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Farmers' Responses to the Flood Action Plan (FAP) of Bangladesh: An Empirical Study

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Summary. — The World Bank has recently prepared a Flood Action Plan (FAP) to solve the flood problems of Bangladesh. The FAP proposed construction of embankments on both sides of all major rivers. There is, however, strong opposition in the country to the "structural solution" to its flood problems. The objectives of this paper are to study the farmers' level of awareness, responses to, and the possible positive and negative impacts of the proposed embankment projects as outlined in the FAP. The data for this study were derived from field surveys conducted in two rural areas of Bangladesh. The survey data showed that slightly less than half of the total respondents had heard about the proposed construction of the embankment. The data further showed that the respondents overwhelmingly supported the embankment projects of the FAP. They were also aware of both positive and negative impacts of embankment construction.

1. INTRODUCTION

Flooding is an annual event in Bangladesh. Every year nearly a third of the country is flooded. But different parts of the country are subject to different degrees of flooding. Benefits from flooding depend on proper timing, duration, and magnitude (Paul, 1984, p. 10; Rasid and Paul, 1987, p. 168). A normal flood (*barsha*), generally associated with annual monsoon rains, is taken as a routine part of life. It is considered a blessing since floodwater provides vital moisture, plant nutrients, and fertile silt for croplands (Alam, 1990a, p. 354; Islam, 1980, p. 52; Paul, 1984, p. 9; Zaman, 1993, p. 986). Two of the three rice varieties (*aus* and broadcast *aman*) cannot thrive without floodwater. Additionally, fish caught during flood season constitute the main source of protein for many Bangladeshis.

Abnormal floods (*bonna*), which occur once every few years, cause widespread damage to crops and property and sometimes cost animal and human lives. This type of flood is regarded by farmers as an undesirable and damaging phenomenon (Islam, 1980, p. 52; Paul, 1984, p. 9; Rasid and Paul, 1987, p. 168). People of Bangladesh successfully adjust to normal floods and benefit from them, whereas abnormal floods often go beyond their ability to cope with the damage and hardship.

To alleviate the flood problems, a large number of small-scale flood-control embankments have been built along numerous river banks since 1960 by the Bangladesh Water Development Board (BWDB) and its predecessor, East Pakistan Water and Power Development Authority (EPWAPDA). Most of these embankments were ineffective in coping with the disastrous floods of 1987 and 1988. These floods, however, have stimulated considerable national and international interest in finding a permanent solution to the flood problem of Bangladesh.

Soon after the 1988 flood, four reports were commissioned by the French and Japanese governments, the United Nations Development Program (UNDP), and the United States Agency for International Development (USAID) (Boyce, 1990, p. 425). These reports have proffered an array of viewpoints; with the exception of USAID's Eastern Waters Study (Rogers, Lydon and Seckler, 1989), the remaining three reports favor a structural solution to the flood problem of Bangladesh. The most dramatic and costly proposals were made by a team of French engineers which recommend the construction of a 3,350 km continuous embankment along the major rivers of the country

