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Flood Plan Coordination Organisation,
Ministry of Irrigation, Water Development and Flood Control

BANGLADESH FLOOD ACTION PLAN

FAP 12
FCD/I AGRICULTURAL STUDY

METHODOLOGY REPORT

1 MAIN VOLUME

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Hunting Technical Services Limited

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Bangladesh Institute of Development Studies
Flood Hazard Research Centre
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Technoconsult International Limited

under assignment to
UNITED KINGDOM OVERSEAS DEVELOPMENT ADMINISTRATION

Sanyu Consultants Inc.

under assignment to
JAPAN INTERNATIONAL CO-OPERATION AGENCY

The present report is one of a series being produced by Flood Action Plan components 12, the FCD/I Agricultural Study and 13, the Operation and Maintenance Study.

The full series is expected to comprise the following reports:

FAP 12

Inception Report (joint with FAP 13)
Methodology Report (2 Volumes)
Rapid Rural Appraisals Overview

Project Impact Evaluation studies of:

- * Chalan Beel Polder D
- * Kurigram South
- * Meghna Dhonagoda Irrigation Project
- * Zilkar Haor
- * Kolabashukhali Project

Rapid Rural Appraisal Studies of:

- * Protappur Irrigation Project
- * Nagor River Project
- * Sonamukhi Bonmander Beel Drainage Project
- * Improvement of Sukunia Beel
- * Silimpur - Karatia Bridge cum Regulators
- * Khatakhali Khal
- Halir Haor
- * Kahua Muhuri Embankment
- * Konapara Embankment
- * Polder 17/2
- * BRE Kamarjani Reach
- * BRE Kazipur Reach

- * Draft Final Report (2 Volumes)
- * Final Report (2 Volumes)

FAP 13

Methodology Report
Appraisal of Operation and Maintenance in FCD/I Projects (2 volumes)
- * Draft Final Report
- * Final Report

Note: * Report not yet available

SUMMARY

The FCD/I Agricultural Study (Flood Action Plan component 12) aims to carry out a comprehensive review of completed Flood Control and Drainage (FCD) and Flood Control, Drainage and Irrigation (FCDI) projects. The review will involve both Rapid Project Evaluations ("Rapid Rural Appraisals", or RRAs) and full Project Impact Evaluations (PIEs).

This Methodology Report presents the proposed approach to the RRAs and the PIEs. A separate report covers the proposed methodology adopted by FAP 13, the Operation and Maintenance Study. As there is a substantial overlap between the two teams much of the methodology presented here applies also to FAP 13.

The FAP 12 team have identified 59 projects which have already had some form of post-completion evaluation. These evaluations vary considerably in their coverage and methodology. Most concentrate on agro-socio-economic impact, but some include comprehensive engineering evaluations. In Chapter 2 the methodological approaches adopted by some of the main previous evaluations are reviewed. When the FAP 12 team considers the overall impact of FCD/I projects the results and conclusions of these previous evaluations, as well as the FAP 12 team's own field work, will be utilised.

The team selected five completed projects for detailed Project Impact Evaluations and twelve for Rapid Rural Appraisals. The criteria for project selection differ to some extent, but in both cases projects that were completed before 1975 or after 1988 are excluded, projects that have already had a well-conducted evaluation are excluded, and an effort has been made to have a representative coverage of types of project, and of the different regions in which the projects are located. For the PIEs larger projects have been selected (usually over 15000 ha of protected land), whereas for the RRAs smaller projects are preferred (usually between 5000 ha and 15000 ha of protected land, although for some categories these limits had to be relaxed.)

The number of PIEs to be covered was reduced to five, from the six specified in the Terms of Reference. The reasons for this are presented in Chapter 6. A review of the statistical basis for the original sampling proposals indicated that the proposed sample sizes were too small to meet normally acceptable criteria for confidence in the main parameters to be studied. It was therefore proposed that sample sizes be increased, and that some additional supplementary surveys be carried out. This has the effect of increasing the total number of interviews for all PIEs from a proposed 1260 to 1825, but concentrating these on five rather than six projects. The increase in interviewing and data processing workload would be offset by the reduced logistics burden saved in eliminating one PIE.

The detailed methodological approaches to the RRA and PIE activities are presented in Chapters 5 and 6. It is emphasised that the two methodologies are different, and each has its strengths and weaknesses. The RRAs aim to provide a cost-effective method of appraising project impact quickly, without too great a sacrifice in terms of data quality and comprehensiveness. Previous experience has shown that RRAs are effective means of interdisciplinary investigation and the assembly of qualitative data. They can usually reliably detect major changes in quantitative impacts (substantial changes in cropping patterns for example), but are much weaker when they aim to identify relatively small changes in yields, cropping intensities or incomes. PIEs are more effective at obtaining quantitative data, but are sometimes less effective at producing the interdisciplinary and qualitative evaluations which are necessary to explain project impact.

The FAP 12 study is required in its Terms of Reference to collaborate with other FAP Components and, in particular, to adopt the economic assumptions and approaches to analysis of project impact that are recommended by the Special Study on Economic Methodology. The team are working with the relevant FAP teams that are already mobilised, but may not be able to make as much use as had been hoped of inputs from some of the studies (such as the Environmental Study) which mobilised later than FAP 12. The FAP 12 team have therefore developed their own methodology for Environmental Impact Evaluation, and this is presented in Chapter 7.

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GLOSSARY AND ABBREVIATIONS

AAM	Agricultural Assessment Matrix
ADB	Asian Development Bank
AER	Agroecological Regions
AES	Agroecological Subregions
Aman	Late monsoon (Kharif-II) season rice crop
Aus	Early monsoon (Kharif-I) season rice crop
BARD	Bangladesh Academy of Rural Development
BCR	Benefit/Cost Ratio
BETS	Bangladesh Engineering Technical Services
BIDS	Bangladesh Institute of Development Studies
Boro	Winter season rice crop grown under irrigation
BNC	Bangladesh National Consultants
BRDB	Bangladesh Rural Development Board
BRE	Brahmaputra Right Bank Embankment
BUP	Bangladesh Unnayan Parishad
BWDB	Bangladesh Water Development Board
CIP	Chandpur Irrigation Project
CIRDAP	Centre for Integrated Rural Development in Asia and the Pacific
DFC	Drainage and Flood Control
DSSTW	Deep-set shallow tubewell (STW, q.v., with depth increased by installing pump below ground level)
DTW	Deep Tubewell (with positive displacement pump)
EIA	Environmental Impact Assessment
EIP	Early Implementation Projects
ESL	Engineering Science Limited
FAP	Flood Action Plan
FCD	Flood Control and Drainage (Project)
FCDI	Flood Control, Drainage and Irrigation (Project)
FCD/I	FCD or FCDI (Project)
FPCO	Flood Plan Coordination Organisation, Ministry of Irrigation, Water Development and Flood Control, Government of Bangladesh.
HTS	Hunting Technical Services Limited
HYV	High Yielding Variety
IBRD	International Bank for Reconstruction and Development (World Bank)
IDA	International Development Agency (of the World Bank)
IEE	Initial Environmental Examination
IIMI	International Irrigation Management Institute
IRR	Internal Rate of Return
JICA	Japanese International Cooperation Agency
Kharif	Monsoon cropping season
KSS	
LLP	Low-lift pump (suction type for irrigation from open water bodies)
Mouza	Smallest revenue-collection area (population typically in range 100-1500 households)
MPO	Master Planning Organisation (see NWAPO)
NWAPO	National Water Plan Organisation, Ministry of Irrigation, Water Development and Flood Control, Government of Bangladesh (formerly MPO)
O&M	Operation and Maintenance (of project)
ODA	United Kingdom Overseas Development Administration
PEP	Preliminary Environmental Post-Evaluation
PIE	Project Impact Evaluation
Rabi	Winter (dry season) cropping season
RRA	Rapid Rural Appraisal
STW	Shallow tubewell (with suction pump - theoretical maximum depth 32 ft., actual less)
ToR	Terms of Reference

1 INTRODUCTION

1.1 GENERAL

Hunting Technical Services Limited (HTS) has been engaged by the United Kingdom Overseas Development Administration (ODA) to provide consultancy services to the Government of Bangladesh for conducting Components 12 (FCD/I Agricultural Study) and 13 (Operation and Maintenance Study) of the Flood Action Plan. Support to these FAP components is also being provided by the Japanese International Cooperation Agency, which has contracted Sanyu Consultants Inc. to provide consultancy support.

The Bangladesh Institute of Development Studies is providing joint technical direction of the FAP 12 study and is fielding senior and junior specialists in seven professional disciplines. Technoconsult International Limited, a Bangladesh-based consultancy, is providing local senior and junior engineering and rural institutions specialists.

