experience of outsiders

Nilangshu Gain, one of the coordinators of agriculture project, Swanirvar, North 24 Pgs (a partner of DRCS). shared that 95% of land in Hingalgunj is suffering from stagnated saline water. In some areas the water evaporated but the soil became brownish black. 70% of livestock have died. Organic matter is scarce. The farmers are collecting seeds of paddy varieties like BDR 1222, 1223, Matla, Canning 7, Nonasri etc. from neighboring villages of Bangladesh. The requirement of salinity tolerant varieties like Kanasol, Talmugur is very high in these areas.

Sujit Kumar Mitra coordinator of Natural Resource Management team of DRCS informed that people are selling domestic animals at a very low price due to scarcity of fodder and fresh water. People are consuming swine meat, which is not the usual practice in these areas. Fresh water fish have died. Growth of palm, coconut trees is stunted. Scarcity of drinking water is acute in almost every AILA affected village.

'Dhani' grass is growing which is a good feed for deer. The mud collected from broken houses, hay, vegetable peels, green coconut shells can be used for making green manure and compost. Fish varieties like parse, talapia, tangra can be grown in the saline situation.

3.2 Session II



Expert opinions (1)

Dr. Ajit Kumar Banerjee, ex-DFO, Sundarbans, pioneer of Joint Forest Management in West Bengal, senior officer in World Bank Development Program, principal guide of a research on the impact of JFM in West Bengal, working to develop a mutually beneficial relationship between Forest Department and the people living in the forest-fringe villages.

Dr. Banerjee identified three basic areas of intervention –

- i. Provide immediate relief to overcome the emergency situation
- ii. Adopt measures to overcome salinity and make the land cultivable, and
- iii. Opening up alternative livelihood options

Among these, he concentrated on the third area and put forward the following suggestions:

- Forest Department has the scope of opening up the reserve forest to provide mutually beneficial forest-based livelihood to the people in order to check widespread migration.
- After reconstruction and repairing of the dykes, planting of mangrove species may be a good option for providing work under NREGA. 'Dhani' grass and reeds can be grown on the slopes as fodder.
- Agro-forestry or pisciculture can also be tried in the forest. Previously it had been a practice in the Sundarbans to excavate channels in order to make inroads for the river water to enter the forest. Then they plugged the inlet point and used the water for growing fish. Thus, livelihood options for the people could be introduced without disturbing the forest cover in any way. Now such interventions are not done for reasons best known to the Forest Deptt, but this is an option that can be introduced immediately.
- Tamarisk tree can be planted for getting excellent fuel-wood.

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- Discussion with the ministry as well as the officials of the Forest Deptt. must be undertaken immediately for developing a detailed step-by-step 2 years' scheme with the aim of generating livelihood for the affected people. Mr. Raha, the Principal Chief Conservator of Forests and Mr. G.B. Mondal, Chief Conservator of Forests (Wildlife) may be contacted for the purpose.

Responses

In view of Dr. Banerjee's suggestion of opening up the forest to the people, *Nilangshu Gain* said that in the village Samser Nagar 3 & 4, tiger roars can be heard quite often that deters the people from entering the forest in fear of being mauled by tiger.

Anurag Danda from WWF informed that on 27th May 2009, just two days after cyclone AILA, the Tiger Reserve was opened up for 4 days to the distressed people for collecting fuelwood. He supported Dr. Banerjee's statement that there is ample scope for Sunderban Biosphere Reserve to employ the people, now that more work is available under NREG Scheme.



In response to Nilangshu and Anurag's comments Dr. Banerjee said that he had no answer for the tiger problem. He was at a loss to understand the reasons for tiger infiltrations in human habitations since it has been proved beyond doubt that the tigers have actually reduced in number. He also clarified his statement that the Forest Department must be proactive in providing alternative livelihood options for the people and said that it was not merely a question of haphazard temporary steps like opening up the forest for 4 days, rather it demanded a long term step-by-step plan that the Forest Deptt. should chalk out with the community in which the ministry should be equally involved.

T.K.Basu, a prominent member of Agriculture Commission said that integration and cooperation among various departments of the govt. like Agriculture, Irrigation, Forestry, PDS, PHE and Health & Sanitation should be given the top priority at this hour of emergency. He insisted on a holistic and integrated approach towards resolving the crisis. All possible elements of agricultural practices must be introduced and integration should be developed among crop & vegetable cultivation, livestock rearing, fish culture, tree plantation, forestry etc. to make the system sustainable. A road map must be prepared in this regard.

Ardhendu Shekhar Chatterjee, a well known Resource Person in the field of Natural resource management said in order to save the Sunderbans, the mangrove population must be saved first. Mangrove is the variety of trees that can grow in a mixed ecological situation of sweet and salt water typical of the Sunderbans. Along the river 30-40 ft of mangrove wall can save the village. Now the main priority should be regeneration of forests. He mentioned the salinity tolerant tree species that can be grown in the AILA affected areas. Berry, Pongamia, Tamarisk tree, Ber, Guava, Papaya, Fig may be planted. Pongamia is a leguminous tree from which honey and bio-diesel can be harvested. After salinity concentration comes down *Philanthus sp.* can be planted. It gives a good yield, which can be utilized for generating income.

3.3. Session III

Expert opinions (2)

Dr. P. K. Mukhopadhyay from CIFA (Central Institute of Freshwater Aquaculture) Bhubaneswar made a presentation on “Aquaculture as a viable livelihood option for stakeholders in the cyclone affected Sundarban areas”.

He started on a hopeful note by saying that in spite of salinity infection of most of the sweet water ponds the oncoming of rains must have reduced the salinity to a large extent. If the present salinity is within 4 – 5 ppt a whole range of fish may be easily cultivated. According to him fishery is the best alternative livelihood option for the farmers affected by AILA. Some important suggestions put forward by him:

- ❑ Generally ponds of 0.02 to 0.1 ha with 1.0-1.5 m depth are used for small-scale fry production while areas up to 0.5 ha can be used for large-scale production of carp. At least 2 crops can be easily harvested from such ponds in one season. Congenial condition of the rearing environment needs to be ensured and adequate natural fish food organisms prior to release of spawn for high survival to achieve stocking density of spawn 3-5 million/ha must be present.
- ❑ Carp culture has enough potential of meeting the ever-increasing demand of the domestic sector.
- ❑ Management of small ponds for seed rearing to achieve high survival of carp is a profitable proposition.
- ❑ Species diversification can be still more remunerative.