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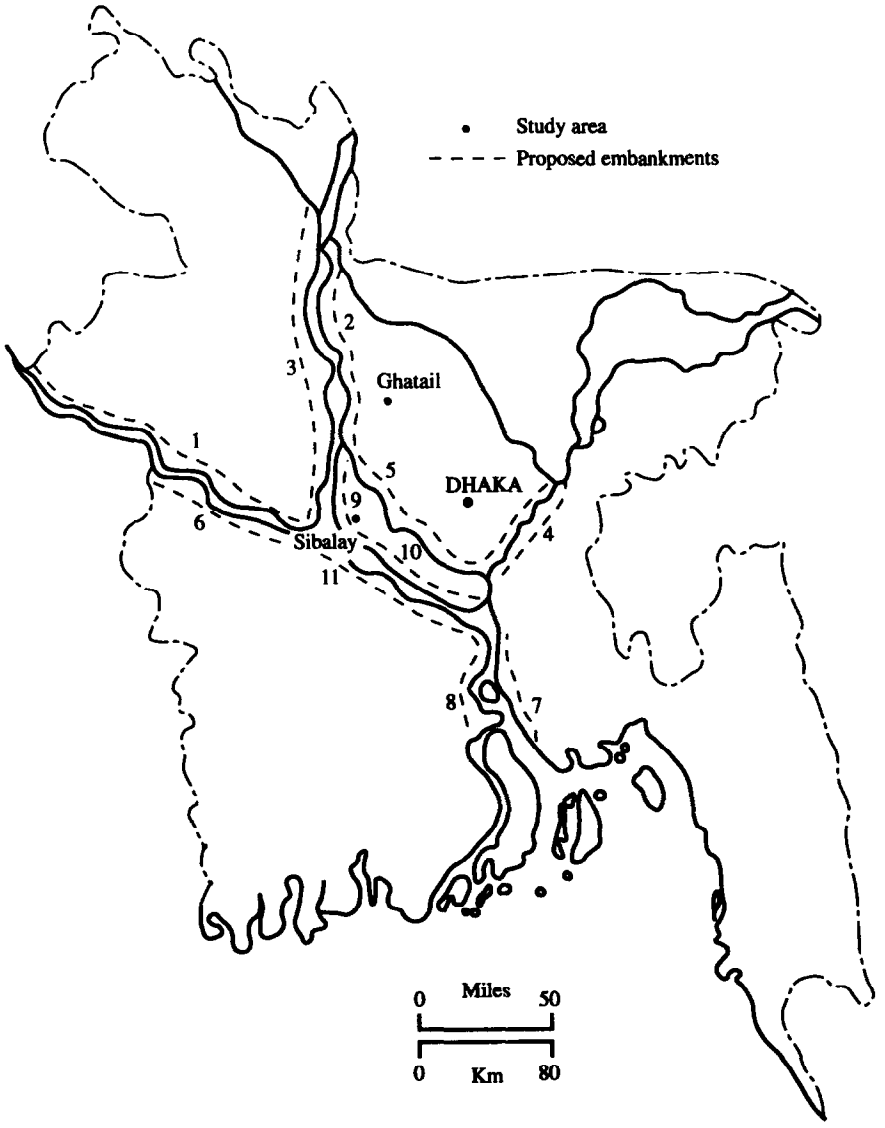


1. Ganges left bank; 2. Brahmaputra left bank (north); 3. Brahmaputra right bank;
4. Meghna left and right banks; 5. Dhaleswari left bank; 6. Ganges right bank;
7. Lower Meghna left bank; 8. Lower Meghna right bank; 9. Brahmaputra left bank (south);
10. Lower Ganges left bank; 11. Lower Ganges right bank

Figure 1. *The study area and proposed embankment sites.*

(FEC and BWDB, 1989). It is estimated that such a project would cost US$10 billion to put in place and would have an annual maintenance cost in the range of US$200–$600 million (Bingham, 1989, p. 42).

The Eastern Waters Study, on the other hand, suggests that techniques of forecasting flood should be greatly improved, and that money should be used to study and promote many indigenous ways of "living with floods." The study further points out that even if it were affordable, huge embankments would deprive vast portions of Bangladesh's richest agricultural land of the water it needs to thrive. The major aid donors to Bangladesh discussed the flood mitigation problem at the G–7 summit meeting in Paris in July 1989. They

agreed that the World Bank should coordinate the efforts of the international community so that a sound basis for alleviating the adverse effects of flood can be established.

The World Bank prepared a multimillion dollar Flood Action Plan (FAP) for Bangladesh at the end of 1989. Although the FAP represents a compromise among different proposals advanced in the four reports, the plan, nevertheless, leans toward the structural position (Boyce, 1990, p. 419; Shaw, 1989, p. 11). It proposes to build embankments all along the major river courses in Bangladesh (see Figure 1). The FAP sets forth an agenda of flood control activities. It is viewed as the first step in the implementation of a comprehensive long-term program for flood control in Bangladesh (World Bank, 1990, p. 1).

There is, however, strong opposition in Bangladesh to the "structural solution" to its flood problem (e.g. Custers, 1992, p. 242; Haque and Zaman, 1993, p. 95). Many Bangladeshis, rural development-oriented non-government organizations (NGOs), and international experts have raised serious questions about the viability of an expensive "technological fix" strategy. They have criticized the FAP for its structural emphasis, use of scarce land for embankments, and potential ecological stresses. It is feared that the FAP will transform Bangladesh into "a land without water" (Alam, 1991).[1] What do the farmers, who are supposed to be the primary beneficiaries of the flood control program, think about the construction of massive embankments along the major rivers of the country? Do they approve of such a measure to control the flood problem? Are they at all aware of the structural solution to the flood problem and the potential consequences? Unfortunately, the answers to these questions have not yet been sought (see Alam, 1990b, p. 2; Miah, 1988, p. 91).

