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Problems in the Adoption of Floating Vegetable Gardening in the Haor Area

[1]Bodrul Amin, [2,6]Aktaruzzaman, [3]Golam Sakil Ahamed,
[4]Mantush Deb, [5]Umme Hani and [7]Mohibul Hasan

[1]Department of Agricultural Extension, Sylhet Agricultural University, Sylhet, Bangladesh
[2]Department of Aquaculture, Sylhet Agricultural University, Sylhet, Bangladesh
[3]Department of Aquatic Resource Management, Sylhet Agricultural University, Sylhet, Bangladesh
[4]Department of Fish Health Management, Sylhet Agricultural University, Sylhet, Bangladesh
[5]Department of Fisheries Technology and Quality Control, Sylhet Agricultural University, Sylhet, Bangladesh
[6]Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute (BFRI), Cox Bazar
[7]Department of Agribusiness, Atish Dipankar University of Science & Technology (ADUST), Dhaka

Abstract: The study focused on identifying the specific challenges that farmers in the Haor region face when growing vegetables on floating farms. It also examined how the farmers' individual characteristics might relate to the difficulties they encounter. The research took place in three areas: Lakshmansree, Gourarang and Katair. In each area, three villages were randomly selected, making a total of nine villages for the study. All 60 floating gardeners from these villages participated in the research. Data was collected from May 1st to May 30th, 2019, using a pre-tested interview schedule. The findings indicate that the majority of floating gardeners in the Haor region face moderate difficulties in cultivating vegetables, suggesting that while the floating farming method is generally manageable, it is not without significant challenges. The fact that a notable 15 percent of farmers experience severe issues highlights the need for targeted interventions to support these farmers. Conversely, the 11.66 percent experiencing minor obstacles suggests that some farmers have adapted well to this farming method, potentially offering insights and best practices that could help those facing greater difficulties.

Key words: Floating Farming · Vegetable Cultivation · Haor Region · Farmer Challenges

INTRODUCTION

The Haor region of Bangladesh, characterized by its intricate network of wetlands and water bodies, presents a unique agricultural landscape [1]. Traditionally, farmers in this area have relied on conventional farming methods to cultivate crops on the fertile lands surrounding the water bodies. However, recurring floods and waterlogging during the monsoon season have long posed significant challenges to agriculture in the Haor area, often leading to crop failures and food insecurity among local communities.

In response to these challenges, farmers in the Haor region have increasingly turned to floating vegetable gardening as an innovative adaptation strategy [2-5]. This method involves constructing floating beds using locally available materials, such as water hyacinths and bamboo and cultivating a variety of vegetables directly on the water's surface. By harnessing the natural buoyancy of aquatic plants, floating gardens provide a stable platform for growing crops even during periods of inundation, offering a promising solution to the adverse effects of flooding on agriculture [6-10].

Floating vegetable gardening not only enables farmers to utilize otherwise unusable land but also offers several other benefits. It helps to conserve soil fertility, mitigate soil erosion and promote biodiversity by creating new habitats for aquatic flora and fauna. Additionally, floating gardens contribute to household food security by providing a consistent source of nutritious vegetables throughout the year, regardless of seasonal flooding [7, 8].

Corresponding Author: Aktaruzzaman, Marine Fisheries and Technology Station, Bangladesh Fisheries Research Institute (BFRI), Cox Bazar, Bangladesh. Tel: +8801746685759.

Despite its potential, the widespread adoption of floating vegetable gardening in the Haor area faces numerous challenges. These include limited access to resources and technical knowledge, environmental uncertainties, market constraints and cultural barriers [9-25]. Understanding and addressing these challenges are crucial for unlocking the full potential of floating vegetable gardening as a sustainable agricultural practice in the Haor region.

The objectives of this study encompass determining the prevalence of floating farming among farmers in the Haor area, identifying the common vegetables cultivated on floating farms, assessing the challenges encountered by farmers in vegetable production within this system and describing the socio-economic characteristics of those engaged in floating vegetable production. Through these objectives, the study aims to gain insight into the practices and challenges of floating agriculture, contributing to a better understanding of its potential and limitations in the region.

