Floating Vegetable Gardening (FVG) as a Sustainable Agricultural System in Bangladesh: Prospects for Kaptai Lake, Rangamati, Chittagong Hill-Tracts

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Abstract: Agriculture is one of the most important contributors to Bangladesh's GDP. Having a large number of wetlands (> 50 percent) and their susceptibility to a climate change impacts, however, presents a case for modification of traditional agricultural systems. Many communities have already developed indigenous floating cultivation methods as an adaptive strategy to reduce their vulnerability due to possible climate change. Floating Vegetable Gardening (FVG)- an age-old indigenous farming practice in Bangladesh, can play a vital role in this regard, particularly in the waterlogged areas. Basically, FVG is a unique hydroponics production system constructed with aquatic weeds, (especially water hyacinth- Eichhornia crassipe), which have been developed in the flood-prone areas of Bangladesh, especially suitable for the poor and smallholder farmers. Effective adaptation actions and knowledge transfer would provide farmers with added resilience and coping ability in circumstances of a changed climate system. This paper deals with a proved indigenous agricultural practice in the wetlands of Bangladesh as an alternative source of sustainable rural livelihoods. Attempt has been made to explore and identify a potential, eco-friendly and productivity-enhancing technology i.e. 'floating vegetable gardening', most suitable for the poor and smallholder farmers in the South and South-East Asia. This is an empirical study based on both primary and secondary data, which has been conducted in the Kaptai Lake area, Rangamati, Chittagong Hill Tracts. The initial outcome of this study includes a solid information base of the technology with clear insights on its various segments including constraints, issues and challenges faced by the farmers in their adaptation of the technology and knowledge transfer. The paper is expected to contribute to the on-going regional attempts for the alleviation poverty through sustainable agriculture.

Keywords: Floating vegetable gardening, climate change adaptation

Introduction

Bangladesh is a country of wetlands. More than two-thirds of the country falls under wetland category as defined in the Ramser Convention (1971). About 50 percent area of the country is comprised of floodplains that are regularly inundated, forming one of the great wetlands of the world (Khan et al. 1994). In a land scarce country like Bangladesh, the prospect of massive and enormous productivity, therefore, lies in the wise-use of wetland resources. During monsoon floods, many people in the waterlogged areas suffer from shortages of food and lack of nutrition due mainly to loss of standing crops and income. However, the poor and the smallholder farmers can manage to get food and nutrition from their floating gardens- a sustainable way of utilising wetlands that are waterlogged for most time of the year in the production of food. The purpose of the technology has been to grow vegetables and seedlings under soil-less condition that aims at adapting to more regular or prolonged flooding, especially in the south-west (coastal) region of the country. People in this region have been coping with such conditions for generations. Finding no other suitable alternative for sustainable rural livelihoods, they have adopted various methods of indigenous wetland farming, locally known as *'Vasoman Chash'*- meaning floating cultivation (APEIS & RIPSO, 2004).

There is also an added dimension to this study. An essential yet overlooked component of food security is 'diet quality and micronutrient nutrition'. FVG can certainly improve the food security status of local population while taking care of the 'hidden hunger' problem- a chronic lack of vitamin and minerals in the diet- affecting two billion people world-wide from reaching their physical and mental potential. As such, the concerns of this study are quite relevant to UN Sustainable Development Goal (SDG) 2: End Hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

FVG in Bangladesh received the United Nations Food and Agricultural Organization (FAO) recognition on 15 December 2015 as "Globally Important Agricultural Heritage Systems (GIAHS)" for innovation, sustainability and adaptability. Technology Fact Sheet on FVG in Bangladesh is now available on-line through the SATNET Asia and UN-ESCAP CAPSA. Concerns on different aspects of FVG can be found in a wide range of literature including Chowdhury, 2014 (TFS 09-FVG); Li et al., 2013; Irfanullah, 2011, 2005; Irfanullah et al., 2011, 2008; Rahman, 2011; Saha, 2010; Islam and Atkins, 2007. What is missing in all these studies is a perspective of technology transfer from floodplains to upland areas i.e. Chittagong Hill-Tracts which is the ultimate goal of this investigation.

The floating method of cultivation represents a possible alternative to conventional agricultural approaches which has attracted much interest especially because of the increasing risk of floods in the country. This method is not only highly productive, but it also uses local, easily accessible agricultural inputs such as water hyacinth. The technology has been successfully practiced in Bangladesh for centuries, and is the only viable form of agriculture in the wetlands (Saha, 2010) during the rainy season (monsoon). In a nutshell, the technology is productivity enhancing, eco-friendly, and socially just. Furthermore, an alternative to the traditional methods of cultivation can serve as an adaptation strategy for Bangladesh considering that its wetlands are susceptible to the effects of climate change and sea level rise (World Bank, 2001). The technology fits well into climate change adaptation concept and strategy (Linham and Nicholls, 2010).

FVG: Description of the Technology

Scientifically, floating cultivation (soil-less agriculture) is similar to hydroponics[1] (Goshal and Haq, 2000). The approach uses platforms of quick rotting vegetation that act as compost for crop growth. These beds are able to float on the surface of the water, making the land area suitable for food productiom. The basic construction of the floating bed requires a few locally available resources; farmers in the floodplains usually uses bamboos, paddy stubs, straw, coconut husk, and various aquatic invasive plants such: as water hyacinths (Kochuripana- Eichhornia crassipes) and various other kinds of aquatic weeds like water lettuce (Pistia stratiotes), duckweed (Najas graminea), Salvinia spp. and Potamogeton alpinus for making the floating mat or organic bed on which crops, vegetables and seedlings are grown. The bed is then built up of layers of these various organic materials and aquatic weeds. The structure of the floating raft is strengthened with bamboo, while bamboo poles are used to fix it in position to avoid damage caused by wave action or drifting. This floating raft can then be transferred to any submerged location for food production purposes (APEIS & RIPSO, 2004).

Vegetables grown

Vegetables and seedlings grown on floating beds during the wet season include ladies finger (okra), cucumber, ridged gourd, bitter gourd, snake gourd, egg plant (brinjal), pumpkin, Indian spinach, taro, wax gourd, and turmeric to name a few. 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. During the winter season spinach, bottle gourd, yard long bean, bean, tomato, potato, cauliflower, cabbage, kohlrabi, turnip, radish, carrot, ginger, onion, green chilli and garlic are grown. Some vegetables are also grown on the bed all the year round, in rotation (Saha, 2010).

