

Sustainability of an integrated livestock-fish-crop farming system as a small scale enterprise

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A model integrated livestock fish crop farm.

Operation of a single commodity farm such as fish, poultry or livestock may not be sustainable in the long run because of high input costs as well as risk involved and cumulative impact of waste disposal on the environment. Scientific integration of different farm components such as livestock – fish – crops etc. can be a viable option for sustainable production of different commodities with lower investment, mitigation of risk factors and environmental impact. The present communication deals with sustainability of an integrated farming system over the long term. This system incorporating fish, livestock and crops in an ecologically balanced proposition may be an ideal example for economically sustainable small scale agri-enterprise through utilisation of available resources. Calculation of benefit cost ratio and analysis of cash flow patterns reveal that the system is economically sustainable in the long run. Additional advantages like mitigation of environmental pollution through waste recycling, avoidance of health hazards, convenience in management and reduction of risk add distinction to the system as farmer-friendly and eco-friendly.

Over the last three decades India has witnessed considerable growth in fish production from inland aquaculture through intervention of science and technology as well as intensifica-

tion in farming. Intensification of fish farming practices is cost intensive and as such often beyond the reach of poor or marginal farmers. Further, intensification of fish culture is often linked with degradation of environment and beset with problems such as the unavailability of essential inputs like low cost, balanced feeds and essential equipment, particularly in rural areas. In view of the above emphasis has been paid to popularise fish farming based on integrated farming practices with low external input requirements and almost zero harmful impact on environment. One such technology is the integrated fish livestock farming system, in which livestock manure is recycled in fish ponds for production of fish without any external supply of manure and feed. Different forms of integrated livestock fish farming viz. pig-fish, poultry fish, duck fish etc. have been evolved and popularised in India.

Livestock production is important for the majority of farmers in developing countries especially for small and marginal farmers. FAO used the term 'Livestock Revolution' to describe the expected massive increase in livestock production in developing countries to meet the increasing demand for livestock products due to growing world population. But the livestock revolution is afraid to compete strongly with human food production. Presently, the livestock industry already

consumes almost 50% of world cereal grain supplies⁴. It is therefore very important to develop livestock production systems which do not depend completely on cereal grain. Alternative low cost and eco-friendly feed sources for livestock nutrition are very important for sustainable livestock production. Technologies developed so far are mainly for intensive and industrialised livestock production systems that do not fit well with the socio-economic status of poor and marginal farmers of India. An analysis of different livestock projects revealed that many were inadequately adapted to the social, economical and cultural reality of the families belonging to the targeted population¹. A common strategy used by rural families to counteract risks and optimise opportunities under changing and adverse circumstances is to diversify their activities⁵. Integration of livestock with other farming components is the most easily adoptable strategy to address these factors.

In view of the above, studies have been undertaken at Fisheries Research Centre, Assam Agricultural University, Jorhat, Assam, India to develop a sustainable integrated farming model for small land holdings. This model is an ecologically sustainable livestock-fish crop farming technology suitable for small and marginal farmers. It is low cost and facilitates maximum utilisation of available biological resources and recycling of organic wastes. In this system, raising of two livestock components, pig and poultry was integrated with fish farming and horticulture crop production. Poultry droppings were used to supplement pig nutrition and pig waste was recycled in fish ponds, whereas the pond muck and excess livestock waste were used for fertilisation of horticultural crops. For rearing of the two livestock components (pig and poultry) simultaneously, specially designed housing units were constructed in the pond embankment. Each unit is comprised of two subunits arranged vertically one above the