MATERIALS AND METHODS

Study Area: The study was conducted in three purposely selected unions: Lakshmansree, Gourarang and Katair, located within the Sunamganj Sadar upazila of Sunamganj district in Bangladesh. These areas share similarities in their physical, social and cultural characteristics with other haor regions of the country. Sunamganj Sadar is situated in the northeastern part of Bangladesh, with coordinates at 25°04'N 91°24'E. Characterized by abundant water bodies, many of which remain stagnant for eight to nine months annually, the region's geographical features are integral to its agricultural practices, particularly in floating farming.

Population and Sample: The farmers who were engaged in floating gardening under Sunamganj sadar upazila constituted the population of the study. There are nine unions in this upazial, of which three were selected randomly. From each of the selected unions, three villages were again selected randomly. In this way, nine villages were selected for this study. All the 60 floating gardeners of the nine villages were taken as sample of the study. The name of the selected unions, respective villages and number of floating vegetable gardeners are given below (Table 1).

Measurement of Dependent Variable: The study assessed the problems encountered by farmers in vegetable production on floating farms by compiling scores from 31 problem items. These items were gathered through Focus Group Discussions (FGD) in the study area prior to conducting the survey. Each respondent rated the severity of each problem item they faced using a four-point scale: "severe, " "moderate, " "low, " and "not at all, " with corresponding weights of 3, 2, 1 and 0, respectively. Therefore, the total score for the 31 problem items of a respondent ranged from 0 to 93, with 0 indicating no problem and 93 indicating the most severe problem encountered by the respondents.

Measurement of Independent Variable: In this study, the selected individual characteristics of the farmers were considered independent variables.

Age: The age of a respondent refers to the period from his birth to the time of the interview.

Level of Education: Education was defined as the ability of an individual to read and write or formal education received from an educational institution for a period. The actual year of schooling was taken as the education score of the respondent. respondents who could not read and write not read and write were given a score of zero. A score of one (1) was given for each year of formal schooling he completed in informal educational institutions. If the respondents passed class VII, their education score was given as 7. Thus, the academic qualification score of the respondent was determined from his response to item number 1 of the interview schedule.

Family Size: The family size of a respondent was measured based on the actual numbers in her family. The family member Included himself/herself, husband/wife and children together with depend members who jointly lived and date together up to the time of the interview. The actual number of members was considered as the family size score of a respondent.

Farm Size: The farm size of a household referred to the total area of land, on which his family carried out farming operations, the area being in terms of full benefits to his family. The farm size was measured in hectares by using the following formula:

