1. Introduction:

The assets of a small and marginal farmer is of various kinds – a small piece of land, a homestead garden, few chickens and ducks, 1~2 cows/pig etc. From the viewpoint of industrial monocropping agricultural pattern, it is not accountable as the sizes of the assets are small. But this is the scenario of most of the Indian farmers. The large scale system, loan, government schemes etc do not support such small scale farmers, as production mostly seen as a singe crop output. Integrated farming is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrate livestock, fisheries, poultry and perennial/seasonal crop production. This system defines output as total biomass outcome of the system.

In the farm level, the farmers/gardeners are motivated to change the shape/style/design of the land so that it could be developed in to integrated farming system that utilizes the waste of one component as a resource for the other and sets up a network of nutrient flow. The diversification that comes from integrating crops, vegetables, livestock, trees and fish imparts stability in production, efficiency in resource use and conservation of the environment. In integrated farming, wastes of one enterprise become inputs to another and thus optimize the use of resources and minimize pollution.

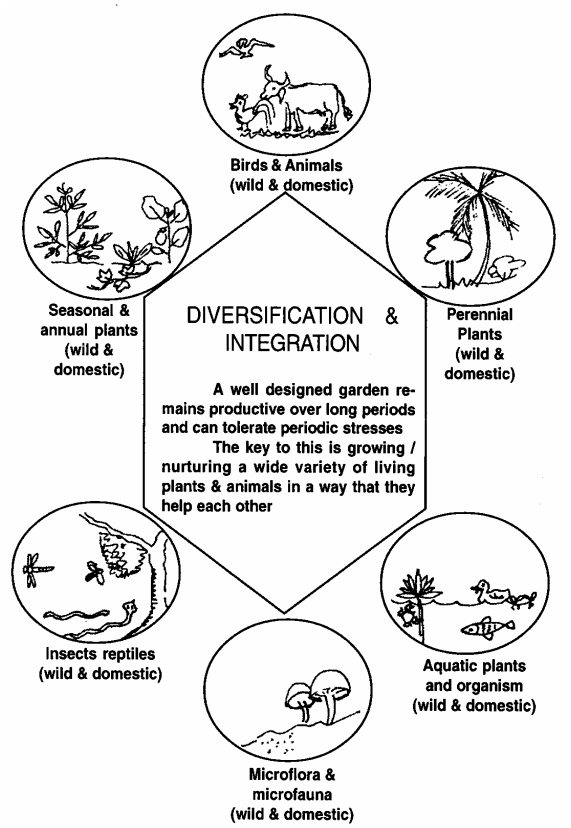
This type of intervention was done in Sukomal Mandal's plot in Viswanathpur village, Gram Panchayat Ramganga, Block Patharpratima, District South 24 Pgs. He is now an acclaimed integrated farmer. He leads a happy life with his wife and two kids.

2. What is the innovative/best practice or the model?

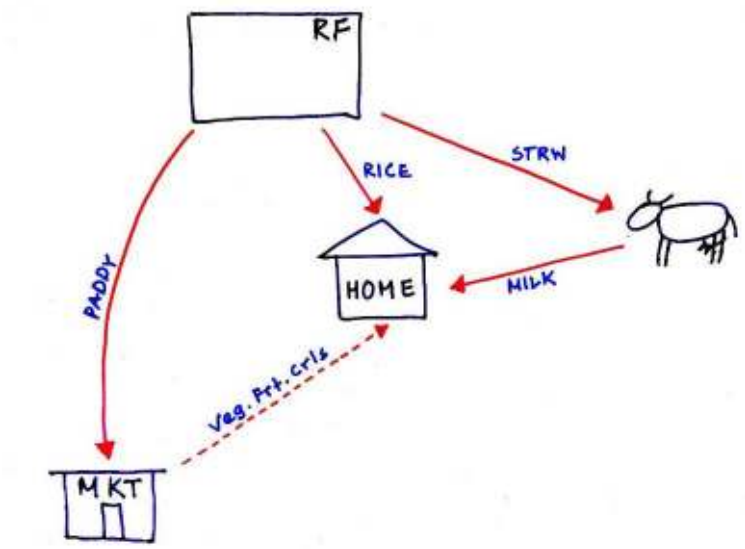
The models are developed & based upon the first principle of ecology that all the components of nature, biotic and abiotic are interrelated. It is an established principle in ecology now, that stability of a system is enhanced by establishing connections among different components among different biotics of a system. A stable system has:

i. Maximum resilience capacity
ii. Optimum productivity with maximum input use efficiency
iii. Higher sustainability