1.2 STUDY OBJECTIVES

The full Terms of Reference for the FAP 12 study are presented in Appendix A. The objectives of the study are to:

- assess the agricultural, economic, social and environmental impacts of FCD and FCDI projects and the extent to which technical and other objectives have been achieved;

- identify constraints to effective project management and to recommend ways in which project design, operation and maintenance can be improved to increase the overall production;

- develop guidelines and criteria to be used in the planning, design, implementation, operation and maintenance and evaluation of projects under the Action Plan.

Achievement of the objectives involves a comprehensive review of completed FCD and FCDI projects. This review will involve both Rapid Project Evaluations and full Project Impact Evaluations. The overall aim of the study is to assess the effectiveness of investment in this sector; to learn from previous experience in the planning, design, implementation, operation and maintenance of projects and to provide an input to the planning of water management under the Flood Action Plan.

1.3 ROLE OF THE REPORT

This report on the methodology to be applied in FAP 12 is submitted in accordance with the Terms of Reference.

The report presents the proposed approach to two different levels of evaluation study of completed Flood Control, Drainage and Irrigation (FCD/I) projects. It also presents the approach used in selecting the projects for detailed study.

Many aspects of the FAP 12 methodology also apply to FAP 13, and the two teams work closely together. A separate report covers the special methodological features that apply particularly to FAP 13.

A draft of this report was submitted in March 1991 and extensively discussed during the Methodology Workshop of 10 March and in further meetings with FPCO and members of the Panel of Experts. The comments on the draft from various sources have been consolidated by FPCO and the final version of the report has been modified to reflect these. In the Final Reports on the Rapid Rural Appraisal (RRA) and Project Impact Evaluation (PIE) activities, due respectively in September and December 1991, the Consultants will review the effectiveness of the methodologies adopted, and describe lessons learned that may be of use in subsequent evaluations.

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2 REVIEW OF METHODOLOGIES USED IN FCD/I PROJECT EVALUATIONS

2.1 EVALUATED PROJECTS

Table 2.1 presents summary data on 59 projects for which the Consultants have identified some form of post-completion evaluation. These evaluations vary greatly in their coverage, format and methodology. The table excludes projects which have irrigation but no FCD components, and it also excludes projects for which Project Completion Reports appear to have been prepared without field verification of project impact. Most, but not all, of the reports referred to have been traced.

The majority of the evaluations concentrate on agro-socio-economic impact, rather than any evaluation of the physical completion or state of the engineering works, or of the physical impact of these (for example actual changes in flooding, impact on hydrologic regime outside the protected area, and impact on siltation).

The earliest FCD/I evaluation the Consultants have seen was carried out in 1973, to review the Dhaka-Narayanganj-Demra Flood Control and Irrigation Project. This evaluation was updated in 1984.

The next series of identified evaluations was carried out by Rajshahi University in 1977. These involved brief reviews of 7 completed EIP projects, and additional reviews of 3 projects that were under construction. The evaluation includes an unusual review of the recruitment and employment of labour for embankment construction.

In 1979 the first major study of Chandpur Irrigation Project, by BWDB, was prepared. Chandpur is the only FCD/I project for which the Consultants have identified three full evaluation studies.

Between 1980 and 1991 there has been an increasing flow of FCD/I project evaluations. More than half of these are included in five distinct groups, each of which deserves separate mention.

a) The EIP programme has been evaluated on four occasions, in 1977, 1981, 1983 and 1988. The first three evaluation missions concentrated on programme rather than project-specific issues, although they commissioned socio-economic studies of some of their completed projects. In 1988 EIP commissioned Bangladesh Unnayan Parishad (BUP) to carry out reconnaissance studies of 16 completed projects, and then to follow these up with more detailed socio-economic evaluations of six of them (see Table 2.1). At the same time BETS were commissioned to carry out engineering evaluations of the same projects.

b) In 1986 the BWDB commissioned Bangladesh National Consultants (BNC) to carry out evaluations of ten completed sub-projects implemented under the IDA Small Scale DFC project (Credit 955-BD). Not all of these had flood control components. These were reported on in 1987.

Table 2.1 FCD/I Projects that have been Evaluated

Ser. No.	Project Name	EIP 1977	EIP 1988 Reconn.	EIP 1988 Detailed	MPO 1990	BWDB 1987	DFC-1 1989	Other (No)	Brief Reference
1	Angarali Haor		XXXXX	XXXXX					
2	Baramanikdi SP							1	Technoconsult, 1990
3	Batkazal Khal Re-excavation	XXXXX							
4	Bhedra Beel		XXXXX	XXXXX					
5	Bhitabari-Damosh		XXXXX	XXXXX	XXXXX				
6	Bhola Irrigation							1	Sajjad Zohir, 1991
7	Bhola Island					XXXXX			
8	Bhutiar Beel							1	BWDB, 1983
9	Brahmaputra RBE						XXXXX		
10	Chakamaya-Panchakuralia							1	Moslehuddin, 1984
11	Chalan Beel Polder D				XXXXX			1	BETS, 1989
12	Chandana Barasia	XXXXX							
13	Chandpur FCDI							4	Thompson, 1989; BUP, 1982; BWDB, 1977; CIRDAP, 1987
14	Char Faizuddin		XXXXX						
15	Chenchuri Beel						XXXXX		
16	Damrir Haor		XXXXX						
17	Dhaka-Nganj-Demra IFP							2	BWDB, 1973; BWDB, 1984
18	Dhurung Khal					XXXXX			
19	Gangrail Closure		XXXXX						
20	GK Phase I		XXXXX						
21	Hail Haor							1	BETS, 1988
22	Harihar River Excavation					XXXXX			
23	Hizla Embankment	XXXXX							
24	Jamuna Khal		XXXXX						
25	Kalaiya-Nehalganj		XXXXX						
26	Karnafuli IP							2	Sarm Associate, 1986, FAO 19
27	Karnahar Barabeel Embankment	XXXXX							
28	Kata Khal - Dublakuri		XXXXX						
29	Katakhali Khal							1	BWDB, 1980
30	Kolabashukhali						XXXXX	1	ESL, 1986
31	Manu River				XXXXX				
32	Mashajan-Lauhajang		XXXXX	XXXXX					
33	Meghna Dhonagoda							1	CIRDAP, 1987
34	Mondakini Khal ISP					XXXXX			
35	Mrigi Khal SP					XXXXX			
36	Nurania Khal					XXXXX			
37	Muhuri IP				XXXXX			2	FAO/BWDB;CIRDAP
38	Pathakali Konai Beel							1	MPO/Harza, 1985
39	Polder 27/2	XXXXX	XXXXX						
40	Polder 34/3							1	Moslehuddin, 1984
41	Polder 35/1 SP					XXXXX			
42	Polder 35/3		XXXXX	XXXXX					
43	Polder 39/1							1	BWDB 1991
44	Polder 42							1	BWDB 1966
45	Polder 46							1	BWDB 1966
46	Polder 47							1	BWDB 1966
47	Polder 48 SP					XXXXX			
48	Polder 55/1				XXXXX				
49	Polder 65/A-3		XXXXX	XXXXX					
50	Polder 66/3		XXXXX						
51	Raktadaha-Lohachura				XXXXX			1	Moslehuddin, 1984
52	Roachala Khal Re-excavation	XXXXX							
53	Sati Nadi							1	Moslehuddin, 1984
54	Satla Bagda							2	BETS, 1989, Moslehuddin, 1984
55	Shanir Haor				XXXXX	XXXXX			
56	Shangair Haor							1	Moslehuddin, 1989
57	Singua River Re-excavation	XXXXX							
58	Teesta Right Bank Embankment		XXXXX						
59	Tulshiganga River				XXXXX				
Totals		7	16	6	8	9	3	30	

Futher details of each project (location etc) and refernce are in Appendix B
EIP, 1977 - projects reviewed by M.Ali Akbar for EIP in 1977
EIP Reconn. = Study of EIP project crried out at Reconnaissance level - see BUP, 1988 and BETS 1988
EIP Detail = EIP project additionally studied at detailed level, see BUP, 1988
MPO, 1990 = Project covered by Harza et al for MPO, 1990
BWDB, 1987 = Project covered by BNP for BWDB - see BNC, 1987
DFC-1, 1989 = Project evaluated for the Completion Report on DFC-1, FAO, 1989
IP = Irrigation Project ISP = Irrigation Sub-project IFP = Irrigation & Flood Control project

Source: Consultants

c) In 1986 the BWDB also commissioned three separate organisations to carry out evaluations of projects implemented under DFC-1 (IDA Credit 864-BD). The three studies were of Chenchuri Beel, Brahmaputra Right Embankment and Kolabashukali.

d) In 1988-89 BWDB commissioned BETS to carry out evaluations of Satla Bagda, Hail Haor and Chalan Beel Polder 'D'.

e) In 1990 the National Water Plan Master Planning Organisation (MPO) carried out an Evaluation of Historical Water Resource Development, to identify the implications for the National Water Plan. This evaluation made an explicit attempt to apply some Rapid Rural Appraisal techniques.

