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Livelihood Improvement of Farmers in the Floating Agriculture System

The southern zone comprises 32% of the land area of Bangladesh with a population of 35.1 million. A unique system of crop production, "floating agriculture" locally known as *bhasoman/ dhapchash*, is traditionally practiced in the low-lying, perennially flooded areas (Fig. 1) of the Gopalganj, Barishal, Bagerhat and Pirojpur districts of southern Bangladesh, which can be visualized as an "open hydroponics" system. This indigenous system of 'soilless cultivation' has been traditionally practiced for at least 200 years now to grow different types of vegetables. Such "floating gardens" are also found in different countries of the world such as, Myanmar, India, Cambodia, Vietnam, Taiwan, Netherlands, Peru, Mexico etc. The floating agriculture system has the potential to provide a means of income and food security for the millions of small farmers who live close to large bodies of water and lack access to land but, productivity and diversity are low due to lack of modern technologies and farmers' knowledge. Farmers of this region do not cultivate forage as fodder for cattle. Not only that, they also do not practice homestead gardening for nutrition or deworming, vaccination for livestock improvement. Aquaculture is another part of livelihood improvement but in these areas the farmers do not usually practice aquaculture. This KGF sponsored project was formulated to develop integrated farming system based floating agriculture to boost production of vegetables, spices, forage, livestock and fisheries in the waterlogged and flood prone districts of southern Bangladesh.

Fig. 1. Perennially flooded waterbody in a low-lying terrain in Gopalganj, southern Bangladesh

Methodology

An integrated farming system was formulated comprising production of vegetables, spices, forage, livestock and fisheries using modern technologies. The On-Farm Research Division (OFRD) of (BARI), Gazipur conducted research on floating agriculture while Palli-Bangla Unnayan Shahojogita Sangstha (PBUSS), an NGO, worked on the dissemination of technologies to the local farmers. Experiments on screening of vegetables, spices and forage

under floating bed conditions, standardization of bed size, nutrient management, case culture, homestead, pest control and effect of different management practices were conducted in a farmer participatory approach in five upazilas, i.e., Nazirpur of Pirojpur, Sadar, Kotalipara, Tungipara of Gopalganj, and Mollahat of Bagerhat.

The floating bed (Fig. 2) was built with natural resources (like water hyacinth, *opapana, dulalilata*, moss, coconut dust etc.) on which different vegetables and spices crops and their seedlings were grown. The residues of water hyacinth used to prepare the floating beds were used for crop production in the main land as a good source of compost. Ten crops/varieties (particularly vegetables and spices) were selected (commodity) and 2 component technologies (non-commodity) were tried in the floating agriculture system. The different components of floating agriculture based integrated farming tested were year round vegetables and fruits, HYV seeds, cropping patterns and production technologies for floating beds and mainland, de-worming and vaccination of livestock, mono-sex tilapia fish culture, etc.

Fig. 2. Floating beds built with locally available natural ingredients

Fig. 3. Fish culture cage

To develop a homestead gardening system, 12 households at each location were selected on the basis of available resources and potentials for homestead farming. Three niches viz., open sunny place, roof top and fence were utilized for homestead gardening. The participating farmers were provided training on the production of year round vegetables and quick growing fruits. Fruit saplings were distributed among the project farmers of the selected upazilas.

Calf rearing followed by de-worming, vaccination and fattening with injected Vitamin A, D and E were provided for cattle health improvement and to reduce mortality. High-yielding fodder crops were grown. Besides, poultry and pigeon rearing were encouraged with the help of Department of Livestock Services (DLS).

To develop an aquaculture practice by the farmers, cage fish culture was introduced in the floating bed water bodies (Fig. 3). Five fish cages (size: 20×10×6 feet) with the capability to grow 60 kg tilapia fish rearing in each cage were provided for 12 households at each site.

Results and Outputs

Among the four Rabi vegetable crops viz. broccoli, cabbage, cauliflower and knolkhol tested on floating beds, cauliflower gave the highest BCR in each project area. Among the Kharif

vegetables viz., bottle gourd, bitter gourd, sweet gourd, okra bottle gourd outperformed the others in respect of yield and profitability. The BARI released turmeric varieties viz., BARI Holud-3, BARI Holud-5 and a local variety were tested and among them BARI Holud-5 performed the best on floating beds. Between Napier and Pakchong tested as forage crops on floating beds, the former with a yield 619.87 kg/bed/year) performed better than the later. Broccoli, cabbage, cauliflower, knolkhol, red amaranth and spinach were tested on residues of floating beds on land where cauliflower and broccoli performed best in respect of profitability. Okra (variety-Chayanika) gave the highest yield of 58 kg/bed and a gross return of Tk. 2030/bed when N-P-K-S-Zn-B @ 75-21-15-5-1-0.5 kg/ha were applied, but yield (43 kg/bed) and gross return were much lower, 43 kg/bed and Tk. 1505/bed, respectively, with the farmers' practice of no fertilizer application.