This has been illustrated amply by a number of experimental validations during the last two and a half decades.



Selection of species: Integrity among Diversity



The present scenario

This is what we call the usual scenario of a small/middle farm. It usually has a rice field (RF), paddies are sold directly in the market, rice is consumed and the straws are for the cattle, if they have any. The milk is either sold in the market or consumed. Vegetable, fruits, cereals and animal protein are bought from the market.

In order to make the farm self-sustaining, energy-efficient and reduce risk factors are introduced –

In the Sunderbans, the low lands remain water logged for at least 6-7 months in a year. In absence of any escape route for the accumulated rain water, farmers try to cultivate these low lands just before the onset of rains. But often these efforts go in vain, as the crops fail due to water logging.

Land shaping: In order to address this problem, the farmers are motivated to change the shape of the land so that a pond is excavated in a portion of the plot and the excavated soil is used to raise a section to make it suitable for growing vegetables throughout the year. Moreover, farmers are intensively oriented on economic, social and nutritional benefits of integrated farming and they are extended technical support in taking necessary measures for soil conservation, rain water harvesting and also prevention of water run off and soil erosion.

Space allocation: The allocation of land and water for fish, crops and livestock varies. The most interesting aspect of this practice is that every portion of the land is used for cultivation. For example, in one farm, about 50 percent of the land is kept for growing paddy and vegetables, 20 percent for fish culture, 15 percent for rearing of cattle and poultry and the rest 15 percent for cultivation of fodder. General farming practices and fish cultivation being amenable and easy for integration, the low land is used for growing short-term paddy, and in rest of the land, vegetables are grown that give them a good income throughout the year.

Paddy-cum-carp culture: In order to facilitate fish culture in paddy-fields, the farmers make water retention or detention structures which help storage and conservation of water favoring paddy growth. These structures are made in the form of trench, pond or ditch depending on the configuration or topography of the land. Some nearly extinct traditional fish varieties are grown in the trenches. Generally, fish culture in paddy fields is undertaken as second crop after the single annual crop of paddy or as an intermediate crop between the paddy harvest and the next transplantation or as concurrent crop with paddy.

These trenches also act as irrigation channels to the paddy field. The fences along the trench are used for planting vegetable-yielding creepers. For irrigating terrestrial crop, pond water is considered to be better than any kind of running water since impounded water is more fertile and add nutrient for the growth of the plant. In fact, this is the basis of integration of agricultural and horticultural crop on the pond dykes. Further, vegetables are also grown on the dikes and adjacent agricultural land as they feed on to the aquatic plants and fish raised in trenches and other adjacent water bodies.

Consolidation of bunds: Nitrogen fixing trees are planted on the bunds for enriching the soil and also for supplying food, fodder and fuel. Self growing local plants and weeds are used for making compost and also as nutritional supplements for humans and cattle. Mulching is done to stop soil erosion and growth of weeds. It also works as an organic matter that protects the micro-organisms from direct exposure to sunlight.