[1] "Hydroponics" (a Greek word, hydro means water and ponics means labour/ working water) or soil-less agriculture is a method of growing plants by placing roots in nutrient solutions instead of soils, under controlled environmental conditions. The term was first coined by Dr.W.F. Gericke in 1936.

Photo 1 and 2: Bottle gourds on typical floating gardens; Courtesy: T.K.Ghosal

Cost-benefit calculation of floating cultivation

Floating cultivation method requires minimal infrastructure and very small capital. Costs can be kept low because of the easy availability of raw materials from local sources for the construction of floating bed. Costs of construction of organic beds can be offset by the production and sale of food stuffs. Haq et al. (2004) conducted an analysis of the costs of implementing floating cultivation in Chandra, Jessore.. Their findings are shown in Table 1.

Table 1: Costs of implementing a floating cultivation beds in Bangladesh

Cost for 10 floating beds (each bed is 45 ft X 6 ft X 3 ft) only in floating condition

Sl.	Cost head	Quantity	Unit cost (Tk)	Total
1	Construction of floating beds	60 man days labor	50.00	3000.00
2	Collection of raw material (weeds)	20 man days labor	50.00	1000.00
3	Seed and or seedling purchase		60.00	600.00
4	Bamboo, rope, crop harvesting and maintenance		100.00	1000.00
Total cost				**5,600.00**

Source: Haq et al. 2004

Table 2: Income from a floating cultivation beds in Bangladesh

Income from 10 floating beds (each bed is 45 ft X 6 ft X 3 ft) only in monsoon period

Sl.	Income head	Quantity (Kg)	Unit income (Tk)	Total
1	Ladies finger (okra)	1,800	5.00/kg	9000.00
2	Ridged gourd	400	6.00/Kg	2400.00
3	Amaranth (red colored)	600	5.00/Kg	3000.00
4	Others (Taro, Indian spinach etc.)	150	4.00/Kg	600.00
5	Organic compost manure	30,000	0.20/Kg	6000.00
Total Income				**21,000.00**

Source: Haq et al. 2004

Where the technology has been adopted?

Throughout recorded history, many civilizations have utilized techniques similar to hydroponics in crop production. The intensive food production system of Tiwanaku (in raised or drained field of pre Columbian civilizations of the Americas) on the shore of Lake Titicaca and the famous *Chinampas* in Mexico (Coe 1964), originated by the Aztecs are good examples of this kind of agricultural practice in the ancient world. The hydroponics system of cultivation also has been practised in other parts of the world since prehistoric time (Islam and Atkins, 2007). There are evidences that this kind of indigenous floating cultivation method has been widely used in Lake Inle in south-eastern Mymenmar (*Kaing)*, the Tonle Sap in Cambodia, Kashmir in India, and in south-west coastal region of Bangladesh in different traditional ways (Haq et. al, 2002 in Saha).

The approach is reasonably widespread in Bangladesh where agricultural land is inundated for extended periods during the monsoon season. From a geographic perspective, floating cultivation (*baira/dhap*) is highly regionalized in the south-western part of Bangladesh, especially in the remote villages of Gopalganj, Barisal and Pirojpur Districts where aquatic weeds such as water hyacinths are largely available. Other Districts namely Jessore, Narail, Bagerhat, Khulna and Satkhira also have numerous wetlands that are suitable for floating cultivation although to a lesser extent. The later categories of Districts have come under organized floating cultivation (*bhira*) only recently due mainly to NGO initiatives (Haq et al. 2004). According to an estimate, floating vegetable gardening (FVG) is receiving increasing interest in low land Region (Haors, Baors, Bells, Lakes and many districts) of Bangladesh. Presently, there are 10 Districts and 42 Upazillas that are practicing this technology Gopalganj (4 Upazillas), Kishorganj (8 Upazillas), Netrokona (6 Upazillas), Brahmanbaria (3 Upazillas), Chandpur (6 Upazillas), Sunamganj (4 Upazillas), Barishal (4 Upazillas), Pirojpur (3 Upazillas), Satkhira (2 Upazillas), Habiganj (2 Upazillas) adopted the technique with financial assistance from the Department of Agriculture Extension (DAE), Khamarbari, Dhaka and the farmer's own interests.

Advantages of the FVG Technology

Contribution to Sustainable Development

Socio-economic benefits: Floating cultivation enhances food productivity and nutrition security through year round vegetable gardening. It helps grow quality food production which positively influences the public health of the local communities. It provides food security not only by increasing land output but also by supporting capacity of the poor people and smallholder farmers (Irfanullah et al. 2007; 2011). The practice also helps supplement the income of local communities and contributes to the alleviation of poverty. People practicing floating-bed cultivation are enjoying a better life economically than those in other flood-affected areas where the technology has not been adopted as yet (Saha, 2010). Since the system is fairly labour intensive, it has the capacity to generate jobs for both men and women. As both men and women can carry out the floating agriculture practices, it can also lead to improvements in gender equity (Haq et al., 2004). The use of floating agriculture as an adaptive measure also provides direct economic benefits. Vegetables and spices produced on the floating beds can be sold at markets and since the approach is fully organic, the produce receives special attention from local buyers and consumers (Haq et al., 2004). It cuts down fertilizer expenses considerably; compost selling could potentially be a good opportunity for income generation in the dry season- winter. It promotes local cultivation techniques, thus, helping in conserving indigenous knowledge. Since the practice is found supportive to open water fisheries, it is possible to simultaneously harvest fish populations when practicing floating agriculture- mixed farming (APEIS & RIPSO, 2004).