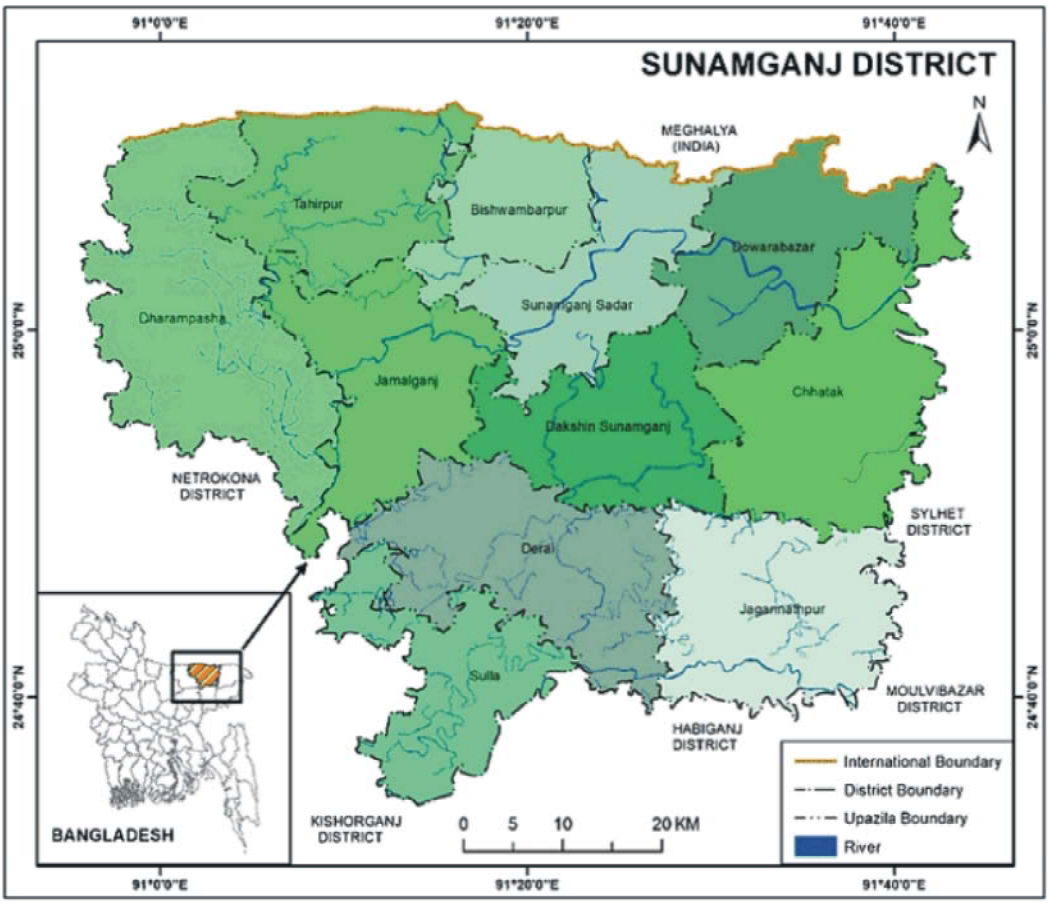

Fig. 1: Map showing study upazila under Sunamganj district

Table 1: Name of selected villages, unions and the corresponding number of farmers taken as sample for the study

Name of union	Name of the selected villages	Total number of farm family	Number of farmers engaged in floating vegetable production
1. Lakshmansree	Gaminpur	236	12
	Modonpur	217	11
	Nilpur	241	9
2. Gourarang	Sreepur	205	4
	Lalpur	187	5
	Bitgonj	193	4
3. Katair	Kalaia	209	6
	Jogdhonpur	178	6
	Sakati	198	3
Total		1864	60

FS=A1+A2+ A3+ 1/2 (A4+A5)

where,

FS = Farm size
A1 = Homestead area
A2 = Land under own cultivation
A3 = Land taken from others on lease
A4: Land taken from others on borga
A5: land given to others on borga

The farm size was determined on the basis of data provided by the farmers. The total farm size in hectare was considered as farm size score of the farmers.

Annual Family Income: The annual family income of a respondent referred to the gross annual income obtained from agricultural crops, domestic animals, fisheries and

non-agricultural sources. The total earnings of a farmer from those sources were added together to determine his annual income and was measured in Taka. However, a unit score of 1 (one) was given for each Tk. 10, 000 of annual income.

Training Received: Training received by a respondent was measured by the total number of days he/she received training on different subject matters during the last five years from various organizations. A score of one (1) was assigned for each day of training participated by the respondent.

Number of Vegetables Grown in Floating Beds: It refers to the number of different vegetables cultivated at a time in a floating bed. Diversity was measured based on the accrual number of vegetables grown in his/her floating bed.

Instruments for Data Collection: Data were collected using a structured interview schedule open and closed from questions were included in the schedule based on the measurement procedures.

Collecting Data: Data were collected personally by the researcher himself through face-to-face interviews. To familiarize with the study area and for getting local support, the researcher took help from the local leaders and the field staff of the Upazila Agriculture office. The researcher made all possible efforts to explain the purpose of the study to the farmers. Rapport was established with the farmers prior to the interview and the objectives were clearly explained by using the local language as far as possible. Data were collected during the period of October 23 to 26, 2018.

