COPING WITH TOO MUCH WATER: POPULAR INTEREST IN FLOOD RESPONSE MEASURES IN BANGLADESH[1]

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Paper prepared for the Annual Meeting of The Association for Asian Studies
Washington, DC, 2-5 April 1992

ABSTRACT

As part of a large array of World Bank-coordinated studies on flooding in Bangladesh, the Flood Response Study, sponsored by USAID, seeks to ascertain: (1) how a sample of roughly 2250 rural Bangladeshis in 30 villages distributed across the country's three major floodplains cope with floods; and (2) what measures they would like to see undertaken to help them ameliorate flood problems. The present brief preliminary analysis of this ongoing study (due for completion in late summer 1992) focuses on the second aspect. It should be viewed as indicative rather than definitive of how the final version will look.

Two useful ways to group the study's respondents are by the degree of physical protection they have and by their recent experience of floods (the two are not at all redundant). Possible flood response measures are of several types: (a) flood prevention infrastructure (such as embankments); (b) floodproofing infrastructure (enabling people to deal with the consequences of floods rather than prevent them); and (c) service delivery systems (such as flood warning schemes). As might be expected, there is no universal preference for any particular measure; instead people in different situations prefer quite different measures. Furthermore, there are some differences in how people of different socioeconomic status view flood response measures, both across the entire sample and within individual villages.

The policy implications thus far are: (1) that appropriate flood response measures will have to be tailored to local needs, (2) that those needs will vary greatly by geography and likely by socioeconomic status as well, and (3) that a democratic regime such as the new government in Bangladesh should make a concerted effort to facilitate local participation of all social strata in formulating its flood response strategy.

Subject to some flood damage even in the best of years (e.g., Mydans 1987), Bangladesh suffered devastating floods in 1987 and 1988. After these two severe flood years, interest in flood countermeasures assumed an even higher profile than usual both domestically and among the international donor community. Inspired in large part by the French government, the donors moved toward considering a massive series of projects not just to ameliorate the effects of floods but actually to control them. Various schemes were mooted at costs estimated up to $US 10 billion (Momen 1990), and before the end of 1989 the World Bank had put together an

[1] The research reported on in this paper has been sponsored by the United States Agency for International Development and conducted by Irrigation Support for Asia and the Near East (ISPAN) as the major contractor. The author served as senior socio-economist on the ISPAN FAP14 team, along with Mohammad Alamgir, Mustafa Alam, Suzanne Hanchett and Murray Leaf as the other senior researchers. Some of the analysis in this paper appeared in an earlier draft paper by the author, "Analysis of Results: Household and Institutional Surveys," mimeo. (Dhaka: ISPAN, 25 January 1992). The analysis offered and opinions expressed in the present paper are solely the author's and are not necessarily shared by USAID, ISPAN or any of the other principal investigators.

awesomely ambitious *Action Plan for Flood Control* (World Bank, 1990), in which some 26 background/feasibility studies and pilot projects were proposed at a total estimated cost of almost $150 million, which would collectively serve to launch the much larger effort.

The basic idea in the Bank's proposal (for which the *Action Plan* would be a precursor) is to construct a series of embankments along both sides of the country's three major rivers -- the Brahmaputra/Jamuna, the Ganges/Padma and the Meghna -- that would in effect channel all river flow directly into the Bay of Bengal and prevent a reoccurrence of the 1987/88 inundation. Some estimate of the scope of the task may be gained from noting that the peak flow of the combined system into the Bay of Bengal is more than twice the Mississippi's, though its total drainage area is only about half (see Brammer 1990; Dury 1990). The total sediment load is estimated at about seven times more than is carried by the Mississippi system that drains so much of the continental United States (Schumm, cited in Boyce 1990).

As might easily be imagined, anything so massive as the Flood Action Plan (FAP) has occasioned a strong and at times even acrimonious debate, both in Bangladesh and abroad. The Bangladesh government, and in particular the Ministry of Irrigation, Water Development and Flood Control, have understandably been anxious to proceed with all dispatch on the FAP, as have a number of donors, especially the French. Others (including some donors) have been more cautious, warning that a massive embankment program could have serious deleterious effects *inter alia* on soil fertility replacement, water supply for the *aman* rice crop (by far the largest in the yearly cycle) and fisheries (see Rogers et al. 1989; Adnan 1991; Boyce 1991).