Agricultural benefits: The practice helps mitigate land loss through prolonged flooding. The fallow waterlogged area can be cultivated, the total cultivable land can be increased and communities can become more self-sufficient. As such, floating cultivation provides additional cropping and seedling raising space in the wetlands, especially during rainy season when the cultivativable land is scant. Short production cycles facilitate early production of seedlings of winter vegetables. This increases supply in the area and the surroundings during monsoon and, thereby ensures better nutritional status of the poor. The productivity of this farming system is much higher than that of terrestrial agriculture (Haq et al., 2004), as no additional chemical fertilizers or manure is required unlike in the conventional agricultural system (traditionally farmed land). The compost manure generates from refused organic bed is nutrient enriched and acts as soil conditioner. When the crops have been harvested and floating rafts are no longer required, they can be used as organic fertilizers in the fields (AEPIS & RIPSO, 2004; Saha, 2010). It would be a major source of nutrients in aquaculture as well. This farming system is quite capable to ensure more agriculture production by restoring wetlands from aquatic invasive plant. During the flood, floating bed can be used as shelter for poultry and cattle.

Environmental benefits: Floating cultivation conserves the environment e.g. water and nutrients; pest and disease problems are reduced. Environment friendly farming system makes wise-use of aquatic resources; restoration of wetlands ecosystem are prompted through management of aquatic invasive species. The approach uses, for example, water hyacinth- a highly invasive weed with prolific growth rates in a highly beneficial way. By harvesting water hyacinth, areas covered by the weed are cleared with the beneficial side-effect of reducing grounds for mosquitoes and improving conditions for open-water fishing (Saha, 2010). Since chemical fertilizers are not used in floating cultivation, cuts down fertilize expense and water pollution considerably. Floating cultivation provides a good method of recycling through the use of water hyacinth which acts as an effective filtration system for cleansing waste breeding water, containing a complex chemical mixture (Wolverton, 1976; Mitsch, 1977); the chance of soil

borne disease is greatly reduced with hydroponics. It can have a positive impact on biodiversity conservation (e.g. open water fisheries) by reducing weed congestion and using nutrients in the water.

Objective

Floating cultivation has already been proved as a successful technology to produce vegetables and seedlings in various wetlands of Bangladesh. However, no detailed study of this technique in the upland has been published as yet in the professional literature except minor exceptions. Further, most of the studies conducted previously have been found concentrated within the narrow limits of technology description and benefits in the floodplains. Very little attention has been paid in addressing issues, constraints and challenges faced by the successful adopters including the potentials for technology and knowledge transfer. This research is expected to full-fill this research gap as an initial attempt.

The major thrust of the study has been to contribute to the alleviation poverty through sustainable agriculture with a focus on the wetlands of Bangladesh, where local farmers have successfully demonstrated the potential of floating cultivation on organic beds over generations. The underlying objective has been to find out an effective copeing mechanism for Bangladeshi smallholder farmers as an adaptive response to the climate change situation in the upland- the Chittagong Hill-Tracts.

Methodology

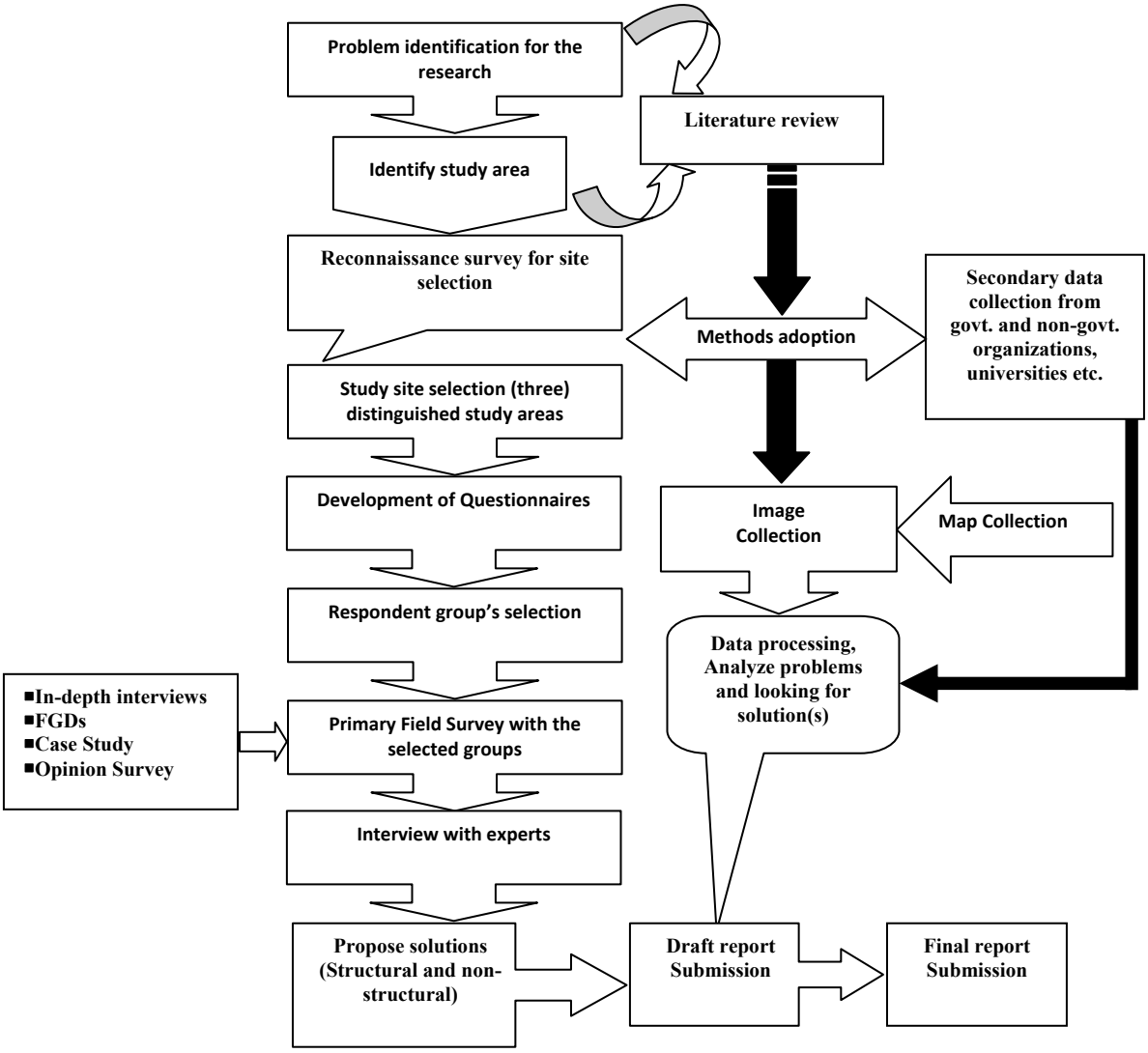
This is an empirical study based on primary and secondary data collected from various sources,. The field work was conducted on Kaptai Lake area- a vast fresh water body of 726 Sq. KM in Rangamati District, Chittagong Hill-Tracts region- covering an area of 13,295 Sq. KM of Hamalayan Range Hills and hillocks. With the help of Chittagong Hill Tracts Development Fund (CHTDF) and Rangamati Hill District Council (RHDC), Floating Vegetable Gardening was implemented in this area in the year 2010. Field data were collected during monsoon season (2016) for 120 sample respondents in the study area. Various research tools and techniques have been utilized including direct field observation, questionnaire survey, Participatory Rural Appraisal (PRA) such as Focus Group Discussion (FGD), In-Depth Interviews (IDI), perception of local community and local authorities. A detailed schematic framework of research methodology is provided below for quick understanding.