Statistical Analysis: The data underwent analysis, aligning with the study's objectives by converting qualitative data into quantitative data using appropriate scoring techniques as needed. Statistical measures such as range, means, standard deviation and number and percentage distribution were employed to describe the variables. Pearson's product-moment correlation coefficient (r) analysis was utilized to explore relationships between dependent and independent variables, with a significance level set at five percent (0.05) for rejecting any null hypothesis throughout the study. The SPSS computer package facilitated all these processes.

RESULTS

Percent of Adoption of Floating Farming by the Farmers: The percentage of the farmers engaged in floating farming, especially the production of different vegetables on floating farms are given below in Table 2.

Vegetables Grown in the Floating Bed: Farmers commonly cultivate eleven types of vegetable crops on floating beds, primarily as mixed crops. Notably, water spinach, leaf amaranth, red amaranth and tomato are among the most frequently grown vegetables by farmers. Table 3 illustrates the intercultural operations adopted by the respondents.

Problems of the Floating Agriculture: The overall problem score for the 31 items of a respondent could theoretically range from 0 to 93 where 0 indicating 'no problem' and 93 indicating 'most severe problem'. However, the observed problem scores of the respondents ranged from 27 to 51 with the mean of 42.23 and standard deviation of 27.79. Based on their overall problem scores, the respondents were classified into three categories as presented in Table 4.

The number of (73.33 percent) of the respondents had medium problems while 15 percent had high problems and only 11.66 percent had low problems in the farming of vegetables on floating beds. This reveals that an overwhelming number of the respondents (73.33 percent) faced medium to high problems in floating farming. To have a better understanding of each of the problems in the production of vegetables on floating problem index (PI) was calculated and presented in Table 5.

Socio-Economic Characteristics of the Vegetable Growers: Eleven socio-economic characteristics of the vegetable growers were selected to describe and find out their relationships with attitudes towards environment-friendly vegetable cultivation. The salient features of eleven socio-economic characteristics of the respondent. Each of which constituted an independent variable are presented in Table 6.

Age: The age score of the respondents ranged from 18 to 62 with an average of 39.4 and a standard deviation of 10.30. Based on their age score. Respondents were classified into three categories.

Table 2: Percent of farmers of the study villages engaged in floating farming under Sunamganj Sadar upazila of Sunamganj district

Name of union	Name of the selected villages	Percent of farmers engaged in floating farming
1. Lakshmansree	Gaminpur	5.1
	Modonpur	5.1
	Nilpur	3.7
2. Gourarang	Sreepur	2.6
	Lalpur	2.7
	Bitgonj	2.1
3. Katair	Kalaia	3.8
	Jogdhonpur	3.4
	Sakati	1.5
Average		3.3

Table 3: The rank order of the cultivating vegetable based on yields

Name of the vegetable	Local name	Average yield(t/ha)	Rank
Water spinach	Kochuripana	27.32	1
Spinach	Shak	2.12	8
Radish	Mula	3.33	4
Country bean	Desi shim	2.42	6
Leaf amaranth	Patasakh	11.6	2
Red amaranth	Lalshak	6.00	3
Cucumber	Shosha	1.12	11
Cowpea	Lomba shim	1.43	10
Ribbed gourd	Jinga	1.67	9
Lai shak	Lai shak	2.67	5
Okra	Deros	2.33	7

Table 4: Distribution of respondents based on their overall problem scores

	Respondents			
Categories of problems	Number	Percent	Mean	Standard Deviation
Low (up to 33.33 score)	7	11.66	42.23	27.797
Medium (37.34 to 46.97 score)	44	73.33		
High (46.98 to 51.00 scores)	9	15		
Total	60	100		

Education: The education score of the respondents ranged from 0-12, with an average of 4.94 and standard deviation of 3.98. Based on their education score, respondents were classified into four categories as shown in Table 4.7

Family Size: The family size score of the respondents ranged from 2 to 12 with a mean and standard deviation of 6.77 and 2.09 respectively. Based on their family size score, the respondents were classified into three categories as shown in Table 9.

Farm Size: The farm size score of the respondents ranged from 0.05 to 1.85 with an average of 0.39 and standard deviation of 0.36. Based on their farm size score, the respondents were classified into three categories as shown in Table 10.