The remaining evaluations are diverse, and vary from the very thorough to the rather superficial. An inventory of Evaluation Reports on FCD/I projects is presented in Appendix B. In the following section some of the methodologies used are presented in brief, and some comments are made on common methodological features. In the Final Report on FAP 12 the Consultants will utilise the results of these studies, as well as the results of FAP 12 investigations, in reviewing the impact so far of FCD/I projects.

2.2 METHODOLOGIES USED

2.2.1 The EIP Studies

The initial 16 studies carried out by BUP for EIP were handled by four study teams, each looking at four projects. These short surveys involved a review of existing data followed by about 10 days field work during which the emphasis was on collection of qualitative rather than quantitative data, using check-lists for interviews with a wide range of informants.

Six projects were then selected for more detailed study. These studies involved further collection of data from secondary sources and household surveys, carried out within the project areas. The data analysis included calculations of financial IRR and BCR, which were based on before/after comparisons. They also included calculation of "Social Benefit Cost Ratios", which were the calculated BCRs adjusted to reflect the distribution of land ownership amongst beneficiaries.

2.2.2 The BWDB Small Scale DFC Evaluations

The BNC evaluations of ten FCD sub-projects were carried out using conventional methods and in considerable detail. An effort was made to integrate the results of engineering and agro-socio-economic investigations, and to present both methodology and results clearly. With project areas were compared to control areas, and IRRs were calculated on the basis of with/without project comparisons. The study included comparisons of pre- and post-project flood frequency and flood hazard.

2.2.3 The DFC-1 Evaluation Studies

The DFC-1 Evaluation Studies were carried out by three different agencies. They follow somewhat different approaches and are of varying quality. They do not include any attempt to recalculate economic analysis parameters, but compare before and after project conditions. The study of Brahmaputra Right Embankment (BRE) in particular shows how an evaluation study can give an effective qualitative view of project impact and integrate the results of engineering and socio-economic studies. The study of Kolabashukhali (KBK) was better in design than execution. Data collection was stratified by land level but results are not presented on this basis. An attempt was made to use probability sampling for selection of villages and households, but it is not clear that the sample did in fact meet the criteria of a probability sample, and no confidence limits are quoted for most of the estimates, nullifying the object of a probability sample.

2.2.4 The MPO Evaluations

In 1989 the Chief Engineer of MPO appointed a committee to list all projects on which evaluation reports were available and to recommend candidate projects for MPO field inspection and evaluation. Subsequently six FCD, two FCDI and a number of floating pump, fisheries and minor irrigation projects were selected for "Rapid Rural Appraisals". The report on these appraisals does not discuss the methodologies used in detail. It notes that teams were usually composed of engineers, agronomists, economists and a fisheries specialist, and that hydrologists visited several projects. There were usually 4 professional staff to a team, a number found to be the minimum to cover the disciplines required and the maximum logistically satisfactory.

Field visits to the FCD/I projects lasted 5 to 7 days (presumably including travel time). The data gathering techniques included field observations and interviews. A clear purposive effort was made to cover all parts of the project area. At some of the projects small sample surveys were carried out and on some occasions project officials, local leaders and extension officials were interviewed. No indication is given of sampling methodology, sample sizes or statistical parameters related to the data collected.

The evaluations covered both engineering (including hydrological impact) investigations and a review of agricultural, fisheries and other impacts. A recalculation of the economic costs and benefits of each project was carried out, including computation of both IRR and N/K ratios.

2.2.5 Other Evaluation Studies

Most other evaluation studies are primarily or entirely evaluations of agricultural and socio-economic impact. The most thorough are the evaluations of Chandpur Irrigation Project by BUP (BUP, 1982) and by P.M. Thompson (Thompson, 1989) and the study of Bhola Irrigation project (a coastal embankment project) by Sajjad Zohir (Zohir, 1991).

The BUP evaluation of the Chandpur Project made use of a range of enquiry techniques. It was centred on a household survey covering areas both inside and outside the project area, but also involved participant observation, a broader reconnaissance survey of 34 villages, a survey of agricultural costs and returns and surveys of pump groups, KSS and non-farm activities, including small groups of rickshaw pullers, fishermen and boatmen. As a result the study was able to review a broad range of project impacts.

The study of Chandpur by Thompson was carried out over a two year period and involved a main household survey (599 households), two specialised surveys (of fishermen and LLP irrigation scheme managers), group discussions in 60 villages and substantial field investigation. It involved data collection in with and without project areas, an appraisal of the project's physical impact on flooding and an effort to evaluate impact on fisheries, domestic buildings and property and irrigation activities. The study involved recalculation of the project's IRR, NPV and BCR, and is generally the most methodologically thorough FCD/I evaluation identified.

Three further studies of the impacts of the Chandpur Irrigation Project (CIP) deserve mention. CIRDAP (Monowar Hussain et al., 1987) in 1986-87 conducted a study in which the completed CIP and Muhuri River Projects were compared with the Meghna-Dhonagoda Irrigation Project, which was then under construction and was used to provide evidence of without-project conditions. This study concentrated mainly on agricultural indicators and used a purposive village sampling approach. BARD, Comilla (Chowdury et al, 1988) evaluated the impacts of irrigation and agricultural change on women in particular, using a with/without comparison. Kaida and Hossain (1988) carried out a detailed single village study in a location bisected by the embankment.

The Bhola IP study was carried out over a four month period in 1990. It describes itself as a "rapid socio-economic appraisal". The study methodology combined a general questionnaire survey (240 households in 6 villages, all within the project area), additional more detailed questionnaire surveys, case studies of Pump User Groups, physical inspection, interviews with BRDB and BWDB staff and other field data collection.

Most of the other evaluation surveys reviewed are considerably less thorough than those referred to above. At times they give very little detail on the methodology applied. Where methodology is apparent common weaknesses (which apply to some of the studies reviewed in the previous sections also) include:

- no stratification by land level or pre-project flood level (or failure to use such stratification in presented results);
- no use of control areas outside the project area;
- associated comparisons of before/after rather than with/without conditions;
- sometimes, a conceptual confusion between with/without and before/after comparisons;
- no explanation for sample size selection;
- no explanation for stratification or cluster selection;
- no indication of the implications of these for sample size or the statistical significance of the data analyzed;
- little or no indication of statistical parameters relevant to the data presented (standard deviations, variance etc), thus giving no indication of the statistical significance of differences in with/without or before/after comparisons;
- frequent absence of any evaluation of the physical achievements of the project or of their physical impact - (a failure to achieve expected agricultural impact may be due to a failure to construct as designed or to a failure of the designed FCD/I structures to achieve their intended physical/ hydrological flood control/irrigation objectives);

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- no attention apparently given to inter-year variations in agricultural (or other) circumstances - yields and cropping patterns in severe flood years for example;

- no attempt to recalculate project returns (IRR, BCR etc);

- when these are calculated there is no adjustment for flood hazard;

- no attempt to look at broader impacts (fisheries, environment, communications, property, household vulnerability and health) in with and without project areas;

- when both engineering and agro-socio-economic evaluations have been carried out the results and recommendations are usually presented separately, and these are at times inconsistent;

- evaluations were often carried out too soon after project completion for project impacts to be detected;

- no post-survey evaluation of the effectiveness of the methodology applied in order to assist others in using the lessons learned.

It must be observed that some of the evaluation surveys reviewed reach conclusions which are not even supported by the data presented. The worst cases ignore evidence that there is no significant difference between the with and without project areas they have studied, use "with project" cropping patterns which do not reflect the results of their own surveys, and then compare them with before project conditions, deriving Internal Rates of Return which are meaningless.

3 RRA AND PIE

3.1 THE METHODOLOGIES

The Terms of Reference for FAP 12 explicitly note that Rapid Rural Appraisal (RRA) methods should be utilised for rapid evaluations of 12 selected completed FCD/I projects, while conventional survey methods should be used in data collection for the more intensive Project Impact Evaluations (PIE). This highlights a key point - RRA approaches are shorter than conventional PIE approaches, but they are also different.

In Chapters 5 and 6 the detailed approaches to be taken by the RRAs and PIEs are presented. In this chapter some of the key features of the two approaches are described briefly, and the differences between them, including the strengths and weaknesses of each approach, are noted.