In part as a response to the criticism engendered by the various proposals, the 26 components of the FAP mentioned above were designed to include a number of studies focusing on the efficacy, impact and environmental aspects of both previous and potential flood reaction efforts. One of these is FAP14, the Flood Response Study, which is among four FAP components being sponsored by the United States Agency for International Development (USAID).[2]

The study's scope and methodology

The Flood Response Study has essentially two purposes: (1) to ascertain what a selected sample of rural Bangladeshis do to cope with floods both in ordinary years and in severe inundations like that of 1988; and (2) to find out what efforts they would like to see undertaken to assist them to ameliorate flood problems. The study itself consists of three surveys, one focusing on households, a second on institutions and a third on gender issues. The first consisted of several hundred questions (many of them open-ended) administered to a stratified, random sample of 2264 rural households (culled from an initial sample of about 8000) in 30 villages

[2] Each of the 26 components has one or more international donors as sponsor. Most of these activities began at some point in 1991 and are planned to end in 1992.

grouped by pairs within 15 upazilas, chosen to reflect a variety of flood conditions as well as occupations, incomes, landholding patterns and the like.[3] The survey were conducted in the summer of 1991 for the first 24 villages and then in the fall for the final six. The geographical distribution of the upazilas is shown in Figure 1.

The second study component comprised a less formal series of interviews with knowledgeable citizens and officials at village, union and upazila level in each of the survey areas. The idea here was to determine what institutional responses from neighborhood up through district level had been undertaken in past floods and what might be done in future. The first round consisted of the same initial 24 villages (which were covered in tandem with the household survey), supplemented by an additional 41 nearby villages for a total of 65. Likewise, the second round of six additional household survey villages also saw institutional surveys in the same locales plus 9 additional nearby villages for 16 altogether and a grand total of 81. FAP14's third aspect was a gender issues survey, which was more purposefully designed, targeting a selected sub-sample within the larger household survey population for more intensive re-interviews in the fall of 1991.

The overall FAP14 sample was designed to be *illustrative* rather than strictly representative, embracing a range of flood conditions so as to give a broad picture of how people cope with floods.[4] The FAP14 study will finish in the late summer of 1992, culminating in a workshop to be held in Dhaka in late July or August and a final report to be issued after that.

The present paper aims to present some very *preliminary findings* from the FAP14 study and to illustrate some of the *public policy issues* that FAP14 will raise when it is completed. It will focus on the first 24 villages studied, and it will employ the household survey as its database. The presentation is intended to be *indicative* of the methodology and general direction pursued by the overall inquiry but should not be taken to be definitive or even illustrative of what will emerge in FAP14's final report. The study itself is still very much ongoing, both in terms of adding the extra villages to the database and developing more effective ways to interpret its findings; accordingly, the study's exact contours as well as its conclusions may differ markedly from what is offered here.

This brief paper will also present a limited glimpse of the overall study universe in that it will concentrate only on how respondents evaluated various flood response measures. Thus it will not look at the various measures actually employed by respondent households to cope with floods, nor the impact of floods on family members, homesteads, food and fodder budgets,

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[3] For a detailed account of the sample methodology, see ISPAN (1991a and 1991b).

[4] Thus generalizations can be made about how people deal with flood problems under different conditions, but the sample is not intended to reflect proportionally the rural population as a whole. To have employed a sample of that sort and at the same time to have included enough villages situated in differing flood conditions to make these generalizations about flood response would have entailed a much larger, costlier and more time consuming effort.

livestock or cropping patterns, all of which are subjects of FAP14's range of inquiry. Nor will it analyze the institutional or gender issues surveys. It should, however, give some idea of where the Flood Response Study is going and the policy issues it will raise for dealing with floods in Bangladesh.

Flood protection and flood experience

The sample areas selected for the FAP14 study were chosen to reflect a variety of flood experiences. Some villages are well protected against inundation by embankments, polders or the like, while others are distinctly more vulnerable. These varying levels of protection could be expected to go along with different views of what further measures people would like to see implemented in order to improve their ability to deal with flooding. At the same time, the FAP14 villages also possess a range of flood experience, in that some very rarely get (one actually never gets) water, while others get flooded virtually every year.[5]

At first glance, it might be thought that the two concepts should be tautological: Flood experience ought to vary directly with flood protection, such that the more the physical protection the less the experience. To some extent this is the case, as indeed it should be if past flood control efforts have had any effect, but the matchup is by no means exact, as Table 1 indicates. If there were a perfect relationship, all 24 villages would line up along the "main diagonal" of the table, going from upper left to lower right. As it is, however, fully 12 of the 24 fall off the main diagonal, in effect having less flood experience than the level of protection by itself would indicate. In some cases this is because a village is situated on relatively high ground, while in others a village has been spared flooding even though it is low-lying. Table 2 shows the same relationship, except that here it is respondents that are shown rather than villages.[6]

This divergence between flood protection and flood experience permits us to test which is more important as a predictor of how people value possible flood response measures. Is evaluation of a specific measure more a function of the degree of protection they presently enjoy, or is it more closely related to their past experience with flood problems? To the extent that protec-

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[5] The term "flood" has been taken to mean a 20 percent crop loss or the equivalent if there is not a standing crop at the time of inundation. This usage accorded with how the FAP14 respondents viewed the matter. As for flood "protection," a village is considered "fully protected" when there is physical infrastructure to protect it completely from all flooding, though the system can fail due to breaches (generally man-made), faulty design, drainage congestion or the like. "Not protected" denotes a total lack of such infrastructure, and "partially protected" means a village is between the two end points. As could be expected, the one village that is completely "flood free" is so by virtue of being on very high ground and thus is literally "not protected," but it is a special case on this account and so is treated as *sui generis* in the FAP14 study.