Training Received: The training received a score of the respondents ranging from 0 to 8 with a mean and standard deviation of 2.85 and 2.24 respectively. Based on their length of training scores, the respondents were classified into three categories as shown in Table 11.

Time Spent in the Vegetable Field: The time spent in vegetable field score of the respondents ranged from 2 to 10 hrs/day with a mean of 5.81 hrs/day and a standard deviation of 1.82. Based on their time spent in the vegetable field score, the respondents were classified into three categories as shown in Table 12.

Table 5: Problems encountered by the farmers in the production of different vegetables on floating farms

	Degree of severity					
Problems	Most severe	Severe	Less severe	Not at all problem	PI	Rank Order
1. Pests attack	53	4	2	1	167	1
2. Disease	51	5	3	1	166	2
3.Heavy weeds infestation	50	5	3	2	163	4
4. Rats	49	9	1	1	166	2
5. Heavy rainfall	50	7	1	2	165	3
6. Lack of capital	48	6	3	3	209	6
7. Duck and birds attack	49	5	3	3	160	5
8. Lack of land	46	5	5	4	203	7
9. Medicine cost	45	2	7	6	146	9
10. Scarcity of water hyacinth	37	7	10	6	135	14
11. Scarcity of raw materials (bamboo, straw)	39	12	4	5	145	10
12. High cost of quality seeds	34	10	7	9	127	16
13. Lack of adequate knowledge	35	19	4	2	147	8
14. Lack of skill in floating farming	35	12	9	4	138	11
20. Complexity in bed preparation	30	20	7	3	137	12
16. Initial expense	20	18	20	7	136	13
17. Lack of won beds	17	18	24	3	111	17
18. Lack of won ponds	12	20	9	24	75	25
19. Sharing of produce	19	16	9	16	98	20
20. Lack of cooperation	8	17	11	24	69	26
21. Lack of skilled labor	27	21	8	4	131	20
22. Ignorance	18	20	7	20	91	22
23. Social insult	19	10	12	19	89	24
24. Leech biting	17	12	20	11	95	21
25. Weeding and harvesting	30	9	5	16	131	20
26. Lack of intensive care	23	11	9	17	100	19
27. Requiring repeated movement of floating farm	12	7	18	23	68	27
28. Skin infection	18	19	9	14	101	18
29. Multiple harvesting	7	5	23	25	90	23
30. Fertilizer cost	5	9	18	28	51	29
31. Over flooded	7	20	7	31	58	28

Table 6: Salient features of the respondents

Sl. no.	Characteristics	Unit of measurement	Observed ranged	Mean	Standard deviation
1	Age	Year	18-62	39.4	10.30
2	Education	Year of schooling	0-12	4.94	3.98
3	Family size	No. of persons	2-12	6.77	2.09
4	Farm size	Hectare	0.05-1.850	0.39	0.39
5	Training received	Days obtained	0-8	2.85	2.24
6	Time spent in the vegetable field	Hours/day	2-10	5.81	1.82
7	Annual family income	Thousand taka/year	62.30-70.00	207.08	81.91
8	Annual income from vegetable cultivation	Thousand taka/year	17.70-247.00	45.84	27.95
9	Knowledge environment environment-friendly vegetable cultivation	Scores	7-32	17.00	6.02
10	Organization Participation	Score	0-10	5.19	2.56
11	Credit received	Thousand taka	0-30	10.7	6.89

Table 7: Distribution of the vegetable growers according to their age

	Respondent			
Categories	Numbers	Percent	Mean	Standard deviation
Young age (up to 35)	13	21.66	39.4	10.30
Middle aged (36-50)	28	46.66		
Old aged(above 50)	18	30		
Total	60	100		

Table 8: Distribution of the vegetable growers according to their education

	Respondent			
Categories	Numbers	Percent	Mean	Standard deviation
Illiterate (0-0.5)	20	25	4.94	3.98
Primary education (1-5)	28	46.66		
Secondary education (6-10)	13	21.66		
Above secondary education	4	6.66		
Total	60	100		

