Research article

Ecology Journal

ISSN (Print): 2957-4471, ISSN (Online): 2957-448X, Website: https://journal.esbangladesh.org
Ecol. J. (2023) 5 (2) : 115-125

VEGETABLE PRODUCTION ON THE DYKES OF BRACKISH WATER GHERS: STATUS AND CHALLENGES

Mohammad Bashir Ahmed* and Md. Matiul Islam

Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh

***Corresponding e-mail:** mbaatku@gmail.com

Received: 20 November 2023, Revised: 25 November 2023, Accepted: 30 November 2023, DOI: https: //doi.org/10.59619/ej.5.2.4

ABSTRACT

The embankments (Dykes) of the shrimp farms (Ghers) have been taken under vegetable production which deserves to be expedited for further implications. The aims of the study were to identify the status and problems of vegetable production on dykes in brackish water Ghers along with its impact on food security. Data were collected from purposively selected 67 respondents following accidental random sampling of the Dacope upazila of Khulna district in Bangladesh from July to November, 2017. The average area of the dykes was 8.89±4.69 decimals, and the average width was 1.73±0.34 m. The dykes were prepared either by spading or by preparing pits. The farmers grew vegetables in Kharif-2 season (July 01 to October 15). The farmers usually grew 16 types of vegetables as mixed crops, among which bitter gourd was dominant followed by cucumber and pumpkin, following two cropping patterns: vegetable-fallow-fallow and vegetable-vegetable-fallow. The cropping intensity was 162%. The majority of the respondents harvested vegetables four times. In terms of yield, the tomato (60 t ha^{-1}) was dominant, followed by brinjal (57.09 t ha^{-1}) and cabbage (55.41 t ha^{-1}). The dykes are occupying an area of 4,149.75 ha which would be able to produce 1, 04,438.83 tons of vegetables. Twenty-nine associated problems were identified, among those “rats attack” was the most severe problem. The confronted problems should be overcome through appropriate measures, and a typical model should be developed through research for dyke vegetable production to make it more resilient and profitable.

Keywords: Dyke vegetable production, status, food security, and problems.

Introduction

Ghers are low embankments or dikes constructed to control the inflow of brackish water into the coastal areas, creating pockets of land suitable for agriculture. Vegetable production on the dykes of brackish water Ghers has been practiced in the regions where these structures are common, such as coastal areas in South and Southeast Asia. The southwest part of Bangladesh is one of those regions. Nowadays, Bangladesh is facing the multidimensional effects of climate change in the forms of floods, cyclones, rising sea levels, drainage congestion, salinity in freshwater systems, etc. The existing literature (Habib-Ur-Rahman *et al.* 2022, Hossain *et al.* 2013, Minhas 2012, Lin 2011, Rahman 2011) suggests that crop production could be highly vulnerable in the face of climate change scenarios, thereby posing a potential threat to the country’s food security.

Brackish water is water with salinity levels between seawater and freshwater. It occurs there where surface or groundwater mixes with seawater, in deep fossil aquifers. Usually, brackish water has been undervalued. Hillel (2000) defined brackish water as the water where 500-2,000 ppm salts are dissolved. In the coastal areas of Bangladesh, plenty of brackish to saline water are available. Thus, shrimp farming got a tremendous boom during the early 1980s. Salinity intrusion in agricultural land is increasing because of sea level rise due to climate change. Thus, the practice of agriculture, particularly vegetable production, has been almost stopped in the coastal areas, except for shrimp farming. The introduction of high-value crops on the dykes of brackish water shrimp Ghers could be an important innovation, although it has been practiced a while back.

The production practice of vegetables on the dykes of Ghers is termed Dyke vegetable production (DVP). DVP is an indigenous knowledge-based practice that is environment-friendly. In-depth knowledge about the present scenario i.e., area (in decimal) of the dyke, the method of cultivation, preparation technique of pond and dyke, the season of dyke vegetable production, materials required, name of crops grown, use of manures and fertilizers on dyke vegetable production, an intercultural operation done, insect-pest and diseases attack dyke vegetables, crop rotation followed cropping intensity, time and frequency of harvest, the yield of vegetables and fish etc., and problems faced by the farmers in DVP, are merely available. To have a comprehensive idea about the above-mentioned issues it has been considered essential to study the present scenario and confronted problems related to DVP.

Vegetable production on the dykes of brackish water ghers represents a promising avenue for enhancing food security and economic prosperity in coastal regions. While celebrating its successes, it is crucial to address the identified challenges to establish a resilient and profitable model for dyke vegetable production. Continued research and community involvement will play a vital role in ensuring the long-term sustainability of this innovative agricultural practice.