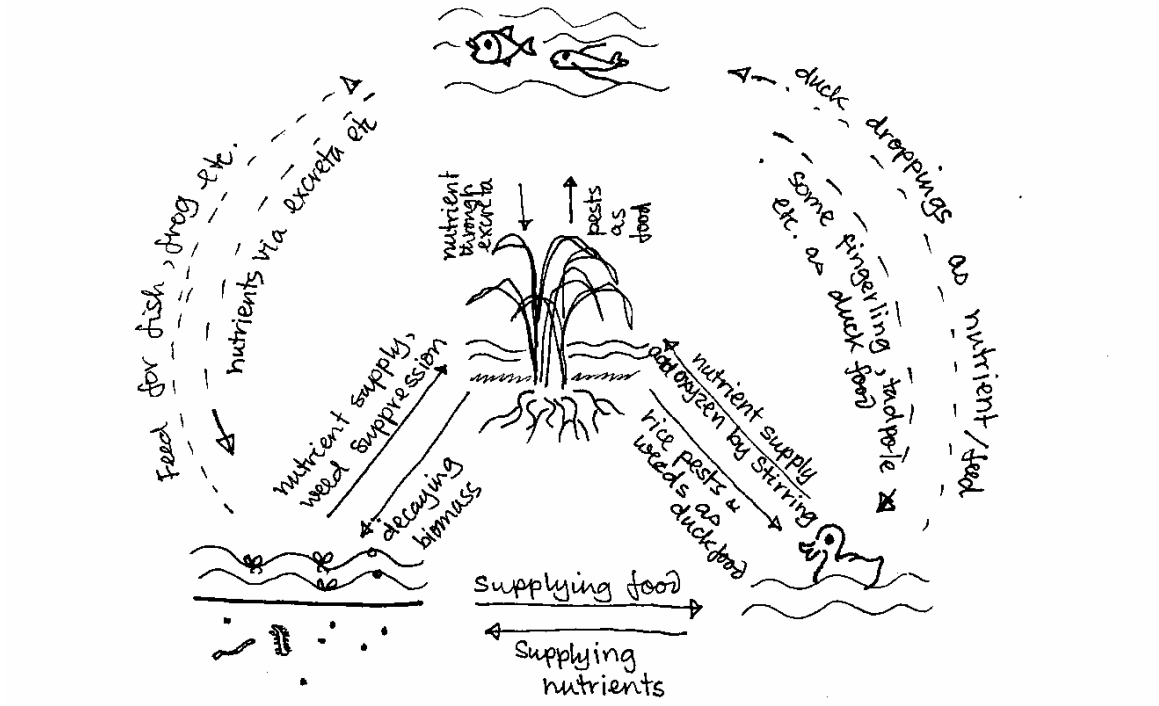
Integration in water (pond-ditch/trench-rice field): Under this system of integration, a combination such as hen-duck-fish-azolla is undertaken where the duck house and hen pen is made to project over the pond so that the droppings, which are very good fish feed, may fall directly in the pond. Fish is grown in the inter-connected water body comprising of the pond, ditch or trench and rice field. Ducks paddle through this entire area that aerates the rice field controlling the growth of weeds. As they move, they shake the rice plants, whereby the pests drop on the water and gobbled up by the ducks. Azolla is a free-floating aquatic fern which is a very good bio-fertilizer, green manure and an excellent duck and fish feed. In this integrated sub-system, Azolla supplements nitrogen to rice crop by fixing atmospheric nitrogen in the soil for crop growth, crop production and maintain soil fertility.

Integration between cattle shed-compost pit-vegetable garden: Cattle are raised essentially for milk. Cow urine and cow dung are used for making compost or vermi-compost in permanent pits or large earthen vessels or on a plastic sheet laid on the ground. Compost, especially vermi-compost serves as

an excellent fertilizer for the vegetable garden. Cow urine and cow dung are also used in the pond as manure.

Integration between cattle shed-biogas pit-kitchen-vegetable garden-rice field: With only a small investment, a bio-gas unit can be a very useful intervention. Instead of using cow dung and urine directly in the compost pit, it may be transferred to the bio-gas unit. The gas generated may be transferred to the kitchen for use as fuel or for lighting gas lamps. The slurry which is collected in a separate pit may be used in the vegetable garden and rice field as an excellent fertilizer.

Awareness regarding agro-chemicals and organic inputs: Farmers are trained and made aware to reduce, rather stop use of chemical pesticides and emphasis is laid on use of organic fertilizer, green manure, vermin-compost, extract of various plants and weeds or ash as organic weedicide, etc.