Table 9: Distribution of the vegetable growers according to their family size

	Respondent			
Categories	Number	Percent	Mean	Standard deviation
Small (up to 4)	20	25	6.77	2.09
Medium (5-8)	27	45		
Large above (above 8)	18	30		
Total	60	100		

Table 10: Distribution of the vegetable growers according to their farm size

	Respondent			
Categories	Numbers	Percent	Mean	Standard deviation
Marginal (up to 0.2 ha)	29	48.33	0.39	0.36
Small (0.2-1.0 ha)	28	46.66		
medium(1-3 ha)	3	5		
Total	60	100		

Table 11: Distribution of the vegetable growers according to their training received

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
No training (0.00 days)	10	16.66	2.85	2.24
Low training (1-5 days)	38	63.33		
Medium training (above 5 days)	12	20		
Total	60	100		

Table 12: Distribution of the vegetable growers according to their time spent in vegetable field

	Responders			
Categories	Numbers	Percent	Mean	Standard deviation
Short time spent (up to 3hrs)	12	20	5.81	1.82
Moderate time spent (4-7 hrs)	36	60		
Long time spent (above 7hrs)	12	20		
Total	60	100		

Table 13: Distribution of the vegetable growers according to their annual family income

	Respondents			
Categories	Number	Percent	Mean	Standard deviation
Low income (up to 200.00)	2	3.33	207.08	81.91
Medium income(200.00-250.00)	48	80		
High income(above 250.00)	10	16.66		
Total	60	100		

Table 14: Distribution of the vegetable growers according to their annual income from vegetable cultivation

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
Low vegetable income (up to 18)	6	10	45.83	27.95
Medium vegetable income (19-73)	46	76.66		
High income (above 73)	8	13.33		
Total	60	100		

Table 15a: Distribution of the vegetable growers according to their environmentally friendly vegetable cultivation

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
Low knowledge (up to 10)	7	11.66	17.00	6.02
Medium knowledge (11-23)	43	71.66		
High knowledge (above 23)	10	16.66		
Total	60	100		

Table 15b: Distribution of the vegetable growers according to their organizational participation

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
Low participation (up to 2.00)	7	11.7	5.19	2.56
Medium participation (3-7)	51	85		
High participation (above 8)	2	3.33		
Total	60	100		

Table 16: Distribution of the vegetable growers according to their credit received

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
Low credit (up to 3)	8	13.33	10.70	6.89
Medium credit (4-17)	45	75		
High credit (above 17)	7	11.66		
Total	60	100		

Table 17: Distribution of the vegetable growers according to their attitude towards environment-friendly vegetable cultivation

	Respondents			
Categories	Numbers	Percent	Mean	Standard deviation
Highly unfavorable attitude(up to 40)	11	19.28	54.82	20.59
unfavorable attitude (40-60)	28	46.66		
Favorable attitude	18	30		
Neutral attitude (60-80)	1	1.66		
Highly favorable attitude (above 80)	2	3.33		
Total	60	100		

Annual Family Income: The annual family income score of the respondents ranged from 62.30 to 700.00 with a mean and standard deviation of 207.08 and 81.91 respectively. Based on their annual family income score, the respondents were classified into three categories as shown in Table 13.

Annual Income from Vegetable Cultivation: The annual income from vegetable cultivation score of the respondents ranged from 17.70 to 247.00 with a mean and standard deviation of 45.83 and 27.95 respectively. Based on their annual income from vegetable cultivation score, the respondents were classified into three categories as shown in Table 14.

Knowledge of Environment-friendly Vegetable Cultivation: Knowledge of environmental friendly vegetable cultivation of the respondents ranged from 7 to 32 against the possible ranged from 0 to 40 with a mean of 17.00 and standard deviation of 6.02. Based on their

knowledge on environmentally friendly vegetable cultivation scores, the respondents were classified into three categories as shown in Table 15.

Organizational Participation: The observed organizational participation score of the respondents ranged from 0 to 10 with a mean of 5.19 and standard deviation of 2.56. Based on their organizational participation score, the respondents were classified into three categories as shown in Table 15.