A cropping pattern Boro-floating bed-fallow was tested as a better alternative to the traditional fallow-floating bed-fallow pattern at Kondorpogati, Kotalipara and Tungipara in Gopalganj and at Nazirpur in the Pirojpur district. The improved pattern gave a higher gross return and BCR than those from the traditional pattern. The intercropping system bottle gourd+red amaranth was found to be suitable in respect of profitability.

During November 2017-May 2022, about 1500 saplings of mango (var. BARI Aam-4), guava (var. BARI Peyara-2) and malta (var. BARI Malta-1) were distributed among selected households and their neighbors to encourage homestead gardening.

Vaccination of 250 calves was done in different upazilas of Gopalganj, Bagerhat and Pirojpur and also 1800 cattle were vaccinated against the foot and mouth disease. De-worming was done in about 1800 calves. Besides this, 600 chicken were distributed among 60 farmers and 60 ducklings were distributed among 12 farmers. Three different vaccines viz., BCRDV, RDV and duck plague were administered to chickens and ducks which significantly minimized the mortality rates to below 4.8, 3.2 and 5% from the high rates of 20, 25 and 20%, respectively before vaccination.

Fig. 4. Raising seedlings on rotten residue of water hyacinth used earlier to prepare floating beds

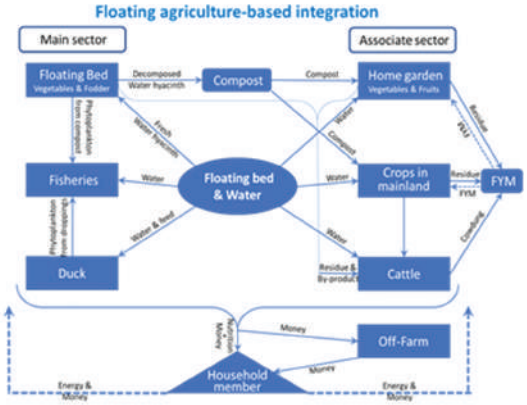

Fig. 5. Integration among different sectors and components of integrated farming

The release of 20 kg monosex tilapia fingerlings in each fish cage produced an average amount of captured fish catch of 51.6 kg/cage with the gross return of Tk. 6199.

The component enterprises of integrated farming (IF) like crops on floating beds and mainland, poultry, fishery, dairying, home gardening, composting etc. were interrelated. The end product and wastes of one enterprise can be used as an input for others. For example, the residue of water hyacinth used to prepare floating beds is a good source of compost without additional cost, but it could be a nutrient-rich manure for crop production in the dry mainland (Fig. 4). Cattle wastes like dung, urine, refuse etc. can be used in the preparation of FYM, which is an

important input for cropping systems. The straw obtained from the crops can be good fodder for cattle used for different field operations for growing crops. Water of the ponds or other water bodies is home to the floating bed as well as fish which again, thrives on phytoplankton feeding and proliferating on compost from the floating beds. These interrelationships are schematically depicted in Fig. 5.

Expected Impact

The project demonstrated that there are good opportunities of enhancing agricultural production on floating beds, homesteads and water bodies in an integrated farming system in the perennially flooded southern districts of Bangladesh. New varieties of vegetables, spices and grasses, e.g., turmeric var. BARIHolud-5 and winter vegetables (cabbage, cauliflower, knokhol, red amaranth and spinach) were identified which could be extended in these areas. These crops can play an important role in improving the farming system as well as safeguard of environment in that pesticide use for crops on floating beds would be substantially cut down. The project demos motivated farmers to include new crops, especially broccoli in their cropping patterns. The floating agriculture based farming systems with new crops and cropping patterns, livestock rearing and fish-in-case culture could substantially enhanced farmers' incomes in the rather unfavorable flood ecosystems of the low-lying basin areas of southern Bangladesh. The competitive advantages of floating agriculture over soil-based agriculture, i.e., easier management that excludes irrigation, better pest control than conventional farming and productivity make floating agriculture an interesting option to mitigate the impact of climate change in flood prone areas.

Recommendations

Research on the floating agriculture system needs to be strengthened and continued to develop and fine-tune technologies crop, livestock and fish production in an integrated farming with a holistic approach and in a cost effective manner. Future research should focus integrated nutrient management for crops on the floating beds. Fish production in cage culture could be recommended in the open water body needs to researched further in terms of species diversity and production technology. Homestead vegetable and fruit production, and homestead chicken, duck, and pigeon rearing should be promoted for generating incomes for the farming families as well as enhancing nutrition for inhabitants of the perennially flooded areas.

This Technical Bulletin has been prepared on the basis of technical information available from a completed BKGET-KGF Funded CGP Project, the details of which are given below:

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