

*Call - 785  
FAP 21/22*

FLOOD PLAN  
COORDINATION  
ORGANIZATION  
(FPCO)

KREDITANSTALT FÜR  
WIEDERAUFBAU (KfW)

CAISSE CENTRALE DE  
COOPERATION ECONOMIQUE (CCCE)

(15)

BANK PROTECTION AND RIVER TRAINING  
(AFPM) PILOT PROJECT  
FAP 21/22

*pm - 6038  
A - 785 (1)*

COMMENTS TO INTERIM REPORT  
AND ANSWERS

OCTOBER 5, 1992



CONSULTING CONSORTIUM FAP 21/22

RHEIN-RUHR ING.-GES.MBH, DORTMUND/GERMANY

COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE  
PROF.DR. LACKNER&PARTNERS, BREMEN/GERMANY  
DELFT HYDRAULICS, DELFT/NETHERLANDS

In association with:

BANGLADESH ENGINEERING &  
TECHNOLOGICAL SERVICES LTD.(BETS)  
DESH UPODESH LIMITED (DUL)



# BANK PROTECTION AND RIVER TRAINING (AFPM) PILOT PROJECT

FAP 21/22

FLOOD PLAN CO-ORDINATION ORGANIZATION (FPCO)

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Consulting Consortium FAP 21/22  
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The Chief Engineer  
Flood Plan Coordination Organization  
7, Green Road  
Dhaka.

Our Ref: CC/FPCO/L/92-765

October 7, 1992

Subject: **Comments to Interim Report**

Dear Sir,

Referring to your memo No. 1967/FPCO/A-21/22/90 dated 17.09.92 we have pleasure in submitting you 30 copies of the report on the comments and our answers.

For easy reference we have included the comments and put them in italic.

As requested in your above letter we have answered the comments of category 1 and 2 only.

In case you should have further questions please do not hesitate to contact us.

Sincerely yours,



Dr H Brühl  
Project Director

Encl: 30 copies of the Report on the Comments and Answers to the Interim Report.

HB/SK



GOVERNMENT OF  
THE PEOPLE'S REPUBLIC OF BANGLADESH  
MINISTRY OF  
IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL  
FLOOD PLAN CO-ORDINATION ORGANIZATION  
7, GREEN ROAD, DHAKA-1215  
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Memo. No-1967

/FPCO/A-021/22/90

dt-17-09-92

To

Dr. H. Bruhl  
Project Director, FAP 21/22  
House no-4, Road no-125, Gulshan  
Dhaka.

Sub: Comments on the Interim Report of FAP 21/22, Bank  
Protection and River Training/AFPM Pilot Project.

Dear Dr. Bruhl,

We received the Interim Report July, 1992 of FAP-  
21/22, Bank Protection and River Training/AFPM Pilot Project  
and have the pleasure to furnish herewith the comments of FPCO  
on the report. The preliminary comments received from KFW are  
also enclosed.

You are requested, to please submit your response on  
category 1 and category 2 comments and also on comments of KFW.  
If you wish we may discuss category 3 comments at a suitable time.

Thanking you,

Yours sincerely,

*(Signature)*  
(M.H. Siddiqi)

Enclo: As stated.

FAP 21/22

Chief Engineer  
FPCO.

R E C I V E D	
No. 611	20.9.92
Action	cf remarks
Draft no. 7	
For info	
Copy	HB, Fvdk, HK, Hvdw

20/9/92

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FLOOD PLAN  
COORDINATION  
ORGANIZATION  
(FPCO)

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KREDITANSTALT FÜR  
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**BANK PROTECTION AND RIVER TRAINING  
(AFPM) PILOT PROJECT  
FAP 21/22**

**COMMENTS TO INTERIM REPORT  
AND ANSWERS**

OCTOBER 5, 1992



CONSULTING CONSORTIUM FAP 21/22

RHEIN-RUHR ING.-GES.MBH, DORTMUND/GERMANY

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Comments of KfW on Interim Report of FAP 21/22, Bank Protection  
and River Training/AFPM Pilot Project

*The preliminary comments made by KfW on the Interim Report of FAP 21/22, are:*

**FAP 21:**

*We suggest to include into the monitoring programme of the next phase the works of the River Bank Protection Project. By doing this, the information basis of the test phase on the behaviour of bank protection works can be considerably enlarged and improved.*

**Answer:**

The Consultant will include this monitoring in his programme. Description will be made in the Draft Final Report.

*We fully agree to the proposal of the Consultant to perform tests only in two test areas to economise between cost for developing a test site and morphological risk of a test site. The proposed test areas at Bahadurabad and Kamarjani are agreeable to us. We further suggest to pre-investigate, whether Sariakandi and Kazipur areas would be feasible test areas in case the agreed test areas may be dropped due to morphological reasons during the course of the project. These areas seem to be very attractive under the aspect of the selection criteria "something to defend".*

**Answer:**

The Consultant has taken note of this suggestion and is proposing to FPCO an updated work plan which would include these pre-investigations. It is assumed that the Consultant will have immediate and free access to all data available on these potential test sites particularly to those produced by FAP 1. The Consultant believes that Kazipur is probably also attractive from the "certainty-of-attack" criterion.

**FAP 22:**

*The Consultant focussed his efforts on the issue of identifying a test programme for AFPM. There are no clear indications in the Interim Report whether the Consultant has already worked on the River Training/AFPM strategy study. The Consultant should be reminded on the importance of this component of FAP 22 study phase.*

*For the preparation of the Final Report the Consultant should take into account that test works for AFPM can only be financed by KfW if a clear justification (need for the project) is presented as basis for our final appraisal.*

Answer:

It is admitted that the Interim Report did not include any study on River Training/AFPM strategies. The Consultant felt that he should first concentrate on the preliminary investigations whether or not recurrent measures for AFPM may be a viable alternative and he has indeed found out that such measures seem to be technically feasible.

It is understood that the Draft Final Report FAP 22 shall contain an assessment on and a recommendation of River Training/AFPM strategies to be implemented on the Jamuna river. The Consultant is presently working on that task and is confident to present an attractive proposition.

## CATEGORY 1 COMMENTS BY FPCO

### 1. General

- 1.1 *The Consultants have produced a high standard of Interim Report. However, it would be improved by a four or five page executive summary. In addition to providing a precis of the main features and findings at this interim stage for those who do not have time to go through the full report, it would provide an initial and useful overview for those who will be reading the full report. All FAP report of substance should have an executive summary.*

*On the question of two instead of four pilot projects for bank protection, the Consultants should continue their search for suitable sites and in any case retain some other sites as a contingency in case one or both of the selected sites proved inadequate.*

*If the findings of FAP-22 continue to be encouraging, consideration should be given to revision of the budget for AFPM. It should be remembered that at the time of formulating FAP 21/22 the donors were apprehensive about AFPM and consequently placed overriding emphasis on FAP-21. Bank Protection. If the proposed tests prove to be successful the Consultants should assist in developing a long term strategy, which does full justice to all aspects of the development and management of land and water resources in the riverine areas. Public consultation will have to be an important issue from the beginning.*

*Unless stated differently, the comments refer to the Main Report.*

#### Answer:

The suggestion to include an executive summary is noted as guidance. The Draft Final Reports will include executive summaries which, additionally, will be presented in separate volumes.

As regards to retaining some spare test sites, reference is made to the second answer to the KfW comments. The sites of Kazipur and Sariakandi will be included on the investigations as such contingency sites.

