Photo: T.K. Ghosal

Planting a floating bed with seedlings contained in tema (compost balls)

Cultivating wetlands in Bangladesh

A. H. M. Rezaul Haq, Tapan Kumar Ghosal and Pritam Ghosh

The village Chandra is situated in the southwest part of Bangladesh on the banks of the river Kabodak, which flows from Jessore to the Bay of Bengal. In the past, the 1500 villagers depended on the river for agriculture, aquaculture, transport and other daily activities. At least 300 villagers had land on the bank of the river and when the river flooded its banks, silt carried by the water was deposited on the land, making it fertile and providing the farmers with good crops. Most of the villagers farmed their land and maintained their livelihoods in happiness. The village was also famous throughout Bangladesh for its mango, jackfruit and dates.

In course of time, however, the river became a curse instead of a blessing. In early 1960s, the then East Pakistan Water and Power Development Authority engaged in the *Coastal Embankment Project* (CEP) to convert the seasonally flooded coastal wetlands into reclaimed land for permanent agricultural production under the Green Revolution Programme, as well as to protect human settlements from the floods. This large-scale engineering intervention ignored the agro-ecological system of the south-west region and disrupted the ecologically complex and highly productive coastal wetland ecosystem. The reclaimed land is now isolated from the river and does not receive any silt to improve its fertility. The silt load is instead deposited in the river, blocking the drainage of the area and leading to permanent water logging. This situation makes both agriculture and aquaculture activities impossible. Social demoralization, diseases, unemployment and migration have increased in the village. The Water Development Board of the Government has not been able to reduce the waterlogging, which takes over an additional 4000 hectares per year. The view of experts and local people is that there is no other way out, but to live with water.

Problems in Chandra

The river is fully congested with water hyacinths *(Eichhornia crassipe*s) and other aquatic weeds and has become a breeding ground for mosquitoes. As the carrying capacity of the river has been reduced and the drainage system has broken down, the water level now rises by more than 2.5 metres during the monsoon. As the flooding stays for 60 - 90 days, trees like mango, jackfruit and date palm do not survive and the waterlogged lands have not produced any yield for the past six years. Without food or safe drinking water, villagers have been forced to migrate elsewhere. The people of Chandra had been seeking an ecologically sound alternative food production system for their waterlogged areas.

To improve the livelihoods and food security, the *Wetland Resource Development Society* (WRDS), a voluntary Research and Development organization, proposed soil-less agriculture as a possible solution for the villagers of Chandra. Considering the regular flooding every year, the waterlogging, availability of aquatic weeds and the situation of the landless farmers, this farming system was considered suitable for the area and capable of high agricultural production. Today, WRDS is implementing soil-less agriculture in waterlogged areas of the south west region of Bangladesh under the project of CARE-RVCC (Reducing Vulnerability to Climate Change), funded by CIDA *(Canadian International Development Agency)*.

Soil-less agriculture

Soil-less agriculture or *hydroponics* (a Greek word, *hydro* means water and *ponos* means labour) is an indigenous practice of sustainable wetland utilization in parts of south-west Bangladesh. People living within the wetland ecosystem utilize locally available paddy straw, water hyacinths and various aquatic plants for making floating islands of organic material on which crops, seedlings and vegetables are grown. The productivity of this farming system is more or less 10 times higher than traditional land-based agricultural production. This farming system is locally known as *baira, geto, bed* or *dhap.* After cultivation, the remains of the floating organic bed is rich in nutrients and make good compost. This

farming system is labour intensive and offers opportunities for the participation of men, as well as, women.

The villagers of Chandra did not know about this farming technique. When this type of cultivation was first proposed, it made them laugh – they could not believe that it could be possible to cultivate on water! After receiving training and technical support on soil-less agriculture, more than 150 villagers started to practise this type of non-conventional agriculture on their waterlogged areas adjacent to the river Kabodak. After some practice, the villagers realized that cultivation on floating beds could give higher production as well as a better cost-benefit ratio than land-based agriculture. A renaissance occurred among the villagers of Chandra.