2. OBJECTIVES

The objectives of this paper are to study farmers' levels of awareness and responses to the construction of the proposed embankment projects as outlined in the FAP. In addition the possible positive and negative impacts of the construction are studied. An attempt is made to determine whether the degree of awareness and responses of the farmers differ significantly with distance from the proposed embankment sites. The magnitude and frequency of floods are expected to decrease with the increase of distance from the major rivers of the country, which might be expected to have bearing on the responses of the farmers living in different parts of a floodplain.

The findings of this study should serve as a useful guide to the contemporary debate of "appropriate" flood control policy for Bangladesh. The study is the first of its kind to provide an insiders' point of view regarding the action recently initiated by the government to solve the country's flood problem. It is important to note that the FAP did not have any mandate from the people of Bangladesh (Adnan, 1991, p. 94) But their support, active participation, and cooperation are required for successful execution of the massive physical works of the FAP. In the past, the government's attempts to prevent flooding by constructing embankments and other flood-control structures were undermined by the farmers who frequently cut embankments to release trapped floodwaters from their cropfields (Boyce, 1990, p. 427; Parker, 1992, p. 3).[2]

3. DATA SOURCES AND DATA COLLECTION PROCEDURES

(a) *Study area*

The data for this paper were derived from field surveys conducted in two rural areas of Bangladesh: three adjacent villages of the Sibalay thana in the Manikganj district and another three villages from the Ghatail thana of the Tangail district (see Figure 1).[3] The villages of the former area are located near the confluence of the Jamuna and Padma rivers and are subject to deep flooding almost every year. Because of their distance from a major river and the relatively moderate local relief, the villages of the latter area experience only moderate annual flooding.

Location near two major rivers and relatively easy access by road from Dhaka, the capital city of Bangladesh, are the main reasons for selecting the villages of the Sibalay thana. The study villages are located four miles south of the Dhaka-Aricha Highway. The villages of the Ghatail thana, in contrast, are located very near the Dhaka-Mymensingh Highway. They were chosen because the author is from the same area and has conducted several field surveys in the locality. No embankment is proposed to be constructed in the latter area because the Jamuna, the nearest major river, is located nearly 15 miles west of these villages.[4]

According to the Flood Policy Study, the Bangladesh Government plans to build a major flood protection embankment, which will pass through the study villages of the Sibalay thana. The construction is scheduled to begin in AD 2003, with completion date set for 2006 (UNDP/GOB, 1989, pp. 6–12; see also Rasid and Mallik, 1993, p. 68). In addition, the FAP has proposed construction of 11 major river embankments during a period of 20 years (1990–2010). Construction of these embankments will occur in stages, starting from the uppermost reaches within

Table 1. *Some selected characteristics of the heads of the sample households*

Characteristic	Ghatail No. (%)	Sibalay No. (%)	Total No. (%)
Primary occupation			
Farming	60 (76)	52 (61)	112 (68)
Business	5 (6)	16 (19)*	21 (13)
Service	10 (13)	8 (9)	18 (11)
Laborer	4 (5)	9 (11)	13 (8)
	$X^2 = 8.276$ (d.f. = 3 and $p = 0.041$)		
Landholding size			
Small	40 (51)	48 (57)	88 (54)
Medium	28 (35)	24 (28)	52 (32)
Large	11 (14)	13 (15)	24 (15)
	$X^2 = 3.787$ (d.f. = 2 and $p = 0.15$)		
Education			
Illiterate	40 (51)	53 (62)	93 (57)
1–5 years of schooling	16 (20)	19 (22)	35 (21)
Above 5 years of schooling	23 (29)	13 (15)	36 (22)
	$X^2 = 4.642$ (d.f. = 2 and $p = 0.091$)		
Age			
<30	7 (9)	24 (28)	31 (19)
30–44	33 (42)	38 (45)	71 (43)
45–59	19 (24)	15 (18)	34 (21)
60 and above	20 (25)	8 (9)	28 (17)
	$X^2 = 15.073$ (d.f. = 3 and $p = 0.003$)		

*Three fishermen are considered under this category since they catch as well as sell fish in the market.

Bangladesh and proceeding downstream (Brammer, 1990, p. 159).

(b) *Questionnaire survey*

Relevant information was collected from sample farmers of the selected villages with the help of a questionnaire. The field survey was conducted during the summer of 1992. A stratified sampling procedure was adopted in order to assure proportional representation from three types of farmers: small, medium, and large. Based on the latest agricultural census classification (BBS, 1986, p. 30) three farm categories were defined as: small farms (up to one hectare), medium farms (1–3 hectares), and large farms (three hectares or more). The number of farmers interviewed in each category is listed in Table 1. The first category also includes a number of pure tenant farmers and landless agricultural laborers. The patterns of land ownership and distribution are more or less consistent with findings from other studies in Bangladesh (e.g. Alauddin and Tisdell, 1988, p. 192). Table 1 shows that the proportion of people drawn from each farm category does not differ statistically between the two study areas.