Note is taken also to include public consultation and in fact first discussions have been held with the local population at the two selected test sites.



- 1.2 *The Consultants have completely ignored the TOR requirement, as enunciated in 3.2 section, para 2 of page 4 of the TOR. This para requires the Consultants to produce one of the outputs; "a critical evaluation of all the tests that have been carried out covering ...social and environmental considerations, as well as institutional requirements." While going through the interim report it was not found any reason advance by the consultants for not providing a critical evaluation of all tests covering social requirements.*

*It seems that the Consultants have either failed to understand to TOR requirement and also the 11th Guiding Principle of the GOB or did not give any serious consideration to what these two documents have obligated the Consultants.*

Answer:

It is true that the Interim Report did not contain chapters on socio-economic and environmental issues. The reason of that is, however, not that he has ignored these topics but that according to his work plan, see Fig. 6.1-1 of the Interim Report, no activities went on in these fields during the period covered by the report viz April to June. The Task 11 and 12 on Environmental and Socio-Economic Assessments, respectively had a break during that period in order to elaborate the basis for the tasks of these experts. The respective studies have been taken up in September.

- 1.3 *FAP 21/22 aims at evolving appropriate bank protection techniques and cost effective methods of work in the Active Flood Plains. As such, the Consultants argue, it is not anticipated to include a full economic analysis of costs and benefits. However, it should be mentioned here that if one requires to find the most efficient alternative out of a number of cost-effective methods for works, then it is necessary to include a full economic analysis of costs and benefits data available from various bank protection works.*

Answer:

A differentiation has to be made between the two Project components: whereas FAP 21, being substantially an investigation on test structures, does not allow to determine economic benefits but is restricted on comparing and minimizing costs, benefits will be assessed for FAP 22 dealing with river training. It should however be stressed that the ToR do not ask for a full fledged cost-benefit-analysis, as stated in the scope of works chapter D-3, clause 5.2.6.



It is understood that the Draft Final Reports shall give some clear indications of the cost-efficiency of proposed bank protection structures for FAP 21 and comparison of alternative investment and recurrent costs, possibly decreased by benefits expected from an improved active flood plain management for FAP 22. The economic feasibility will, however, have to be examined within overall development projects including the construction of FCDI-structures which are outside the scope of the Pilot Projects.

## 2. Chapter 2, Selection of sites for FAP-21 test works

2.1 *The Consultants propose to reduce the number of test sites from the originally proposed number of 4 to 2: Bahadurabad and Kamarjani. Since the time the earlier recommendation was made new evidence apparently rendered the other sites (Chandanbaisa and Nakalia) less useful. It is now proposed to test a number of groynes at Kamarjani and some types of revetments at Bahadurabad. The proposal in itself may be logical, but it raises a number of questions:*

- *If circumstances that govern the selection of suitable sites are apparently so fluid, how certain can one be that after one or two more floods also the two remaining sites may not be suitable any more ? The study seems to suggest that the certainty may be rather low indeed. The implications of this could be far reaching, because it could mean that a strategy to gradually stabilize the bed of the river by means of a number of hard points might not be very effective, as there would be no certainty that such point would be under attack for any duration. The only effective way would in that case be that the river is trained in phases, which cover much greater lengths than considered now. This conclusion cannot easily be accepted, and therefore implicitly neither the suggestion made by the Consultant that hardly any points could be found on either bank, which will be under attack for some years. The Consultants may have to study available data on the entire river more carefully.*
- *The proposal to limit the number of sites to two only, has some clear advantages, as far as construction and monitoring are concerned. The assumption is of course, that sufficient length of the river bank is under attack at each of the two sites to test various structures under representative conditions. The Consultants may elaborate this point. At the same time they may discuss the assumption that the two points proposed now, which are both situated at the upstream stretch of the Jamuna, are sufficiently representative for the entire river.*
- *In addition to the above, the Consultants are requested to have another look at the Nakalia site. Although there may be tendencies of a reduced erosion at this point, there probably always will be a channel of some importance near the west bank, because of the storage effect of the Hurasagar-Atrai. Stabilizing this point would*

*always be useful, since it will enhance the chances for a stable outfall of the Hurasagar, which is important for the control of the hydrological regime in the Chalan beel area, as well as for navigation.*

**Answer:**

The comment on the selection of the test sites addresses one of the most critical issues of FAP 21, notably the need to maximise the possibility that the test structures will actually be tested during the test phase of the project. The comment gives rise to the following observations:

**(a) Number of test sites**

Never it has been stated or implied by the Consultant that the number of test sites would be four. In the Scope of Works (Task 14) it is stated that "it appears advisable to restrict the number of independent test sites to three". This statement was based on a first cost estimate done during the proposal phase. In the Inception Report (p.4-36) it is stated that: "It is planned to carry out test works at 2 or 3 different sites contingent on the volume of work possible to be executed within the financial budget ceiling". A better estimate of the costs of constructing the test structures is the basis of the text in the Interim Report. As is shown in Chapter 4 (see page 4-5), the present budget for the construction of the test structures within the framework of FAP 21 and for the pilot project of FAP 22 amounts to DM 49,000,000.-, in which the consultancy costs during the planning, design and testing phase are not included. Obviously, planning for more than 2 independent test sites would result in having more expenses for "non-active" items such as site installations, access roads, mobilization and demobilization and last not least the termination works. Hence, having a fixed ceiling amount at disposition only, the funds for active test structure would be reduced.

Further, due to the different sites the comparability of the results would probably be lower. Therefor the Consultant is at present favouring one site to test groynes and the second one to test revetments.

In the Draft Final Report an assessment of the "non-active" cost will be made allowing to determine the net test works length as a function of the numbers of sites.

**(b) Selection of test areas**

Right from the beginning of the project the Consultant was aware that locations which were selected in an early stage as test sites could, in a later stage, be rejected because of a more detailed study of the available data. During the inception phase of the project only satellite images were available of the years 1987, 1988 and 1991 (the latter on a fairly small scale, obtained from a report by FINNMAP), and the latter two only of the reach south of Bahadurabad. Only the SPOT satellite maps of 1989 as provided by FPCO were quite detailed and covered the full river reach. Based on this information supplemented by other data, in Technical Report no. 1, a number of potential areas were selected and assessed as



to their suitability. In the period since March of this year a very extensive remote sensing study was carried out covering the full period of 1973 through 1992. Especially the latest images are of course very useful and they allowed to assess the pre-selected areas in much more detail. The results of this more detailed analysis are reported upon in the Interim Report, and based on these results the two most promising areas as far as the certainty-of-attack and other criteria is concerned were selected. Hence, the fact that two sites will not be considered any further is a logic consequence of the procedure followed and the budget available.

Hence the changes that have taken place after the flood of this year will be studied by the Consultant and comparisons will be made with the predictions presented in the Interim Report. The implications for the selection of the test areas, if any, will be presented in the final reporting for the planning phase.

**(c) Are the two selected test areas enough and sufficiently representative?**

It is felt that there is no specific advantage to select more than two sites to increase the length of river bank under attack. If the various test structures are not attacked under entirely the same conditions (and most probably they will not!), it is needed to interpret the observations made and damage recorded carefully. In their approach Consultants intend to do model investigations parallel to the testing of the structures in the field to correct for these effects of not-similar attack and to learn as much as possible from the observations done in the testing phase.