[6] In statistical terms the gamma statistic for Table 1 is .740 and for Table 2 is .806. Zero-order correlations (r) between the two measures are .591 for the villages in Table 1 and .636 for the respondents in Table 2.

tion is the best predictor, the policy implication would be to undertake (or avoid undertaking) a given measure depending on what had been done previously -- a matter of filling in the gaps by constructing levees, polders, etc., where they are presently lacking. Where experience is a better predictor, though, matters could be a bit more subtle. Those lacking physical protection measures may not want them, and those having some protection may not want more if what they have seems of little use.

The range of flood response measures

In public policy terms, a wide spectrum of flood response measures exists, varying from complete physical protection against all floods to supplying relief to flood victims. The FAP14 study asked how respondents would evaluate some 20 specific measures and then invited them in a number of different ways to name particular measures on their own in reply to open-ended queries.

This range may conveniently be divided into three types of measures. First, there are measures of physical *flood prevention*, such as embankments. Then second, there are *flood proofing* measures, such as provision of high ground or drainage systems that do embody some degree of physical infrastructure but are intended to ameliorate flood conditions rather than preclude flooding altogether. And finally, there are various *service delivery* measures, like breach warning systems, which involve an institutional effort but not physical infrastructure *per se*.[7] Obviously the level of commitment and costs involved would vary greatly across these three types, with flood prevention being the most ambitious and service delivery the least.

Flood experience/protection and evaluating flood measures

Respondents were asked to evaluate each of the various institutional flood measures on a scale of 1 to 5, with 1 being very helpful, 3 neutral and 5 very harmful. The lower the answer scored, in other words, the more positive the view of the particular measure in question. Table 3 illustrates how respondents evaluated a range of flood measures in all three categories outlined just above.

The first row of Table 3 will serve as an example for interpreting the Table as a whole. Here we find that for the evaluation of an embankment between the respondent's dwelling and the

[7] Some of the measures contemplated in the FAP14 study do not fit easily into a single one of these three categories. For instance, domestic tubewells for drinking water (lack of potable water is a major health problem during and after floods) are physical items, but the actual mechanism for supplying one would generally be to provide the credit needed for a household to finance it, thus making it a more a "service delivery" measure.

major source of flooding, the entire sample[8] has an average answer of 1.83. When the sample is divided up into three groups according to level of flood protection, we see that those living in the five fully protected villages average 1.75 in their answers, while those in the partially protected villages are somewhat less enthusiastic in their assessment of this type of embankment, with an mean score of 1.98. Finally, respondents from completely unprotected villages average 1.55 in their answers, making them the group most favorably inclined toward this flood response measure. This seems reasonable, in that those enjoying the least protection at present would be the most keen on having the kind of flood protection afforded by an embankment between one's house and the major source of flooding.

At the same time, we find that those now enjoying full flood protection think that embankments are somewhat more valuable than those who are at present only partially protected (1.75 mean vs. 1.98). Again, this seems logical, for those who are now fully protected are most likely enjoying that degree of protection precisely because of adequate embankments, while those who are only partly protected may well attribute the incompleteness of their protection to embankments that are not always effective. Though they are more favorably disposed than not towards embankments in general (the mean score of 1.98 is considerably lower than the "neutral" response of 3), still they are not as enamored of such flood protection measures as those who live in fully protected villages.

When we turn to flood experience, we find that those most in favor of embankments between themselves and the major source of flood are the respondents living in areas that get flooded every year (mean score = 1.28). This in fact is the most enthusiastic group to be found whichever grouping scheme is used. Again, this makes sense, for those most exposed to flooding could be expected to be those keenest for embankments to deal with their floods.

The F statistic listed for each set of groups results from an analysis of variance (1-way ANOVA) performed for them. The F is significant at the .0001 level for both sets, meaning that there is a 99.99 percent chance that for both flood protection groups and flood experience groups there is in fact a real difference between the mean values for the three groups in the set.[9]

But use of the F test in the present context is not so much for its value in showing whether a statistically significant difference exists among the means of the groups (though this use will

[8] That is, the entire sample of those who answered the question. In this case 1768 answered and 84 did not, which taken together makes up the total sample size of 1852 (1768 + 84 = 1852).