Dyke area creates an avenue for increasing vegetable production in the water-logged areas of the southwest region of Bangladesh. In view of the above-cited facts, the present study was conducted with the following specific objectives: to identify the status and problems of vegetable production on dykes in brackish water Ghers along with its potential impacts on food security. Besides, the relationship of the selected characteristics of the respondents with their problem confrontation in brackish water dyke vegetable production was also explored.

Materials and Methods

Design of the study, source, method, instrument, and time of data collection: Descriptive and diagnostic research design postulated by Kothari (2004) was followed in conducting the study. All the dyke vegetable producers of Pankhali and Tildanga unions of Dacope upazila of Khulna district in Bangladesh were treated as the population of the study. Data were collected from sampled 67 dyke vegetable producers out of 87 (20 producers were excluded as they were included for pre-testing). Data were collected through face-to-face interviews by the Research Assistant from July to November, 2017. A number of 29 problems related to DVP were listed and identified through focus group discussion (FGD). After that, each of the respondents was asked to identify the problems indicating their extent of severity.

Status and impact of dyke vegetable production (DVP) on food security: The present status of DVP was determined based on following parameters (total 14) viz. area of the dyke, method of cultivation, preparation technique, materials required, season of DVP, types of vegetables grown, use of manures and fertilizers for DVP, intercultural operations done in dyke vegetables, insect-pests and diseases attack in dyke vegetables, crop rotation or cropping pattern followed, cropping intensity, time and frequency of harvest, yield of vegetables, and expenditure of and income from dyke vegetable production. Food security was measured in terms of dyke area and potential production of vegetables on the dykes in the study area during the survey period. The evaluation of food security in the study area was intricately tied to both the physical extent of dyke areas allocated for vegetable cultivation and the anticipated production of vegetables from these areas. This comprehensive approach provides a nuanced understanding of the region's capacity to meet food needs through the cultivation of vegetables on dykes.

Selection and measurement of the variables of the study: The selected 13 personal and socioeconomic characteristics (Table 11) of the dyke vegetable growers were treated as independent issues while the problem confrontation in dyke vegetable production was considered the focus issue of the study. The selected characteristics of the respondents were measured following standard procedure (Nishi *et al.* 2019).

Measurement of problem confrontation: A number of 29 problems (Table 9) were incorporated into the interview schedule (identified through FGD) to determine the problem confrontation of the respondent farmers in DVP. A 4-point rating scale, such as 'highly severe', 'moderately severe', 'negligible', and 'not at all' were employed to indicate the intensity of each of the faced problems by the respondents. A score of 3, 2, 1, and 0 were assigned against the scales respectively. The problem confrontation score (PCS) of a respondent was calculated by summing up all the scores obtained against the 29 problems. Hence the PCS could range from 0-87. Based on PCS, the respondents were classified into three categories, such as low problem confrontation (1-29), medium problem confrontation (30-58), and high problem confrontation (58-87). Besides, a "Problem Confrontation Index Score" (PCIS) was calculated using the formula used by Akter *et al.* (2019) to understand the severity and magnitude of the faced problems.

Data processing, interpretation, and statistical analysis: Statistical treatments such as range, means, standard deviation, maximum, minimum, rank order, etc. were used to interpret data. To explore the relationship between the concerned variables Pearson's Product Moment Coefficient of Correlation (r) for normalized variables, and Spearman's Rank Order Coefficient (ρ) of Correlation for rank data, were employed.

Results and Discussion

Most (92.5%) of the respondents possessed medium to large dyke areas (Table 1). This finding is similar to that of Akter *et al.* (2019). They also found that most (86.9%) of the respondents had medium to large size of dykes.

The width of the dykes of the Ghers is usually decided by considering the convenience of intercultural operations (weeding, earthling-up, fertilizing, etc.). The respondents followed nine types of width (Table 2) in preparing dykes. More than half (55.2%) of the respondents considered the width of dykes as 1.82m (6ft), followed by 1.52 m (5 ft) (13.4%) and 1.37 m (4.5 ft) (11.9%). The respondents followed 67 different lengths depending on land size.

The farmers of the study area cultivated vegetables either by seeding (sowing/dibbling) or by planting method. Farmers produced climber types of vegetables such as bottle gourd, cucumber, bitter gourd, bean, etc., on a net or loft. The pumpkin and wax gourd were produced as creepers.

Before starting the season, the farmers first prepare their dykes for vegetable production either by spading or by preparing pits for creepers and climbers. For climbers, the vegetable growers of the study area prepared a netting loft (মাচা-platform) with the help of plastic ropes and bamboo over the water body of the Ghers.