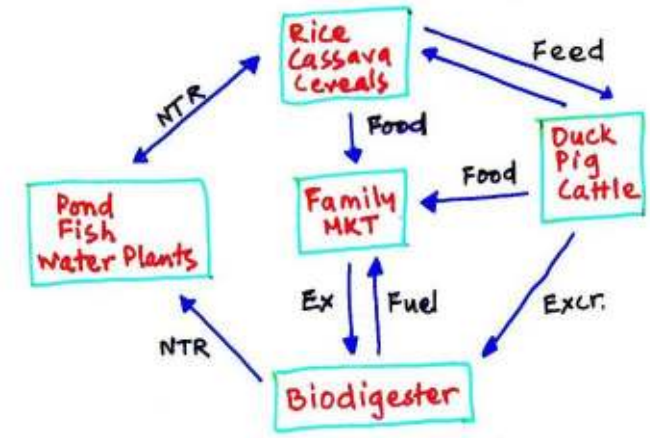


The Intra Subsystem Links in a Fish-Duck-Azolla-Rice system (NTR=Nutrient)

Especially in the wetland, a portion of the field is raised and the **bunds** are widened with the excavated earth from the pond for growing vegetables and trees to address water logging that makes it possible to cultivate vegetables round the year. The rest of the field is left intact to grow **rice**. The farmer is advised to grow native varieties of rice with 2 saplings planted at an interval of 9" instead of the present practice of planting 5 saplings at an interval of 6". This results in considerable reduction in requirement of seed & inorganic fertilizer, less pest infestation, almost same or increased yield and qualitative amelioration.

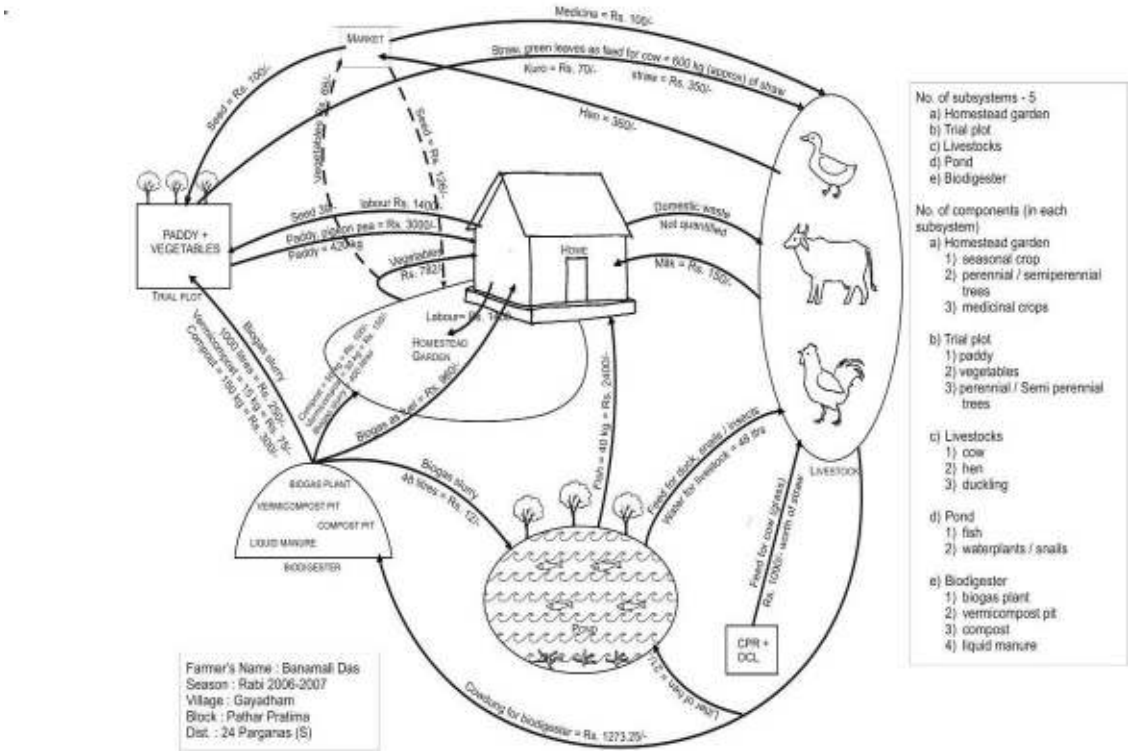
Recycling is always an important part of integrated system. Plant wastes can feed birds and animals, their manure can be used to make biogas, and slurry produced can be used as fish food or earthworm food and remaining part can be used as organic manure to produce human food and animal feed. In a home garden, kitchen wastes, wood ash, animal & bird manure and urine, rotten roofing material, wastewater etc are always possible to recycle. Multi-use of elements/products and multi-step processes help to increase the energy efficiency of a production system.