- ❑ Fish varieties like *metro plus (paira chanda)*, catfish like *shingi, magur, koi, pabda, tangra* etc., local fish like *parse* etc. — in other words those that can survive in both saline & fresh water can be cultivated. *Central Institute of Brackish Water Aquaculture (CIBA), Kakdwip Research Centre* supply the seeds of these species and varieties.
- ❑ Omnivorous, herbivorous fish that can grow in intensive culture method are also suitable.
- ❑ Indian major carp can also tolerate salinity if raised during fry to ling stage with controlled salinity.
- ❑ *Bhetki* is also suitable but its feed is very costly. It will be unjustified to suggest rearing of *bhetki* to the resource poor farmers affected by AILA.

- ❑ Pond management with fish-duck-vegetable on the scaffold-azolla is important now.
- ❑ Plankton population can be raised in the hollow of bamboos packed with cow dung & oil cakes.
- ❑ Indigenous knowledge, wisdom of farmers need to be documented.
- ❑ Seeds should be collected from reliable sources and from healthy brood stock.
- ❑ Azolla culture should be encouraged, as it is a nutritious fish feed.
- ❑ Ducks can be reared along with fish. Duck dropping which is a slow release nutrient is good for the growth of fish.
- ❑ Duckweeds like Lemna, is also a good feed for fish.
- ❑ Snails are an excellent feed for catfish.
- ❑ The farmers themselves should prepare the feed. Homemade feed is much better than those sold in the market. A 2-day training on feed frequency, feed strategy etc. must be arranged for the farmers.
- ❑ In rice-fish cultivation catfish is the ideal component.
- ❑ In this period of crisis, fish seed business may be a good livelihood option.

Contacts

Dr. P. K. Ghosal & Dr. Akshay Panigrahi

Ph# (03210)-2255072 & Mobile: 9840252383 (Dr. Ghosal)

For the seeds of catfish: Rahara Fresh Water Aquaculture Research Centre

For the seeds of *pabda*: Kalyani Centre, Santalpara, Kalyani

For other fresh water fish seeds: Naihati Fresh Water Farm

3.4 Session IV

Expert opinions (3)



Dr. Indranil Mukhopadhyay, veterinary expert, Govt. of West Bengal discussed ways of improving livelihood status in AILA-affected West Bengal.

The cyclone has caused death of livestock. It is mainly due to crisis of potable water, feeds and fodder and isotonic dehydration. This has led to distress sale of livestock at a very low price. There is a high possibility of epidemic. Shelter reconstruction of the affected people is urgently required to combat the situation. A general strategic plan is immediately needed. Separate plans must be made particularly for landless people, marginal farmers, cattle owners, fishermen and for

people having lands with hyper salinity. Special focus should be given on restoration of the ecological and social balance.

Discussion



- For improving the livelihood of the poor people proper livestock management is required. Food (fodder) is very important for rearing livestock. So for supplementary food, saline resistant fodder varieties like *Coix* commonly known as *Kara*, *Gargara* etc. should be cultivated.
- After some days when salinity minimizes fodders like *Dinanath*, *Para*, *Napier* can be cultivated.
- After cyclone and flood, the livestock becomes susceptible to various bacterial and viral diseases. In order to combat this, *Rafoxamite* 10mg/kg (large animal)

& 15mg/kg (small animal) can be administered. Herbal dewormer *Helmex* is also used for this purpose.

- Traditional preventive and curative measures may also be adopted. Water in which betel nuts had been kept soaked for some time, Ghentu leaf juice etc. can be tried as de-wormer, but the dosage must be carefully maintained.
- Selection of new livestock should be need and situation based. Sufficient provision of feeds, fodders and water must be ensured before introducing new livestock. Other essentials for biological substances must be secured. Sufficient care must be taken to restrict introduction of animals from other affected area.
- The sequence of animal introduction in the farm may be as follows. First, poultry or duckery basically for serving the nutritional needs of the family rather than as a supplementary source for income Then, goaterly can be tried. Last in the sequence should be the introduction of dairy or draught cattle.
- *Ardhendu Shekhar Chatterjee* had some other suggestions. He said that Sunderban, in general, is a waterlogged area where the drainage system is poor. In selecting the fodder crops for this area we should bring this factor in our consideration. Regarding fodder crops suitable for this area, he mentioned *para*. *Shola*, which is leguminous in nature, can also be grown as fodder. *Dhanche* (*Sesbania sp.*) and *Jayanti*, which are salinity tolerant, can also be grown for the same purpose. *Jiol* tree can be planted by using sticks. Its leaves are used as fodder. *Habal* is a fast-growing multi-purpose tree, leaves of which may be used as fodder and the timber can be harvested in 10-12 years. *Melaluca sp* that can withstand waist deep water can also be a good fodder supplement. *Rhodes* grass is another salinity-tolerant fodder crop. During winter *Alfa alfa* can be cultivated for regeneration of fertility as well as for supply of fodder. He mentioned of a protein-rich feed for the livestock that may be prepared by extracting leguminous leaf juice and making a concentrate by boiling it.

Contact

For seed and training: Local BLDO or Assistant Director (Fodder) at district level.

3.5 Session V

Expert opinion (4)



Kamal Kumar Bhadra, a botanist from Govt. of West Bengal made a presentation on *Varietal selection & management of Aman paddy cultivation in AILA affected areas*.

□ Paddy is the main crop for the farmers in Aman/Kharif season. *Matla, Hamilton, Nonasal, Nonabokra, Kumargor, Getu* etc. are salinity tolerant varieties known to the farmers for many many years. These varieties were practiced earlier but due to low yield people shifted to HYVs.

□ Some local varieties, which can be cultivated in the coastal areas are *Kumargor, Patnai 23,*

Getu (CSR-2), Damodar (CSR-1), Sadamota, Kalomota, Bhasamanik, Rupsal, Damal (CSR-3), Dudherswar.

- For *rabi* (winter) season rainwater must be harvested and stored in ponds.
- For *Boro* paddy cultivation short-duration varieties must be selected.
- *Sesbania* can be cultivated as relay crop.
- Sunflower, cotton, watermelon, chili can be grown in Rabi season.