As far as the representativity is concerned, indeed the conditions in the downstream Jamuna are sometimes somewhat different from the upstream reaches: in some years the river tends to a slightly more meandering appearance. It is felt, however, that the behaviour is not so different that the lessons to be learned from the test structures in the upstream reaches are not equally important for structures along the more downstream reaches. Furthermore it is felt that erecting bank protection works along the downstream reaches is not posing specific problems to those as present more upstream. Hence there is no need to select a test site more downstream.

**(d) More careful study of available data on entire river needed ?**

It is suggested that the Consultant should study the available data on the entire river more carefully, because it apparently is felt that such a study would result in the discovery of "hard points" not identified earlier by the Consultant. The Consultant does not agree with this view. They have used all available data extensively, adding new information via the satellite image study and developing new techniques for prediction of planform changes at the same time. Only a completely different approach, like deciding to build the bank protection works like a protusion, would increase the certainty-of-attack (see also hereafter). Such a strategy would be much more expensive, and would not be representative for future bank protection works. Hence, the Consultant does not agree with the comments on this point.

**(e) Nakalia site**

In the comments it is proposed to once more consider Nakalia as a potential test area. There are apparently some benefits to obtain and "there probably will always be a channel of some importance". However, the criterion of certainty-of-attack should not be interpreted as the certainty-of-a-channel-being-present. Indeed the certainty-of-a-channel-being present near Nakalia is almost 100%. This does not imply however that the test structures are attacked fiercely by the river. The latter however is required, and considering the predicted changes near the Nakalia site (see Fig. 2.3.2-4 of the Interim Report), there are good reasons to assume that in a few years the heavy attack near Nakalia will stop.

**(f) Implications for strategy for stabilizing the river**

The implication that nowhere the attack of the river on the banks in the period 1994-1997 can be guaranteed fully, is not that a strategy of gradually stabilizing the river by means of hard points is not effective. On the average the Brahmaputra/Jamuna river system is "taking" a width of 15 km. Along the (imaginary) axis of the river (or the axis of the two anabranches), a band of river course the river may take, can be drawn. The further away from the axis, the smaller the probability that one of the anabranches of the river is flowing there in a period of say 20 years.

Hard points will be constructed at a certain distance from the axis. The nearer to the axis the hard point is constructed, the more the likelihood is that the hard point will be attacked. This is also the very reason why the river is almost always attacking Sirajganj: because of the gradual shift of the river in Western direction since many decades, the location of Sirajganj is very near to the "axis". An important part of the river training strategy would be where to build the hard points. If they are built in an exposed position (e.g. at a location where in that particular year a char is present), then by building an increasing number of groynes as hard points, the river will be trained gradually. For a river which is slowly moving in a preferred direction (as is the case for the Jamuna River, according to FAP 1), erecting hard points at the edge of the river will gradually lead to a constricted river reach. Hence these hard points will gradually be attacked more and more, and hence they will be more and more effective in training the river (supposing that they are at a not too large mutual distance).

**2.2** *The Consultants are expected to present in due course more details about the various test works. Apparently 3 different groynes are to be tested and some of the varying characteristics are shown in Figure 2.3.5-3. However, more details are needed before final approval can be given. Will various structural designs be tested? Why is the scour depth set at 15 m only, see p.2-33.d and also Annex 3 for the different types of scour that could happen.*



Answer:

In accordance with the work flow chart the preparation of alternative and preliminary design for both types of structures is in progress. Details will be presented for approval with the Draft Final Report. The same holds for the scour depth, the investigation of which is not yet finished.

- 2.3 *At Bahadurabad ten types of revetment are to be tested. Also here the Consultants are expected to provide more information in due course. The same observation as above with respect to the scour depth apply.*

Answer:

Same answer as above. The number of ten types has to be taken as an indicative figure. It will be decided during the preliminary design, which is under way, which and how many different types of bank protection techniques will eventually be proposed for testing.

- 2.4 *p.2-37, Conclusions: Even though there are probably no significant adverse environmental impacts in undertaking bank protection pilot trials, the Consultants should nevertheless identify/list all possible impacts and demonstrate that they are either insignificant or can be easily mitigated. Potential impacts due to the experimental nature of the project (i.e. failure of a revetment could result in exacerbated erosion) should be explained, FAP 16 will doubtlessly advise.*

Answer:

The Consultant is investigating possible beneficial and adverse environmental effects and, in case of the latter ones, identify mitigating measures. The Project is in close touch with FAP 16 and 17 in that respect. As to the possible failure of an experimental revetment, erosion will probably be not more severe than it is now either naturally or when a "regular" revetment or groyne happens to fail.

### 3 Chapter 3, First tentative conclusions for AFPM

*The discussion in this chapter is very encouraging. The Consultants explain that there could be cost effective measures by which the distribution of flow in braided channels can be influenced. Notably surface panels appear to be promising. In reality a combination of measures, possibly including dredging, may be more effective than one single intervention. There are some questions which the consultants may answer.*

*In section 3.5 the consultants underline the necessity of having a clear strategy in mind when interventions in a river like the Jamuna are being considered. In this respect the professional recommendation of the Consultant is solicited. It would seem that a modest initial strategy would be advisable, implying that the first objective should be limited to demonstrating at a well selected site that the suggested measures can be effective. A next step would probably be to prevent/relieve bank erosion at some critical point(s). In later stages, when results continue to be positive, a more aggressive strategy could be adopted. In doing so full attention is to be given to all aspects of AFPM, that is the development and management of land and water resources in the riverine areas, which will require integrated planning. Although this may not be a point of immediate concern as long as the feasibility of the proposed interventions has not been demonstrated, the Consultants should have a broad-minded approach with respect to AFPM. In particular they should be aware that even small scale interventions could have an impact on the system of rivers and chars. Jointly with developing technical plans, they should think about mechanisms by which the population living within the flood plain should be consulted.*

*If the prospects for AFPM are as positive as the consultants appear to believe, there might be reasons to make some changes in the respective budgets. As proposed now, the budget for AFPM is less than 8% of the total budget. The estimates for both permanent and recurrent measures are still preliminary. They were established at the start of the projects, when the donors were apprehensive about AFPM and consequently placed overriding emphasis on FAP-21, Bank Protection. However, if the findings of FAP-22 continue to be encouraging, consideration should be given to the revision of the budget. Therefore at this stage the relative budgets may considered to be flexible and the Consultants should give an indication when latest firm commitments have (to be made ?)*

Answer:

A combination of measures will undoubtedly give better and quicker result. Due to the lack of knowledge of such measures for Jamuna conditions, the most promising measure (surface panels) has been selected for thorough investigation into its possible applicability. The suggestion of a combination of measures, however, is noted.

The suggestion as to the selection of a strategy is noted for guidance. Details on possible strategies will be dealt with in the Final Report. Mid term and long term effects of intervention will be considered within the limit of presently available theories and data. However, the recurrent river training/AFPM measures will have the advantage, that negative impact can be stopped or even reversed. This, of course, depends very much on a good organization and monitoring system.

The decision on how to utilize the budget is up to the Client in concurrence with the Financing Agencies. The Consultant will give his cost estimations and recommendation for test structures with his final report. It may be stated however to date that the findings on efficiency of recurrent measures are based on simplified mathematical models and cannot by any means already taken as granted. Before going for a first test on the prototype, more in detail investigations will be required including physical model tests. Only after the additional investigations giving positive results a first (small) trial on the Jamuna should be done. This may take one to two years from now. On the other hand, there is no doubt that bank protection measures will be needed on the Jamuna as well as in other parts of the country and it is also generally agreed that new design and construction methods are needed as soon as possible.