[9] The ANOVA in all cases reported in Table 3 applies only to the three groups that did experience some flooding. The one village (Kismat in Chirirbandar Upazila) that never experienced flooding is left out. It is included in the sample mean for the entire population, however, as shown toward the left of the two tables. The reason for excluding it from the ANOVA exercise is so that the F statistic will reflect only a comparison between the two sets of three groups each. Including the one flood-free village would dilute the comparison while adding nothing analytically.

come into play at times), as it is as a way of telling which of our two measures more closely relates to differences in respondents' evaluations of specific flood measures. In this particular case, flood protection ($F = 24.6$) is more strongly related to differences in desire for embankment protection than is flood experience ($F = 15.4$).[10]

As for embankments on elevated roads, everyone seems to like them equally well. The group means when arrayed by flood protection level are all just about the same and the F test ($F = 1.3$) is not statistically significant at all ($p = .28$). When we divide the respondents by flood experience, there is some difference between those who get flooded each year (mean = 1.03) and everyone else (mean = 1.20 for the other two groups), but although it is statistically significant ($F = 11.2$), the difference between the means for the three groups is rather less than what emerges for most of the other flood measures.

The flood proofing measures show a somewhat different pattern, with those already enjoying some degree of flood protection being the most enthusiastic supporters. In the "public high ground" question, people were asked about a school or other public area on high ground where they could go in an extreme flood situation. Understandably enough, those who already have some degree of security against normal floods and annual inundation are most concerned about this measure. Thus there is more enthusiasm for this measure among those now fully protected (mean = 1.13) or partially protected (mean = 1.18) than among people who have no protection at all (mean = 1.40, and $F = 48.3$). For the groups based on flood experience, the differences are parallel if less pronounced. Along similar lines, a quick drainage system finds the greatest favor among those best situated already, who can perhaps get another crop planted if they can drain their fields quickly,[11] whereas those more exposed to floods may be less concerned with draining areas that are likely to be covered in water for several months anyway, whether there is a drainage system present or not.

Table 3 also presents evaluations of several service delivery measures. Two kinds of flood warning systems were assessed by FAP14's respondents, one for storm warning and the other

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[10] It could be argued that regression/correlation analysis would be a better measure here, but the advantage of ANOVA is that it permits an assessment of the values (i.e., the means) for each group as well as the effect of the groups as a whole. It also facilitates comparison and interpretation for the users of this report, who are assumed to be non-statisticians.

Interpreting the F statistic here is relatively simple. The lower the F value shown in any of the lines of Table 3, the less the chance that there is any real difference between the three groups being compared, with respect to the particular flood measure being considered. The real value of F in the present context, however, it somewhat different, as noted above in the text. Here it gives a good indication of how much difference there is between the groups. Thus there is a great deal more difference between how the three flood protection groups evaluate quick drainage systems ($F = 57.2$ in the table) than there is when it comes to assessing the worth of elevated roads on embankments ($F = 1.3$). To put it another way, all respondents tend to agree about the value of elevated roads on embankments, regardless of the level of flood protection, whereas there is great disagreement about quick drainage systems between people when they are divided into groups in the basis of flood protection.

[11] A shorter flooding period often permits an extra crop, sometimes even a foodgrain crop.

for warning of breaches in embankments. On storm warning systems, there is not much distinction among flood protection groups (F = 2.8), but there is a great deal of difference in how the flood experience groups view this measure, with those suffering frequently much keener (group mean = 1.50) than those dealing either with rare floods (mean = 1.73) or those faced with yearly flood problems (mean = 1.93). Evidently people confronting an uncertain flood situation each year (i.e., frequent but not yearly floods) show more concern with warning systems than those who get flooded only rarely or those who get inundated every year anyhow.

On breach warning systems, the pattern is much the same, with the frequently flooded villagers much more enthusiastic (mean = 1.44) for a warning system than those in the other two groups (means = 1.84 and 2.14), presumably for the same reasons that would explain the evaluations of flood warning systems. The differences are reflected in the high F value (F = 113.1) for the ANOVA exercise (compared with a F of only 6.9 for the flood protection groups).

Community grain drying facilities (which would charge a fee) show a most intriguing pattern. Here we find that while there is little difference among respondents when they are grouped according to flood protection level (means around 1.9, F = 2.0, not significant even at 14 percent), quite a large difference emerges when people are categorized according to their flood experience. Those dealing with yearly floods show a much greater enthusiasm for grain drying facilities (mean = 1.38) than the other two groups, with a high F (= 88.3).

In an overall sense, flood experience has a much stronger relationship with people's evaluation of service delivery measures (higher F values), while flood protection relates more strongly to at least some infrastructural measures. The implication, then, is that when infrastructural measures are proposed for an area, the present level of flood protection should be taken into account, whereas when service delivery schemes are suggested, people's previous experience at actually getting inundated should be considered first in deciding what specific measures might be most appropriate. Planners cannot assume *a priori* that either single indicator, whether present level of flood protection or past flood experience, will be an accurate guide to the desires of all rural Bangladeshis for enhancing their ability to cope with floods.

Socio-economic conditions and flood response

The physical flood environment, both objective and subjective, plays a very large role in how people deal with floods and what improvements they would like to see in their ability to do so. But these are far from the only factors at play in rural Bangladesh. Social and economic conditions have always been powerful forces at work in other aspects of rural life, and there is good reason to think that this is the case for flood response issues as well.