A sample size of 164 households was covered and the heads of the sample households were interviewed by a team of three field investigators. The respondents were asked two types of questions. Background information, such as age, educational level, and landholding size, was collected first, followed by questions on the construction of the embankment and the perceived advantages and consequences of its construction as a measure of flood control. The second part of the questionnaire consisted of both close- and open-ended questions. First, respondents were asked to provide spontaneous responses, and then they were asked to choose their responses from a set of predetermined alternatives.

(c) *Selected characteristics of the heads of the sample households*

Selected characteristics of the heads of the sample households are presented in Table 1. All heads of the sample households in the study villages were male. The sample household heads are categorized under four occupational groups: farmers, businessmen, service holders, and laborers (predominantly agricultural). Since the overwhelming majority of the businessmen and service holders are, respectively, engaged in small business and low-paid jobs, they are not further disaggregated according to the level of business or type of the job. Similarly, farming is not disaggregated on the basis of tenurial status.[5] Tenant farmers comprise nearly 45% of total farm operators in Bangladesh. The distribution of tenant farmers in the sample villages roughly corresponds with the national proportion.

An examination of the occupation characteristics indicates that nearly 68% of the total head of the

sample households were engaged in agriculture. Business is the primary occupation of 13% of the total respondents, while 11% are employed in the service sector.[6] The chi-square test shows that the two selected rural areas differ significantly with respect to occupational characteristics of the head of the sample households. Table 1 suggests that people of Ghatail are more dependent on agriculture than are those in the Sibalay area.[7]

The field survey suggests that business is the secondary occupation of a far higher number of people living in the Sibalay area than in the Ghatail area. This can be considered one type of occupational adjustment to the floods. Because of the frequent loss of crops due to severe floods, people of the Sibalay area look for nonagricultural activities either as a primary or secondary occupation in order to generate sufficient income to ensure their subsistence. Additionally, the average land owned per household is only slightly higher in the Ghatail area than in the Sibalay area.

Data on educational attainment given in Table 1 indicate that 43% of the total heads of the sample households were literate. Given the country's overall literacy of 25% in 1991 (BBS, 1991, p. 6), the sample represents a higher literacy rate. This is not surprising since male literacy in Bangladesh is much higher than female literacy. Twenty-one percent of the respondents had one to five years of schooling while 22% had more than five years of schooling.

There is an educational level differential between the two selected rural areas. The Ghatail area had a higher literacy rate than the Sibalay area. The rate differed as much as 11 percentage points between the two regions. An even higher difference (14%) is observed in percentage of heads of households with more than five years of schooling (Table 1). But the difference is not statistically significant at the 0.5 level.

An examination of the age of the heads of the sample households indicates that 19% of the respondents were 29 years old or younger, and 43% of the sample belonged to the age group of 30–44 (Table 1). The percentage then continuously decreased as the age group years increased. The age distribution of the two regions differs statistically from each other (see Table 1).

Analysis of selected characteristics of the heads of the sample households reveals that the two selected rural areas significantly differ in occupational characteristics and age structure. But no such difference is observed in farm size and educational level of the respondents of the two areas.

4. RESULTS OF THE SURVEY

(a) *Knowledge about construction of the embankment*

"Knowledge" here refers to whether a respondent knows about or has heard of the construction of embankments along the major rivers of Bangladesh, especially on the nearby Jamuna river. Information presented in Table 2 indicates that slightly less than half of the respondents have heard about the construction of the embankment. As noted earlier, because the respondents of the Sibalay area live near the proposed embankment site, it was expected that they would have greater awareness about the construction of the embankment than the respondents of Ghatail area, who live further away from such a site.

Table 2 demonstrates that the degree of awareness is highly polarized between the two rural areas

Table 2. *Knowledge about construction of the embankment*

	Area		
Knowledge	Ghatail No. (%)	Sibalay No. (%)	Total No. (%)
Yes	71 (90)	7 (8)	78 (48)
No	8 (10)	78 (92)	86 (52)
Total	79 (100)	85 (100)	164 (100)

$X^2 = 109.437$ (d.f. = 1 and $p = 0.001$).