Discussion

Destruction or damages by natural hazards are quite common to the people living in the islands of Sunderbans. They have the instinctive skill to fight back such hazards. This time also the people have started applying their very own coping strategies, although without external help it would not be possible to overcome the disaster. Central & State Government have taken the initiative to prepare a master plan with the participation of Self-Help Groups, Non-Governmental Organizations, Co-operatives along with various Government Departments and very importantly the grass-root people which ensure sustainable farming involving livestock rearing, fishery, bee-keeping, poultry, duckery, horticulture, medicinal plant cultivation and similar other components to improve the social and economic status of the affected people.

3. 6 Session VI

Expert opinion (5)

Prof. R. N. Basu, Chairman of former Agriculture commission, Govt. of West Bengal told that level of inundation would be higher in areas, which has connections with tidal water. This is happening in most of the AILA-affected areas. Both short and long term interventions must be tried.



- ❑ Short-term intervention should be selection of the proper varieties and ensuring the availability of those seeds.
- ❑ In long term a model can be developed by making deep trench around the plot after bunding. This is in view of the fact that the salt cannot be removed from the soil in the near future.
- ❑ *Electrical conductivity and Osmotic potential* of water must be measured.
- ❑ The EC of sub-soil water should also be measured.
- ❑ In this situation, non-leguminous plants may be soaked in clear water for 6 hrs. This will help in growing future crop.
- ❑ Modification of the method of agricultural system in vogue must be made.
- ❑ In *Boro* season tomato, beetroot and sunflower can be cultivated.

3.7 Session VII

Expert opinion (5)

Ardhendu Shekhar Chatterjee, President and founder member DRCSC, told that agricultural practices must be done in a way that ensures sustainability. Rainwater harvesting is very important at this time. Rainwater can be stored in 5'-6' earthen jars with proper plans to utilize the water. Low cost storage system should be developed.

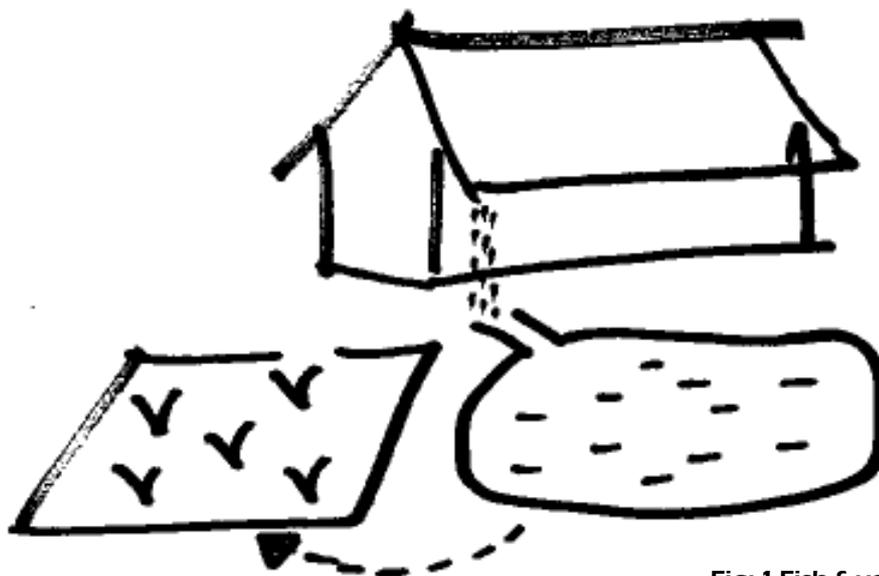


Fig: 1 Fish & vegetable cultivation with harvested rain water

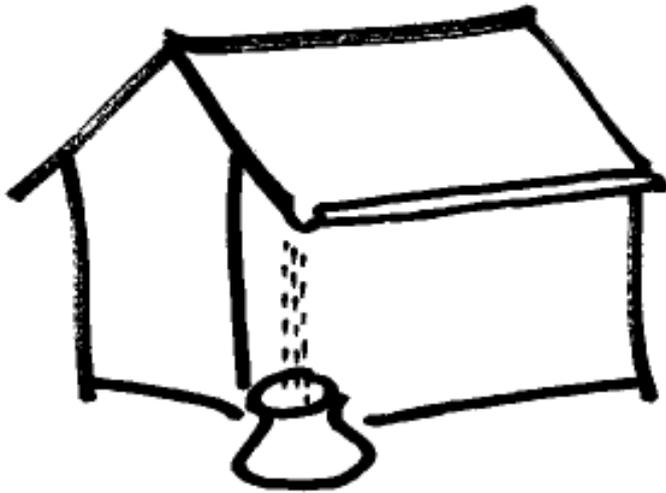


Fig: 2 Rainwater storage in earthen jar

Rainwater can be used in fish cultivation, which, in turn, can be used for irrigating vegetable beds.

In Boro season *beetroot*, *tomato*, *sunflower* can be cultivated. *Kusum* can be cultivated as oilseed. *Betho*, a highly nutritious edible weed and *pearl millet* can also be grown.

Some sustainable management aspects should be adopted round the year in home garden, orchard, farms, forest and agro-forestry. A plan must be developed following this chart:

Items	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Home garden												
Orchard												
Farms												
Forest & Agro-forest												

For example: in the rainy season in so far as the farm is concerned, ducks can be reared. During winter, mushroom can be cultured with straws in home garden.

He presented some models, which is suitable for this type of land.



**Immediate / short-term / temporary responses for this season (Kharif/rainy)
to supply nutrition for the family**



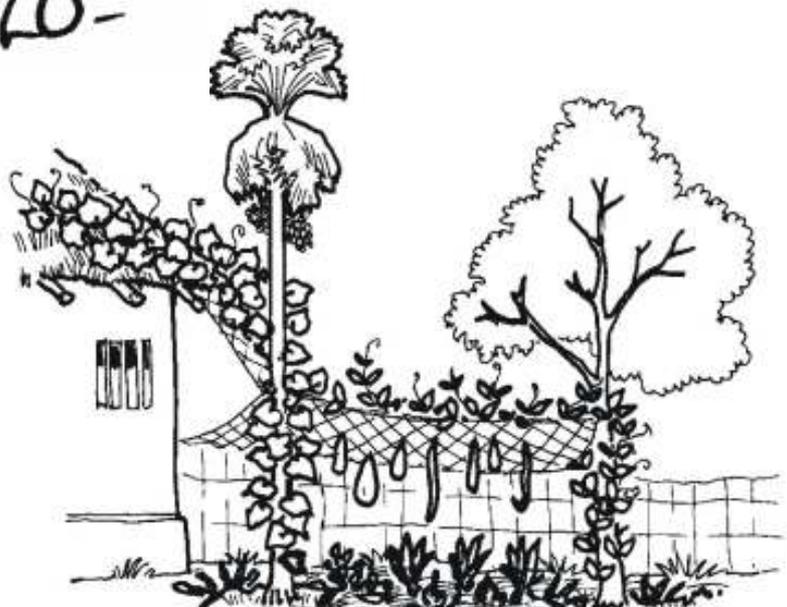
Container gardening may be practiced as a daily nutrition source (as there is hardly any land & soil available for cultivation): Vegetables can be grown in broken earthen pots, bamboos (for long rooted plant), jute bags, poly bags etc. Suggested plants are wild spinach, amaranths, Indian spinach (long rooted), *Salunche*, *potulaka*, *Ipomia*, sweet potato, brinjal etc.