The principal socio-economic measures gathered in the household survey were identified and collected as part of the original 100 percent survey of all 6685 households resident in the 24 selected survey villages.[12] The major indicators here dealt with household income/expenditure, occupational and landholding patterns (including land rented in and out) and educational levels.

Table 4 will give some idea of how the socio-economic data might be employed in analyzing the FAP14 survey results. Two evaluational measures were chosen as dependent variables -- a quick field drainage facility and a community grain drying facility -- on the thought that a socio-economic component would be more likely to turn up in the predictor variables for these two flood responses than with other measures such as flood warning systems, which would be more likely to interest people of all rural class levels. Five predictors were chosen for this stepwise multiple regression exercise, balanced between socio-economic measures (monthly household expenditure,[13] farm size and household head's educational level) and two flood-related indicators (the flood protection and flood experience variables that have been employed earlier in this essay).

The quick drainage facility finds a respectable multiple correlation (adjusted $R^2 = .177$ or about 18 percent of the variance in evaluation of quick drainage facilities "explained" collectively by the predictors[14)], though as can be seen in the presentation of the standardized (beta weight) coefficients, flood experience is carrying most of the freight here, with education and expenditures picking up some and farm size (which might have been expected to be the most powerful predictor of interest in a facility that would presumably benefit people in direct proportion to the area they farm) accounting for rather less. Flood protection, on the other hand, did not even get included in the stepwise regression before the limit for exclusion had been reached.[15]

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[12] These data formed the basis for then choosing the final sample of 1852 households that the FAP14 survey teams interviewed at length in the May-to-July period of 1991.

[13] Experience elsewhere has shown that rural households tend to find it easier to estimate expenditures than income.

[14] For those not familiar with regression analysis, the single statistic most easily interpreted is the "adjusted R square" measure, which gives a "percent explanation" of the variance in the dependent variable. Here the four predictors included in the final equation statistically account for about 18 percent of the variance in the evaluation of a quick drainage facility by the 1762 household respondents who replied to the question on it. The "R square" statistic also has the excellent quality that it varies between zero (no explanatory value) and unity (indicating an identity between predictors and the variable being predicted). The respective values of the "betas" or standardized coefficients indicate how much each one contributes to the regression; in this case, flood experience (beta = .408) is far and away the largest contributor.

[15] A glance back at Table 3 will recall that flood experience had a much greater relation to assessment of quick drainage systems (F = 219.2) than flood experience (still strongly related at F = 57.7). Predictor variables get included in the stepwise regression equation only if the significance level for its coefficient is less than 0.05 when it enters the regression. As can be seen from the column labeled "T signif." in Table 4, all the coefficients meet this test.

The second exercise, regressing enthusiasm for a community grain drying facility on the same five independent variables, was also expected *ex ante* to show a strong relationship with the socio-economic predictors, especially farm size in view of the presumed beneficiaries of such a facility. The results appearing in Table 4, however, are distinctly unimpressive, with less than eight percent of variance accounted for (adjusted $R^2 = .076$). This time both flood experience and flood protection get included in the stepwise regression equation, but neither has the power observed in the first multiple regression.[16]

Bringing the flood response study home: village level analysis

Thus far our analysis has concentrated on finding patterns in the study area as a whole, contrasting villages with each other in terms of the kind of flood protection or flood experience they have had. This effort has been useful in discovering that different flood response measures appeal to different kinds of localities. In general terms, for instance, we know from Table 3 that people who live in fully protected villages or totally unprotected villages are more enthusiastic about embankments than those who live in partially protected villages. People who live in fully or partially protected villages think more positively about providing high ground public areas for extreme floods than do those who have no flood protection. And people who experience frequent floods value storm and breach warning systems more highly than those who contend with flooding only rarely or all the time.

But all the villages within one of the groups in Table 3 do not show the same scores on any of the questions. Why, for example, does one fully protected village put a higher or lower value on embankments than another? And why does one frequently flooded village esteem warning systems more highly than another? Furthermore, when we look within a given village, say one of the partially protected ones where we know people are generally less keen on embankments than are villagers in the other two flood protection categories, is it everyone who is unimpressed with embankments, or is it certain kinds of people, perhaps those with low-lying land?[17] If we believe that institutional efforts to improve people's capacity to respond to floods should take their wishes into account, then we must ask such questions.

To take the two examples given just above, the main arithmetical reason that partially protected villages as a group show a high score (i.e., low evaluation) on embankments between one's dwelling and the source of flooding is that within the group of seven such villages, two in particular stand out: Pakisha in Shingra Upazila (mean = 2.74); and Rukoni in Madhukali

[16] That is, the "beta weights" (-.282 and .148) are both considerably less than that of flood experience in the first regression (where its beta = .408).