The study team members organized formal and informal Focus Group Discussions (FGD) with individual farmers and key informants. In addition to the individual interviews, three FVGs were also held in the selected areas. Among the principal discussants were farmers, community leaders and the officers of Department of Agricultural Extension (DAE). The FGD there was centered on problems, prospects, issues and challenges related to knowledge transfer and the adaptation of technology by smallholder farmers.. The collected data have been processed and analyzed in a sequential manner using suitable computer software.

Photograph 1.1: Focus Group Discussion (FGD) conducted by the Author for Floating Vegetable Cultivators

Source: Field Work- 2016, Duluchhari, Mogban Union, at Kaptai Lake area, Rangamati Sadar, Chittagong Hill Tracts (CHT)

Figure 1.1: Schematic Framework of Research Methodology



History of Floating Vegetable Cultivation in Rangamati, Chittagong Hill Tracts

Due to limited area of cultivable land in Rangamati, Chittagong Hill Tracts Development Fund (CHTDF) had introduced floating vegetable plots for the first time in Chittagong Hill Tracts (CHT) in 2010. This was done in cooperation with the Rangamati Hill District Council (RHDC). That year, 244 new floating vegetable plots were established where different types of vegetables were grown by utilizing water hyacinths. Those vegetable plots had increased possibility of cultivating vegetables in Kaptai Lakeshore inhabitants for household consumption and income generating activities. The farmer who earlier had used water hyacinths as floating beds were then utilizing the biomass of water hyacinths after harvesting vegetables in their fruits garden which also had enhanced environment friendly technique. It has also reduced the use of chemical fertilizer gradually (RHDC, CHTDF, UNDP, January, 2011).

Background the Study Area

Rangamati Sadar Upazila : The Rangamati Sadar Upazila was the focal point for floating vegetable cultivation in Rangamati Hill tracts. Duluchari, Mogban Union under Sadar Upazila, Rangamati. FVG was cultivated on floating beds made with water hyacinth in the Lake side area of the village. The local farmers were growing different winter vegetables in the floating beds such as Red Amaranth, Green Radish, French bean, Pea and Coriander. There were

244 floating beds that were established in and around Rangamati. At that time, some new beds were also developed to cultivate other late winter and early summer crops like Tomato, Indian Spinach, Potato, Kangkon, and Okra (RHDC, CHTDF, UNDP, 2011).

Photograph- 1.2: A farmer named Kungon Chakma working on his floating beds, Kaptai Lake, Rangamati Sadar upazila, Chittagong Hill Tracts

Source: Chittagong Hill Tracts Development Fund (CHTDF), RHDC, UNDP- 2016

Kaptai and Bilaichhari Upazila: Under the supervision of UNDP, CHTDF took measures to grow vegetables on floating beds in Kaptai and Bilaichhari Upazilas. That innovative technology was useful to control water hyacinth problem in Kaptai Lake while the farmers in land scarce lake areas would be able to produce vegetables and at the end of cultivation period the floating beds were used as compost fertilizer (RHDC, CHTDF, UNDP, 2011).

Photograph- 1.3: Spinach (Lal shak), Bean, Tomato, Pumpkin, Kolmi Shak, Cucumbe on Floating Beds at Kaptai Lake, in Kaptai Upazila, Rangamati, Chittagong Hill Tracts (CHT)

Source: Chittagong Hill Tracts Development Fund (CHTDF) - 2016

Some 40 families were taken as respondents for the questionnaire survey in the Kaptai Lake area, Rangamati, Chittagong Hill Tract. There are occupational variations in the respondents who are related to the FVG. The data

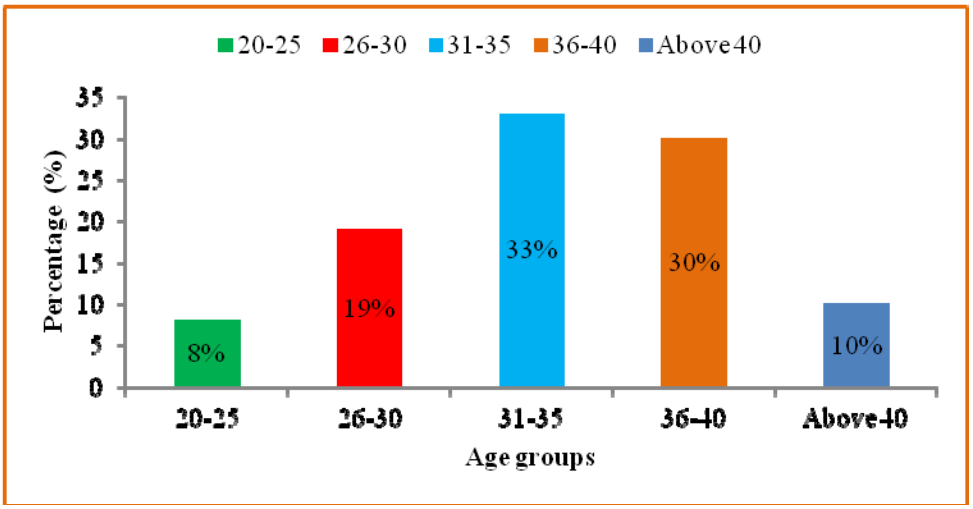
and information collected from the field survey is given below with critical analysis.

