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Aqua-agroforestry can become safety net of Indian farmer

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Combining several production components decreases the risk element which agriculture entails. If one component fails, the other can provide the critical mass for survival; the different components interact in a symbiotic and synergetic manner, enhancing overall production, optimising resource use and thus providing for the subsistence needs of the household. Trees provide shade for crops and livestock while producing fruit; livestock manure is used as a fertilizer and crop by-products are fed to animals. The diversification of farming systems to include aquaculture diminishes the risks associated with small-scale farming. This is because pond water not only yields fish, an edible and tradable commodity, but can also contribute to crop irrigation and livestock watering in the dry season, thereby increasing the viability of year-round production. The choice of tree species and the associated crop have a great influence on the profitability

Improved food and economic security: The limited supply of protein food is currently a serious problem in around the world. The extra production from aquaculture can imply an increased availability of protein for household consumption. Alternatively, aquaculture products can be treated as a commodity which can be traded for cash or essential household items. Both strategies increase household economic security.

Enhanced production: Certain edible plants, such as water spinach and water chestnuts, can be cultivated in fishponds. With adequate flotation and support, so can some terrestrial vegetables and herbs. Other plants which grow in ponds without additional inputs, such as azolla, duckweed or water hyacinth, can be used as green manure or compost to enhance soil fertility, or as fodder for fish and livestock. Also, seasonal or rain-fed ponds may be used for crop production when they fall dry during the dry season, using no additional water or nutrient sources. Rotations between aquaculture and agriculture have been shown to improve soils over time.

Multiple use of ponds: Double use of water seems to make sense, especially in a country where freshwater resources are limited. But are farms indeed benefitting from the integration of fish with crops or trees? The fish were fed commercial feed pellets. The fish feces enriched the water with fertilizer, and integrated farms with a fish culture component should therefore require less chemical fertilizer for the trees and crops. The water in aquaculture ponds need not only serve to culture fish. In parts of South Asia, fishponds are used for bathing and irrigating homestead fruit and vegetables, others for disposing of domestic wastewater. As a source of irrigation water, pond water is usually richer in nutrients than well water and also contains nitrogen-fixing blue-green algae which can improve soil fertility. After the fish harvest, nutrient-rich pond mud can be used as fertilizer or the pond can be used to grow forage and other crops. Double use of water, first for fish farming and next for irrigation, is an efficient way of using water in situations where the water supply is limited. It adds income from the sales of crops and fruits to a fish farm and adds income from the sales of fish to an agricultural farm. Compared with single-use systems, the overall productivity and value generated per unit of water is improved. Especially when intensive fish farming production systems are used, the application of the effluent for irrigation purposes contributes to savings on fertilizer and other costs. In areas where seasonal water shortages occur, a pond can be vital for ensuring year-round crop production, livestock watering, domestic water supplies and fire protection.

Environmental benefits: Agro-ecosystems that address numerous environmental issues. In comparison with agricultural systems, can contribute

substantially to increasing the return of organic matter to the soil as a result of residues (litterfall) from aboveground tree biomass and *in situ* decomposition of tree roots, especially those of the fine root fraction. Humus from hardwood litters is often of excellent quality and can therefore be managed like a true fertilizer, which could translateinto a decreased reliance on commercial inorganic fertilizer. Organic matter from trees generally results in an increase in soil microbial biomass and earthworm populations contributing to the improvement of soil fertility. As trees fi x CO_2 and generally tend to increase the quantity of organic matter in the soil, can also play a major role in the sequestering of carbon and the offsetting of other greenhouse gas emissions such as N_2O. Use of fast-growing tree species can increase the potential for atmospheric carbon fixation. The 13th year of tree growth, the net annual carbon flux 13 tons C per hectare, compared with 1 ton C per hectare in a food crop monoculture system. Where farm wastes are produced in significant quantities, their application into aquaculture ponds not only leads to a more efficient system, but prevents them from being disposed into the environment. Some forms of integrated aquaculture, such as rice-fish farming, can decrease if not eliminate the need for harmful pesticides. Some fish species not only eat rice pests but also disease carrying organisms of human health importance, such as mosquito larvae or snails. When appropriate fish species are stocked in rice fields, the feeding of the fish on weeds and algae, and their subsequent excretion, not only reduces the need for herbicides but also increases phosphorus and nitrogen levels in the water. This therefore reduces the requirement for chemical fertilizers.

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