[17] It might be pointed out here that the ANOVA exercise reported in Table 3 compares variation among individuals *within the groups* to that among individuals *between the groups*. There is also variation among individuals within the *villages* within each group, but that is not the subject of the ANOVA test employed here.

Upazila (mean = 3.82). What makes respondents in these two villages relatively unimpressed with the value of embankments? For Pakisha it emerged from the institutional survey that this village inside the well-known Chalan Beel polder in Natore district suffered much distress in both the 1987 and 1988 floods, so much so that they found breaching the embankment necessary to relieve the water congestion inside the polder scheme. It probably makes sense, then, that residents there are less than completely confident about embankments as a protection against flood problems. Rukoni is a relatively remote village which has not suffered much from floods in the past, though objectively it is only partly protected from them. In 1988, however, embankments failed to offer any protection at all, with the result that 85 percent of the standing crop was heavily damaged. Thus the people there found embankments of little use when they needed them, even if they did not need them very often.

For breach warning systems, three villages contribute the most to the low group score (i.e., high evaluation) of 1.44 for the nine villages subject to frequent flooding: Pakisha again in Shingra Upazila (mean = 1.08), Rampur in Nasirnagar Upazila (mean = 1.10) and Auliapukur in Chiribandar Upazila, where all respondents gave such systems their utmost favor (yielding a perfect village score of 1.00). Why should these places be so enthusiastic about breach warning systems? Quite likely Pakisha's inhabitants are interested in such systems because Pakisha suffered considerably before the Chalan Beel polder was breached in both the 1987 and 1988 floods; on those occasions the breaching was seen as a salvation, but on some future occasion it could be actually harmful to the village. In any event, people there are very conscious of problems leading to embankment breaching and deem it highly important to find out quickly when a breach has occurred.

Auliapukur village was also badly flooded in 1987 and 1988, when a breach in the railway embankment running through the area would have helped alleviate their water problems. But government authorities were worried about a breach washing away the railway line and so posted police pickets there precisely to prevent such an act. So there was no breach, but many local residents thought it would have been a good idea, and high on their list of institutional priorities are more culverts passing under the railway track in order to relieve future flood congestion. Clearly there is much awareness of the significance of breaches, and so it stands to reason that there would be much support for a breach warning system.

Rampur village is more difficult to explain in this connection. It is located in a *haor* area where inundation is a perennial problem, so much so that cultivators there can raise only a *boro* rice crop. In effect there are no embankments to offer any kind of flood protection, and so there should be little concern about breaching embankments. In this case it will be necessary to go back to the field data assembled there, perhaps even to visit the study site at some point to discover some explanation for the anomaly.

The data gathered in the FAP14 survey offers many rich opportunities to probe within village level data sets for further explanation. For the villages analyzed in the preceding paragraphs, the information assembled just below provides an opening for such an inquiry.

Flood measure	Village	Mean	Std dev	n
Embankment betw	Pakisha	2.74	1.48	72
house & flood	Rukoni	3.82	0.89	92
Breach	Pakisha	1.08	0.32	72
warning	Rampur	1.01	0.11	79
system	Auliapukur	1.00	0.00	52

We see here that while in Pakisha village there was a good deal of reservation about embankments, there was at the same time much disagreement about them, as reflected in the relatively large standard deviation of 1.48 around the mean value of 2.74. In Rukoni, on the other hand, although there was considerably more distrust of embankments (mean = 3.82, definitely on the negative side of the "neutral" value of 3), the standard deviation of 0.89 indicates that there was rather less disagreement about what people felt on this issue. On the breach warning system question, Pakisha showed a much higher degree of consensus with a standard deviation of only 0.32 around the mean value. For Rampur disagreement was even less, and for Auliapukur there was apparently a complete unanimity on the value of a breach warning system, with everyone agreeing it would be "very helpful" and thus giving the same answer.[18]

In Pakisha, some people evidently considered embankments a good deal more helpful than others, whereas in Rukoni there was less disagreement on the matter. What might account for the lack of consensus in Pakisha? A good guess might be occupation, on the thought that people with crops to lose might well see things differently from those whose major concern was a place of safety for their families. For a breach warning systems, people might well be less divided by occupation, since the warning would presumably affect everyone similarly.

Table 5 pursues this conjecture by dividing households according to occupation of its head into three categories and matching them against the evaluation scores on embankments and breach

[18] The standard deviation is a measure of dispersion around a mean, such that (assuming a normal or bell-shaped distribution) about two-thirds of the cases will fall within one standard deviation above or below the mean. For Pakisha, then, two-thirds of the respondents gave answers between (2.74 - 1.48 = 1.26) and (2.74 + 1.48 = 4.22), with the remaining third being less than 1.26 or more than 4.22. For Rukoni, two-thirds would have been between (3.82 - 0.89 = 2.93) and (3.82 + 0.89 = 4.71). In the case of Auliapukur, since everyone apparently gave a ranking of 1 to a warning system, there was no dispersion of answers, and so the standard deviation was zero.

warning systems.[19] Here we find self cultivators and day laborers rather divided on embankments, with clusters in both the 2 ("moderately helpful") and the 4 ("moderately harmful") columns. Households following other occupations, on the contrary, think much more favorably of embankments, with fully half the group answering 1 ("very helpful"). What is bad for some farmers and laborers is apparently good for others, as well as for non-farming households generally. When it comes to warning about breaches, however, almost everyone (67 out of 72 households) thinks most positively about the idea.