As a whole, if we generalize the subsystem integration and resource flow, it will be something like –



NTR= nutrients, Excr./Ex = Excreta

The model is self-sustaining as the paddy field itself is transformed into a multi dimensional agro ecosystem within which several overlapping food chains develop and need for external inputs, such as chemical, mineral & organic fertilizer or herbicides, pesticides & other bio control agent is drastically reduced or eliminated. For the farm household it means additional food, less labour and input costs as well as higher and better distributed income. It also means that the farmer is free from the clutches of spurious input vendors and also his field remains healthy.



A Resource flow diagram of the plot of a farmer in Patharpratima

3. What are the success criteria in the given context/background?

This model increase whole farm productivities (land, labour and input), ensure food and nutritional securities of the farm families through out the year, reduce stress periods in the farm, increase the profitability of the farming enterprises, and Increased cash flows in the farm families.

Sukomal has benefitted by many ways, precisely as follows;

Social benefits:

This type of activity is labour intensive, which creates on-farm person-days and most of the labour required in the production process is contributed by the farmer himself and also his family members. It gives year round availability of nutritious and seasonal food. Seasonal migration is reduced. Fodder and fuel shortage is also minimized

Ecological benefits:

In respect to ecological impacts soil health is improved, % organic carbon increased and the fossil fuel dependency is practically zero as all the variable inputs are produced within the farm. The diversity of crops is huge as various type of crops, creepers, climbers, strategic crops etc. are cultivated within the farm. Many number of local crops are introduced, soil micro/macro fauna increased. Each and everything is recycled within the system, it is actually a zero waste farming system. As it is diversified, hence it is disaster resilient.

Economic benefits:

The input cost is reduced, so net income increases. In addition as income is diversified that is from different sub-systems, risk is reduced. The income has time wise and source wise diversified, i,e, the farmer is getting income through out the year from different sources, which reduces the dependency on a single system.

Income-Expenses

Year	Expenditure (Rs.)	Income (Rs.)
2007	8540	33119
2008	10055	45096
2009	4670	31578

4. Process Adopted:

Sukomol and Alpana Mondal live with their two sons on a farm in Biswanathpur, a village on the Ganges delta in West Bengal, India. The farm's size is 0.7 hectares. Their youngest son, Pallab, who is four, is physically challanged. The Mondals fell into debt because they were having to pay various costs relating to their son's treatment at hospital. The only way they could afford this was to take out costly loans and sell most of the produce from the farm along with the assets he had. This created a severe food shortage for the family.

In the middle of this crisis, in 2006, the Mondals decided to make a switch to a integrated farming system, having seen its positive effects on other farms in the area propagated by DRCSC through Area Resource and Training Centre (ARTC). ARTC/DRCSC capacitated Mondals to do site planning of their farm, gave training and initial loan/seeds/equipments to transform his monocropped land into a multisubsystem farm. They constructed a pond and a new drainage system composed of a main channel through the rice field and smaller channels around the perimeter linking to the pond. The earth was used to raise the level of several of their plots. A gradual transition was made to organic paddy cultivation in SRI technique. Native species of carp and catfish were introduced in the pond and channels, and crops like cowpea and bitter gourd grown on trellises over the water. More than twenty different crops are now being grown, including