3.1.1 Full Project Impact Evaluations (PIE)

The PIEs carried out by FAP 12 will aim to provide as comprehensive a picture as possible, within given time and resource constraints, of the impact of a specific project. In particular the PIEs will involve:

- a comprehensive review of the engineering structures;
- a review of the impact of these on flooding, drainage and irrigation inside and outside the project area;
- an analysis of hydrological data allowing calculation of flood hazard parameters;
- a random sample survey of households inside the project area, adjacent to it and in a control area, to permit an analysis of with and without project conditions, and an understanding of possible project impacts on those immediately outside the project area;
- detailed data collection on a wide range of topics related to project impact, including agriculture, livestock, fisheries, communications, environment, nutrition, social institutions...

In general the methods of data collection will be conventional. Team members from each discipline will be primarily responsible for data collection and analysis within their own areas of responsibility. Physical inspection and measurement will be necessary for engineering enquiries. The random sample survey will employ standard techniques for sample design and the data assembled should be robust enough to permit the use of statistical parameters in analysis and verify the confidence limits within which statements can be made. Further details of the proposed PIE methodology are presented in Chapter 6.

3.1.2 Rapid Rural Appraisals (RRA)

In contrast, the RRAs will recognise that within the time and resource constraints given, they must accept some sacrifice of precision and detail. What will not be accepted is sacrifice of the balance of observations between different types of areas and population groups; to economise on resources by taking observations only on the easily accessible is almost certain to bias the results in unforeseeable directions. As quantitative data collection and verification in the field will not always be feasible, the RRAs will concentrate more on the collection of qualitative data, but wherever quantitative data can be obtained with the resources available the RRAs will do so.

The teams carrying out the RRAs will be aware of the principles behind RRA (see Section 5.1) and will aim to avoid the biases that frequently affect less disciplined approaches to rapid rural data collection. In order to achieve this they will consciously utilise some of the tools that have been developed for RRA including the assembly of project dossiers, the use of checklists, multidisciplinary field activities, transect analysis and triangulation. These approaches are discussed further in Section 5.4.

3.2 STRENGTHS AND LIMITATIONS

3.2.1 The Programme as a Whole

The overall FAP 12 data collection and analysis programme will involve:

- 5 initial short RRAs of the projects which are to subsequently be the subject of PIEs;
- a brief methodological review of the initial RRA experience;
- 12 further more thorough RRAs;
- commencing at the same time as the 12 RRAs, the full PIEs of 5 projects.

This programme has both advantages and disadvantages. The initial RRAs of the projects which will subsequently be subject to PIEs will allow more thorough preparation for the PIEs and provide a strong awareness at the outset of each PIE of some of the issues that will need to be addressed. It will allow the different disciplines to more precisely plan their data gathering requirements and programmes, and should ensure that each discipline has a broad understanding of the overall context within which further data collection will take place. It will also mean that the FAP 12 study team will be familiar to some of the local people, and should assist in preparing logistical arrangements.

The short methodological review will allow for some introspection, and should permit more effective implementation of the main round of RRAs. The fact that RRAs will have been carried out on all 17 projects (even if at a slightly lighter level in the first 5 cases) should provide a useful ability to compare the conclusions of the PIEs with the conclusions of their initial RRAs. If the more detailed PIE studies lead to substantial revision of the RRA conclusions this will make the team more cautious in interpreting the results of the other RRAs. It is more likely that the PIEs will show that their initial RRAs were strong in some areas and weak in others - again providing useful guidance in interpreting the results of the other RRAs, and in developing methodological approaches for future appraisal of FCD/I projects.

On the other hand, the fact that the first 5 RRAs will be carried out in a briefer and slightly different manner to the remaining 12 may reduce this comparability.

The greatest methodological weakness of the programme has been the requirement to preselect the projects for PIE before the RRAs are complete. The experience of the Project Selection activity (see Chapter 4) has reinforced the Consultant's view (presented in the initial Technical Proposal) that it would have been better to have carried out all the RRAs using the same methodology, and then to select the projects for PIE. However, the programme adopted was inevitable, given time and resource constraints.

3.2.2 RRAs

The major strength of RRAs is that they will prove, it is hoped, a cost-effective means of assessing project impact quickly without too great a sacrifice in terms of data quality and comprehensiveness. The RRAs will involve a major effort to overcome the biases that are too often present in rapid data collection (see Section 5.2).

The major weakness of the RRAs is expected to be their lack of comprehensive detail and their weakness in confident presentation of quantitative data on project impact. Previous RRA experience has indicated that RRAs are effective means of collecting qualitative information and of making multi-disciplinary investigations. They are able to detect major changes in quantitative impacts (substantial changes in cropping patterns for example), but have usually been regarded as weaker when changes in yields, cropping intensities or other agricultural parameters are involved. However, techniques do exist for minimising the difficulty of collecting quantitative data for representative situations, one of which is discussed in Section 5.4.

Where RRAs are undeniably inferior to PIEs is in the firmness with which findings can be generalised over the project area and with which real differences can be separated from random season-to-season and area-to-area variation. This is because the required statistical testing techniques all assume the use of probability sampling, which usually (though not axiomatically) turns out to require greater resources than are available in an RRA programme.

Thus, a PIE using a properly designed sample of sufficient size can produce statements such as "Mean paddy yield in the project area is 38 per cent (+/-11 per cent) higher than in the control area", where there is a known probability (usually at least 80 per cent) that the quoted margin of error will not be exceeded. In contrast, in RRAs the significance to be attached to observed differences depends wholly on the judgement of the observer. A corollary is that for best results RRA requires highly experienced (and thus usually quite senior) field workers who can make an informed assessment of the significance of their observations. The availability of such workers in sufficient numbers, and also their cost, may be a serious resource constraint for widespread use of RRA.

Attempts to recalculate the usual economic parameters for project evaluation may be unrealistic for the RRAs, given the limitations on the amount of quantitative information which they can obtain. The RRAs should allow the identification of major failures to achieve project objectives but are less likely to be able to permit more than an extremely rough estimation of changes in farm incomes and actual project IRR, BCR or N/K ratios.

3.2.3 PIEs

The advantage of the PIEs is that they should provide far more comprehensive and reliable information on project impact. The more detailed engineering investigations should allow a confident evaluation of the projects' engineering performance and the quantitative assessment of with and without project flood hazard. The agro-socio-economic investigations should permit a statistically reliable analysis of project impact by comparing with and without project conditions, and an evaluation of project impact on those living adjacent to, but outside, the project area. All project disciplines will carry out investigations in the projects subject to PIE.

The quality of PIE data should allow a confident appraisal of project impact, including the physical achievement of project flood control, drainage and irrigation objectives, the physical impacts on areas outside the project, and the socio-economic impact of the physical changes on the affected population. It should be possible to assess resulting farm income changes, impacts on the non-farming population (the landless, fishermen, transport operators etc) and the calculation of standard economic parameters for project post-evaluation.

The major disadvantage of PIEs is expected to be their increased cost, and the increase in time required to evaluate project impact.

4 PROJECT SELECTION

4.1 SELECTION CRITERIA

Projects selected were required by the Terms of Reference (ToR) to be "representative of the types of FCD/I projects undertaken in Bangladesh" and to include some from the North-west and North-centre regions (the first regional studies).

A comprehensive list of all completed FCD and FCDI projects, excluding ones south-east of Feni (outside the FAP area), has been drawn up (Appendix F). This is based on lists provided by BWDB with additional information from and crosschecked with data held by MPO, the UNDP technical assistance project to BWDB and reports of various projects and programmes (such as EIP). The project locations have been checked using the existing MPO map of projects as the basic source. These data sources usually included enough of the required project information to permit a preliminary selection of shortlisted projects, and where necessary further information has been gathered during short visits to the areas concerned.

The selection process has differentiated between projects which are to be evaluated using PIE and RRA methods, since the strengths of the two approaches, and hence the selection criteria, vary between projects.

The "projects" considered here are closer to the 'systems' considered by management and O&M studies than to the 'projects' considered by implementing and funding agencies. Each spatially distinct flood control system is considered as a separate project. There may have been several investments in the same system (for rehabilitation for example) but this is only listed as one project - the earliest completed one - since the impact of later additions cannot easily be separated from the original project. In this way a number of investments are excluded from the project or system list.

4.1.1 Representativeness of projects

The evaluations are intended to cover projects which are representative of the range of general characteristics of FCD and FCDI projects in Bangladesh. The key characteristics considered were:

a) Type of FCD/I Project

Following discussions with FPCO and the FAP Panel of Experts it was decided that six main types of project involving FCD could be identified in Bangladesh, each one being characterised by particular flooding-hydrological-hydraulic conditions, types of engineering response, and types of likely impact:

- FCDI projects;
- embankments along main rivers;
- polders and flood protection projects providing 'full' flood protection (up to some defined return period as a design standard) within the main fresh water drainage systems;
- submersible embankments;

- embankments along rivers subject to flash flooding; and

- coastal zone polders protecting against flooding and salt water intrusion.