Results and Discussion

Demographic and Socio-economic Information

In the study area, the respondents were both male (55 %) and female (45 %), and their age groups were in between 31-35 (33%) and 36-40 (30%).

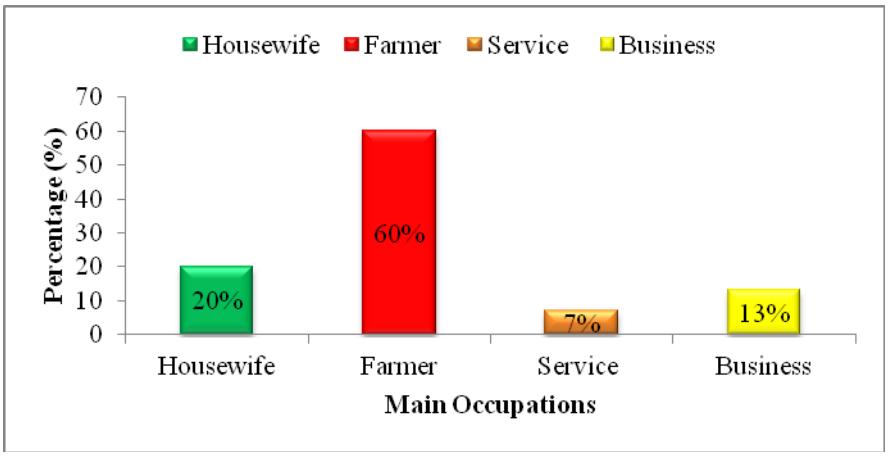
Figure 1.2: Age group of the respondents



Source: Field Survey (Kaptai Lake, Rangmati) - 2016

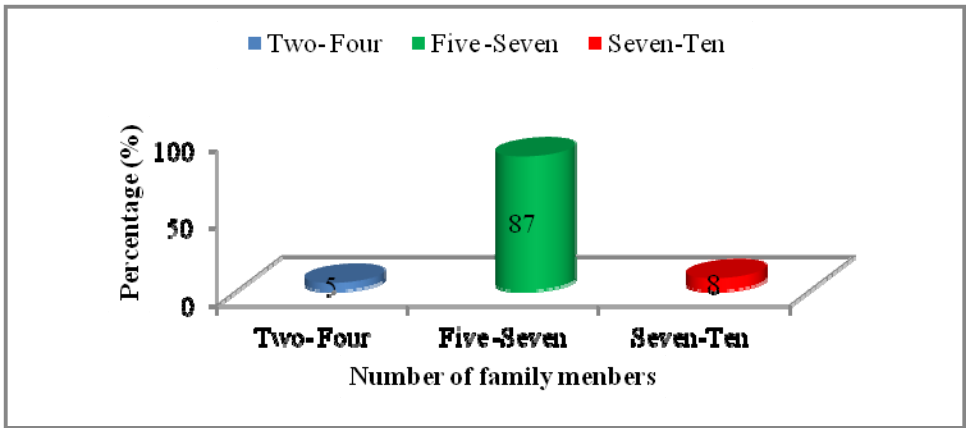
About 60% of the respondents were found engaged in agricultural activities (Figure- 1.3) in the study area. Around one- fifth of the respondents are housewives (20%). People engaged in business and service sectors are negligible.

Figure 1.3: Occupation of the respondents



Source: Field Survey (Kaptai Lake, Rangmati) - 2016

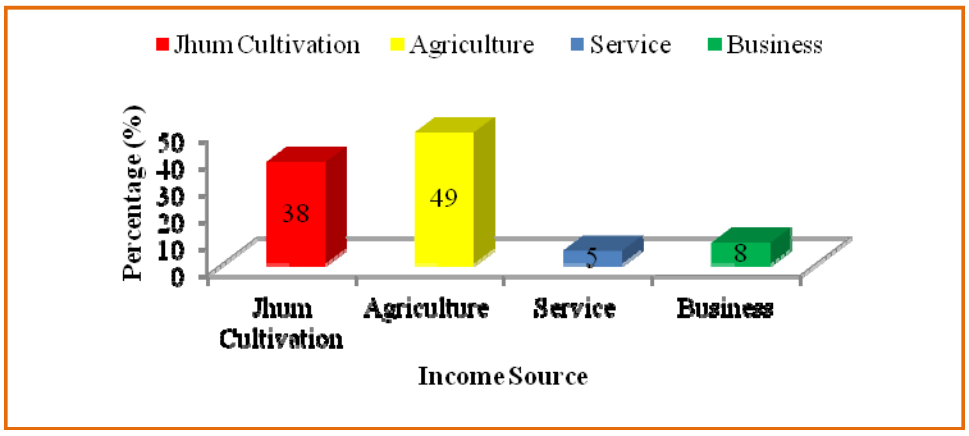
Figure 1.4: Number of family members of the respondents



Source: Field Survey (Kaptai Lake, Rangmati) – 2016

Family size represents the social and economic condition of an area. Most families in the study area are joint family, and about 87% families consist of five to seven family members (Figure- 1.4). In terms of household income, some 49% people earn their income from Agriculture; 38% people earn their livelihood from *Jhum* cultivation (Figure-1.5). Only 5% people get their income from Service sector and 8% earn from Business.