various spices, vegetables, oilseeds and pulses. “Live fences” of mango, neem, subabul, rain tree, bamboo, banana, coconut trees and fodder were also planted around the farm’s edge. Some perennial trees surrounding his homestead garden were grown. It included guava, water apple, sapota, lemon, mango and coconut. He has cow, duck and hen as livestock and adopts suitable complex farming design with rice-fish-duck-azolla during kharif. He cultivates fish such as Rohu, Katla, Bata, minor carp and catfish in his pond and the trench that acts as a link between the paddy field and the pond. For fish feed, he uses only left over of fodder, domestic waste, cow dung and sesame cake. As fodder he uses hay, grass and various crop residues. For chicken and ducks, he uses rice grains, husk, residues of the paddy harvest and small snails from the pond. His dependence on the market for chemicals, pesticides, seeds, etc. has reduced to a very great extent. He preserves the seeds and also prepares a mixture of neem extract, garlic paste and kerosene for use as pest repellent.

5. Institutions involved:

DRCSC (Development Research Communication and Services Centre) is a non-government development organization working in 12 districts of West Bengal and other states to ensure food and livelihood securities 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. This organization has been working to develop this kind of models focusing on sustainable agriculture and biodiversity restoration, conservation for many years. Sukomal has learnt most of the farming techniques he applies now from his mother, but he owes his success of being an ‘integrated farmer’ to DRCSC’s field staff, who helped him in landscaping his small piece of land and in adopting integrated farming system.

DRCSC, with support from Department of Science and Technology, developed models of 500 such integrated farms in 14 states of the country with 16 partner NGOs in an All India Coordinated Programme on BIOFARM (www.drcsc.org/aicp.html). In Coastal Zone, DRCSC has developed around 50 integrated farmers and a total of 200 under DRCSC implementation area.

6. Problem/issued faced:

The problems are not so technical but mostly social and organizational. Land reform is incomplete in most of the states; consequently a land of 1-2 bigha is further subdivided. But for a farmer of 5-6 family members, at least 50 cent of land is required to fulfill the nutrition requirements of the family!

Distance of the field from the household is another problem, which leads to lack of security. The police, *gram Panchayet* (and members of various youth clubs affiliated to different 'isms') has failed to play an effective role in theft of fish/fruit/rice etc. The location of the land is also a problem. If it is located at one corner along the side of the road or canal, there will be no problem as such regarding widening of the bund and planting trees. But if the land is at the middle of the field, it is difficult to bring such changes.

People who have so far successfully carried out this practice, their land is usually at one corner or side of the field and very near to the homestead. They have also received training or suggestions and short term loans from different organisations. Moreover all of them are marginal farmers and are very dedicated. We are still skeptical whether this farming practice can be successful if done only to earn profit by employing labour (other than the landowner) in the field.

7. How they were overcome:

- We tried to make farmers work in small groups of 5-6 farmers, each of whom has a land of 1-1.5 bigha. So that the cooperation between the farmers increases and the social and technical barriers often addressed easily in a coordinated way by the farmer's group.
- The MGNREGA scheme has often been used as initial seed money for landshaping.
- There is no single prescribed model for everyone, but it is based on the basic philosophy of integration and diversification. The stress period of the farm families with specific focus on food, fodder, firewood, work, cash and water; existing resource, skill & wealth; living area for animal & human; distances of farming areas (field/homestead/orchard/poultry/pond etc) from household; cash need of the family – all these has to be considered during site planning, so that the models are really owned by the farmers.
- The model has some initial investment, if that can be arranged, as IFS takes the farmer to almost zero budget farming, it is affordable and sustainable.

8. How to replicate?

These IFS model has been developed under government support in many part of the country which has been approved for large scale replication. The MGNREGA, and various schemes of NABARD is easily applicable for this. We can share the country level data which might create an example for the willing farmer. It is very important to have convergenece between various department, research institutes, NGOs and universities, as the IFS is a multidisciplinary and complex system.