Hence the type of project also distinguishes between the sources of flooding (fresh water or salt water) and velocity of flood occurrence. Projects which provide only irrigation or only drainage were excluded from consideration at the outset.

b) Location

The spatial distribution of both types of evaluation should, where possible, include all the regions as defined in the FAP regional studies, but excluding areas outside the FAP. The regions defined for FAP are the North-west, North-centre, North-east, South-west and South-centre (treated as one regional study), and South-east. The area of Bangladesh south-east of the Feni river has been excluded from the FAP and hence was excluded from consideration for project selection.

c) Size (flood protected area)

FCD projects range from very small (under 1000 ha.) to very large (over 50,000 ha.) projects. The contributions to the total area protected from flooding in Bangladesh varies between size ranges, and the design, implementation, management and O&M problems are likely to vary with size of project.

In general the larger projects are best assessed using PIE, since the PIE property of statistically valid generalisation of results can be exploited to the full in extrapolating from the observed sample to the whole project. Conversely, attaining even qualitative assurance of the representativeness of results from a large and diverse project using RRA may make such demands on the scarce resources of suitably experienced staff (cf. Section 3.2.2 above) that the savings in time and cost over PIE disappear.

An exception is the case of the very largest projects such as the Brahmaputra Right Embankment, which cannot be studied in their entirety using either PIE or RRA within the available resources. The approach adopted for these is RRA of subsections of the project, selected for representativeness with the assistance of other FAP components.

d) Age (year of completion)

In well established projects full impacts should have occurred, whereas in more recently completed ones the important transition period will be fresh in beneficiaries' memories and findings may have greater impact on operation. Projects which were completed before 1988 should be selected since this will give a practical indication of their performance during an exceptional flood year compared with subsequent and previous years and, where appropriate, with conditions in control areas. Likewise projects completed more than approximately 15 years ago pose the problem of unreliable recall of pre-project conditions, and so are excluded from the evaluations.

In addition to these four main characteristics, other aspects of representativeness considered, but not of vital importance to project selection, are variations in agricultural conditions (which should be reflected in the regional spread and types of project/flooding) and differences in funding agency, since differences in pre-appraisal methods, implementation practice, and emphasis in the aims of projects may be correlated with the source of funding.

Also, on the recommendation of FPCO and the Panel of Experts, projects in the coastal cyclone prone zone have been excluded from selection since this area is already under study as part of FAP Component 7. Likewise projects which are restricted to town protection (usually from erosion) are also excluded since the focus is on agricultural/rural projects.

4.1.2 Project Characteristics

From the data base of projects, and the main aspects of representativeness sought in the sample, the population of completed projects was analysed to establish the numbers within different categories (Table 4.1) and the sample which would be representative of the total areas under different types of project (Table 4.2) and in different regions (Table 4.3).

This analysis indicates that major proportions of the area under flood control and of the projects completed are in the coastal zone. However, many of these projects are relatively old or in the cyclone zone. It also confirms the regional concentration of some types of projects - submersible embankments in the north-east and polders in the coastal zone, for example. It was also noted that, although the total area under FCDI projects is relatively small, the cost per hectare is much higher for this type of project, so on a sample based on proportionate expenditure their weighting would be higher. However a lack of construction cost records at constant prices precluded a full analysis on a cost rather than area basis.

4.1.3 Sampling strategy

Compromise between the types of project indicated for study by RRA and PIE, based on the total areas under different types of projects, and the need for a regional and project type balance has been sought in finalising the sampling strategy for project selection. The key consideration has been the need to provide feedback from completed projects which is relevant for the regional planning for future flood mitigation measures being carried out under FAP. This has meant that polder type projects in both the North-west and South-west are identified for PIE, for example, since the river/drainage systems are different hydrological units.

Table 4.4 summarises the numbers of projects selected for RRA and PIE from each of the categories. Following discussions with FPCO and members of the Panel of Experts, the classification of flood management issues and FCD projects has been revised by breaking down one of the six main categories to reflect regional differences in drainage systems and project size.

The first three categories reflect the central flood issues arising from the 1987/88 floods and hence are a focus of the FAP. These would be concentrated on in the Project Impact Evaluations (PIEs), although one submersible embankment project would also be studied by PIE since this is an important strategy which may be appropriate in other regions and which has not previously been subject to a full multi-disciplinary evaluation. However, the other project types are important to the regional studies and to flood hazard responses in Bangladesh in general, and raise important issues and experience in project management (O&M). Hence they would all be studied through the RRAs.

Table 4.1 Completed FCD/I Projects

Project Type	Category	NW	NC	SW/C	SE	NE	Total
FCDI	total	4	5	3	4	2	19
	eligible	2	2	1	2	0	8
Main river	total	6	0	2	0	0	8
	eligible	3	0	2	0	0	5
Coastal Polder	total	0	0	70	2	0	72
	eligible	0	0	7	2	0	7
Submersible Embankment	total	0	0	0	0	24	24
	eligible	0	0	0	0	17	17
Flash Flood protection	total	0	0	0	3	5	8
	eligible	0	0	0	3	2	5
All Other FCD	total	34	14	31	9	5	93
	eligible	11	8	17	3	3	42
All Projects FCD	total	44	19	106	18	36	224
	eligible	16	10	27	8	22	84

Note : "Eligible" indicates that the projects are eligible for evaluation (excluded projects not normally complete by 1988).

Source : Consultants.

Table 4.2 Distribution of Flood Protected Area by Project Type

Project Type	Area (ha.)	%	Sample Number	
			RRA	PIE
FCDI	236,442	9.9	1.2 = 1	.5 = 1
Main Riv. Emb	478,254	20.0	2.4 = 2	1.0 = 1
NW - Main FCD	294,242	12.3	1.5 = 2	.6 = 1
SW - Main FCD	134,603	5.6	.7 = 1	.3 = 0
SC & SE Main FCD	238,755	10.0	1.2 = 1	.5 = 1
Small FCD	128,505	5.4	.6 = 1	.3 = 0
Sub. Emb.	152,107	6.3	.8 = 1	.3 = 0
Flash Flood Protection	33,434	1.4	.2 = 0	.1 = 0
Semi-Saline Coastal Polder	417,259	17.4	2.1 = 2	.9 = 1
Other Coastal Polders	282,999	11.8	1.4 = 1	.6 = 1
All	2,396,600		12	5

Source : Consultants

Table 4.3 Distribution of Protected Area by Region

Region	Area (ha.)	%	Sample Number	
			RRA	PIE
N - W	878,809	36.7	4.44 = 4	1.8 = 2
N - C	36,924	1.5	.2 = 0	.1 = 0
S - W	582,046	24.3	2.9 = 3	1.2 = 1
S - C	325,817	13.6	1.6 = 2	.7 = 1
S - E	354,728	14.8	1.8 = 2	.7 = 1
N - E	218,276	9.1	1.1 = 1	.5 = 1
All	2,396,600		12	5

Source : Consultants

Main river embankments are represented by only two RRAs since the main embankment, the Brahmaputra Right Embankment (BRE), is too large for PIE and lacks suitable control areas. Instead two RRAs are planned for short sections of the BRE as transects running from the riverside through to areas little affected by the embankment. There are no larger FCD projects in the North-central region so there would be no PIE there. To keep some regional balance two of the smaller FCD projects studied by RRA would be from the North Central region. Coastal zone polders, even in the semi-saline zone, are under represented, partly because most are older projects - and also because all are liable to face similar management problems.

The regional breakdown of selected projects which arises from this sample is: six projects from the North-west (four RRAs), two from the North-centre (both RRAs), three from the North-east (two RRAs), four from the South-west and South-centre (three RRAs), and two from the South-east (one RRA).

4.1.4 Other factors

Several other factors, whilst not key criteria for the selection of projects, are relevant to the final choice of projects in terms of finding a representative sample, and were considered in the selection of PIEs from shortlisted projects:

- the existence of previous post-evaluations, whether full, rapid, or specific impact evaluations, is a reason for avoiding re-evaluating a project;
- the availability of secondary source and baseline data on project performance, pre-project conditions, or non-project related studies in the same area, including water system modelling would be an asset, for use in the evaluation;
- the availability of suitable control areas is particularly important to the PIEs;
- existence of background data is desirable where external impacts (to the project) are likely, for example data and analysis of the hydrological-hydraulic impacts of a project on non-project areas;
- some of the selected projects should be known to have had adverse impacts on fisheries, or conflicts in management such as between shrimp farming and cultivation, since this has already been identified as a topic of special concern in the study and is believed to be one of the main negative impacts of FCD projects in Bangladesh.

4.1.5 Selection criteria ultimately used

In summary, the key criteria for project selection were that all projects selected should:

- have been completed between 1975 and 1988;
- not be south-east of Feni;
- not be in the cyclone prone coastal zone; and
- provide some form of flood protection.