Credit Received: The credit received score of the respondents ranged from 0 to 30 with the mean and standard deviation of 10.70 and 6.89 respectively. Based on their credit received score, the respondents were classified into three categories as shown in Table 16

Farmer's Attitude Towards Environment-Friendly Vegetable Cultivation: The observed scores for attitude toward environment-friendly vegetable cultivation ranged from 34 to 83 against the possible range of 20 to 1400 with a mean of 54.82 and a standard deviation of 20.59. Based on the attitude toward environment-friendly vegetable cultivation scores, the respondents were classified into five categories as shown in Table 17.

Size and Area of the Floating Bed: The respondents of the study area are used to preparing different sizes of floating beds for seedlings and vegetable production. However, one of the most frequently practiced floating beds was selected from each of the 60 respondent farmers. Thus, a total number of 150 beds were taken into consideration. The respondents prepared 6 different sizes of floating beds for seedlings and vegetable production beds were prepared considering the size of 54.9m Length ´1.83 m Width´ and 0.91m Depth (180 ft´ 6 ft´ 3ft). Hence, it might be the most popular bed size in the study area. About 20% of the beds were 48.8m´ 1.83m´ 0.91m (160ft´ 6ft´ 3ft), 16.8% of the respondents prepared bed size 42.7m´ 1.83m´ 0.91m (140ft´ 6ft´ 3ft), 20.6% respondents prepared bed size 36.6m´ 1.83m ´0.91m (120 ft 6 ft 3ft), 13.6% of the respondents prepared red bed size 30.5m´ 1.83m´ 0.91m (100ft´ 6ft´ 3ft) and 10.4% of the respondents prepared bed size 24.4m´ 1.83m´ 0.91m (80 ft ´6ft´ 3ft) respectively.

DISCUSSION

The study presented the adoption and challenges faced by vegetable growers engaging in floating farming, with a particular focus on its environmental implications. The extent of the adoption of floating farming by farmers across different regions highlights the number of farmers cultivating vegetables in floating gardens in various unions. Additionally, it details the types of vegetables grown on floating beds, with water spinach, leaf amaranth, red amaranth and tomato being the most commonly cultivated crops. The study identifies several problems encountered by farmers in adopting floating farming for vegetable production. These include pest attacks, diseases, heavy weeds infestation, rat infestation, heavy rainfall, lack of capital, duck and bird attacks, lack of land, high medicine costs, scarcity of water hyacinth, scarcity of raw materials, high cost of quality seeds and knowledge and skill deficiencies. Similar findings were observed by Islam *et al.* [26]. Each problem is discussed in detail, shedding light on its severity and impact on vegetable cultivation in floating beds. Furthermore, the socio-economic characteristics of vegetable growers are analyzed, including their age, education level, family size, farm size, training received, time spent in vegetable fields, annual family income, annual income from vegetable cultivation, knowledge of environment-friendly vegetable cultivation, organizational participation, credit received and attitude towards environment-friendly vegetable cultivation. Overall, the study emphasizes the importance of addressing these challenges to promote sustainable and environmentally friendly practices in vegetable cultivation. It underscores the need for targeted interventions, including education, training, access to resources and organizational support, to enhance the adoption of floating farming and mitigate its associated risks.

CONCLUSION

The study highlighted significant problems in floating agriculture, with 73.33% of respondents facing medium difficulties affecting production. Despite challenges like pests, weeds and floods, floating agriculture was deemed profitable if these issues were addressed. Farmers perceived pests, diseases and weeds as major obstacles but acknowledged the practice's potential to combat climate change and provide self-employment opportunities for rural communities. Socioeconomic factors like farm size and knowledge significantly influenced floating agriculture production. Initiatives to expand floating agriculture, improve market access and address environmental concerns were recommended for sustainable development. Additionally,

efforts to introduce floating agriculture in new regions and integrate it into relief programs were suggested to address poverty and land scarcity issues. Ultimately, establishing effective market systems could allow floating agriculture to thrive beyond national borders in the growing global market for organic foods.

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