Table 1. Distribution of the respondents according to the dyke area

Categories	Score (Decimal)	Respondent (N=67)		Mean±SD	Range	
		Number	Percentage		Min.	Max.
Small	<4.2	5	7.5	8.89±4.69	1.85	26.85
Medium	4.20-13.59	53	79.1			
Large	>13.59	9	13.4			

Table 2. Distribution of the respondents according to the width of the dykes of brackish water Ghers

Categories (Width)		Respondent (N=67) Min.		Mean±SD Max.	Range	
Meter	Feet	Number	Percentage (%)			
0.91	3.00	3	4.5	(1.73±0.34) m or (5.75±1.13)ft	0.91m or 3ft	2.74m or 9ft
1.21	4.00	1	1.5			
1.37	4.50	8	11.9			
1.52	5.00	9	13.4			
1.82	6.00	37	55.2			
2.13	7.00	2	3			
2.20	7.25	1	1.5			
2.28	7.50	4	6			
2.74	9.00	2	3			

In preparing dykes, the farmers used spades for land tillage operations and for pit preparations. Bamboo and synthetic ropes were used for preparing the loft. Hand-hoe (খুরপি) and small shovels were used for intercultural operations.

Mostly the farmers grew vegetables in the Kharip-2 season (July 01 to October 15). The farmers perform various activities for growing vegetables on the dykes. Some of the operations are mentioned below along with timings:

a) Old dyke repair or new dyke preparation: April-May
b) Net setting or loft preparation: April-May
c) Seeds/seedlings collection: April-May
d) Sowing / Planting: May-June
e) Harvesting: June-August and lasts up to November

The farmers of the study area grew 16 types of vegetables on the dykes of the brackish water Ghers. Most (86.56%) of them grew bitter gourd in their dykes followed by cucumber (82.08%), pumpkin (76.11%), and bottle gourd (64.17%) (Table 3). However, a few (2.98%) of them grew cabbage, Indian spinach, and potato. Akter *et al.* (2019) found that most (92.85%) of the respondents cultivated cucumber and bitter gourd on dykes of freshwater Ghers.

In preparing the pit, the farmers used compost. Besides, farmers used Urea, TSP, DAP, and MoP for increased production and quality of the produce.

All (100%) of respondents practiced weeding, irrigation, and setting trailers (বাউনি) followed by soil loosing (98.5%), mulching (97.01%), and control of insect-pests (88.05%) and diseases (70.14%) in their dykes of the Ghers (Table 5).

Highest proportion (29.9%) of the respondents cited that their dyke vegetables were infested by mosaic virus followed by downey (19.40%) and powdery (13.43%) mildews. A few respondents (11.9%, 4.5%, and 1.5%) also reported that their field was infested by wilt, root rot, and blight respectively (Table 6). The highest proportion (26.90%) of them addressed that fruit fly attacked their dyke vegetables followed by red pumpkin beetle (25.37%), caterpillar (13.43%), and aphids (11.94%). A few of the respondents cited that *epilachna* beetle (5.97%) and brinjal shoot and fruit borer (4.5%) also attacked their dyke vegetables (Table 6).

All of the respondents grew vegetables as mixed crops following two cropping patterns viz. vegetable-fallow-

Table 3. Types of vegetable crops grown in the dykes of brackish water Ghers

Sl.No.	Name of the vegetables	Respondents (N=67)	
		Citation	Percentage (%)
1.	Bitter gourd	58	86.56
2.	Cucumber	55	82.08
3.	Brinjal	22	32.83
4.	Pumpkin	51	76.11
5.	String bean	30	44.77
6.	Wax gourd	26	38.80
7.	Snake gourd	10	14.92
8.	Bottle gourd	43	64.17
9.	Bean	06	08.95
10.	Cabbage	02	02.98
11.	Knolkhol	13	19.40
12.	Tomato	27	40.29
13.	Indian spinach	02	02.98
14.	Potato	02	02.98
15.	Okra / Lady's finger	14	20.89
16.	Ribbed gourd	04	05.96

Table 4. Distribution of the respondents according to their use of manure and fertilizers in the dykes

Name of fertilizers	Respondents (N=67)	
	Citation	Percentage (%)
Cowdung	61	91.04
Urea	66	98.50
Triple Super Phosphate (TSP)	65	97.01
Di Ammonium Phosphate (DAP)	60	89.55
Muriate of Potash (MoP)	64	95.52

Table 5. Distribution of the respondents according to their intercultural operations practiced in the dykes during vegetable production

Name of intercultural operations	Respondents (N=67)	
	Citation	Percentage (%)
Weeding	67	100.00
Irrigation	67	100.00
Mulching	65	97.01
Setting Trailers (বাউনি)	67	100.00
Soil loosing	66	98.50
Control of diseases	47	70.14
Control of insects-pest	59	88.05

fallow and vegetable-vegetable-fallow. A number of 65 combinations of the crops were practiced under the two cropping patterns by the 67 respondents in the study area. Two combinations, viz. Bottle gourd+Bitter gourd+Pumpkin—Knolkhol+Tomato—Fallow and Cucumber+Bitter gourd+Bottle gourd+String bean+Pumpkin+Wax gourd—Fallow were repeated in the case of two and two respondents respectively.