Construction of floating beds

The basic construction of the floating bed requires bamboo poles, a boat and a simple tool to cut the weeds. The bed is then built up of layers of aquatic weeds, mainly water hyacinths *(Eichhornia crassipes)* but also other kinds of water weeds like water lettuce *(Pistia stratiotes)*, duckweed *(Najas graminea)*, *Salvinia* spp. and *Potamogeton alpinus*. Organic materials like paddy stubs, straw and coconut husk are also added. In perennial wetlands and permanently waterlogged areas it is possible to cultivate on these floating beds the whole year round. In seasonally waterlogged areas, the beds are used during the wet season and left to decompose on the agricultural land, once the water withdraws. The floating beds are primarily constructed where water hyacinths are available. The beds can be prepared in any depth of water and they can be moved by dragging them behind a boat.

In Chandra, the villagers construct floating beds using the masses of water hyacinths and other aquatic weeds that grow naturally and profusely in the river, surrounding wetlands, canals and ditches. Construction starts at the beginning of the monsoon (June-July) with the collection of water hyacinths and other aquatic weeds and it continues up to late autumn. To start the construction, farmers put a long bamboo pole (as long as they want the final bed to be), on a collected mass of fully matured water hyacinths. To build one bed, water hyacinths growing in an area roughly five times larger than the bed itself are required. Mature water hyacinths are preferred because they decompose slower than immature water hyacinths. The first layer of water hyacinths acts as the base of the floating bed and maintains the stability, buoyancy and thickness of the bed. A single man then stands on the bamboo pole lying over the mass of water hyacinths and starts to pull the water hyacinths together from both sides of the bamboo. In this process, he proceeds towards the end of the bamboo and compacts the accumulated hyacinths under his feet. This process is continued until the desired height and length of the bed is obtained. When the construction of the bed is complete, the bamboo is removed. After 7 - 10 days a second round of water hyacinths are dumped on the bed and then the bed is left to decompose before being planted.

The top of the floating bed needs 15 - 20 days to decompose before sowing seed or planting seedlings. Sometimes farmers use semi-decomposed aquatic plants such as water lettuce, duckweed and immature water hyacinths on the top of the bed to speed up the decomposition, thereby making nutrients available for seedlings and reducing evaporation from the bed. To improve conditions for the young seedlings further, the seeds are sometimes placed inside a ball made of compost, manure and aquatic creepers (locally called tema), before being planted on the floating bed. In this way, a smooth germination and sufficient nutrients are ensured for the initial establishment. However, the newly constructed floating bed can also be cultivated from the first day – if compost is available and is spread thickly on the bed before planting.

There are no fixed rules about the size and shape of the floating beds, but generally the villagers construct beds that are

Floating bed with bottle gourd

Photo: T.K. Ghosal

The benefits of hydroponics

Making waterlogged areas productive

Bangladesh, being an overpopulated country, can ill afford to depend only on its ever-shrinking areas of arable land to feed the population. Wetlands, including waterlogged areas, have been seen as crisis regions, as no terrestrial crops would grow there. A number of projects have been undertaken by the government and NGOs since the 1960s to increase agricultural production by controlling flooding and draining the wetlands. However, these projects have adversely affected both the economy and the environment. Soil-less cultivation can help to mitigate this crisis and reduce the pressure on arable lands by turning wetlands into a strong base for the rural economy, without altering the natural environment.

Conserving water and nutrients

A properly designed hydroponic system needs much less water and nutrients than conventional soil-based agriculture, as the nutrients are recycled. This advantage is important as it can help in reducing the pollution of water bodies with the high level of runoff nutrients from agricultural land. In addition, an enormous amount of compost material is produced, which can be used to increase the organic content of the soil for land-based agriculture systems. Compost selling could potentially be a good opportunity for income generation, as soil degradation due to loss of organic matter is significant in Bangladesh.