A possibility for deeper analysis here is offered by the socio-economic data collected in the FAP14 survey. A quick look finds the following pattern between embankment evaluation and size of landholding for self-cultivators:

Evaluation score	Mean size of landholding (decimals)	Cases
1	568	5
2	440	10
3	533	1
4	266	9
5	528	1

Except for the two farmers who answered with a "3" and a "5" value on this survey question, there is a distinct pattern here, with landholding size and enthusiasm for embankments directly related, so that larger farmers like them while smaller landholders do not. Clearly there appears to be some class difference at work. A possible explanation could be that the real distinction here is land level, but in fact some 98 percent of all land in Pakisha village is low (i.e., more vulnerable to flooding), so this could not be a factor in accounting for interest in embankments. Household monthly expenditure patterns offer confirming evidence here for the class explanation, as can be seen below:

[19] Because occupation is a "nominal" category that cannot be ranked (or at least not easily), the gamma statistic, which assumes some ranking among categories (and which was employed in Tables 1 and 2 earlier), is not appropriate here. If there are only two categories -- such as "yes" and "no" answers -- this is not a problem, since rank can be assumed between the two nominal answers (as with "yes" and "no" in a binary sense), but with three or more categories such an assumption cannot be made.

Evaluation score	Mean household monthly spending (Taka)	Cases
1	2925	20
2	2285	20
3	3000	1
4	1580	21
5	2080	10

Again there is a trend except for the one household answering "3" and those most hostile to embankments with their "5" answers; interest in embankments varies negatively with household expenditure level.[20]

Conclusion

Though its findings are necessarily tentative, this brief essay has indicated something of the scope of interpretative analysis that will be undertaken as FAP14 moves toward its conclusion in the summer of 1992. It seems evident at this point that people's attitudes about flood response are not a simple matter of wanting more and bigger institutional activity than they have seen in the past. Instead they are quite selective in what they think will be useful. For example, those who face uncertainty in the flooding regime value flood response measures differently from those who get inundated either rarely or yearly. They would prefer breach warning systems over embankments, for example, while people who are already protected against ordinary floods would rather have secure ground for refuge against extraordinary floods like those of 1988 than more embankments. On the other hand, people who have no protection at present would prefer embankments to warning systems.

The present essay is only an initial exploration of a large data source which it will take considerable time and effort to plumb thoroughly. Still, it is possible to draw out some tentative policy implications for future flood response measures on the part of the Government of Bangladesh and the international donor community. First, there appears to be no one flood measure that everyone wants as their first choice, nor can people's choices be inferred from some simple measurement like the level of flood protection presently in place. Appropriate flood measures will have to be tailored to local needs.

[20] The zero-order correlation (r) between embankment evaluation and household expenditure is -.256, while that between it and total landholding is -.290, offering further confirmation of the class hypothesis (not surprisingly, the intercorrelation between the two predictors here is a very high r = .846). As noted elsewhere in this evaluation report, reported monthly household expenditure was thought to be a better measure of affluence than recollection of income itself.

Second, while people in some situations, for instance those in areas suffering from yearly flooding, see physical infrastructure measures like embankments as high on their priority list, people in other situations, even though they may experience frequent flood problems, would put other measures higher on their lists, such as breach warning systems. While many of these preferences vary primarily between one village and another, or between one group of villages and another, some preferences show considerable variation across class and occupational lines, indicating that they would probably benefit rich and poor quite differentially.

Third and finally, a democratic regime committed to popular participation like the present government in Bangladesh will have to make a concerted effort to enlist the considered input of its flood-prone citizenry if it wants future flood response measures to reflect popular desires. Planners will not know what people want and need until they ask them. Older practices of centralized decision-making on flood control will no longer suffice.

In sum, there is no one strategy that is going to be best suited for all places and occasions, and any institutional effort that is going to take people's wishes into account in devising a plan to help them cope with flood problems will have to proceed in directions very similar to those being charted by the FAP14 Flood Response Study.