The net dyke area covered by vegetables in the study area was 2.1755 ha, while the total area under dyke vegetable production was 3.5245 ha. The cropping intensity was 162 percent.

Irrespective of the types of vegetables, the harvesting time ranged from 40 to 75 days after seeding or planting (Table 7). The majority (76.1%) of the respondents harvested vegetables four times followed by three times (16.4%) and five times (7.5%) irrespective of types of vegetables (Table 8).

Highest amount of yield was obtained by the farmers in the case of tomato (60 t ha^{-1}) followed by brinjal (57.09 t ha^{-1}), cabbage (55.41 t ha^{-1}) and bottle gourd (40.68 t ha^{-1}) (Figure 1). The lowest yield was observed in the case of Indian spinach (6.75 t ha^{-1}) followed by cucumber (8.48 t ha^{-1}), pumpkin (8.57 t ha^{-1}), and potato (10.88 t ha^{-1}).

Irrespective of the types of vegetables, the yield obtained from one ha of dyke area was 25.12 t ha^{-1}. But Akter *et al.* (2019) found less yield (6.45833 t ha^{-1}). Rai *et al.* (1992) stated that the pond dyke yielded 5,626.5 kg of vegetables which worked out to 85.9 t $ha^{-1}y^{-1}$.

The cost (without considering the types of vegetables) involved laborers' wages for land preparation, netting (loft), intercultural operations, fertilizing, irrigation, pest control, harvesting, etc. The per hectare cost incurred for vegetable production on the dykes ranged from 30,000 to 1,10,000 BDT (353.03 to 1,294.44 USD) with a mean and standard deviation of 79,531.25 BDT (935.90 USD) and 18,943.30 BDT (222.92 USD), respectively. Besides, a huge amount of recurring expenditure incurred for de-weeding and cleaning of farm areas reduces the profitability of aquaculture practices (Roy *et al.* 1996).

Table 6. Distribution of the respondents according to diseases and insect-pest infestations in the produced vegetables

Name of diseases and insect-pests	Respondents (N=67)	
	Citation	Percentage (%)
Diseases		
Powdery mildew	9	13.43
Downey mildew	13	19.40
Mosaic virus	20	29.90
Blight	1	01.50
Wilt	8	11.90
Root rot	3	04.50
Insect-pests		
Brinjal shoot & fruit borer	3	04.50
Fruit fly	18	26.90
Jassids	2	02.98
Aphids	8	11.94
Red pumpkin beetle	17	25.37
Mealy bug	2	02.98
Epilachna beetle	4	05.97
Thrips	1	01.49
Fruit borer	1	01.49
Caterpillars	9	13.43

Table 7. Harvesting time of vegetables grown on the dykes of brackish water Ghers

Name of vegetables	Time of harvesting (DAS/DAP) *
1. Bitter gourd	40-50
2. Cucumber	40-50
3. Brinjal	55-65
4. Pumpkin	60-75
5. String bean	40-50
6. Wax gourd	45-50
7. Snake gourd	40-50
8. Bottle gourd	50-60
9. Bean	50-60
10. Cabbage	45
11. Knolkhol	40 -45
12. Tomato	45-50
13. Indian spinach	40
14. Potato	60
15. Okra / Lady's finger	45-55
16. Ribbed gourd	45