Conserving biodiversity

The present waterlogged areas can, over time, be turned into productive wetlands because of their biodiversity and the abundance of various kinds of highly productive aquatic vegetation, fish, aquatic organisms and birds. For example, hydroponics can have a positive impact on open water fisheries by reducing weed congestion and using nutrients in the water. This biodiversity, if properly managed, could contribute to revitalizing the rural economy, particularly for the poorer sections of the community.

Costs and Benefits

Table 1. Costs to construct 10 floating beds of 15x2x1 metres

1 Bangladesh Taka (Tk) = approximately US$ 0.02

Cost head	Quantity	Unit cost (Tk)	Total (Tk)
Construction of floating beds	60 man days	50	3000
Collection of raw material (weeds)	20 man days	50	1000
Seed and/or seedling purchase		60	600
Bamboo, rope, crop harvesting and maintenance		100	1000
			5600

Table 2. Income from 10 floating beds of 15 x 2 x 1 metres, only in the monsoon period

Income head	Quantity (kg)	Unit income (Tk/kg)	Total (Tk)
Ladies finger (okra)	1800	5.00	9 000
Ridged gourd	400	6.00	2 400
Amaranth (red colored)	600	5.00	3 000
Others (Taro, Indian spinach etc.)	150	4.00	600
Organic compost manure	30000	0.20	6 000
			21 000

The total benefit in this example is 21000 – 5600 = 15400 Tk. If the farner does not sell the organic manure (decomposed water hyacinths and aquatic weeds) but instead keeps it to fertilize his own field, he/she will gain 9400 Tk. If the farmer contributes his/her own labour instead of hiring workers he/she will save 4000 Tk and the net benefit will be 13, 400 Tk, excluding the income from compost.

15 - 50 metres in length, 1.5 - 2.5 metres in width and about one metre in height above the water level.

Crops and vegetables

Vegetables are the main crops of this farming system. The villagers have grown 23 different types of vegetables and 5 types of spices. Vegetables and seedlings raised on floating beds during the monsoon season include ladies finger (okra), cucumber, ridged gourd, bitter gourd, snake gourd, amaranth, red amaranth, egg plant (brinjal), pumpkin, Indian spinach, taro, wax gourd, and turmeric. During the winter season spinach, bottle gourd, yard long bean, bean, tomato, potato, cauliflower, cabbage, kohlrabi, turnip, radish, carrot, ginger, onion, chilli, and garlic are grown. Some vegetables are grown on the bed all the year round, in rotation. In seasonally flooded areas, the beds are spread over the soil as the water withdraws. Winter crops can then be grown on this soil without further tillage or fertilizer.

Conclusion

Bangladesh has the highest wetland to total land ratio in the world: Almost half of the area of Bangladesh consists of wetlands. Bangladesh also has an excessive population growth, leading to increasing pressure on agricultural land as well as an increasing number of people that are landless. To increase the agricultural production, high yielding varieties together with fertilizers and pesticides have been introduced. However, this production system is cost intensive and has led to negative environmental consequences. Today, yields are stagnating. In addition, in some areas of Bangladesh drastic water regulation projects have reclaimed land to allow continuous cultivation of high-yielding varieties. These drastic changes have had large negative environmental effects and in some areas, like Chandra, have had devastating environmental consequences.

At the same time, soil-less cultivation has existed for more than 250 years in parts of Bangladesh's wetlands. The system has proven itself to be highly productive and ecologically sound, but is only practised to a limited extent, in around 2500 hectares. In the south-west region of Bangladesh there exists about 200, 000 hectares of natural and artificial wetlands. Of this, about 20, 000 hectares could potentially be used for of soil-less agriculture.

The WRDS has realized the potential of soil-less cultivation and is promoting it as an alternative in new areas such as Chandra, where the villagers now see the aquatic weeds as blessing and a resource. The number of farmers that are cultivating on floating beds is increasing at a significant rate in and around the village. As the system is fully organic, the agricultural products from the floating beds get special attention from the local buyers and consumers. The local community is therefore very hopeful that they will be able to improve their condition through rapidly increasing production from this farming system in their waterlogged areas. The lost happiness is returning among the villagers of Chandra.

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Photo: T.K. Ghosal

Women constructing floating beds using water hyacinths