Figure- 1.5: Source of household income of the respondents

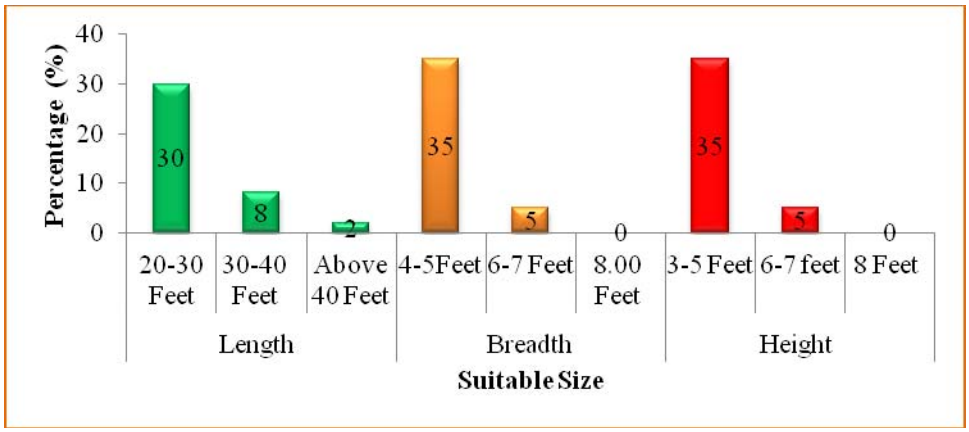


Source: Field Survey (Kaptai Lake, Rangmati) - 2016

Technological, economic and social characteristics

Farmers in Rangamati hill tracts are already familiar with the floating vegetable gardening by the help of Chittagong Hill Tract Development Fund (CHTDF). The organization hired a skilled farmer from Kishoreganj district who trained the local farmers of Rangamati about the suitable size of the floating beds (Figure- 1.6).

Figure- 1.6: The suitable size of the floating beds



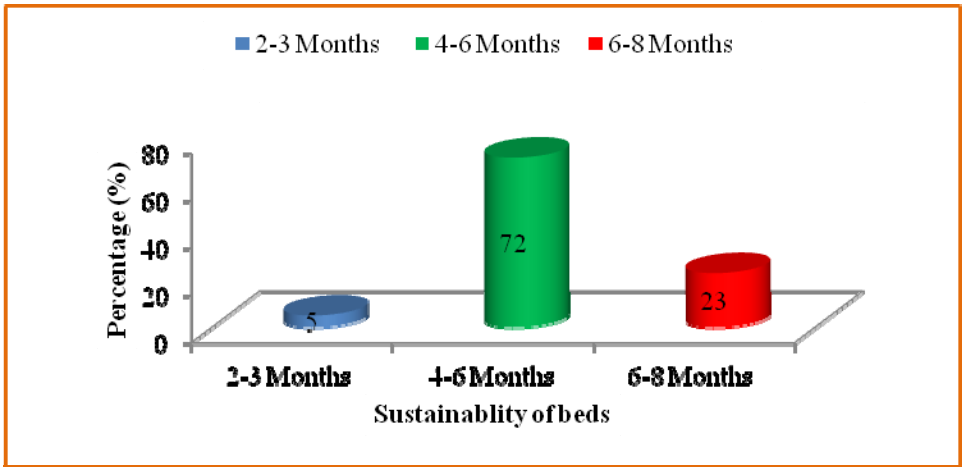
Source: Field Survey (Kaptai Lake, Rangmati) - 2016

The standard length of the floating beds was found to be 20-30 feet, breadth was 4-5 feet and the height was 3-5 feet in the study area of Kaptai Lake, Ranamati, Chittagong Hill Tracts.

sustainability of floating beds-

If the farmers can use the floating beds 7-8 months it is beneficiary to them. Most of the floating beds (72%) sustain 4-6 months; only 23% beds sustain 6-8 months to use (Appendix- III: Table-10). The durability of a floating bed depends on the raw materials which are used to make the floating beds (Figure- 1.7).

Figure- 1.7: The sustainability of floating beds

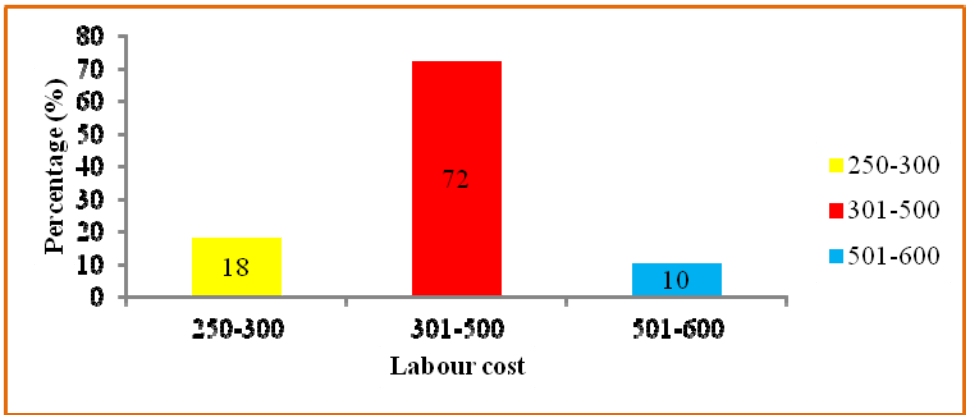


Source: Field Survey (Kaptai Lake, Rangmati) - 2016

Economic characteristics of the study area

Labor cost to make a floating bed: The labor cost is not fixed in the study area, the range of labor cost to build a floating bed it varies from 200-400 taka. Making a floating bed is continuous process. Collection of water hyacinths, storing those and finally make the beds with the help of bamboo and sharp arms.

Figure- 1.8: Labor cost to make a floating bed



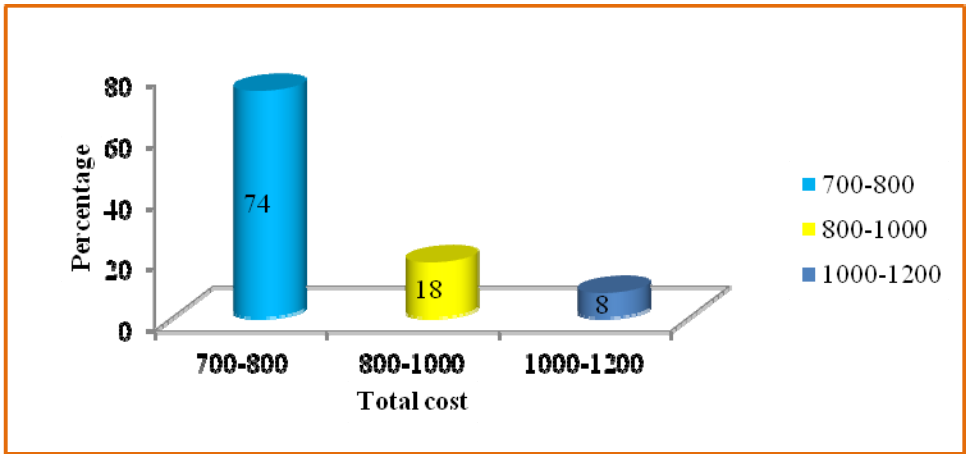
Source: Field Survey (Kaptai Lake, Rangmati) - 2016

To build an average size floating bed it needs 301-500 taka, reported by 72% respondents. About 18% respondents answered that they need 250-300 taka to build a floating bed as a labor cost (Figure- 1.8). 10% people told they need 501-600 taka as labor cost.