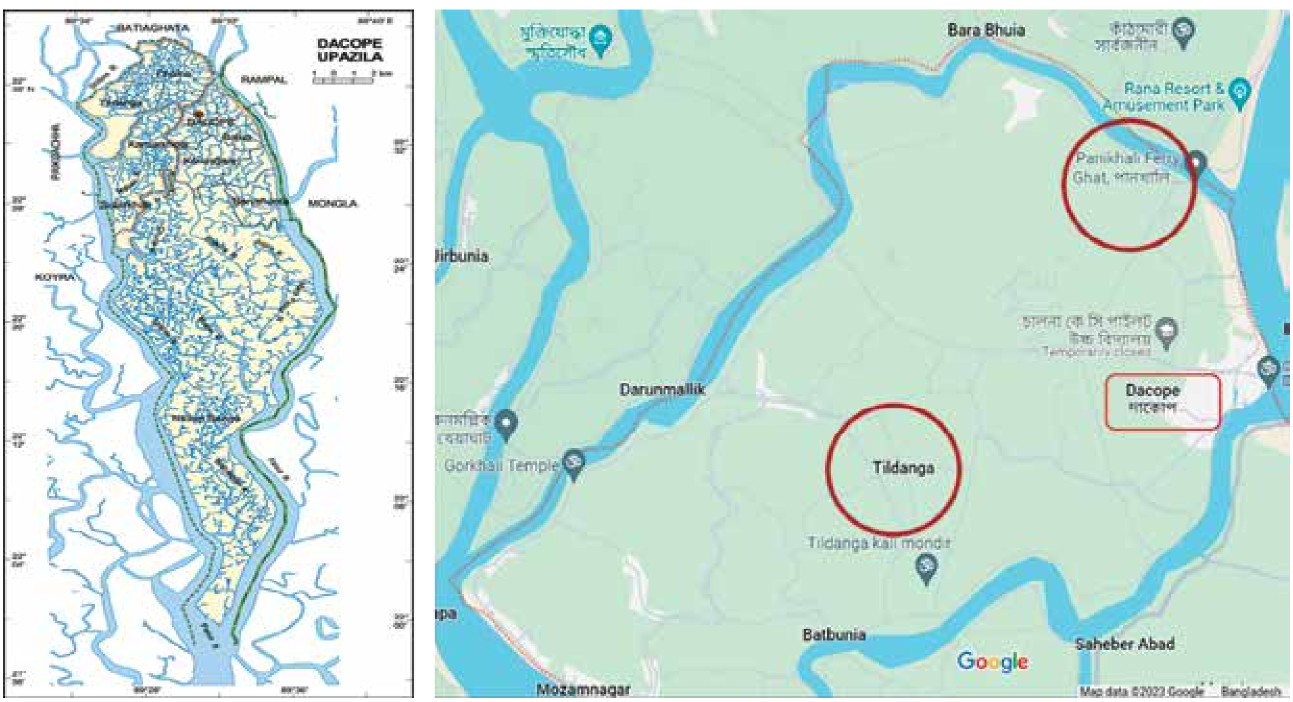
* DAS= Days After Seeding, DAP= Days After Planting

Table 8. Distribution of the respondents according to their frequency of harvest of the grown vegetables

Harvesting Times (frequency)	Respondents (N=67)	
	Citation	Percentage (%)
3	11	16.4
4	51	76.1
5	5	7.5

The average gross income from vegetable production in one ha of dyke area ranged from 1, 28,550 to 4, 75,000 BDT (1,512.73 to 5,589.64 USD) with a mean and standard deviation of 3, 20,293 BDT (3,769.10 USD) and 1,11,518.50 BDT (1,312.31 USD), respectively. The average net income from vegetable production in one ha of dyke area ranged from 73,550 to 3,77,000 BDT (865.51 to 4,436.41 USD) with a mean and standard deviation of 2,40,762.5 BDT (2,833.21 USD) and 9,940.44 BDT (116.98 USD) respectively. The findings of the present study indicate that the average income from one hectare of land for dyke vegetable cultivation was considered higher than that of Akter *et al.* (2019) who obtained BDT 30,093.02 (USD 354.12) ha^{-1}. Akter *et al.* (2019) conducted their study in Mollarhat upazila of the Bagerhat district in 2017. During that year the freshwater Ghers of that area were inundated due to heavy rainfall, and consequently, the dyke vegetables were damaged, and the production was less which contributed to low income.

According to Ahmed (2011), there are 3,594 brackish water shrimp farms (Khulna 1,425, Bagerhat 1,249, Satkhira 920) in the southwestern coastal region of Bangladesh, which covers an area of 82,995 ha (Khulna 25,485 ha, Bagerhat 33,214 ha, Satkhira 24,296 ha). The dykes covered 5% area (on average) of total shrimp Gher areas. The dykes of 3,594 brackish water shrimp farms (i.e., brackish water Ghers) in the southwestern coastal region (greater Khulna) of Bangladesh occupy an area of 4,149.75 ha. If we are able to undertake these dyke areas (4,149.5 ha) under vegetable production, we would be able to produce (25.16 t ha^{-1}×4,149.75 ha) = 104438.83 tons of vegetables. The increased amount of vegetables produced in this way, from the dykes, would definitely be added to the present amount of produced vegetables. Moreover, the vegetables produced during the lean period (transition time of seasonal changes when vegetables are merely available in the field and market) would add extra security to the required food as vegetable supplements.



Map 1. Administrative map of Dacope upazila of Khulna district.