## CATEGORY 2 COMMENTS BY FPCO

### 1. Volume I, Page 2-1, Section 2.1, Para 4

*The criteria fixed for recommendation of test works at two sites only should not be limited to the scenarios mentioned. It should also consider how the available fund could best be utilized covering more sites. It is felt that such heavy expenditure oriented test works should be utilized where immediate protection are also necessary for the protection of important establishments. This can be achieved by applying alternative designs for other locations besides Kamarjani and Bahadurabad. In this context Nakalia site may also be considered for test works.*

#### Answer:

Reference is made to the Technical Report No.1 of 01/03/92 on the pre-selection of test areas, Section 3.1. The "something-to-defend" criterion was elaborated as follows:

"Although the prime objective of the project is the testing of alternative structural solutions for optimizing bank protection works, it is nevertheless understood that the money spent should at the same time fulfill some useful purpose. Therefore, the selection of test sites should also take into account the protection of some valuable infrastructure, e.g. towns, market places, ferry ghats, existing hydraulic structures etc.

However, since the objective of optimum and most economic design solutions does not rule out that certain damages to the structures may occur or may even be desirable for assessing possible failure mechanisms such sites shall be excluded which call for protection purposes on top priority basis. A further reason to exclude these sites is that there the protective measures have to be built as a whole so that the total construction will be larger than needed for testing purposes only. That would mean the use Project funds for non project-related purposes."

As to having more test sites than two and to Nakalia, reference is made to the Consultant's answer (a) and (e), respectively, to the comment 2.1 of category 1.

### 2. Volume I, Page 2-12, Section 2.2.1

*The Consultant has given predictions of erosions of Jamuna river bank at various proposed test sites which needs to be assessed also in the following manner:*



- *The satellite images up to 1988 may be reviewed and predictions of erosion up to March, 1992 may be made according to the methodology of the Consultant. These predictions may be compared with the actual satellite images of 1992 available with the Consultant. If the predictions and the actual are close, then the concluding prediction of erosion of the Consultant up to 1995 would be justified.*

Answer:

Rightly FPCO indicates that the method used by the Consultant to predict the future developments of the planform of the river should be verified. This has not been done explicitly. During the analysis of the different processes active in the Jamuna River, as done in the remote sensing study, the data of the period 1988-1992 were already used, hence independent verification will be difficult. It is intended however to continue along the lines suggested by FPCO. At this moment possibilities for further development and verification are being explored and proposals for this will be part of the recommendations at the end of the planning phase.

It should be realized, however, that most of the processes are stochastic (bank erosion rates e.g. are in fact predicted as an average with some standard deviation). That means that ideally not one prediction of the future bank lines and bank erosion rates should be provided but that for each reach the probability of a certain development is indicated. In terms of developments over a number of years this implies a "tree" of events. Hence it will be difficult to truly verify the model for a specific period.

3. Volume I, Page 2-13, Section 2.2.1, Last Para (Kamarjani)

*It has been mentioned that Manos Regulator may be eroded away before a test structure can be built. In view of this it is necessary to review the possibility of expediting the test work in addition to the review of the erosion predictions at that site.*

Answer:

The time schedule for implementing test structures is given by the necessities of planning, designing and preparing the construction as well as by the methodologies and rules applied by GoB and the Funding Agencies for Financing works. The commencement of construction on the first test site, which would be Kamarjani, is planned for immediately after the monsoon 1993. This date can only be achieved if final design would start in February 1993 and first purchases of equipment shortly later, say April 1993.

At the time where this answer is being formulated, end September 1992, the Manos river regulator is still working, albeit damaged, and it seems that it may survive the 1992 flood season. In that case it would be highly recommendable to have done some emergency works by BWDB in winter 1992/1993 to improve the chance to have the regulator served after the 1993 monsoon.

The comment rightly hints at the necessity of fast and flexible reactions to morphologic changes and the Consultant will take that aspect in consideration when preparing institutional strengthening and in his own programming and organizing the construction, monitoring and adaptation of the test works.

4. Volume I, Page 2-14, Para 2, (Bahadurabad)

*The test work site has been proposed about 3 to 4 kilometers downstream of the present ferry ghat. As one of our interest is to defend something, the Consultant need to consult more with the Railway Authority as they are to be in agreement to change the present ghat to the new locations involving construction of new railway line, other establishment etc.*

Answer:

The Consultant took note of that comment and is in contact with the Railway Authority.

5. Volume I, Page 2-15, Section 2.2.2, Para 2 (Kazipur)

*The new studied Kazipur site has been ranked as second on consideration of 'certainty of attack' and further justified considering its attractiveness of construction on the charland. This needs further discussion with the Consultants as the marking of Nakalia and Chandanbaisa needs to be reviewed in the light of the subsequent comments.*

Answer:

See Answer to next comment 6.

6. Volume I, Page 2-17, Section 2.2.3

*The Consultant has given marks for "something to defend" without giving details of the assets which are to be defended.*

*Again the marking given on Criteria for "Certainty of attack" differs significantly between the Inception Report and Interim Report, specially for Nakalia and Chandanbaisa, which needs further justification.*

*In the marking criteria for left bank, Bahadurabad has been given 'o' marking while Kamarjani scores 1 which seems to be wrong and needs correction.*

*In addition "maximum marks distribution" amongst different selection criteria needs justification and elaboration.*

Answer:

These comments address the marking system used by the Consultant. It goes without saying that there is an arbitrary element in this type of marking, but the Consultant does not feel that their ranking is biased in any way. The following observations are made:

(1) Something-to-defend criterion

Changes made for Kamarjani (4 → 3) because of supposed loss of Manos Regulator, Bahadurabad (6 → 4) because the revetments works are now planned downstream of the railway terminal, Nakalia (4 → 3) because the Kaitola pumping station is more downstream than the location of possible heavy attack. See also p.2-17, where the above is already explained.

(2) Certainty-of-attack criterion

For all potential areas the marks for this criterion are reduced, based on the extensive morphological analysis reported upon in Annex 2 of the Interim Report. The reduction made reflects the decreased probability of attack as resulting from this analysis. The Consultant does not agree that at this moment a further justification is needed.

(3) Maximum marks distribution

Is based on the understanding of the Project, as presented in the Technical Report No. 1 on the pre-selection of test sites (early March 1992) and taken up in the Inception Report (mid March 1992). It is remarked that this distribution was not changed since the Inception Report and no criticism has been raised in the comments on the Inception Report.

(4) Left-bank criterion

Marking for Kamarjani and Bahadurabad are indeed wrong, which brings the total marking for Bahadurabad to 13 points and for Kamarjani to 12 points (same as Kazipur).



7. Volume I, Page 2-18, Para 2 item 4

*It is felt that the river should be studied for the full length to ascertain the behaviour of the river in order to fix up some nodal or hard points which in longrun way help in aligning the river.*

Answer:

Helping in aligning the river is part of the River Training/ AFPM component and the Consultant studies the river on his full length. The para mentioned refers to the selection of test sites for the Bank Protection component. That selection has been made looking at the entire river as well as is shown by the 'long list' of potential test sites, see the Technical Report No.1 and Inception Report, both March, 1992. Obviously the choice is generally narrowing with the time as more and more detail knowledge on the sites becomes available. On the other hand, the Consultant is aware of the fast morphological changes and keeps an eye on the river to identify new potential areas which may become attractive, such as shown in the Interim Report, bringing into discussion the area of Chauhali.