Total cost to build a floating bed

Total cost to make a floating bed needs around 500 to 1500 taka that varies from place to place. Where the water hyacinths are available the labor cost and other material cost is low. Some 74% respondents told they need 700-800 taka to build a complete floating bed. However, 18% of the respondents answered they need 800-1000 taka to build a bed (Appendix- III: Table-13). Some (8%) of them told they need 1000-1200 taka to build a complete floating bed (Figure- 1.9).

Figure- 1.9: Total cost to build a floating bed

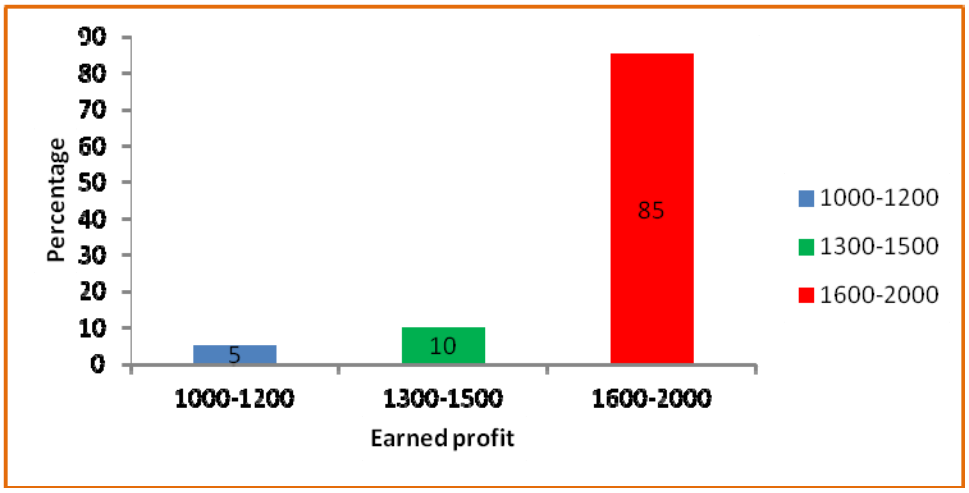


Source: Field Survey (Kaptai Lake, Rangmati) - 2016

The earned profit from each bed

Floating Vegetable Gardening is a profitable agricultural system for Bangladesh. As a lower riparian country every year flood visits here with a great loss. In the rainy season farmer suffer from the flood problem.

Figure-1.10: The earned profit from each bed



Source: Field Survey (Kaptai Lake, Rangmati) - 2016

They can't work in their agricultural field because of water logging. So, farmers practice floating bed method which provide them vegetables, spices etc. Some 85% respondents earn 1600-2000 taka as profit from per floating bed (Figure- 1.10). About 10% respondents earn 1300-1500 taka from each bed, and 5% people earn 1000-1200 taka from each bed.

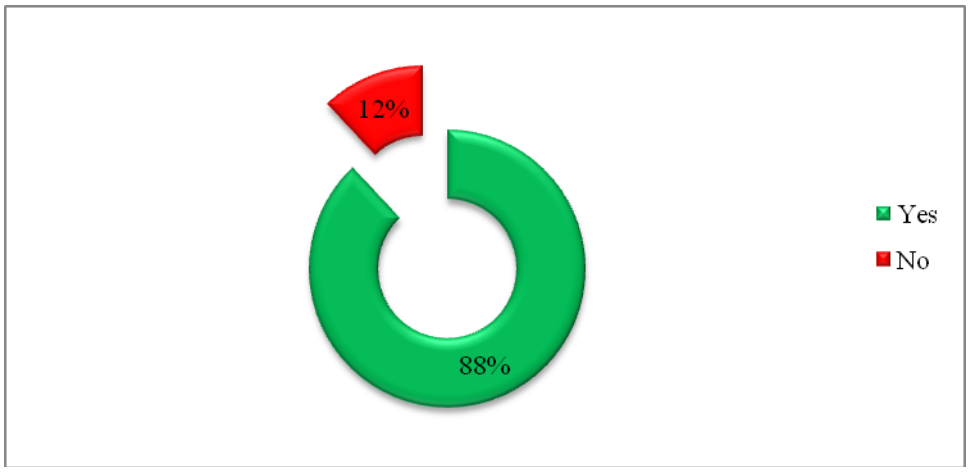
Problems of marketing the vegetables

The farmers cultivated Cabbage, Brinjal, Cucumber, Chili, White gourd, Bitter gourd, Tomato, Beans, Bitter gourd, White gourd, String beans, Ladies finger, Pani kachu, Radish, Snake gourd, Spinach, Palang shak. There are 95% respondents who told they did not face any problem to marketing their vegetables (Figure- 4.15). There are only 5% respondents told that they faced some problems to marketing them.

Is this agricultural system is profitable or not?

Although the method is not practicing at this time in Kaptai Lake, Rangamati, Chittagong Hill Tracts, some 88% respondents reported that the system is profitable for them (Figure- 1.11). They also told that if the Govt. on NGOs provide support to them they will start the agricultural system again.