Table 4.4 Summary of sample of projects by project type

Project Type			PIE	RRA
1	FCDI		1	1
2	Embankment along main river		1	2
3	FCD non-main river			
	a	North-west region	1	1
	b	South-west region	1	1
	c	South-centre and South-east	0	1
	d	North-centre (small)	0	2
4	Submersible embankments		1	1
5	Flash flood rivers (canalised by embankments)		0	2
6	Coastal Zone			
	a	semi-saline polders (Khulna area)	0	1
	b	other CEP polders	0	0
Total			5	12

Source : Consultants.

For the PIEs additional criteria usually used for short-listing were:

- larger projects protecting 15,000 or more ha;

- not previously subject to a detailed post-evaluation; and

- the availability of potential control areas (nearby unprotected areas unaffected by the project and at project completion similar to project area).

For the RRAs additional criteria for short-listing were:

- small-medium projects of 2,000-15,000 ha; and

- not previously evaluated, whether by RRA or PIE methods.

4.2 SELECTION OF PROJECTS FOR PIE

A short list of approximately 15 projects, excluding submersible embankments, was originally drawn up based on the criteria in Section 4.1.5. Selection from these projects was **purposive** based on discussions with FPCO, the Panel of Experts and team leaders of FAP regional studies; and on reconnaissance visits by members of the FAP 12 team to collect additional information and assess conditions inside the projects, in adjacent areas affected by them, and in potential control areas. Where a choice had to be made typicality and relevance to future flood mitigation planning were considered.

4.2.1 A FCDI project

There have been relatively few larger FCDI projects completed within Bangladesh during the period considered suitable for PIE (1975-1988). These are, in order of completion: the Chandpur Irrigation Project; Manu River Project; Muhuri Irrigation Project; and the Meghna-Dhonagoda Irrigation Project. With the exception of Manu River (North-East) all of these projects are in the South-East region. In addition the Ganges-Kobadak project in the South-West was considered. However this project was largely completed earlier and is mainly an irrigation project although it does include some FCD components. Other FCDI projects are nearing completion.

Of the four projects considered, the Chandpur Irrigation Project has already been evaluated in detail (see Section 2.2.5), and both the Manu River and Muhuri Irrigation Projects have been evaluated using RRA techniques (MPO, 1990). The Manu River Project was considered for PIE but is not typical of its region and is not replicable since it combines full flood protection for a haor area with irrigation, and hence lessons learnt from it would be of limited use for the FAP. The Muhuri project is on the fringe of the South-East region and is not being considered by the regional study.

This leaves the **Meghna Dhonagoda Irrigation Project**, which has been selected for PIE. The project embankment was closed in early 1987, the gross area protected is 17,584 ha, and funding was from ADB. The project has the advantages that detailed feasibility studies and some baseline surveys are available (CIRDAP, 1987), and also that households in part of the area are monitored by International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). Moreover, control areas exist in the unprotected parts of Matlab and adjoining Upazillas, and the results may be compared with those from previous studies of the nearby Chandpur project.

4.2.2 A main river embankment in the North-west

Flooding from the main rivers, particularly the Brahmaputra, is seen as one of the main sources of flooding addressed by the Flood Action Plan, and compartments to control flooding along the main river are one of the options being considered. Hence it is appropriate for one of the projects for PIE to be an embankment along a main river. However, most of the total length of this type of embankment has either grown piecemeal as the Brahmaputra Left Embankment (BLE) or forms a very large project, the Brahmaputra Right Embankment (BRE) constructed over a long period. It was thus decided to carry out two RRAs for parts of the area affected by the BRE, (see Section 4.3), and to select a 'smaller' embankment project of this type from the northern part of the North West. There the choice narrows to embankments along the Teesta or in Kurigram District, and a reconnaissance visit was made to obtain more information on these projects.

The Teesta Right Embankment forms a continuation of the BRE. An area stated to be 38,886 ha. was protected by an EIP project completed in 1978/79. Although it appears to provide effective protection to areas immediately behind the embankment, the limits of the area intended to benefit are in practice not clear. Areas on the river side of the embankment may have been adversely affected, but this would be difficult to establish as this is a sandy riverbed area. More importantly there is no comparable control area close to the project, since the embankment continues upstream as far as the Teesta Barrage.

The smaller (14,170 ha.) Sati Nadi project on the north (left) bank of the Teesta was also completed in 1978. However part of the protected area is relatively high and was not flood prone previously, as are some areas outside the project. There do not appear to have been adverse effects in adjacent areas, but part of the embankment has now eroded causing a sizeable part of the project area to revert back to approximately previous conditions. This could form a control area but would leave a small project area.

The Kurigram North Unit is an ongoing project with only part of the embankment built. So far it protects an area east of the main road through the unit. Since all work on even this part is yet to be finished it would not be appropriate to evaluate it as a project.

The project selected by the consultants is the **Kurigram South Unit** completed in 1980/81 and protecting about 65,000 ha. The project area is protected from flooding from both the Teesta and Brahmaputra, and includes the District town of Kurigram. Some areas on the river side of the embankment were reported to have been adversely affected by the project, while suitable control areas could come from the unprotected part of the Sati Nadi project (immediately to the west) and/or from the unprotected part of Kurigram North Unit just to the north.

4.2.3 A Chalan Beel Polder

Some 15 or more FCD projects have been completed or are under construction in the Atrai River Basin, which forms a major drainage basin in the North West. Of these the Chalan Beel Polders are the largest completed units and a reconnaissance visit was necessary to obtain background information on the projects and to assess actual conditions there.

Chalan Beel Polders A, B and C were all built under food-for-work programmes, and were completed in about 1973/74. They range in size from A (31,080 ha.), and B (33,153 ha.), to C (42,477 ha.), and were not subject to full feasibility studies, unlike many other subsequent projects of similar size. 'Polders' A and B have incomplete embankments - the Atrai river is embanked but roads, a railway embankment and the natural banks of minor rivers were all used as the other boundaries of the two projects. Polder A has the smallest length of embankment and the benefited area may be least affected by the project. Polder B contains a sub-project which has been provided with additional drainage facilities and was relatively high - it appears to be protected from flooding compared with the rest of that polder where embankment cuts or breaches are a problem. Polder C appears to be most plagued by design problems: people living on the river banks of the canalised Atrai, and adversely affected by floods there, cut the embankment to open up flood storage space, so damaging crops inside the project and causing drainage problems. To relieve these problems farmers at the downstream end of the polder cut the embankment there too.

Polder D was constructed later, being completed in 1985-88, is larger (52,860 ha), and was funded by IDA. It includes a number of beel areas and a mixture of land levels, some of which have been adversely affected by cuts or breaches. It should thus be possible to identify disbenefited areas adjacent to and inside the project. **Chalan Beel Polder D** has previously been evaluated using a RRA approach (MPO, 1990) and by a PIE-type survey (BETS 1989). The latter study is not of good quality. The project has therefore been selected for PIE because it represents a fully planned project which should have incorporated experience gained with the earlier Chalan Beel Polders in its design. It would be less useful to evaluate one of the other polders since some of the problems are already known and such unplanned large projects would not be repeated again, whereas feedback on the impacts of Polder D are directly relevant to future project planning. Additionally feasibility studies and surveys at completion are available for Polder D for comparison with the PIE results.

Identifying suitable control areas is a common problem for all these polders and did not influence project selection. However, the ongoing Barnai project, which is adjacent to Polders D and C, could act as a control area as baseline surveys are being undertaken there.

4.2.4 A submersible embankment project in the North-east

The selection of a typical submersible embankment project for PIE raised certain difficulties when the usual PIE selection criteria were applied. Features which distinguish submersible embankment schemes include their relatively low capital cost, relatively high annual maintenance costs (repairing embankments which are annually overtopped) and presence of structures which allow the poldered areas to be filled in a controlled manner once the Boro crop has been harvested.

An attempt was initially made to select a scheme which was relatively large (over 8000 ha), was a typical submersible embankment scheme, and satisfied the other main selection criteria (control available, completed between 1975 and 1988, baseline survey available, no previous evaluation). It became clear however that none of the possible schemes satisfied these criteria. Of the 7 larger schemes considered, 3 were incomplete (Naluar Haor, Haijda Embankment, Kushiyara-Bardal), one only recently completed (Hail Haor), two were high-cost and therefore atypical (Haijda, Hail Haor), two were very large and hence atypical (Pagoner Haor, Hail Haor), one had none of the control structures normal in such a scheme (Damrir Haor) and two had previously been evaluated (Damrir, Hail Haor).