8. Volume I, Page 2-25, Para 5

*The difficulties mentioned in the report are known to everybody but we are to find out on easy acceptable and cost-effective method.*

Answer:

The Consultant fully agrees to that comment. He should like to amend that not all we are looking for, may be found at the end.

9. Volume I, Page 2-25, Para 6 & 7

*The Consultant should also keep in mind that in future it might be necessary to do all the works in active eroding places. As such the outcome from the proposed locations should be supplemented for these eroding places also.*

Answer:

The Consultant is fully aware of this problem as can be seen on page 2-25 of the Interim Report. However, one of the main objectives of the project is according to the ToR to find improved solutions for the structural design by constructing different types of full scale test protection works and by monitoring the behaviour of these test works. In order to be able



to monitor the behaviour of the test structures under full flow attack, a precise and verifiable execution in strict accordance with the design is required. This cannot fully be guaranteed for construction works in flowing water with more or less high velocities, to which they will be exposed in any case after completion and during the monitoring phase. Moreover, it has to be taken into account with regard to available funds that construction works in stagment water are significantly less costly than in flowing water. After assessment of advantages and disadvantages of the works tested and the reliability of the results, recommendations for appropriate concepts of structural design and construction methods will be elaborated taking into account as a matter of course a wide spread application and the need of execution in flowing water. Finally, the Consultant thinks that construction of bank protection at active eroding places should not be regarded as standard (i.e. planned) measures but rather than emergency measures.

**10. Volume I, Page 2-26, 1st para. (Helping the River)**

*It is appreciated the idea expressed in this para. It would be helpful if more explanation is given for such proposal.*

**Answer:**

The Consultant thinks that, assuming relatively simple recurrent measure were available, these could not only be applied to guide an aggressive eroding current away from a threatened bank but also to direct a flow that is too weak to really attack a test structure towards that structure.

More details on what these measures could be, can only be given after further investigation within the FAP 22 component which is under way.

**11. Volume I, Page 2-26, Section 2.3.2 and Figure 2.3.2-1 to 2.3.2-4**

*Details about the prediction of future morphological changes are needed to be incorporated in the report. Expected bank lines as shown in Fig. 2.3.2-1 to 2.3.2-4 seem to be exaggerated, without those details. Prediction of the morphological changes may be verified through some model, before finally selecting the test sites.*

**Answer:**

The Consultant does not agree with the observation that the "expected bank lines as shown in Fig. 2.3.2-1 to 2.3.2-4 seem to be exaggerated, ..". These estimated bank lines are based on (1) extrapolation of recent changes (1989-1992), (2) the first results of the remote sensing

study and (3) sound engineering judgement. Further justification for the results of the remote sensing will be given in forthcoming reports. As far as the site of Kamarjani is concerned, the erosion has up to September 1992 already reached the bank line as predicted for 1993. As far as the model as suggested to be used is concerned, it is the Consultant's firm believe that such a model would on the average not yield decreased bank erosion because it is based on the same data. Nevertheless such a model is very much needed, especially because it may help to bridge the gap between the deterministic approach used in the Interim Report and the stochastic and sometimes even chaotic behaviour of the real river. Such a model, however, does not exist at this moment. At short notice the Consultant will start the conceptual design of such a model, hopefully in close cooperation with FAP 19, as much pre- and post processing on the basis of satellite images will have to be done.

**12. Volume I, Page 2-31, Section 2.3.3, items 2 (Sub-soil Investigations)**

*The Consultant should have some boring up to the probable maximum scour depth envisaged.*

Answer:

At each selected test area one of the borings was sunk down to 40 m below the surface of the flood plain and the embankment respectively, see Fig. A8-6,7,11,15 in Volume III, Annex 8. That is in-fact below including of course the maximum scour depth envisaged.

**13. Volume I, Page 2-32(b), Para 1**

*It contradicts with the Government policy as regards to the use of geotextiles. It may be more specifically mentioned where jute material can be used and in what form.*

Answer:

The Consultant has organised in September 1992 a seminar of filter technology where, for the first time ever, representatives of the end users (river engineers), the jute industry, and the technical science (BUET) informed each other on their problems, requirements, investigations, products etc. The Consultant sees good chances of using geonaturals (jute e.g.) together with geosynthetics. It will, however, not be possible to do completely without synthetics since durable geonaturals fulfilling all technical criteria have not yet been developed. The Consultant is in contact with the jute industry and other organisations to assist them in developing applications for jute fibers for geotextiles.



14. Volume I, Page 2-33, d, Para 2

*Scour depth of 29 meter below HFL is not clear and should be ascertained carefully.*

Answer:

The existing formulas for the prediction of local scour depths give a rather wide range of possible scour depths. Assuming that the FAP 21 test structures will be constructed along the medium size channels of Jamuna, and that the designed geometry of these test structures will generate moderate local scour depths, a first tentative calculated scour depth was close to the scour depths recommended by BRE Priority Works  $26 + 3 = 29$  m below HFL.

As stated in the Interim Report this subject will be further investigated (in two physical model investigations) and the mentioned design scour depth may have to be revised later on. In the final report this subject will be elaborated more in detail.

HFL is defined in the glossary, but water depths and heights/ depths of structures could also be referred to PWD = Public Works Department (datum level).

15. Volume I, Page 2-34, (4), Para 2

*There is no scope of dredging to place filter and armour layer as well as falling apron.*

Answer:

Dredging refers to the level of placing the falling apron, not to placing the filter and armour layer. A description of the planned construction of revetments at Bahadurabad may be seen on page 2-41 to 2-46 and Fig. 2.3.5-5.

16. Volume I, Section 2.3.4, Page 2-34, item 3

*It is mentioned, "Groynes can be dangerous to navigation". But there is no mention how to avoid this situation. Since this waterway is very important as mentioned above, due consideration should be given to navigational aspects such as existing river routes, width, depth and their possible changes due to proposed construction of groynes and revetment etc. It may also be mentioned that, along with the Bank Protection and River Training Works the regulation of the channel and channel flow keeping in view the navigational aspects should be taken into consideration within the study. Otherwise, this protection works may not be very fruitful.*



Answer:

The Consultant will include the requirement for navigation in his Task 34a, Navigational study that has been proposed in the Inception Report and that is being carried and in October 1992.

17. Volume I, Page 2-37, sub section 3

*Are the Consultants aware that FAP-2, Gaibandha Improvement Project Feasibility Study may propose the removal of the Manos regulator ? Therefore Criteria 2 should be altered to read: Manos Regulator and/or the proposed drainage outfall. FAP 2 Consultants will confirm.*

Answer:

The Consultant is in contact with FAP 2. It is suggested to first observe if the Manos regulator survives the 1992 flood and then to decide further.

18. Volume I, Page 2-41, Section 2.3.5, items 3, (Kamarjani site)

*For testing groynes, the Consultant assumed scour depth 15 meters only, but they should consider the past experience at Serajganj and other places of Jamuna river where such structures have been built.*

*Further length of the groyne has been chosen as 100 meters only and full work is on the flood plain. It is not understood the utility and effectiveness of such structure for the Jamuna river and its objective is not also clear.*

Answer:

The Consultant has analysed already to some extent the experiences with the main bank protection works along rivers in Bangladesh. This analysis is not included in the Interim Report but it is intended to include it in the Draft Final Report.

In Serajganj and other places along the Jamuna river groynes have build often along a main channel of the Jamuna River. These structures are often protruding over a considerable distance into the river and have rather steep side slopes near the head of the groyne. The planned test structures are planned along a medium size channel, are protruding over a short distance into the river and have rather gentle slopes.