Table 3. *Time elapsed (in months) since first learning about construction of the embankment*

Months Ago	Ghatail No. (%)	Sibalay No. (%)	Total No. (%)
1–3	7 (10)	7 (100)	14 (18)
4–6	36 (51)	0	36 (46)
7–9	23 (32)	0	23 (30)
Above 9	5 (7)	0	5 (6)
Total	71 (100)	7 (100)	78 (100)

Table 4. *Farmers' responses to the construction of the proposed embankment projects*

Study Area	Response: Yes No. (%)	Response: No No. (%)	Total No. (%)
Ghatail	75 (95)	4 (5)	79 (100)
Sibalay	83 (98)	2 (2)	85 (100)
Total	158 (96)	6 (4)	164 (100)

selected for this study. It is surprising that 90% of the total respondents of the Ghatail area have heard about the construction of embankment as a measure of flood alleviation while the corresponding percentage is only eight for Sibalay area. This dichotomy might be attributed to a number of factors. The villages of the Ghatail area are physically more accessible compared to the villages of Sibalay area. Thus, the villages of the former area might have higher access to the relevant information than the latter area. The literacy rate is also higher in the Ghatail area than in the Sibalay area (see Table 1). The difference in the degree of awareness may also be attributed to the occupational and age differences of the two study areas.

Table 3 shows that of the 78 respondents who were aware of the embankment project of the government, only 14 (18%) heard about the project 1–3 months ago. Thirty-six respondents (46%) learned about it 4–6 months ago. About 6% of the respondents became aware of the project more than nine months ago. Table 3 further shows that a large majority of the respondents of the Ghatail area learned about the construction of the embankment much earlier than the respondents of the Sibalay area. All seven heads of the sample households of the latter area who had knowledge about the embankment project learned of it only 1–3 months ago.

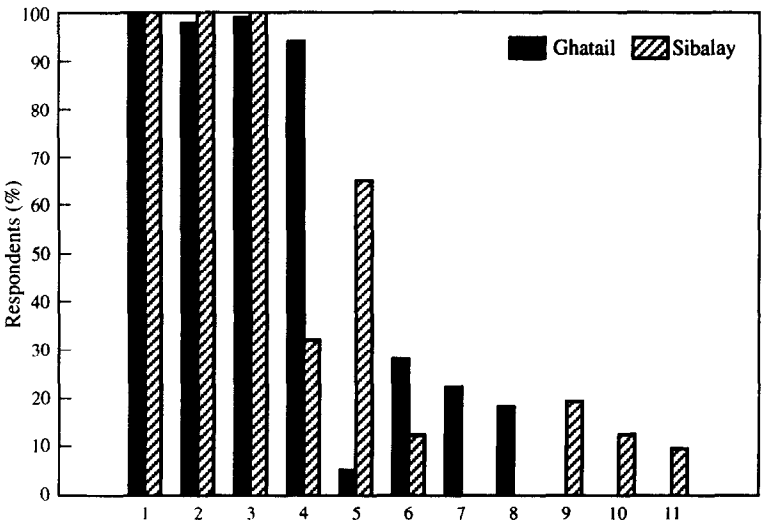
(b) *Respondents' reaction to construction of the embankment*

Contrary to the expectation, Table 4 suggests that the respondents of the study villages strongly support the construction of massive embankments along the major rivers of Bangladesh. Nearly 95% of the respondents of the Ghatail area favor the structural solution to the country's flood problem. The corresponding percentage was 98 in the Sibalay area. The near unanimous support of the respondents can be explained in a number of ways. One possible reason for this could be their recent experience with the catastrophic floods of 1987 and 1988. Environmental hazard studies claim that the peoples' response to extreme events are strongly influenced by the recency of the experience.

It may be that the responses of some of the heads of the sample households were influenced by local officials and leaders, who often blindly support government development programs. In addition, the respondents might have thought that the construction of embankments would bring benefits at the individual, local, and national levels. There is no doubt that the villagers of Sibalay area anticipate wage labor in the construction and maintenance of embankments. The farmers of Ghatail area may not directly benefit the embankment project, but they believe that the country will benefit from such a project. The field survey further suggests that respondents usually have a high regard for Western technology. Thus, they have great confidence in the technological solution to their flood problem. Unfortunately, they are not aware of cases where "structural solutions" fall far short of realizing their goals. Worldwide, embankments have seldom achieved their purpose over the longer term.