It was therefore decided to broaden the selection to include schemes of more typical scale (most are in the 1000 to 6000 ha. range). Within this group it was noted that many of the schemes are poorly documented, but that the EIP projects are generally better documented. Four such projects were considered. Two have already been evaluated (Angarali Haor and Sanghair Haor) and one has been selected by EIP as a project for special attention under its FOCUS project (Sanghair Haor). Of the remaining two, the Consultants selected **Zilkar Haor** as it was understood to be the hydrologically more typical. This project has not previously been evaluated, two baseline studies of the project area were carried out, control areas adjacent to the project area exist and new submersible embankment projects have been proposed in adjacent areas.

4.2.5 A FCD project in the South-West

Four projects were originally shortlisted for selection for PIE (Alfadanga-Boalmari System, Chenchuri Beel Project, Kolabashukhali Project, and Polder 24). A reconnaissance visit to obtain further information on these areas and possible control areas was made and based on this **Kolabashukhali Project** was selected. The project is relatively large (17,000 ha.) and is typical in technical approach of many polder projects in the South-West intended to protect against a mixture of daily saline tidal flooding and seasonal freshwater river flooding. It appears so far to have been relatively free of the public cuts to relieve drainage congestion which plague many projects in the region, and therefore provides an opportunity to assess this type of design when working more or less as planned. An unprotected control area exists on the far side of the Chitra River. The project has previously been evaluated for BWDB using a PIE type of approach (ESL, 1986) but both the specification and conduct of the evaluation were faulty and it was carried out too soon after completion to detect long-term impacts.

4.3 SELECTION OF PROJECTS FOR RRA

A short-list for each of the categories of project given in Table 4.4 was drawn up based on the selection criteria detailed in Section 4.1.5. Between one and seven projects were identified as candidates for RRAs in each category. From these a random selection (using random number tables and projects ordered alphabetically) was made. Additionally a second (random) choice for each of the RRAs was also made. These second choices were to be taken up instead of the first choice, if major problems were identified either by the Panel of Experts or during compilation of the project dossiers (see Appendix D).

Some additional conditions used in shortlisting projects for random selection were:

- that the FCDI project should not be from the North-centre, since with two other FCD projects to be selected a third would have substantially over-represented the region (see Table 4.3)

- that the submersible embankment should come from the Sunamganj area, since this is the main concentration of these projects and the PIE submersible embankment comes from the Sylhet side of the region; and

- that one of the flash flood protection projects be from the area north of Mymensingh, with the other one from the South-east, as directed by FPCO/Panel of Experts.

The final project selection included 7 of the first choice projects. In three cases second choices had to be adopted:

i) In the south-west, Sonamukhi-Bonmander Beel drainage scheme was selected in preference to Singia Nebugati, since the latter is adjacent to the PIE project (Kolabashukhali) and protects against identical flood characteristics;

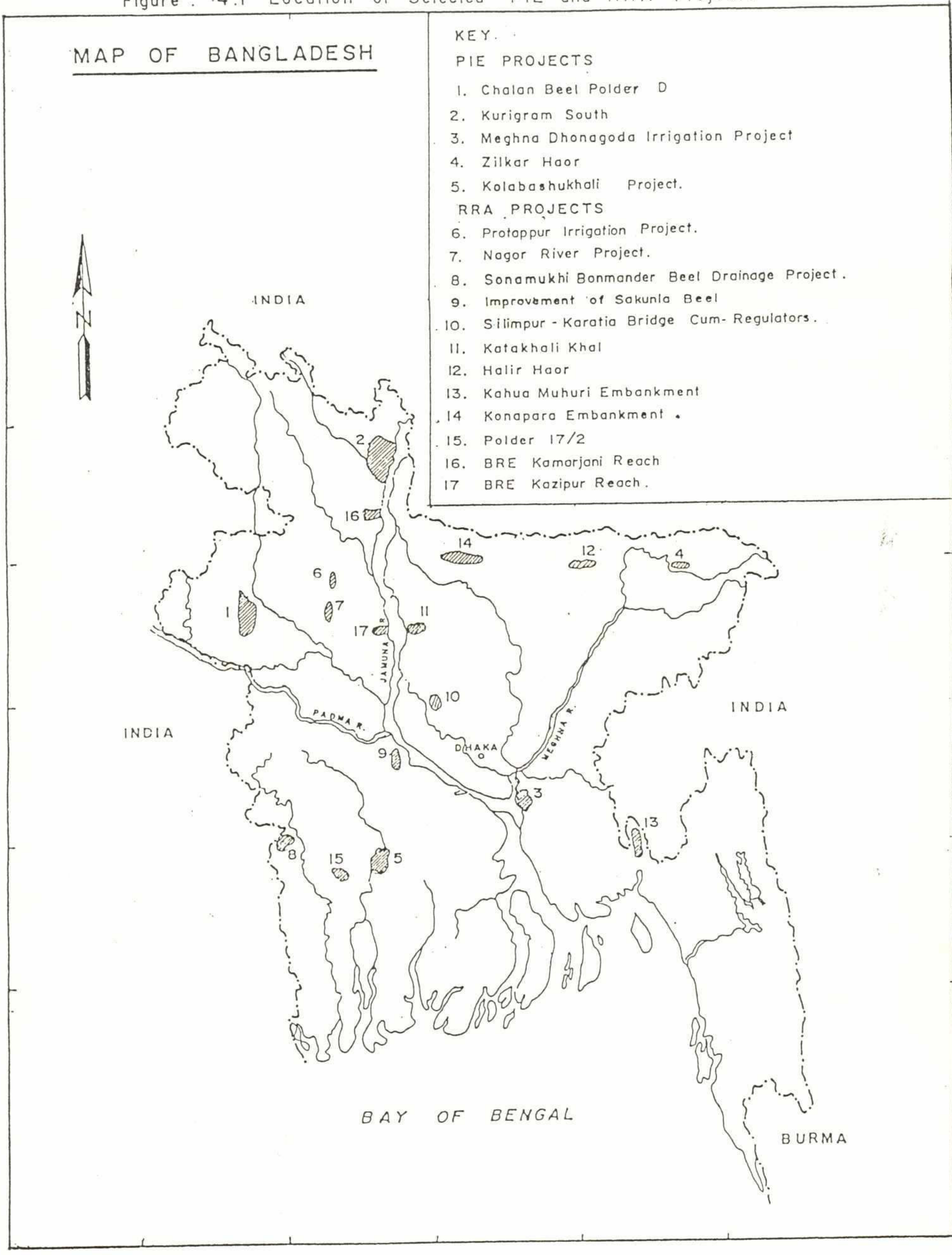
ii) In the north-west, Nagor River Project was selected when it was found that Chiknai-Gechua Project had been subsumed within the Pabna project, and that any flood protection provided in the last few years would be due to the latter project;

iii) In the north-centre, Balushail embankment was found not to have been completed when PIE questionnaire pre-testing took place there. The first alternative, Lakhya-Old Brahmaputra Scheme, was then found from the responsible BWDB officer to have planned excavation of the channel, but since it is now cultivated the project was thought unlikely to be implementable. The last option from the original replacement list, Selimpur-Karatia bridges-cum-regulators had to be taken up, but does cover part of the Tangail pilot compartment (FAP 20).

For the RRAs along the Brahmaputra Right Embankment (BRE) a different selection procedure was necessary. The two reaches were selected purposively through discussion with FAP 1 (and checked with FAP 2). They were selected to represent the most typical morphological and drainage conditions found along the BRE: one had not until 1991 suffered much recent erosion, the other has been affected by continuing persistent erosion since 1986.

Table 4.5 gives details of the 17 selected projects and their locations are shown in Figure 4.1.

Figure : 4.1 Location of Selected PIE and RRA Projects



Source Consultants.

5 RAPID RURAL APPRAISAL METHODOLOGY

5.1 BACKGROUND

5.1.1 RRA Principles and Approach

The development of RRA principles as an explicit approach to rural data gathering started in the late 1970s. The need for a "RRA methodology" was identified as awareness developed that:

- traditional methods of rural data gathering were time consuming, expensive and frequently failed to deliver the necessary information to decision-makers in a timely or accessible fashion;

- decisions on rural development frequently had to be taken quickly. More speedy methods of data collection had therefore been improvised, but these suffered from a variety of weaknesses, which can be summarised as spatial, project, person, time, and professional biases.

An effort was therefore made to develop an overall approach and a "box of tools" for use during RRA activities, which might improve the cost-effectiveness of rapid data collection. The objective was to allow decisions that had to be taken quickly to be reached with a better understanding of the situation. The objective was not to replace longer and more thorough methods of data collection - in fact one of the frequent uses of RRA is to undertake an initial rapid assessment of an issue in order to better design a longer term data collection programme.