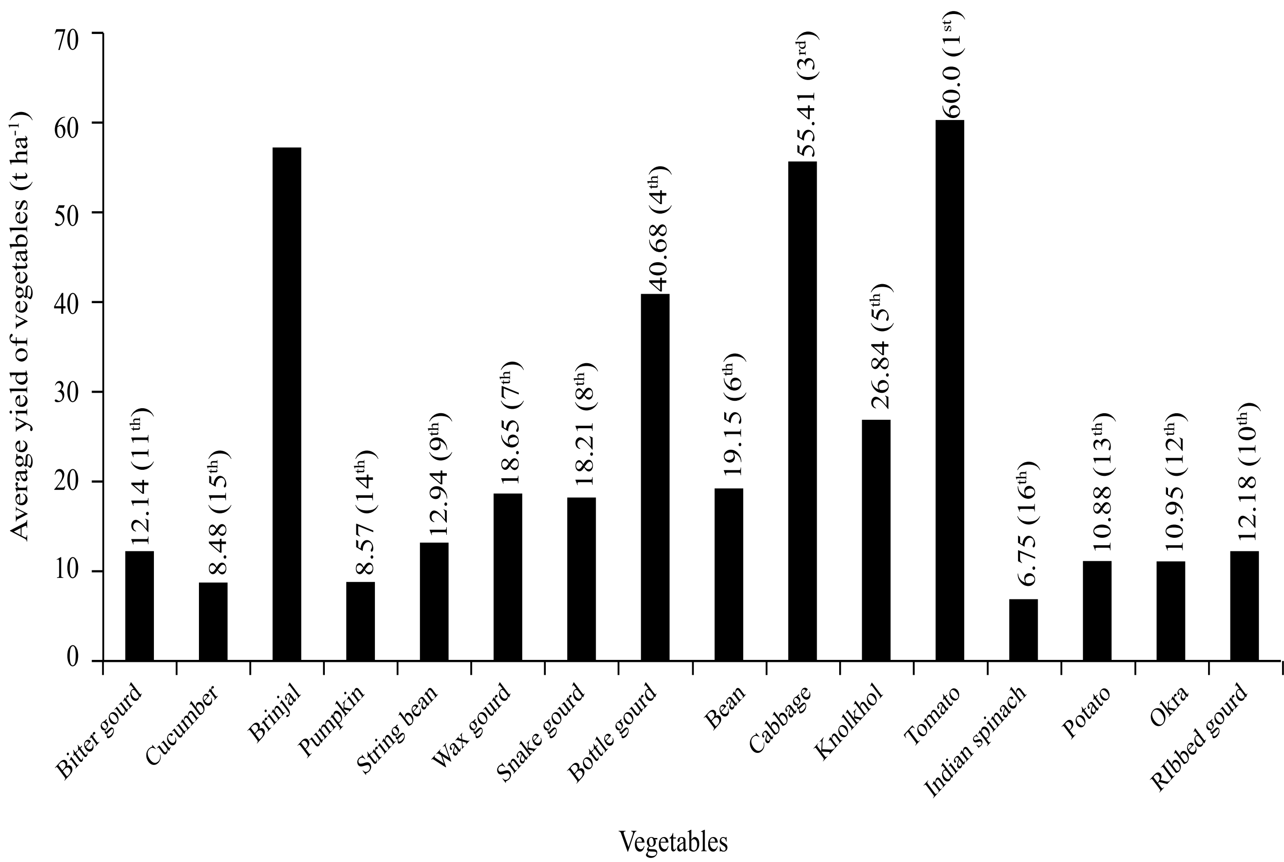


Figure 1. Yield of vegetables grown on the dykes on brackish water ghers in the study area (value in the parenthesis indicates the rank order based on yield).

Vegetable production on Ghers can contribute significantly to local food security. By utilizing otherwise challenging environments, communities can diversify their agricultural activities and enhance their resilience to changing environmental conditions. Vegetables are rich in essential nutrients, and their cultivation can provide a valuable source of nutrition for local populations. Additionally, successful vegetable production can have positive economic impacts by creating opportunities for local farmers to generate income through the sale of their produce.

Farmers confronted a total of 29 problems to different extents of severity. ‘Rats attack’ was the highly severe problem while ‘Shortage of laborer’ and ‘High wage of laborer’ were the least severe problems (Table 9). The other major problems were ‘Lack of preservation facilities’, ‘Lack of technical knowledge for identification of diseases’, ‘Lack of technical knowledge for identification of insect-pests’, and ‘High percentage of insect-pests attacks’. Akter *et al.* (2019) also reported that lack of technical knowledge for the identification of diseases (1st) and insect pests (2nd)” had been the two most severe problems of dyke vegetable production at freshwater Ghers. About three-fourths (74.6%) of the respondents had confronted medium problems followed by high (25.4%) problemsi.e., all of the respondents (100%) fell into medium to high problem confrontation categories. None of the respondents belonged to the low problem confrontation category (Table 10). Akter *et al.* (2019) and Rashid *et al.* (1992) found that all of the respondents belonged to low to medium categories of problem confrontation and none of them confronted high problems.