As stated in the Interim Report this subject of scour depths will be further investigated in two physical models and the mentioned design scour depth may have to be revised lateron. In the final report this subject as well as the design of the groynes will be elaborated more in detail.

**19. Volume I, Page 2-41, Section 2.3.5, items 4 (Bahadurabad)**

*The predictions of siltation at the present Railway Ferry ghat has encouraged the Consultant to select a new down stream site for testing at Belgacha. Thus proposing a new Railway line upto that location. This needs Consultation with Railway Authority and simultaneously it is so be ensured in maintaining a deep channel near that location for Railway ferry service.*

Answer:

See answer to comment No.4.

**20. Volume I, Page 2-43, Last para**

*List of the ten different types of revetment combination works and apron design may be shown.*

*The SLW and SHW may be explained somewhere as in Bangladesh, these terms are not used.*

Answer:

In accordance with the work flow chart the preparation of alternative and preliminary design of revetments including falling apron is in progress. Details of different types of revetments will be presented for approval with the Draft Final Report.

SLW and SHW are explained in the glossary. Moreover, the Consultant found that these terms are actually used in Bangladesh. The definition can be taken from "Determination of Standard Low Water and Standard High Water levels in Bangladesh", Vol. II, of Bangladesh Inland Water Transport Authority (BIWTA), edition 1990.

SLW and SHW are referred to the Fortnightly Mean Levels (FML) and are defined as follows:

SLW is the datum below which the water level is likely to fall on an average of 18 days per year only. SHW is the datum above which the water level may rise on an average of 18 days per year only.

**21. Volume I, Page 2-45, Para 1**

*The different assumption on velocity, scour depth, etc. need some justification in choosing the same.*

**Answer:**

Preliminary assumption on velocity scour depth etc. has been taken considering the field situation anticipated to be met at test site.

**22. Volume 1, Page 3-1 and 2 and Annex 1, Chapter 3**

*It seems that the Consultants in their review of the state of the art, give relatively little attention to the construction of sills in the channels. They probably are expensive, but could still be feasible for relatively small channels, which show a tendency to develop and where timely closure is important. The application of geotextiles in one form or another could make this an attractive option.*

**Answer:**

Sills stabilize the river bottom by controlling the slope of the river flow. Sills create local fix points, between which controlled erosion goes on until a stable slope is attained after which no further erosion occurs. River reaches in sharp bends can also be successfully improved by placing submerged sills in the deepest part of the channel, without changing the alignment of the river. Sills improve the sharp bend of narrow river by changing the flow pattern and re-distribution of velocities. Submerged sills have been successfully utilized in Danube River for improving navigation.

Sills are costly structures and have to be built in series. However, introduction of geo-textiles has given an opportunity to reduce some cost of construction by using geo-textile tubes. Sills can also hinder navigation due to the acceleration of flow over the crest of the sills. Induction of local flow over the sills can be reduced by costly armoring of river bed. (Evaluation of the River Training Technique, State of the Art, Part-II, Pilarczyk et.al. Delft 1990). As to the use of geotextiles some contradiction of this comment to comment No.13 is noted.

The aim of this project is to find cost-effective measures by utilizing river's own fluvial process to close a channel instead of making a closure.



23. Volume 1, Page 3-4 to 3-11, Section - 3.2 and 3.3

*It is not clear whether the different proposed methods throw some light of their performances without only indicating the theoretical results. No reference has been made for theoretical considerations.*

Answer:

A review of existing recurrent measures and the actual experience with them at present has been given in Annex 1, Part A "State-of-the-Art" in River Training. As an example of test results reference is made to the bottom vanes in the Loire river as presented on page 3-17 of Annex 1 of the Interim Report.

The "State-of-the-Art" shows clearly that application of recurrent measures up to now is mainly based on experience in specific situations, which differ considerably from the Jamuna conditions. Therefore a set-up is made to derive design guidelines for the present Jamuna conditions, which is presented in Section 3.2 and 3.3 of the Interim Report.

24. Volume I, Page 3-6, Section 3.3

*Effective Recurrent Measures (AFPM) ----- The old concept with new thoughts like redistribution of sediment/water flow in the bifurcation, interference of spiral/helicoidal flow to reduce erosion in the outer bend and artificial cut-off as suggested by the Consultant may be effective in reducing or alleviating erosion in a major channel. Further study on the above may yield low cost measures for controlling erosion.*

Answer:

The Consultant agrees to that comment and is working on that line. Further study within the available time and funds is going on.

25. Volume 1, Page 3-6, Section 3.3.1

*Recurrent measures with surface screens seem to be an effective tool for erosion control. Examples of such measures taken in similar rivers and their effectivity should be incorporated in the report.*

*In selecting the recurrent measures, artificial cut-offs may be associated with protective measures at outer bank. In addition to that other measures to change the flow condition should be applied in certain reaches to prove its effectivity and to arrive at some basic design consideration.*

Answer:

Detailed reply to question about theoretical consideration and practical result about effectivity has been stated in the Consultant's answer to comment No. 23. Details about artificial cut-offs will be incorporated in the Final Report. An artificial cut-off itself is a complete measure requiring huge costs. Nevertheless a partial artificial cut-off as a supporting measure will be considered.

Non-availability of sufficient dredger fleet is also another limitation to be taken into account with respect to artificial cut-offs.

26. Volume I, Page 3-23, Section 3.4-3

*The different proposed state of arts need consideration of their feasibility in practical application in river like Jamuna. The Consultants may also consider to have some laboratory tests for arriving at a definite conclusion.*

Answer:

Section 3.4-3 describes what the Consultant intends to investigate within the remaining period of the Planning Study. It is fully agreed that the efficiency of recurrent measures would have to be investigated in and confirmed by physical tests prior to commence any prototype tests. Such laboratory tests are envisaged for the next phase of the Project and are tentatively budgeted in subsection 4.2.2 of the Interim Report.

27. Volume I, Page 3-25, Section 3.5

*The single strategy of preventing bank erosion with the use of surface screens is sensible and is endorsed. However, only the application at bifurcations is considered. Could the panels also have potentials for use in combination with groynes, or even more general, in places where erosion cause an embankment along the riverbank. If they are effective, they could lead to a larger spacing between groynes.*

Answer:

Referring to the answer on question 23 a review of recurrent measures has been presented in Annex 1 of the Interim Report. From this it can be concluded that some measures may be effective in places where erosion occurs along the river bank (see also Table 3.2-1 of the Interim Report). However, up to now no guidelines are present for estimating their affectivity on a larger scale (e.g. Jamuna conditions). It might be expected that some measures can lead to a larger spacing between groynes. Details on this have to be elaborated in future studies.

28. Volume I, Page 3-26, 2nd para. (Selection of Channels)

*In this context, the Consultant should consult BIWTA who are maintaining a navigation route to India for a long period. The historical information may help in defining the classification of channels.*

*How the Consultants conclude the category of channels from the life time of the channels ? This needs elaboration. Why the consideration of depth and discharge should not be the criteria for such classification ? The main channel has also not been defined.*

Answer:

As to the navigation channels the Consultants indeed expects further criteria and guidance through BIWTA, and respective discussions are taking place in October in the context with the Navigation Study.

As to the categories mentioned it should be pointed out that the para commented refers to the selection of a channel for testing recurrent measures say floating bandals for the first time on a river like the Jamuna. Of course also depth and discharge of the potential channels will be considered but the tests will certainly not be undertaken in a main channel, for obvious reasons.