Hanging Gardens are also possible in pots, plates, bottles. Suggested plants are short-rooted plants like wild spinach, amaranths etc

Gardens can be made on **tyre, jute bags, drum or even 2 lit pet bottles**. The lowest layer can be filled up with waste from green coconut. Suggested plants are sponge gourd, pumpkin, ridged gourd etc as these need larger amount of nutrient, has a high biomass production rate and leaves are also very nutritious, which can be harvested from the 7th day of planting.



Garden and nursery can also be **floating** on water hyacinth, bamboo, plantain raft etc. with a thin layer of compost mixed soil on the top. Suggested plants are mostly leafy vegetables with short root.

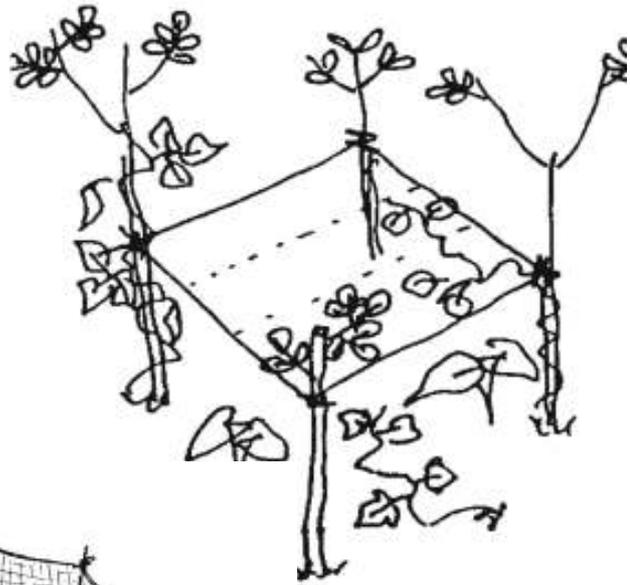


Immediate but mid-term / semi-permanent responses to supply nutrition for the family and generate small amount of excess to sell

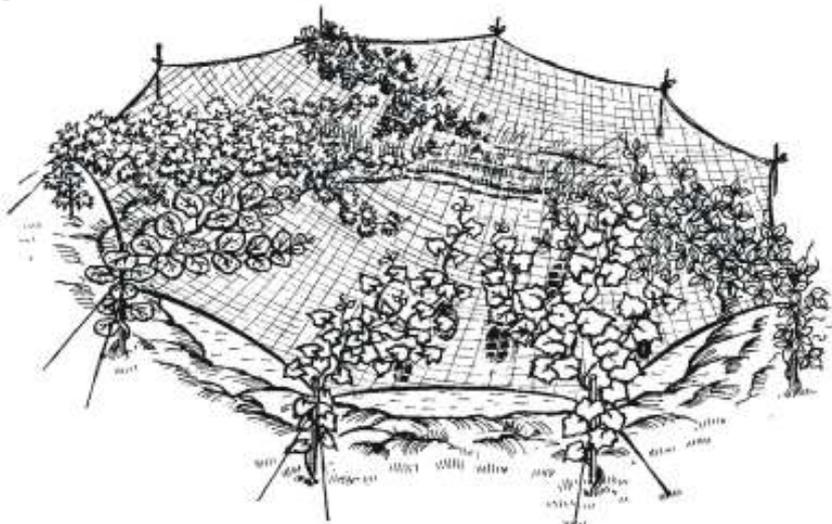
Garden on elevated structure to avoid saline soil and water

In any part of the garden or homestead area a platform can be made and any creeper can be grown over it. Beneath the platform, *Centella asiatica*, *Oxalis corniculata*, *Hygrophylla sp.*, field mint, *Marsilea minuta* L, etc. can be planted. *Moringa oleifera*, *Areca catechu*, etc. can be used as poles to support the trellis and the creepers growing on it. In dry areas, a water-filled pitcher with 3 small holes at its lower end is placed. Spinach, *Hemigraphis sp.*, sweet potato etc. are planted round the pitcher. Beside it creepers like gourd, *Lucida sp.*, etc. are planted. The water oozing out of the pitcher moistens the adjacent soil and the rate of evaporation is decreased due to the platform providing a shade over it.

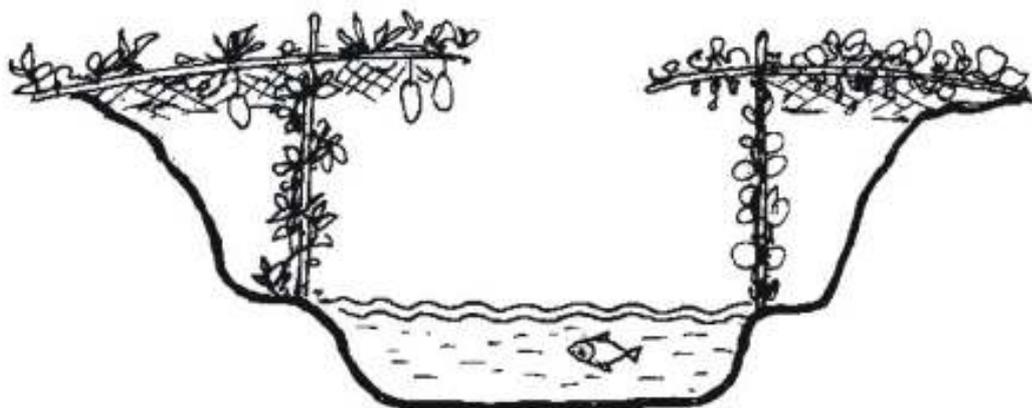
A multi-storey pergola with trees as poles, climbers, creepers, under-storey plants in a home garden.