Figure- 4.11: This agricultural system is profitable or not for them

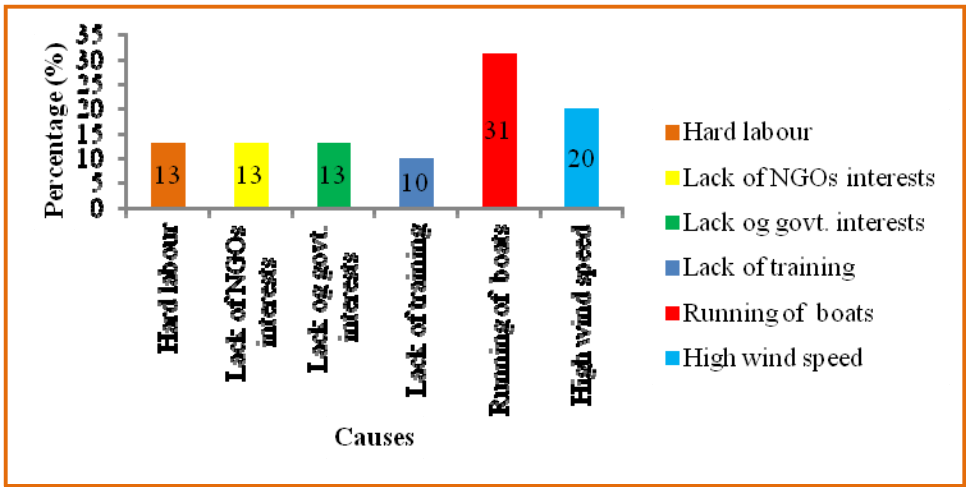


Source: Field Survey (Kaptai Lake, Rangmati) - 2016

Problems to practice this cultivating system

There are some problems to practice the system of floating bed in Kaptai Lake. These are running machinery boats (31%) and high wind pressure (20%) (Figure-4.12). Machinery boats are very common in this area. As it is a large area people generally use these types of boats for their transportation. When the boats run on the water it creates a wave which is very harmful to the floating beds.

Figure- 4.12: Problems to practice this cultivating system



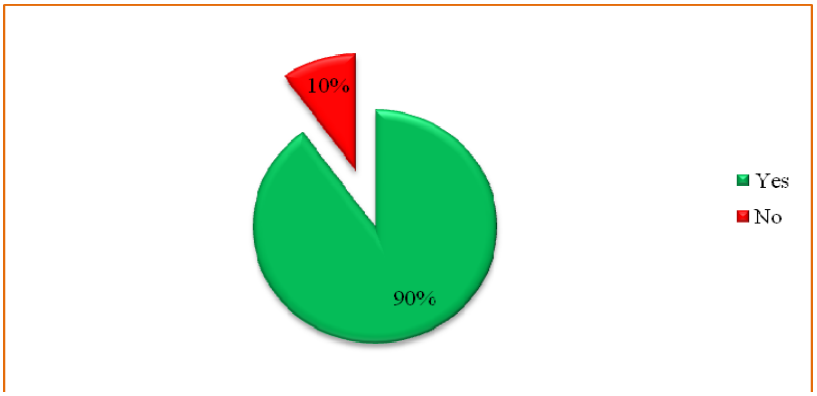
Source: Field Survey (Kaptai Lake, Rangmati) - 2016

The beds cannot sustain long time for this problem. Some farmers told about their hard labor (13%) to practice it. Lack of govt. and NGOs interest is the main issue to practice it in this area. 13% respondents have the opinion that if the Government and NGOs help (13%) to continue in this area, the system may be profitable for the farmer. It is hoped that proper training and providing Govt. facility in this study area the technology will be transferred very quickly.

Eagerness to start floating vegetable gardening again

The farmers are very much interested to start floating vegetable cultivation in the study area. However, they need the help of government and the support of non-governmental organizations like CHTDF, UNDP and mostly Department of Agricultural Extension (DAE). There are 90% farmers who previously used to practice floating bed vegetable cultivation in Rangamati Sadar Upazila and Kaptai Upazila, and are eager to practice it now if opportunity permits (Figure- 1.13). Only 10% farmers replied in the negative about practice Floating Vegetable.

1.13: Eagerness to start floating vegetable gardening again



Source: Field Survey (Kaptai Lake, Rangmati) – 2016

Summary

There is enough supporting evidence to justify that FVG Is a profitable (88 percent) agricultural practice in the study area. The floating practice has remarkably improved the food security status of local population in terms of availability of nutritious food such as vegetables, their diversification and consumption. Some 90 percent of the farmers who previously practiced FVG are eager to practice it again in the study area. However, the Government, international donors and NGOs should come forward to facilitate the practice including training and other facilities. Results reveal that some 63 percent of the respondents use their own premises to cultivate FVG and about 80 percent of the floating beds can sustain 4-6 months during monsoon in the study area. Some 74 percent respondents reported that the construction of a floating bed is quite reasonable (BDTaka 700-800/-. About 85 percent of sample respondents reported that they can make BDT 1600-2000/- as profit from each floating bed under use.

This floating technique is helpful to grow vegetables and other horticultural crops almost year-round, providing numerous, economic, social, ecological, and agricultural benefits to the local population. Many communities have already developed indigenous floating cultivation methods as an adaptive strategy to reduce their vulnerability due to possible climate change. Effective adaptation actions and knowledge transfer would provide **farmers** with added resilience and coping ability in circumstances of a changed climate system. This, in turn, will help the poorest people lift themselves out of poverty and respond to the challenges of climate change. The paper is expected to contribute to the on-going regional attempts for the alleviation of poverty through sustainable agriculture in Asia and the Pacific.

Conclusion

Wetlands have been seen as crisis regions as no terrestrial crops would grow there. A number of projects have been undertaken by the government of Bangladesh and NGOs since the 1960s to boost agricultural production by controlling flooding and draining the wetlands. These projects, however, have adversely affected both the economy and the environment. Bangladesh being an overpopulated country, can ill afford to depend only on its ever-shrinking areas of arable land to feed her ever growing population. Floating agriculture can help to mitigate this crisis on a sustainable basis and reduce the pressure on arable lands by turning wetlands into a strong base for the rural economy, and without altering the natural environment. The technology has been receiving renewed interest as a potential solution for smallholder farmers whose lands have been waterlogged for most time of the year. It is also an environmentally sustainable way to make wise-use of wetlands for poverty alleviation and also as an important adaption measure to cope with the possible climate change.

Recommendation

Rangamati Hill District is the largest administrative District in Bangladesh. However, the agricultural land is very limited here. A large area is covered by the man made Lake; it gives us fishery resource and hydro-electricity, but if we can use the shore line of the lake to practice floating vegetable gardening, it is hoped that the dwellers of the area will be able to ensure their food security and nutritional outcome, and also the financial support. As the farmers are very much eager to practice it, the government, local NGOs and the foreign NGOs should come forward to provide training and other facilities to them.

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