Among the 13 selected characteristics of the respondents, experience in farming and experience in fish farming showed a positive significant relationship with the problem confrontation (Table 11). It means that the higher the experience in farming and experience in fishing, the higher the ability of the farmers to identify the problems in dyke vegetable cultivation. The statement suggests

Table 9. Rank order of problems based on problem confrontation index

Types of problems	Severity of the problems (N = 67)					PCI		Rank order
	HS (3)	MS (2)	LS (1)	NAA (0)	Total	Score	%	
1. Unavailability of seed and/ seedlings	10	46	11	0	67	133	66.16	10th
2. High price of seed / seedlings	22	44	22	0	67	176	87.56	7th
3. Problem of seed germination	11	50	6	0	67	139	69.15	9th
4. Purity of seed	23	39	5	0	67	130	64.67	11th
5. Lack of knowledge for selecting appropriate vegetables	0	17	50	0	67	84	41.79	19th
6. Unavailability of fertilizer in season	5	44	17	1	67	120	59.70	14th
7. High demand and high price of Fertilizer	17	40	10	0	67	124	61.69	12th
8. Lack of good quality fertilizer	36	24	7	0	67	163	81.09	8th
9. Lack of knowledge of balanced fertilizer	2	13	52	0	67	84	41.79	19th
10. Fertilizer enhance insect attack	58	7	2	0	67	190	94.52	6th
11. Lack of technical knowledge of Fertilizer application	1	24	42	0	67	93	46.26	17th=
12. Deficiency of irrigation water in season	3	10	53	1	67	83	41.29	20th=
13. Contamination of salinity in irrigation water	2	8	56	1	67	79	39.30	21th
14. High percentage of insect attack	58	6	3	0	67	189	94.02	5th
15. High percentage of diseases	54	7	6	0	67	182	90.54	6th
16. High price of insecticide or pesticide	58	8	1	0	67	191	95.02	4th=
17. Lack of technical knowledge for identification of Insects	59	6	2	0	67	191	95.02	4th=
18. Lack of technical knowledge for identification of Diseases	59	7	1	0	67	192	95.52	3rd
19. Poor productivity	5	26	34	2	67	101	50.24	16th
20. Low market price in respect of production cost	0	22	44	1	67	89	44.27	18th
21. Lack of marketing facilities	9	3	50	5	67	83	41.29	20th=
22. Lack of preservation facilities	64	1	2	0	67	196	97.51	2nd
23. Lack of loan facilities	8	38	21	0	67	121	60.19	13th
24. Lack of information	8	19	40	0	67	102	50.74	15th
25. Salinity reduce the productivity	8	10	49	0	67	93	46.26	17th=
26. Rats attack	67	0	0	0	67	201	100	1st
27. Security of products	0	7	56	4	67	70	34.82	22th
28. Shortage of labor	0	0	64	3	67	64	31.84	23th=
29. High wage of labor	0	2	64	1	67	64	31.84	23th=

HS=Highly severe, S= Severe, LS= Less severe, NAA= Not at all, PCI= Problem confrontation index that individuals with more experience in both farming and fishing are more likely to possess enhanced skills in identifying issues related to dyke vegetable cultivation. In other words, the accumulated knowledge and expertise gained from practical involvement in farming and fishing activities contribute to a higher ability to recognize and address problems specific to cultivating vegetables in dyke areas. The implication is that hands-on experience in these related fields can enhance problem-solving capabilities in the context of dyke vegetable cultivation. The rest of the characteristics of the respondents did not show any significant relationship with their problem confrontation. Rashid *et al.* (1992) and Ahmed *et al.* (2007) reported similar types of findings. Ahmed *et al.* (2007) and Rashid *et al.* (1992) found that experience in poultry farming and experience in crop farming had a positive significant relationship with problem confrontation in poultry farming and Agroforestry practices respectively.

Conclusions

The dykes, averaging 8.89±4.69 decimals in area and 1.73±0.34 m in width, are prepared using spading or pits. Vegetable cultivation occurs during the Kharif-2 season (July 01 to October 15). Farmers grow 16 types of vegetables, predominantly bitter gourd (86.56%), cucumber (82.08%), and pumpkin (76.11%), employing two cropping patterns. The cropping intensity is 162%, with 76.1% of respondents harvesting vegetables four times. Top yields include tomato (60 t ha^{-1}), brinjal (57.09 t ha-1), and cabbage (55.41 t ha^{-1}). The average expenditure and net income per hectare for vegetables are 79,531.25 BDT (935.90 USD) and 2,40,762.5 BDT (2,833.21 USD), respectively. The dykes cover 4,149.75 ha, potentially producing 1,04,438.83 tons of vegetables. The study identifies 29 problems, with “rats attack” being the most severe (100%).