Vegetable cultivation in trellies



Vegetable cultivation using pond bank



Pond is a very important natural component here. Many plants occur here naturally. Plants tolerating waterlogging like elephant ear, *Marsilea minuta* L, *Bacopa monnieri*, etc. can be planted near water. A little above that where water does not come up directly, vegetables like *Centella asiatica*, *Oxalis corniculata*, *Hygrophylla* sp., etc. can be grown. *Azolla* can be cast in the soil and pond water as the food for fish and duck.

Duck and chicken can be raised to provide nutrition. Duckweed and *azolla* can be raised in small pots to feed them. Chicken can be fed with household waste also.

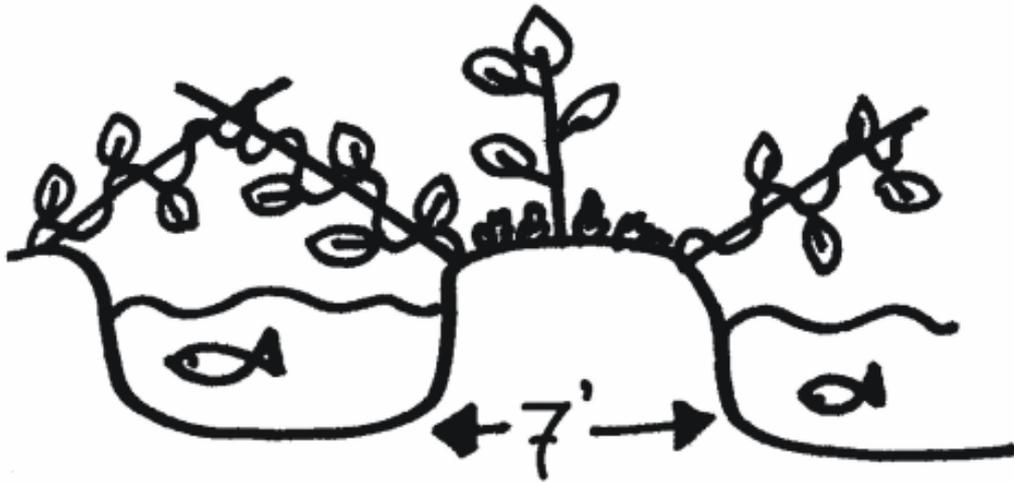
4. Conclusion

Actually farm is a synergy – a teamwork of different natural resources available in that particular area. What people have in their surroundings must be considered first and managed. In this situation where drainage system is poor, rice cannot be cultivated solely. In this saline condition the integrated models discussed above must be adopted for the regeneration of land. These trials must be conducted in as many places as possible and for that awareness to adopt these models must be developed. Low-cost technologies must be adopted in a way that does not affect the socio-economic condition of the poor underprivileged people.

Annexure 1

Long term responses after saline water recedes

Model 1: (Vegetable + Legumes + Fish + Duck + Crab + Shrimp) Integrated model for completely flooded paddy field area. Land shaping is needed to accommodate the multiple subsystem.



Fish varieties: Metroplus, varieties of Cat fish, *Pabda*, *Parse*, *Tangra*, *Mourala* and even carps can be grown in saline water if raised from fry to fingerling. Bhetki can be grown, but the feed is very costly.

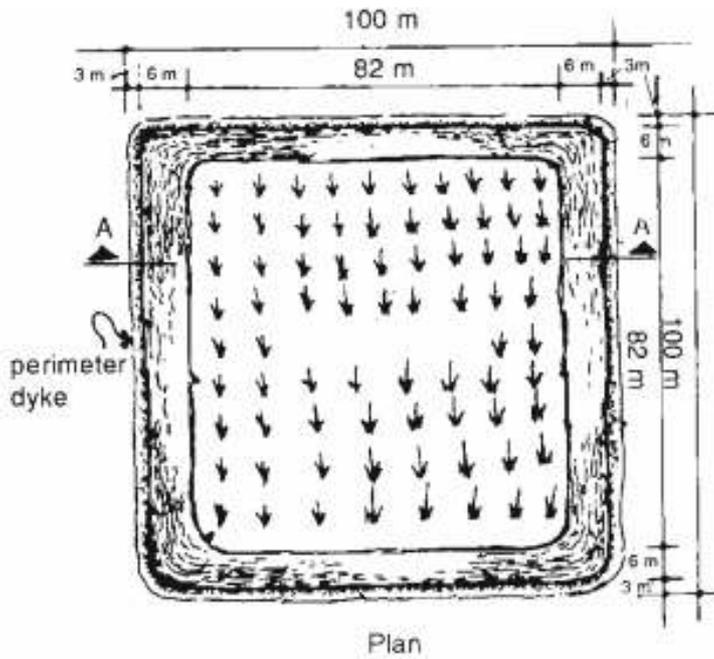
Duck must be of local breed.

It is better not to go for bigger livestock due to fodder shortage. **Goats** can eat *Nalkhagra*, *Dhani grass*, *Para*, *Kara*, *sesbania* etc which are salinity tolerant.

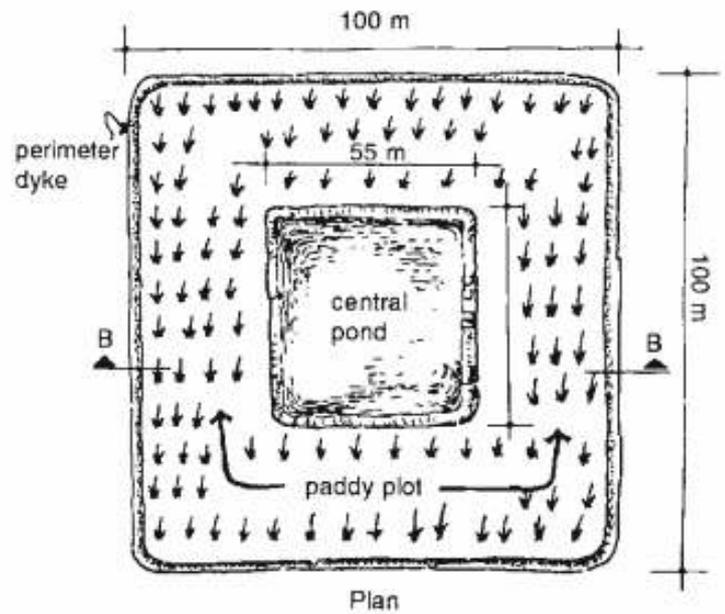
On the fence biomass generating and salinity tolerant plants can be planted for supplying fodder and raw material for composting. Some plants are *Pongamia*, *Ber*, *Philanthus sp.*, *Fig*, *Guava*, *Jayanti*, *Habol* etc

Model 2: (Rice + Vegetable + Fish + Duck + Azolla + Duck weed) integrated model.