Table 1

VILLAGE FLOOD PROTECTION AND FLOOD EXPERIENCE
FOR ORIGINAL 24 VILLAGE SAMPLE

		FLOOD EXPERIENCE				
		Never floods	Rare floods	Frequent flood	Yearly floods	TOTAL
FLOOD PRO-TEC-TION	Flood free	121 Kismat				1
	Fully protected		12 Panchtupi 82 Shanakoir 101 P.Durga—pur 111 Goalpota 112 Bokchara			5
	Partially protected		51 Kamaldia 52 Rukoni 71 Budhal	11 Boroitoli 22 Bororia 42 Pakisha 81 Goalbathan		7
	Not protected		31 Shibsen 32 Shingjala 41 Lalua 102 Ut.Shanki bhanga	21 Ch.Bash—alia 72 Bhitidaud-pur 91 Rampur 92 Chotipara 122 Auliapukur	61 Maradpur 62 Fenibil	11
	TOTAL	1	12	9	2	24

Note: Village numbers are union codes used to identify unions and villages in the FAP 14 study.

Gamma = .740

Table 2

VILLAGE FLOOD PROTECTION AND FLOOD EXPERIENCE
FOR 14 HOUSEHOLD SURVEY RESPONDENTS IN 24 SURVEY VILLAGES AND
(number and percentage by row)

		FLOOD EXPERIENCE				
		Never floods	Rare floods only	Frequent flood	Yearly floods	TOTAL
FLOOD PRO-TEC-TION	Flood free	86 100.0				86 4.6
	Full protected		455 100.0			455 24.6
	Partially protected		248 47.1	279 52.9		527 28.5
	Not protected		263 33.5	380 35.6	141 18.0	784 42.3
		86 4.6	966 52.2	659 35.6	141 7.6	1852 100.0

Gamma = .806

Table 3

HOUSEHOLD EVALUATION OF INFRASTRUCTURAL AND SERVICE DELIVERY FLOOD RESPONSE MEASURES BY LEVELS OF FLOOD PROTECTION AND FLOOD EXPERIENCE
(Figures show group means)

Flood Measure	Entire Sample		Flood free	Level of Flood Protection				Level of Flood Experience 1980-1990			
	N	Mean	Village	Full	Partial	None	F	Rare	Fre-quent	Yearly	F
FLOOD PREVENTION INFRASTRUCTURE											
Embankment between house and flood	1786	1.83	3.75	1.75	1.98	1.55	24.6	1.75	1.82	1.28	15.4
Elevated road on embankment	1850	1.19	1.26	1.21	1.12	1.13	1.3	1.20	1.20	1.03	11.2
FLOODPROOFING INFRASTRUCTURE											
Public high ground for extreme flood	1848	1.30	2.08	1.13	1.18	1.40	48.3	1.19	1.36	1.33	22.4
Quick drainage system	1848	1.45	1.24	1.23	1.45	1.60	57.2	1.32	1.48	2.35	219.2
SERVICE DELIVERY											
Storm warning system	1249	1.64	1.23	1.69	1.68	1.62	2.8	1.73	1.50	1.93	57.7
Breach warning system	1831	1.77	3.01	1.63	1.79	1.71	6.9	1.84	1.44	2.14	113.1
Grain drying facility	1840	1.93	2.41	1.88	1.96	1.88	2.0	2.10	1.72	1.38	88.3
Total Sample n	1852		86	455	527	748		966	659	141	
Village n	24			5	7	11		12	9	2	

Note: FAP 14's one totally flood-free village is included in the "Entire sample" column (both for n and mean) but is not included in the three flood protection groups in the ANOVA statistics. The different figures in the "Entire sample" n column reflect non-response.

Table 4

MULTIPLE REGRESSIONS FOR TWO FLOOD RESPONSE EVALUATIONS

Evaluation of quick drainage facility

Multiple R .423
R square .179 n=1762
Adjusted R square .177

Predictor Variables	Beta	T	T signif.
Flood experience	.408	18.86	<.0001
Educational level	-.082	-3.65	.0003
Monthly household expenditure	.073	3.16	.0016
Farm size	-.051	-2.27	.0232

Evaluation of community grain drying facility

Multiple R .280
R square .079 n=1754
Adjusted R square .076

Predictor variables	Beta	T	T signif.
Flood experience	-.282	-10.23	<.0001
Farm size	-.143	- 6.20	<.0001
Flood protection	.148	5.39	<.0001
Educational level	-.073	- 3.16	.0016

Table 5
FLOOD MEASURE EVALUATION AND OCCUPATION IN PAKISHA VILLAGE, SHINGARA UPAZILA

Embankment between house and flood

Occupation	evaluation score					
	Very helpful 1	2	Neutral 3	4	Very harmful 5	Total
Self cultivator	5	10	1	9	1	26
Day laborer	2	6	0	8	4	20
All others	13	4	0	4	5	26
Total	20	20	1	21	10	72

Breach warning system

Occupation	evaluation score					
	Very helpful 1	2	Neutral 3	4	Very harmful 5	Total
Self cultivator	23	2	1	0	0	26
Day laborer	19	1	0	0	0	20
All others	25	1	0	0	0	26
Total	67	4	1	0	0	72

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BANGLADESH
FAP-14 Flood Response Study
Sample Upazilas

FIGURE 1