Table 10. Distribution of respondents based on confronted problems scores

Categories of problem confrontation	Score	Respondent (N=67)		Mean±SD	Range	
		Number	Percentage (%)		Min.	Max.
Low	1-29	0	0			
Medium	30-58	50	74.6	55.91±4.7	40	67
High	>58	17	25.4			

Table 11. Relationship between the selected socioeconomic characteristics of the respondent farmers and their problem confrontation regarding dyke vegetable production

Focusissue	Characteristics (measuring unit)	Correlation coefficient	Correlation type
Problem confrontation of dyke vegetable production	1. Age (year)	0.190^{NS}	PPCC (*r*)
	2. Level of Education (year ofschooling)	-0.002^{NS}	PPCC (*r*)
	3.Experience in farming (year)	0.308^{*}	PPCC (*r*)
	4.Experience in fishing (year)	0.281^{*}	PPCC (*r*)
	5.Experience in Dyke vegetable cultivation (year)	0.019^{NS}	PPCC (*r*)
	6. Family Size (number)	0.014^{NS}	PPCC (*r*)
	7. Farm Size (hectare)	0.083^{NS}	PPCC (*r*)
	8. Annual family income (‘000’ BDT)	0.216^{NS}	PPCC (*r*)
	9. Organizational participation (score)	-0.133^{NS}	SRCC (ρ)
	10. Loan from organization (0’000’ BDT)	0.114^{NS}	PPCC (*r*)
	11.Cosmopoliteness (score)	0.006^{NS}	SRCC (ρ)
	12. Training experience (number)	0.081^{NS}	PPCC (*r*)
	13. Extension media contact (score)	-0.025^{NS}	SRCC (ρ)

NS= Non-significant; ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed); PPCC – Pearson’s Product Moment Correlation Coefficient (*r*); SRCC – Spearman’s Rank Order Correlation Coefficient (ρ)

Acknowledgement

The authors are grateful to the University Grants Commission (UGC) of Bangladesh for selecting and issuing grants for conducting the research project.

References

Ahmed MB, Biswas S, Mannan MA and Amin MR. 2007. Problem confrontation of poultry farmers of Dumuria upazila under Khulna district. South Asian Journal Agriculture, *2*: 15-20.

Ahmed MB. 2011. Shrimp farming: Impact on socioeconomic, agriculture and environmental conditions in the southwestern coastal region of Bangladesh. LAP LAMBART Academic Publishing GmbH & Co., Germany, p. 174.

Akter J, Ahmed MB, Mannan MA, Islam MM and Mondal AB. 2019. Present status and problem confrontation of dyke vegetable production at freshwater gher in Bagerhat district of Bangladesh. Research in Agriculture, Livestock and Fisheries*, 6*: 69-78. https://doi.org/10.3329/ralf.v6i1.41387

Habib-Ur-Rahman M, Ahmad A, Raza A, Hasnain MU, Alharby, HF, Alzahrani YM, Bamagoos AA, Hakeem KR, Ahmad S, Nasim W, Ali S, Mansour F and El Sabagh A. 2022. Impact of climate change on agricultural production; Issues, challenges, and opportunities in Asia. Front Plant Science, *10*: 13:925548. doi: 10.3389/fpls.2022.925548.

Hillel D. 2000. Salinity management for sustainable irrigation: Integrating science, environment and economics. The World Bank, Washington DC, p. 24.

Hossain MS, Uddin MJ and Fakhruddin ANM. 2013. Impacts of shrimp farming on the coastal environment of Bangladesh and approach for management. Reviews in Environmental Science and Biotechnology, *12*: 313-332.

Kothari CR. 2004. Research Methodology: Methods and Techniques. 2nd Edition. New Delhi: N*ew* Age International Publishers.

Lin BB. 2011. Resilience in agriculture through crop diversification: adaptive management for environmental change. Bio-Science*, 61*: 183-193. https://doi.org/10.1525/bio.2011.61.3.4.

Minhas PS. 2012. Sustainable management of brackish-water agriculture. National Institute of Abiotic Stress Management, Maharashtra, 413115, India.

Nishi NY, Islam MM and Ahmed MB. 2019. Participation of rural women in organic farming. Asian Journal of Agricultural Extension, Economics & Sociology *33*: 1-14. https://doi.org/10.9734/ajaees/2019/v33i330178

Rahman MM. 2011. Country report: Bangladesh, ADBI-APO Workshop on Climate Change and its Impact on Agriculture. Ministry of Agriculture, Bangladesh.

Rashid HA, Ali MY, Ahmed MB, Islam MM and Majumdar I. 1992. The economics of horticulture on fish pond dykes, 2-31. In: Tripathi SD, Ranadhirand M and Purushottarnan CS (Eds.), Aquaculture Economics Proceedings of the Workshop on Aquacultural Economics, 20 November 1992.

Roy AK, Rai SP, Saha BK, Sen PR, Datta AK, Das CR and Rai SP, Roy AK, Datta AK, Das CR and Ghosh JK. 1996. A record production from an integrated farming system utilizing sewage enriched water. Journal of the Indian Fisheries Association, 26 (Proc.Nat.Symp. Aquacrops): 33-40.