29. Volume I, Page 3-28, Para 3. (Section 3.5.2)

*The conclusion drawn that "learning by doing" is very much expensive. It is felt that one should be very much sure of the results before any such expensive field tests are done. Otherwise all these works would be tests for sake only.*

Answer:

In a river like the Jamuna no morphological changes can be induced, either by conventional or by recurrent measures, being very much sure of the measures undertaken. The large amount of failures of all kind of measures ever since are a prove of that. The very name of the Project to be a "Pilot Project" proves it to be an investigation and includes the possibility of failures, hence "trial and error" or "learning by doing" is a original component of the Project approach. It is of course understood that all tests shall be prepared and pre-investigated as thoroughly as possible in order to minimize the risk of total failures.



30. Volume I, Section 3.5.2, Page 3-28, 1st line

*It is mentioned in the report at article 3.5.2, page 3-28, 1st line- "The inland navigation: If the inland navigation uses the selected channel, then alternative routes have to be indicated". This matter requires special attention since the Brahmaputra river is one of the important inland waterways and at the same time an "Indian Transit route".*

*Therefore, while making proposal for Bank Protection/river training works in the above region sufficient precaution should be taken for the navigational aspect of Brahmaputra/Jamuna river.*

Answer:

The navigational aspects will be investigated in the Navigational Study, Task 34a, which had been proposed by the Consultant in the Inception Report (March 1992) to be undertaken in October.

31. Volume 1, Page 3-30 to 3-32, Section 3.6.30

*Only bankfull condition has been considered. No consideration has been given for overbank spilling and embankments. The consultant may give some thought in these areas also.*

*Further theoretically the Consultant assessed the longterm effect on option 2 proposal. It is suggested here that Consultant should identify few locations in the Jamuna river from the satellite images keeping in conformity with the theoretical assessment.*

*Clarification may please be given how the slope of the river will be reduced.*

Answer:

As a first estimate it was assumed that the bankfull discharge of the Jamuna River will not change. This was done in view of the fact that it was assumed that the flow over the floodplains on both sides of the river is fairly minor. In the coming months this approach will be refined, to the extent as appropriate with the fairly rough predictors applied here. In the final report on FAP 22 the results of this further refinement will be presented.

Option 2 was and is in fact being assessed on the basis of satellite images. This assessment has been the basis for the considerations in Chapter 3 of the Interim Report.

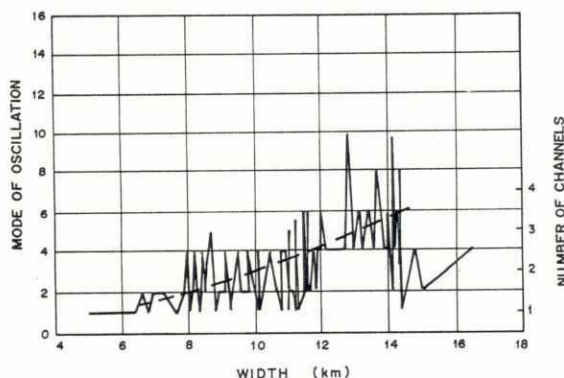
Slope reduction is the direct consequence of concentrating more discharge in a river. For fixed banks this can be demonstrated easily (see e.g. Jansen (1979), Principles of River Engineering, pp. 349-352). For a river that can adjust its width a similar phenomenon will occur, though to a lesser extent.

32. Volume 1, Page 3-31, Figure 3.6-1

*How is it possible to have less than one channel ?*

Answer:

Figure 3.6-1 indeed needs revision as far as the axis on the right side is concerned. A revised figure is given below.



Correct Figure 3.6-1

33. Volume 1, Page 3-32 Art. 3.6.3 (option 3)

*It would be appreciated if through the study the probable locations of the hard points can be identified as a strategy for Jamuna River Training works.*

Answer:

This is noted and will be considered in the Final Report.

34. Volume 1, Page 3-35, Table 3.7-1

*For recurrent measures durability and movability are important features. For example, barges or barge mounted screens (4 and 5) should have the advantage of being transferable to other sites. Whereas fixed bamboo devices (1 and 2) have limited life time and should be classed as having poor durability. This aspect could be expanded in the text.*

Answer:

For the shallow water portion of the channel the use of bamboo structures seems to be attractive with respect to functional, economical and construction aspects. So their use in the low water portion of the channel deserves consideration in spite of their limited life time.

35. Volume I, Page 3-39, top line

*After "development" suggest inserting "including bank protection".*

Answer:

The Consultant agrees to that comment.

36. Volume I, Page 3-39, bullets

*Suggest adding another bullet:*

- *Potential of advancing embankments.*

Answer:

Noted.

37. Volume I, Page 3-39, Section 3.8 (Last para)

*It is too early to decide about an organization for AFPM. The Consultant during the study may elaborate the organizational setup with Job descriptions.*

Answer:

In his institutional assessment, the Consultant will also elaborate of organizational aspects. He will mainly point out the objectives for a possible AFPM organization and a certain structure. This may perhaps not go into such a detail that already "job description" could be given. Before going into such a detail the set-up of such an organization and its relation to the existing administrative bodies have to be discussed and agreed upon. The Consultant hopes to draw some benefit out of the specialized FAP 26 "Institutional Development Program".



38. Volume I, Page 4-2, Section 4.1.1, Para 2

*The cost estimate for groyne and revetment appears very high. The basis of cost estimate may be presented. The other expenditure covers about 37% of the total cost. The Consultant may review the overall cost which may help to test at more locations within the same cost.*

Answer:

The cost estimate was based on prices available at the time of preparation of the report and taking into account the actual design stage. In the meantime the Consultant gathered new informations according to which some prices seem to be even higher.

The Consultant will present the bases of the cost estimate in the Draft Final Report.

39. Volume I, Page 4-2, to 4-4, Section 4.2

*The suggested tests should be done at specific locations to have some benefits of these research works.*

*The Consultant has proposed only "bandalling works" for testing under FAP 22, though they discussed various options in page 3-30 to page 3-32. No elaboration made on how these options would be achieved through these bandalling works only.*

Answer:

As to the locations for test works of surface bandals or any other recurrent measures it is fully agreed that a location should be chosen at which the expected effects would be beneficial.

The options on page 3-30 to 3-32 refer to possible AFPM works. Surely not all of these options may be achieved by light, recurrent measures. Hence the Consultant will choose an option for testing the structures that will be suitable.

40. Volume I, Page 5-27, Section 5.4.2 and 5.4.3

*The design water levels and design discharges for selected return period and boundary conditions through FAP 25/GM model should be annexed in the Final Report.*

Answer:

The design water levels and design discharges for a range of return periods are planned to be included in one of the annexes of the Final Report. The relevance of boundary conditions is not clear in this respect.

41. Volume II, Page 3-38, Section 3.3.6

*Jack may be tested as a protective works. This was used in Serajganj during early seventies and that induced heavy siltation in a single year.*

Answer:

In spite of the Consultant's effort no documentary evidence as to the effectivity of jacks in this country was available. Jacks have been found to be effective in reducing bank erosion. They are costly structures.

FAP 22 is trying to find out means of closing outer channels by using the river's own fluvial process in a cost-effective way. Measures at bifurcations for this reason have been given first priority.

Use of jacks has been kept as measure for reducing localised erosion. This aspect has been expressed in page 5-18, Volume II of Interim Report.