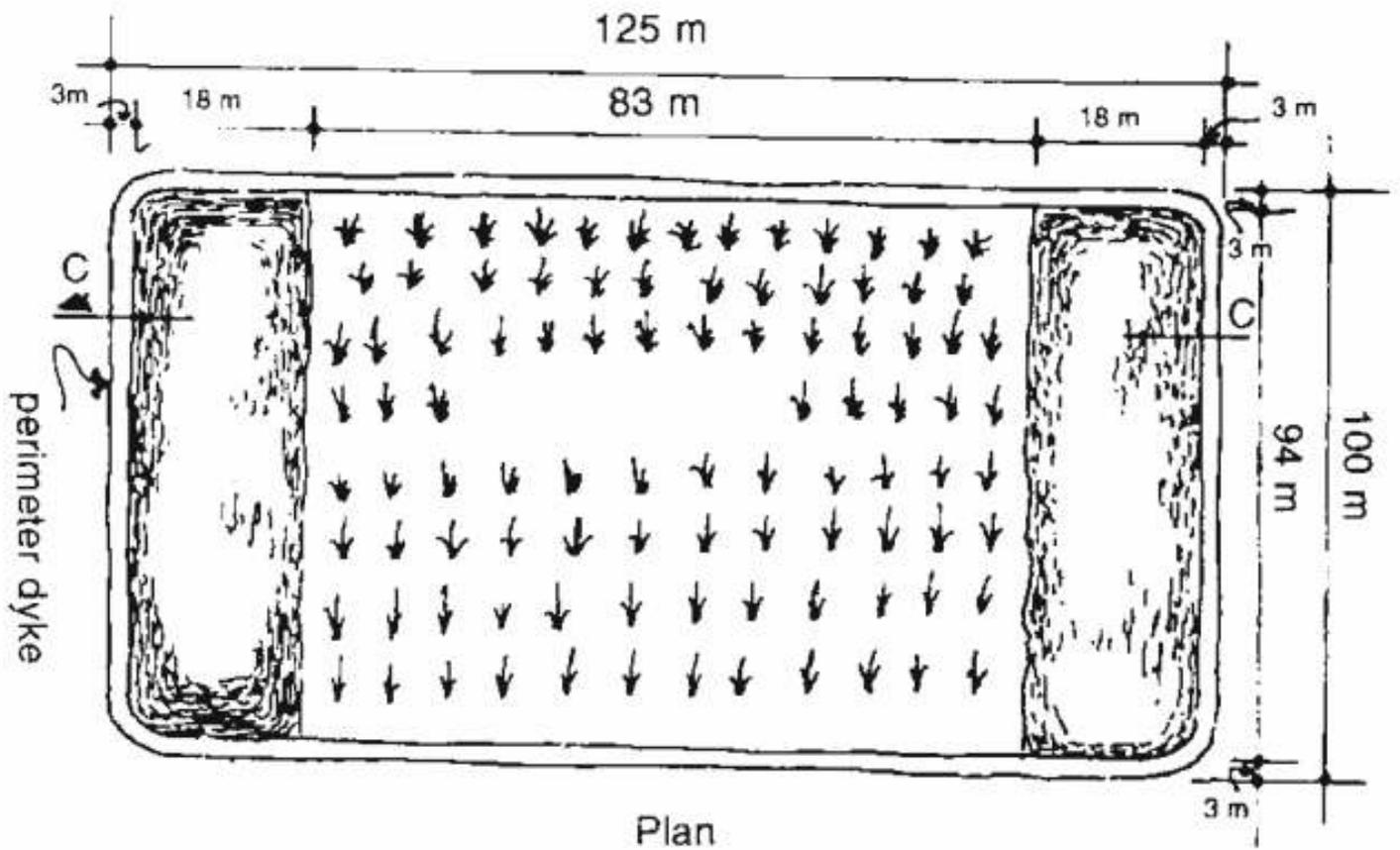
This model can have several designs:



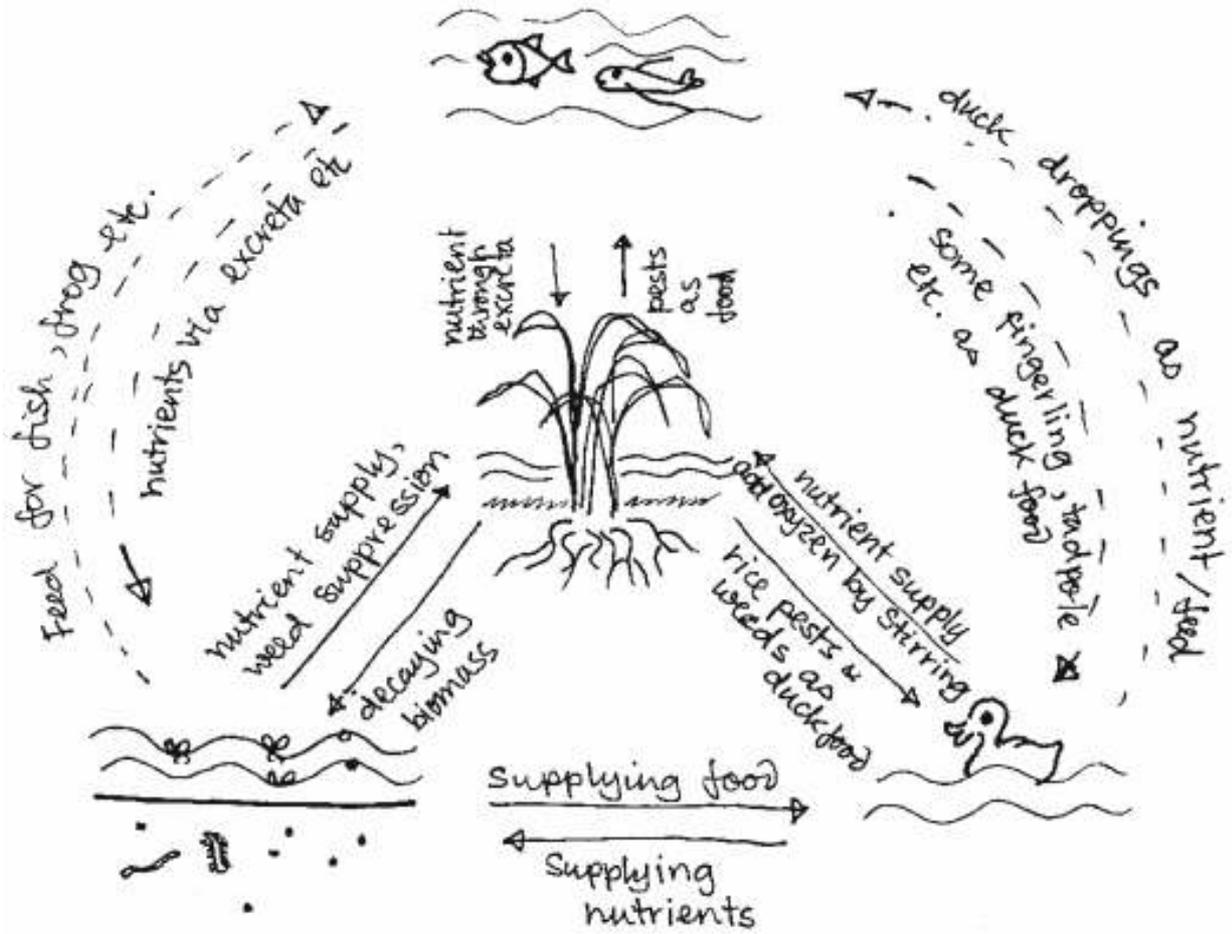
Perimeter type trench



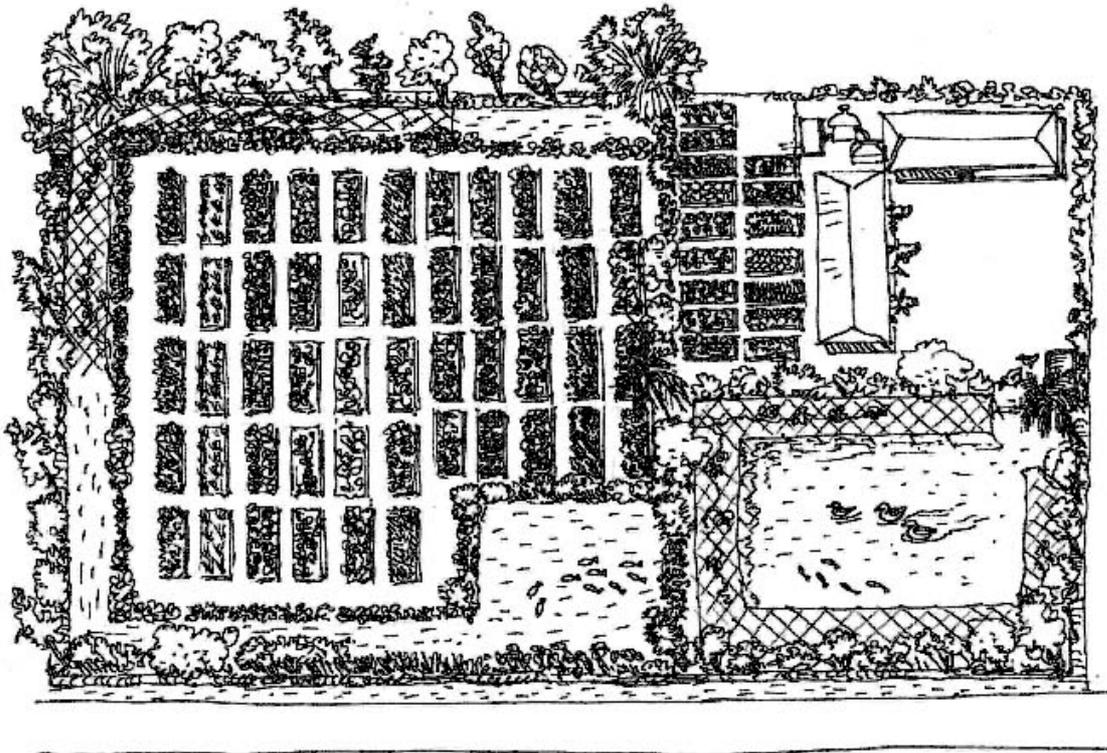
Central Pond type trench



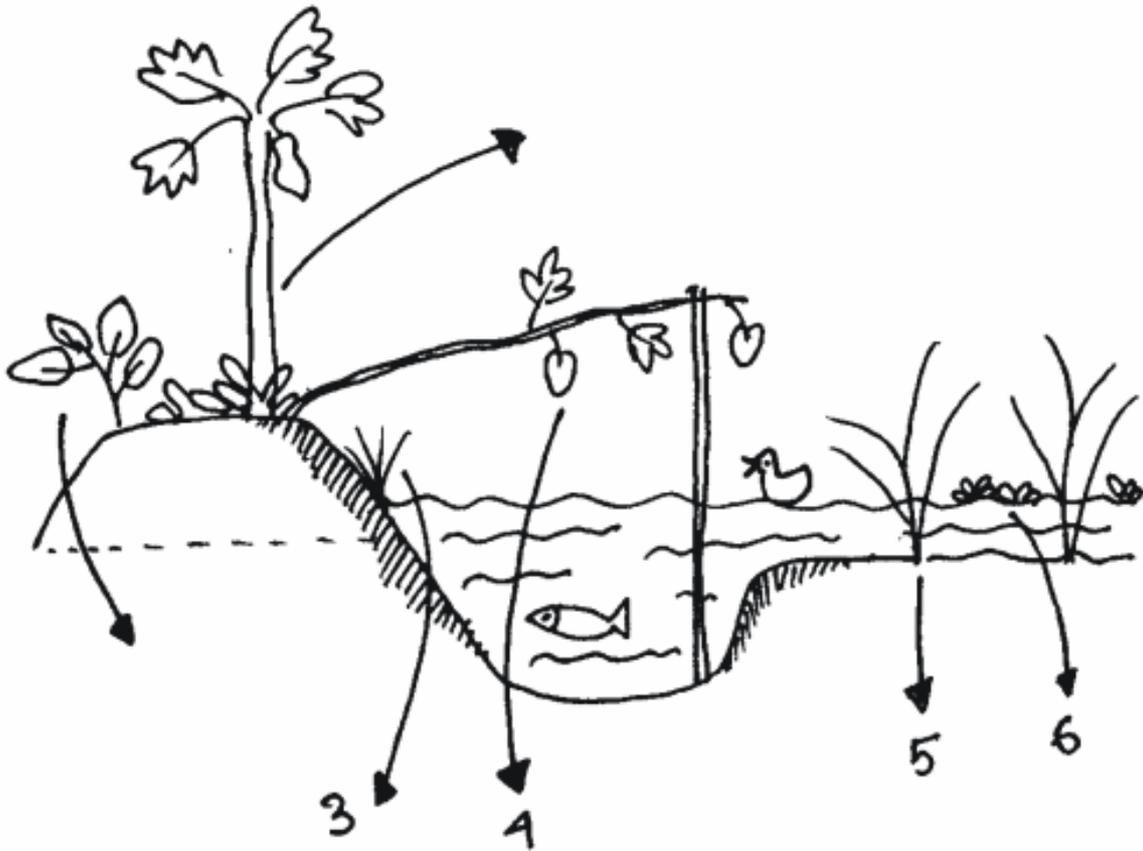
Lateral type trench



Nutrient flow in rice - fish - duck - azolla system



A standard farm layout where household is elevated from the soil of trench to avoid water inundation



Cross section of a remodeled paddy field for duck-rice-azolla mixed culture

1. Shrubs such as *Sesbania aculeate* or *Tephrosia* or *Crotalariaa* sp or bitter/sweet jute, roselle etc.
2. Small fruit trees such as papaya, lemon, banana, drumstick etc
3. Lemon Grass/Water Convolvulons etc
4. Gourds projected above water
5. Rice Plants
6. Azolla/Duckweed

Annexure 2

Saline Tolerant Indigenous Rice Varieties (5-7 Months) available with our farmers

- Matla
- Nona Bokra
- Hamilton
- Lunishri (Nonasri)
- Nonasal
- Velki
- Kumargor
- Dadshal
- Kanta Rangji
- Hogla
- Gentu
- Hamai
- Talmugur
- Kamini
- Kalo Bhutia

Water logging Tolerant Indigenous Rice Varieties available with our farmers

- Shrabanti Sal
- Panikalas
- Jaganath Sal
- Bhasa Manik
- Sada Jabra
- Ajirban
- Jaladhi
- Jalbora

Annexure 3

Affected trees, herbs, crops

	Fruit trees	Crops	Herbs	Wood trees
Destroyed within 2 days	Jackfruit, papaya, banana, lime, Hog-palm	Chili, Brinjal, celery (local herb)	Napier, Durba, Chhapna	Sal
Destroyed within 7 days	Star apple, lichi, Emblic	Ladys finger, Arum, Ginger, Turmeric	-	Mehagani
Destroyed after 15 days	Pomengranate, Betel nut, Fig, Tamarind	Water convolvulus	-	Eucalyptus
Still living (upto 10 th July)	Coconut, Ber, Mango, Berry	Sanche (local leafy vegetable)	Khoil grass (local herbs)	Albizzla

Affected Fish and Others

	Fish species	Others
Destroyed within 2 days	Rohu, Mrigel, Bata, Katla, Silver carp, Khoiro, Punti, Mourala, Nados, Grass carp, Japani punti	Snails, Geri, Gugli, Teli Crabs
Destroyed within 7 days	Koi, Magur, Singi, Sol, Pakal, Kunche	-
Destroyed after 15 days	-	-
Still living (upto 10 th July)	Shrimp	Nona, Chite Crabs

Annexure 4

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Annexure 5

About DRCSC

Development Research Communication and Services Centre (DRCSC) is a non-government development organization working in West Bengal and other states. It's major concern is food and livelihood security of the rural poor through sustainable management of natural resources on the basis of principles and actions, that are environment friendly, economically appropriate, socially just and developed by mutual cooperation. It offers training, consultancy and PME services to other states of India and countries like Laos, Nepal, Bangladesh, Vietnam, Japan etc.

Development Research Communication and Services Centre (DRCSC) was formed in 1982 as a resource centre for collection, collation and dissemination of information on various socio-economic issues and to highlight the struggles of various NGOs, CBOs and individuals to ensure social justice; especially for informal sector workers, indigenous communities and small & marginal farmers/landless labourers as well as self employed artisans.