Table 5. *Perceived positive impacts of construction of the embankment*

Positive Impact	Ghatail No. (%)	Sibalay No. (%)	Total No. (%)
Reduce crop damage	79 (100)	85 (100)	164 (100)
Reduce property and road damage	77 (98)	85 (100)	162 (99)
Locality/country will prosper	78 (99)	85 (100)	163 (99)
Partially stop flood	74 (94)	27 (32)	101 (62)
Totally stop flood	4 (5)	55 (65)	59 (36)
Reduce flood frequency	22 (28)	10 (12)	22 (13)
Possible to supply water through sluice gate for crop production in time of necessity	17 (22)	—	17 (10)
Embankment can be used as shelter for people and livestock during severe flood year	14 (18)	—	14 (9)
No sand deposition in crop field	—	16 (19)	16 (10)
Facilitate fish cultivation	—	10 (12)	10 (6)
Reduce bank erosion	—	8 (9)	8 (5)



1. Reduce crop damage
2. Reduce property and road damage
3. Locality/country will prosper
4. Partially stop flood
5. Totally stop flood
6. Reduce flood frequency
7. Possible to supply water through sluice gate for crop production in time of necessity
8. Embankment can be used as a shelter for people and livestock during the severe flood year
9. No sand deposition in crop field
10. Facilitate fish cultivation
11. Reduce bank erosion

Figure 2. *Perceived positive impacts of construction of the embankment as reported by the respondents of the two study sites.*

(c) *Perceived positive impacts of construction of the embankment*

Table 5 (also see Figure 2) shows that the respondents mentioned as many as 11 advantages of construction of the embankments. The table further shows that the respondents in both research sites concur with respect to several benefits of the proposed embankment projects, while they differ about other benefits of the projects. In addition, some benefits of the embankments mentioned by the respondents of one area are totally omitted by the respondents from the other area.

All respondents perceived that the construction of embankments would reduce crop damage incurred by floods. All respondents of Sibalay and 98% respondents of Ghatail believe that the project would reduce property and road damage as well. The respondents' conception of massive damage to crops, property, and roads resulting from flooding seems not to be grounded in reality. In a recent study, Paul and Rasid (1993, p. 154) found that the average annual loss of rice production during 1962–88 was nearly 4% of the total rice production. This loss is comparable to the annual loss of foodgrain production caused by drought (Ahmed and Bernard, 1989, p. 39; Hossain, 1990, p. 37). Even postharvest loss of rice production seems higher than the loss resulting from floods (see Greeley, 1987, pp. 120–121).

Large-scale damage to housing structures, roads, and railways only occur during a severe flood year (BBS, 1989, p. 631; Siddique, 1989, p. 245). In fact, damage to roads and railways are not entirely caused by the magnitude of flooding. Islam (1990, p. 24) claimed that in many areas, roads were constructed in an unplanned way, without adequate provision for culverts and bridges. As a result, existing roads and railways block swift passage of floodwater, and, thus, create waterlogging situations, which intensify flood damage to roads and other structures (also see Mirza, 1984, p. 32).

Almost all respondents at both sites reported that their own locality as well as the entire country would benefit from the building of the proposed embankments (Table 5 and Figure 2). This does not necessarily mean that embankments will solve the flood problem of the country. Ninety-four percent respon-

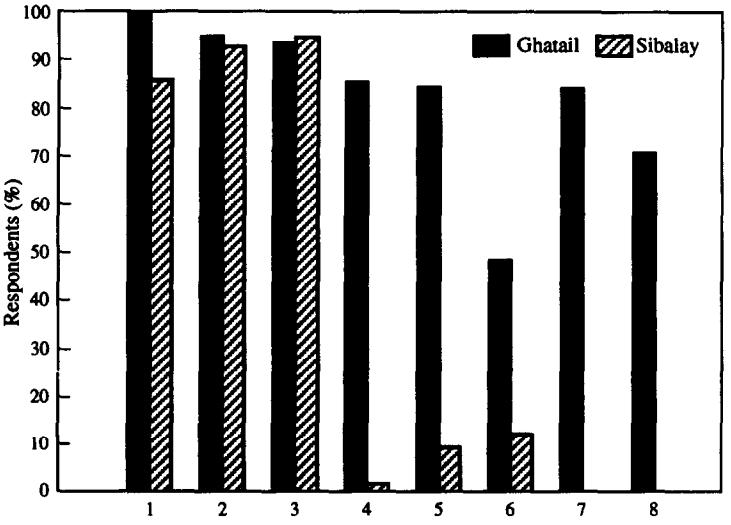
dents of the Ghatail area and 32% of the Sibalay area thought that the embankment would prevent flooding partially. The respondents were also divided in their perception regarding the total prevention of flooding. About 65% of the respondents of the Sibalay area believed that the construction of the embankment would prevent flooding of their locality entirely. Only 5% of the respondents of the Ghatail area agreed with the above statement. A small number of respondents from both sites also believed that the proposed embankment project would decrease frequency of regular, severe, and sudden floods (Table 5).