42. Volume II, Annex 1

*It appears in this report, as in other publications on the morphology of braided rivers, that whenever attempts are made to establish relationships between various variables, the results often do not show a clear pattern. Graphical presentation show a "cloud" of points, which do not allow to draw a representative line. One wonders whether one of the reasons could be that the effects of individual floods are neglected. This will probably be acceptable for other river types, where the pattern of the (only) channel is established anyway. This is not the case, however, for braided rivers. It is a well known fact that one major flood could have a decisive impact on the channel configuration of such river. It is recognized that the introduction of the annual flood (possibly characterized by volume and/or peakflow) as another variable, will complicate the analysis, but it seems worthwhile to make some attempts.*

Answer:

The Consultant agrees fully with the statements made by FPCO. In fact, in the remote sensing study they are also addressing the effect of the annual hydrograph on the bank erosion rates and on the occurrence of cutoffs. More results to appear in the Final Report of the Planning Phase.

43. Volume III, Page A2-8, Section 2.1.2

*It has been mentioned under Chapter 2.1.2. (Processing), that "The geometrical correction was done on the basis of some ten points which could be identified on the image of the year 1977 and from which the coordinates should be obtained from topographical maps. The accuracy of this correction was evaluated and the inaccuracy is not greater than the size of the pixels after resampling. All the other images were corrected using the 1977 image as a "base Map".*

Answer:

Described procedure is a correct account of the Consultant's geometrical correction.

44. Volume III, Section 2.1, Page A9.1 - A9.2

*Past expenditures in current Taka have been converted to 1991 constant Taka by using BBS deflator index. Past current expenditures are most likely to be incurred in both local currency and foreign currency. While local currency can be converted to 1991 constant Taka by the method described above, no manufacturing unit value (MUV) index have been used for the past current foreign currency expenditures to be converted to 1991 constant US\$ MUV index is available from the World Bank sources. Consultants should, therefore, analyze the past current expenditure data by breaking them down into local and foreign currency components and use appropriate deflator indices for them.*

Answer:

Past expenditures by BWDB for bank protection were reported as local costs as the works were entirely executed by local contractors. It may be supposed that the BBS deflator index for Construction reflects the actual inflation of costs including impact of imported materials and equipment on the local costs.

It is worth mentioning that reported expenditures are in financial terms and not in economic terms.



45. Volume III, Section 3.3, Page A9.5-6

*The proposed method for unit rate analysis is not intelligible. In order to find then, all one has to do is to take a weighted sum of the specific conversion factors of project inputs. The weights for project inputs will be the relative sizes of the input factors for project inputs are given in Guidelines for Project Assessment (GPA), May, 1992.*

Answer:

The proposed method was as requested. In the Draft Final Report the explanations will be made more understandable.

46. Volume III, Section 3.4, Page A9-6, Cost Analysis

*The comparison between different alternatives proposed and the previous construction methods may be based on (a) Present value of expenditures at economic prices (not net present value) at 12% discount rates and/or (b) Annualized expenditure. Please check.*

Answer:

The comment is right. "Net present value" was an oversight and should be read as "Present value".

47. Volume III

*There should be thorough study of benefits from bank protection and river training. Available benefit assessments are concerned with selected locations where bank erosion causes damages to existing economic resources, infras-tructures and properties. These are based on present development activities and hence justified for projects that are planned in the short run. However, when planning for medium and long runs, it is necessary to envisage interactions between river training and communication. Communication is one of the most important requirements of the accelerated development of the industry services, etc. River training appears to be an important component for comprehensive development plan with benefits which cannot be isolated. The Consultant should therefore, consider the benefits from communication in the analysis.*

Answer:

The Consultant agrees and is giving due attention to the communication in his Navigational Study.

48. Volume III

*Apart from undertaking cost analysis, in order to prioritize the selection of projects, it is necessary to analyze the potential benefits of river training and basic protection works.*

*The Consultants do not suggest any concrete procedure for evaluating such benefits except pointing to the two FAP studies (FAP 1 and 9B) which provide valuable information on potential benefits of protection works. Since the procedures adapted in these two studies differ, the Consultants should come up with suggestion of their own which procedure they intend to adopt in their own study.*

Answer:

Apart from utilizing the results of FAP 1 and FAP 9B studies the Consultant will suggest an own procedure if required.

49. Volume III, Page A10-7, Section 3.4

*The resistance radius in the MIKE 11 given by the equation is based on the Chézy formula. If the effects of hydraulic radius and resistance radius are compared using Manning's roughness coefficient, then there would be discrepancy in the effect of resistance radius.*

Answer:

The Consultant agrees with this observation and prefers to use as much as possible the Chézy equation and the hydraulic radius in the whole study. Mixing of these expressions with the Manning's equation and the resistance radius should be prevented during the study, because the mentioned discrepancies can create confusion and can affect the results of the study.

50. Volume III, Page A10-8, Section 3.5

*Dredging involves mainly removal of bed material. It is not clear how the removal of bed material at the grid points is represented.*

Answer:

The removal of bed material at the grid points is represented by stopping the calculation, lower the bed levels in the selected grid points with the input menu and restart the calculation.

51. Volume III, Annex 4, Figure A4-1

*The irregularity of the differences for the various stations between floods with return periods of 2 and 100 years raises doubts about the overall accuracy.*

Answer:

The overall accuracy of the calculated discharges is much lower than the overall accuracy of the water levels, see also the final report of FAP 25. The importance of the presented graphs is to illustrate that the Gumbel distribution and the log normal distribution give a fairly good prediction of the extreme high discharges.

52. Volume III, Annex 4

*Not necessarily have the test structures to be designed for a 1:100 years flood. While in the long run, the annual chance of such flood is 1:100 indeed, for structures that are to last in principle for a limited number of years a flood with a higher frequency of occurrence would have the same chance of occurrence within this limited period. This could result in some savings on the construction costs, depending i.a. on the steepness of the water level frequency curve.*

Answer:

A preliminary idea for the design of the test structures is to design the main body of the structure and some essential parts of the top layers to resist the 1 : 100 years flood without severe damage. However in different test sections the toplayers and the filter layers will be designed for the 1 : 2 year or the 1 : 5 years flood, because with this design criteria some damage on the toplayers and filter layers can be expected during the monitoring period, the damage being needed to identifying function of the structure and determining safety criteria.

53. Volume III, Annex 4

*The Consultants will be aware of the fact that under the present conditions it is difficult, if not impossible, to do discharge observations on the Jamuna during floods. In that case the maximum discharge is established by means of the extrapolated rating curve. Data on peak discharges are therefore secondary data, derived from the primary data, viz. water levels and caution is to be exercised when doing statistical analysis. The Consultants should moreover be aware of the fact that data on peak discharges may not be homogeneous: discharges remaining below bankfull stage constitute a different population than those*



*related to higher stages, when part of the total discharge is diverted anteverted as (unmeasured) overland flow. Once embankments would be constructed at not too large a distance from the river banks, the data related to over-bank stages will tend to constitute a homogeneous series with lower stages.*

Answer:

The Consultant agrees with these remarks and intends to use the results of the FAP 25 study for the hydrologic study as part of FAP 21/22. In FAP 25 these problems have been studied and with the results of FAP 24 the knowledge of the accuracy and the homogeneity of the maximum discharge data will be improved in the near future.

**54. Volume III, Table 3, Annex 6**

*The updated conversion factors for unskilled labour (used in construction) and steel as persisted in the Report is incorrect. These should be 65 (instead of 72) for unskilled labour and 75 (instead of 61) for steel as mentioned in the GPA (Table 3, Annex 6).*

Answer:

In the Final Report the Consultant will apply the correct figures.