Along with that, since 1992, the centre focused on Sustainable Agriculture & Natural Resource Management for improving food & livelihood security of the rural poor. The resource centre started to expand its services through a Network of local NGOs and Development Cooperation Groups.

DRCSC has senior soil scientists, agricultural & horticultural experts as our honorary advisors. We also have experienced trainers and a network of innovative farmers who have learned organic farming, practiced it and are now capable of training other farmers. Among our staff we also have competent & trained communicators, community organizers, documentors, audio & video technicians, computer & graphic designers etc.

Creating demonstration sites on farmers' fields and training village youth to be community organizers and skill trainers was important part of the strategy. Collaborating NGOs were assisted to develop training facilities, demonstration sites, seed banks, bio-labs, documentation and information dissemination facilities etc. In the villages, grain golas, seed-centres, community ponds, group-based tree nurseries,



community woodlots, etc. were developed and management of these were handed over to local groups after training them. Small household gardens and farms were improved into demonstration sites where many bio-inputs, such as vermin-compost, liquid manure, botanical pesticides were produced and used and many techniques such as raised beds, circle gardens, crop rotations and relays, etc. were practiced. Many nutrient-rich cultivated and uncultivated plants were identified and popularized through seed exchanges, farmers fairs, etc. Small scale experiments on food processing, medicinal plant processing, improved fishery and animal husbandry were also supported on a household or small group basis and apprenticeships with skilled artisans were facilitated.

DRCS's major area of operations are-

Enhancing production of food, fodder, fuel etc. through training, demonstrations and collaborative field trials on sustainable utilization of natural resources.

Assisting rural communities to conserve and regenerate common properly resources like grazing lands, ponds & wetlands, roadside & canal bank/riverbank areas, permanent fallows etc. through group based management

Enabling school teachers and educational workers to promote environmental awareness and activity based participatory learning among children and adolescents and to take up agro based enterprises.

Arranging and supporting documentation of overall developmental issues, indigenous technologies & knowledge especially in the areas of food production & processing, seed selection & storage, nutrition & health care, water harvesting & storage etc.

Assisting and capacitating small organisations to develop and maintain libraries, documentation centres, seed centres & nurseries, revolving funds, grain banks, bio-labs, publication design & production units etc. and also to develop food security & environmental protection related projects Service/training