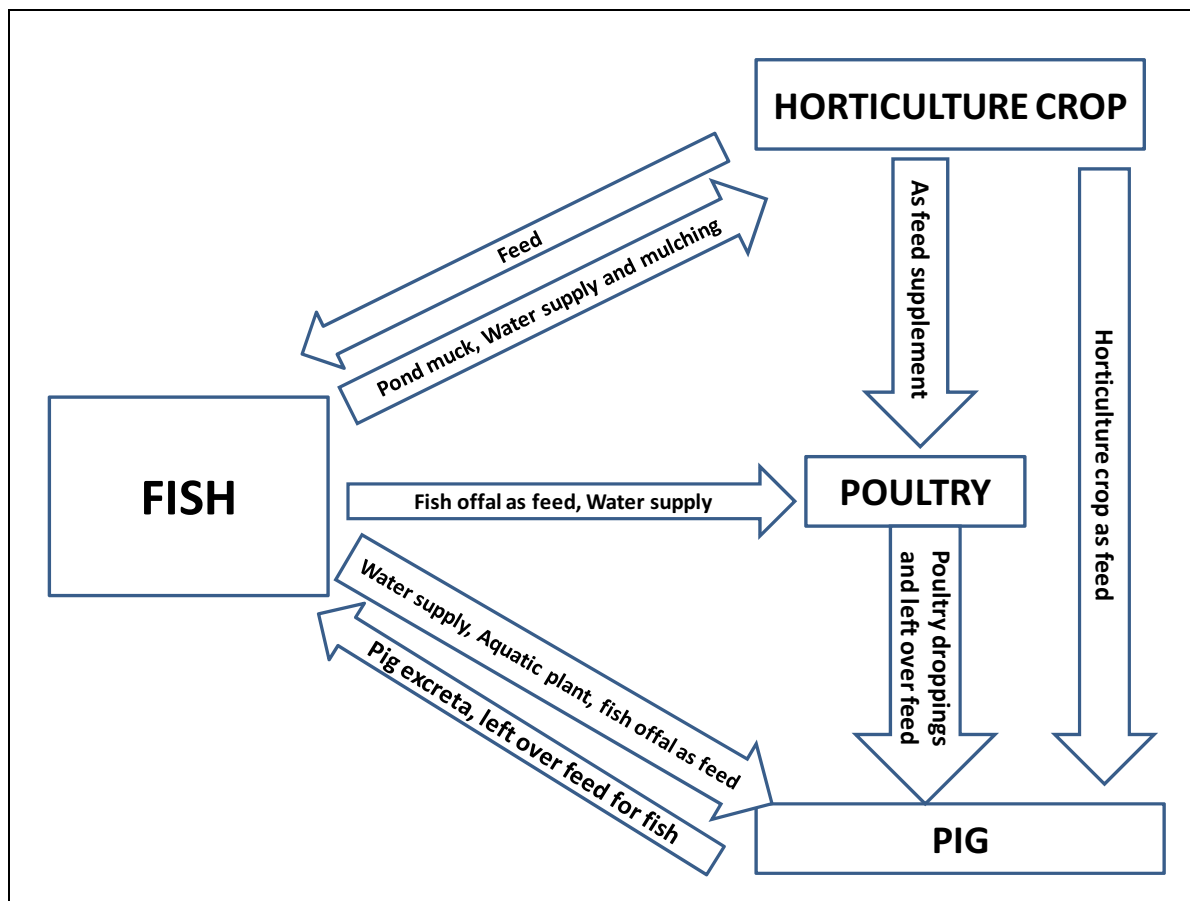
other. The upper subunit was designed to raise poultry as per standard practice of poultry husbandry and the lower subunit was constructed as per specification for pig husbandry. A perforated floor between the two subunits and a galvanised iron sheet fixed just below the perforated floor in a slanting manner, facilitated use of poultry droppings and leftover feed as pig feed. The pig droppings and left over pig feed were washed down to the pond through a cemented drain connecting the floor of the pigsty to the pond.

Six species were used in semi-intensive carp farming i.e. rohu, catla, mrigal, common carp, grass carp and silver carp following the standard package of practices for pig-fish farming. Ponds were stocked with carry over seed (yearlings) at a density of 8,000/ha. No extraneous supply of feed or manure was used except for grass carp feed in the form of aquatic or terrestrial vegetation. Stocking rates of pigs were kept at 40/ha and 10 birds (layers or broilers) per pig to supplement around 40% of pigs' daily feed requirement². The ratio of chicken : pigs : fish was kept at 10 : 1 : 200 in this system. Every six months pigs attaining slaughter size were disposed of and new batches were procured. Water quality parameters were monitored and pH of water was regulated by interim application of lime. Desilting of the pond bottom, bottom raking as well as control of algal blooms as and when required was done by following standard methodology. The pond embankments, inter pond spaces and other free areas of the farm were used for crops such as banana, lemon, areca nuts and coconuts etc. Regular observation of health and weight gain of the livestock and fish was conducted. Data on total production of fish, pigs, poultry, horticultural crops, total investment revenue generated and net income were collected annually. Analysis of cash flow, calculation of percent profit over operational cost, benefit cost ratio, and



Specially designed house for poultry and pigs.

Figure 1:



internal rate of return was conducted for the entire period (13 years) following standard methods to ascertain the economic sustainability of the system.

In intensive production systems generally resources or raw materials are extracted from the earth's surface, turned into desirable products and then byproducts of this process in the form of massive amounts of waste materials are discharged back, the cumulative impact of which leads to air, water or soil pollution. This linear model, often referred to as 'cradle to grave' model is not sustainable in the long run, as earth's surface does not have the capacity to endlessly supply increasing amounts of resources, or to absorb all the pollution and waste indefinitely. In contrast, sustainability can be achieved in the 'cradle to cradle' model for production where the concept of waste is eliminated entirely, as the wastes produced during production of one commodity are recycled or utilised for production of other commodities³.

The pattern of nutrient flow in the system under study makes it a perfect paradigm for sustainable 'cradle to cradle' model. In this integrated system all waste is reutilised as input for another component of production. This circular model for production will not exploit nature for raw materials or degrade it with pollution. External input for the whole system includes 100% ration for the poultry and 60% ration for pig. Exclusion of external feed and manure input for fish crop reduces the cost of production of fish to the tune of 60 - 70% and use of poultry dropping, left over horticultural crops, aquatic weeds etc. in pig production reduces costs 50-60%. Production cost of horticulture crops are also reduced to around 60% through utilisation of organic wastes as manure as well as

mulching material. Hence this system involves low external input costs but assures production of multiple commodities from unit area through nutrient flow from one commodity to other forming a food circle. The cash flow analysis done on the system indicated a steady positive cash flow from second year onwards which indicated the economic viability of the system. The cost benefit ratio calculated for the last 13 years (2.68-3.04) also supports the economic viability of the system.

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