Nearly 22% of the respondents of the Ghatail area said that once the embankment is constructed they will be able to use water for crop production in times of necessity through a sluice gate. Almost a similar proportion of respondents reported that the embankment can also be used as shelter for people and livestock during a severe flood year. None of the respondents of the Sibalay area mentioned these benefits of the proposed embankment projects.

Sand deposition in crop fields is a concern of 19% of the total respondents of the Sibalay area (Table 5 and Figure 2). Another 12% mentioned that the embankment would facilitate fish cultivation. Fish are generally raised in private ponds and tanks, the banks of which overflow frequently during the monsoon season as a result of flooding. Submersion by flood-

Table 6. *Perceived negative impacts of construction of the embankment*

Negative Impact	Ghatail No. (%)	Sibalay No. (%)	Total No. (%)
Structural failure of the embankment will cause severe damage to properties	79 (100)	73 (86)	152 (93)
Decrease of soil fertility	75 (95)	79 (93)	154 (94)
Decrease of crop yield	74 (94)	81 (95)	155 (95)
Decrease of *aman* acreage	68 (86)	1 (1)	69 (42)
Decrease of fish supply	67 (85)	8 (9)	75 (46)
Loss of land due to construction of the embankment	38 (48)	—	38 (23)
Detrimental to farming	67 (85)	—	67 (41)
Problem for washing jute	56 (71)	—	56 (34)



1. Structural failure of the embankment will cause severe damage to properties
2. Decrease of soil fertility
3. Decrease of crop yield
4. Decrease of aman acreage
5. Decrease of fish supply
6. Loss of land due to construction of the embankment
7. Detrimental to farming
8. Problem with washing jute

Figure 3. *Perceived negative impacts of construction of the embankment as reported by the respondents of the two study sites.*

water inadvertently releases fish stocks from ponds and tanks. Once these fish are swimming in open floodwater, they become common property resources. Only 9% of the respondents thought that the proposed embankment project would protect river banks from erosion (Table 5 and Figure 2).

As noted above, some benefits of the embankment projects were cited by the respondents of only one of two study areas. This might be related to the variation of the two areas with respect to some physical characteristics. Bank erosion was not mentioned by the respondents of the Ghatail area. The selected villages of this area are located far from the major river and, thus, the area is not prone to river bank erosion due to flooding. For the same reason, the respondents of the Ghatail area did not mention sand deposition in the crop fields.[8]

(d) *Perceived negative impacts of construction of the embankment*

Although the respondents of the study villages unanimously support the construction of the embankment, they foresee some negative impacts of its construction to solve the flood problem of the country. Irrespective of the location of respondents, the overwhelming majority expressed reservations about the structural stability of the embankment (Table 6 and Figure 3). In the past, many embankments were washed away because of inadequate design, construction, and maintenance standards (Brammer, 1990, p. 161; Parker, 1992, p. 3). Most respondents fear that embankment failure and the resulting onrush of water might cause severe damage to properties, lives, and infrastructure. Respondents were concerned about the proper maintenance of the embankment.[9]

Respondents of both sites also shared common views about the decrease of soil fertility and crop yield due to construction of the embankment (Table 6 and Figure 3). Contrary to this, some answers were highly polarized between the two sites in terms of the respondents' concern about the effect of the embankment on crops. An overwhelming 86% of the respondents of the Ghatail area reported that the construction would decrease transplanted *aman* acreage, compared to only 1% of the Sibalay respondents. This dichotomy might be related to the cropping systems of the two sites. Transplanted *aman*, which needs flood water in the early stage of its growth, is the dominant crop of Ghatail area, while broadcast *aman* is the main crop of Sibalay area during the flood season. The latter *aman* variety usually thrives best on deeply flooded areas.

Another wide discrepancy was found with respect to fish supply. Eighty-five percent of the respondents of the Ghatail area asserted that construction of the embankment would decrease the fish supply in the locality (Table 6 and Figure 3). The corresponding percentage for the Sibalay area was only nine. The respondents of the Ghatail area mentioned that the proposed embankments would impede the movement of freshwater fish and cut off their spawning areas. They saw this as a threat to millions of traditional fishermen and poor farmers of the country, whose income and subsistence rely heavily upon free public access to floodwaters and their aquatic life. They further mentioned that the decrease of the fish supply due to the construction of the embankment would jeopardize the already marginal supply of animal protein in their diet.[10]

Three other problems, related to construction of the embankment, were mentioned by a considerable number of respondents of the Ghatail area only (Table 6 and Figure 3). Nearly half of these respondents mentioned that valuable agricultural land would be lost due to the construction of the embankment. Some farmers, might even be homeless because their land would be acquired to accommodate embankments and to provide sources of earth. In the context of a fast-growing population, increasing landlessness, and high pressure on land, Bangladesh can ill-afford to lose land for embankment projects.

More than three-fourths of the respondents of the Ghatail area thought that controlling flooding through the construction of embankments would be detrimental to farming. The flood prevention would not allow silt to deposit on the floodplains of Bangladesh. As a result, soil fertility would decrease. Farming would also be hampered because of the lack of necessary moisture. The problem of washing jute due to lack of flood water was also mentioned by 71% respondents of the Ghatail area.[11] Flood water is the main source for washing jute in the Ghatail area, whereas farmers of the Sibalay area wash their jute primarily in the river.

In summary, the respondents of the Ghatail area were not only more aware of the embankment project, their responses regarding the positive and negative impacts of the project were also more diversified and thought-provoking than those of their counterparts living in the Sibalay area. Factors other than proximity to the river have played important roles in providing information about the construction and consequences of the embankment in the study villages.

Irrespective of their location, the respondents were aware of some consequences of building the embankment to protect against flooding. But they were not concerned about the cost of the construction of embankments. They had no knowledge that the construction would result in a steady rise in the nation's foreign debt burden. They were also not familiar with nonstructural measures of flood control, such as zoning, flood insurance, flood forecasting, and early flood-warning systems.

5. CONCLUSIONS

The results of the field survey provide support for the structural solution to the flood problem of Bangladesh. This suggests that the government would receive full cooperation from the farmers in implementing its plans to prevent flooding. The findings, however, need closer examination. The field survey reveals that respondents were not familiar with the multitude of ecological and environmental impacts which might be created due to the construction of embankments along the major rivers of Bangladesh. The number of adverse impacts mentioned by the respondents was fewer than the perceived positive impacts of the construction of embankment.

Although the findings of the present study run counter to the "conventional" wisdom of the opponents of embanking schemes, these opponents can also benefit from this study. The execution of the major flood works proposed in the FAP will proceed in stages. Therefore, they still have time to provide information to the farmers about the environmental and other impacts of the embankment projects. A deliberate attempt may be needed on their part to change villagers' attitudes toward the structural solutions of the flood problem.

NOTES

1. Much of the apprehension about the FAP and its potential efficacy arises from the past performance of older flood control structures. The historical track record displays recurrent and systematic failures of such physical constructions (Adnan, 1991, p. xi).

2. Similar action was also taken by the farmers in order to save their land and property from in-coming floodwater (Adnan, 1991, p. 98).

3. A *thana* is a basic administrative unit in Bangladesh, while a district is the second largest administrative unit, consisting of several *thanas*.

4. Since the two rural areas were purposively selected for field survey, no attempt is made to generalize about farmers' perception of FAP. Nevertheless, because of virtual absence of national level study on farmers' perception toward FAP, the present study may provide valuable insights for both supporters and critics of the FAP.

5. There are two types of tenure farmers: pure tenants and owner-*cum*-tenant farmers. The former do not own any land but cultivate lands of others on a sharecropping basis, while the latter cultivate a portion of their lands with the rest being cultivated by tenants, or they cultivate all of their lands together with the lands of others as sharecroppers.

6. Farming is the secondary occupation of both these groups.

7. The Sibalay area more frequently experiences severe floods compared to the Ghatail area, which might explain the greater dependency of the Ghatail area on farming.

8. Because of the nature of distribution of the responses, no attempt is made to study the sample household heads' responses about the embankment projects in terms of their selected socioeconomic and demographic characteristics.

9. Even the French feasibility study questioned the ability of the Bangladesh government to maintain embankments (FEC and BWDP, 1989, p. 49). Similar concern was also expressed in the UNDP report (UNDP/GOB, 1989, pp. 25–26).

10. Adnan (1991, p. 71) reported a sharp decline in the output of open-water capture fisheries following the construction of a major flood control embankment in the Noakhali and Chandpur districts. Open-water fishing has been estimated to give 80% of the country's total inland fish production (Adnan, 1991, p. 71).

11. Jute is a fiber crop and it has long been Bangladesh's major foreign exchange earner. Jute fiber is the skin over the stem of the plant. It must be softened by fermentation and then removed by washing. The fermentation takes place when the plants are cut, made into bundles and kept under water from 10–20 days. Deep, clear, standing water is the best for retting, while running water is next best, and muddy and stagnant waters are the worst. The nature of retting water determines the quality of the fiber.

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