The overall approach of RRA will be adopted during the rapid evaluations of FCD/I projects that are to be carried out. The following principal features will be observed:

- every effort will be made to avoid the biases which are otherwise liable to particularly affect rapid rural data collection. These are discussed further in Section 5.2;

- a range of methods of data gathering will be used. These include many of the "tools" which have been found most effective in RRA appraisals of irrigation schemes. These are discussed further in Section 5.4;

- reports will be produced immediately following the completion of data gathering, and be the reports of the team as a whole. Every effort will be made to keep reports brief and to the point, in order to maximise their use to decision-makers;

- the teams carrying out RRA will be particularly aware of the methodological aspects and potential weaknesses of RRA. It is recognised that this approach to rural data collection is relatively new to Bangladesh, and that the team may be able to contribute to improving the approaches. After the first round of RRAs the team members will have an internal review of their initial experience and may attempt to improve the approach for the second round of appraisals. Methodological approaches, strengths and weaknesses will be fully reported on, so that subsequent RRAs can benefit from our experience.

5.1.2 Previous RRA Experience in Bangladesh

In Bangladesh RRA methods have already been used to evaluate completed water management projects, including FCD projects, by MPO (initially in a study of Pathakali-Konai Beel FCD project in 1985), and later in their "Evaluation of Historic Water Resource Development" in 1990). Their methodological approach has been discussed in Section 2.2. RRA methods are also being used at the planning stage of some new proposed projects. The Early Implementation Projects (EIP) team in particular are using RRA methods at one stage in their appraisal process. The FAP 12 team have discussed EIP's experience with RRA techniques with several of the EIP staff who have carried out RRAs, and the following approach incorporates some of the lessons learned by EIP.

5.2 AVOIDING BIAS

The development of RRA techniques was stimulated by an awareness of the weaknesses of what was critically described as "Rural Development Tourism" (Chambers, 1983). It was shown that conventional rapid methods of data collection were liable to a range of biases, which were to a large extent mutually reinforcing, and could together present an appraisal team with a substantially distorted view of "reality".

In the FAP 12 RRAs explicit efforts will be made to avoid some of the most common biases.

5.2.1 Spatial Bias

Team members will visit a range of areas which cover the full area of the project, and represent the range of conditions believed to exist (see also Section 5.4.5). During fieldwork team members will be on the alert for information (e.g. from farmers) on unexpected conditions and will modify their programme where these are identified. Areas outside the project area will also be visited, to the extent that this does not involve abandoning the resource-saving advantages of RRA, both to assess possible external impacts and, if possible, to visit "control" areas which indicate what conditions might have been like without the project. A particular effort will be made to go to the heads and tails of both irrigation and drainage systems and to visit areas distant from project facilities and road access.

5.2.2 Person Bias

The team will meet as wide a range of informants as possible, including landless people, fishermen, farmers in a range of landholding categories, women, government officials at different levels in the hierarchy, teachers, petty traders, rickshaw pullers, boatmen and other key informants.

5.2.3 Time Bias

The team will be very aware of the need to investigate what conditions are like throughout the year, and between years. In the case of FCD/I projects it is particularly important to identify what happens in high and low flood conditions. Experiences in the 1987 and 1988 floods (both inside and outside the project area) will be of particular interest.

5.2.4 Professional Bias

The team will usually work in pairs, and rotate disciplinary groupings, in order to maximise the interdisciplinary nature of the investigations. There will be regular team meetings throughout the RRA, so that staff in the different disciplines can exchange their reactions.

5.3 OBJECTIVES OF THE RRAs

The RRAs in this study have three purposes:

(a) The initial five will form a pre-test of the methodology and will provide background insight and information for finalising the detailed questionnaire surveys (PIEs) for the same projects;

(b) To evaluate relatively quickly the impacts of 12 completed FCD and FCDI projects, with implications and recommendations for future flood mitigation investments based on this;

(c) To recommend, based on this experience, a methodology for RRAs which can be adopted subsequently for evaluating other FCD/FCDI projects in Bangladesh.

The evaluation outputs will in general comprise a qualitative assessment of the projects' agricultural, socio-economic and environmental impacts (particularly fisheries), including where possible estimates of impacts on human health/diet, and on livestock. Their engineering effectiveness, operation and maintenance problems, and effectiveness in targeting benefits and compensating activities towards disadvantaged groups will also be assessed, and a revised actual cost cash flow calculated.

Where possible impacts will be quantified by comparison with and adjustment of pre-project and secondary source data according to the RRA findings. Whenever possible this will include an approximate estimate of the IRRs of the projects, but this will be carefully qualified since the method which will be adopted will not be directly comparable in its scope to that in the PIEs.

5.4 RRA TOOLS

5.4.1 Prior Organisation - Project Dossiers

One of the keys to effective RRA is careful organisation, prior to fieldwork. Team members need to have clear objectives, to have prepared checklists, and to have made maximum possible use of existing data before the field visit. For the FAP 12 RRAs a Project Dossier will be assembled before each RRA commences (see Appendix D for outline contents). This dossier will include maps of the project, and details of all known previous studies.

At the start of each RRA each team member will receive a copy of the project Dossier. The team will then have up to a week for background reading, meetings and further data assembly in Dhaka, and a team meeting to discuss organisation, programme and data requirements.

5.4.2 Checklists

Each discipline will prepare checklists of essential, and less important but useful, data to be collected during the field work. Examples of such check-lists are in Appendix E. These checklists are not questionnaires. They will be used as guides and prompts during field inspection and interviews, allowing the specialist to carry out open-ended interviews but to be able to occasionally check that all the important items are covered. Wherever possible checklists will be kept to one page, allowing less obtrusive use.

Subject areas for which checklists have been prepared include engineering (including operation and maintenance), agriculture, non-farm economic activities, social and institutional change, environment and ecology, fisheries, fish trading, livestock and dairying, nutrition, and economics (see Appendix E for further detail).

5.4.3 Agricultural Assessment Matrices

An extension of the checklist concept is the use of an Agricultural Assessment Matrix (AAM), an example of which is shown in Appendix F. The AAM provides a framework for assessing the division of an area by agricultural capability (primarily a function, in pre-project conditions, of elevation/flood depth) for each of the main cropping seasons. It is essentially an instrument for structuring the output of a group interview with informed respondents who are familiar with the area, and the land classifications which will result are those of the respondents. To translate RRA findings into terms useful for planning future projects these classifications will require to be correlated with absolute elevations and 'F' levels.

Definition of typical rotations by land type in turn provides a structure for obtaining data on inputs and outputs, and hence of estimating with and without-project net output per unit area. A measure of area quantification can be introduced into use of the AAM if respondents are asked to estimate relative proportions of area (not absolute acreages) falling under different land classes and crop rotations, in terms of fractions familiar to them; one possibility is to obtain relative areas in annas (multiples of 1/16) which is a subdivision commonly used in rural Bangladesh and small enough to provide adequate precision.

5.4.4 Triangulation

The concept of triangulation is based on the fact that there are many different ways of looking at rural development, and of the impact of FCD/I projects in particular. Different participants may have very different points of view about a project's impact, and, particularly during rapid appraisals, there is a danger of taking the views of one person as the total truth. During RRAs there has therefore to be an explicit effort to obtain information in a variety of ways and from as many sources as possible. Wherever possible more than one source should be used for the same information items, unless field verification of the situation can provide solid data. It has often been noted during RRAs that different sources provide contradictory information - this can itself be useful as it allows the team to either carry out further data collection or to ask themselves why different sources see a situation differently.

In the present case methods of data collection will include field inspection and measurement, guided discussions with government officials, informal discussions with other key informants, open-ended but structured group interviews, direct one to one interviews in the field and walking in the project area in the company of farmers and, probably, a UP member. As noted in Section 5.2.2, as wide a range of informants as possible will be addressed.

5.4.5 Randomisation and Stratification

It is not possible during an RRA to carry out sample surveys which would provide data with rigorous statistical significance. However it will be necessary to use stratification and randomisation techniques in order to ensure that areas and individuals reflecting different important phenomena are all covered with as little bias as possible.

(a) Village/location sampling

Land types, particularly normal flood depths (land levels), are the key factor in variation in the impact of FCD within a project; and villages are the smallest administrative strata. Villages should therefore be categorised by general or average land level. Additionally, villages which are thought to have been adversely affected by the project need to be identified.

Lists of all villages for each land level within the project, plus a list of affected villages outside it, would be drawn up. 1-3 villages per list could then be selected at random for site visits and group discussions. Adjacent villages in the same list would be rejected for an alternative random selection. Additionally sites/villages where problems have occurred within the project would be visited as well, and if not already selected a village cut by the project embankment would be selected to investigate implementation and O&M issues.

An alternative approach which also generates a spatial spread of sites for visits is to select villages at a pre-determined interval on a grid or transect basis in the project and adjacent areas. However a transect cutting across all land types identified would be necessary to ensure that the full range of land types is covered.

(b) Sampling for group discussions

As with selection of villages, so with selection of respondents for group discussions, it is preferable to know the characteristics of those involved and that they are random selections of people in a given category rather than an unknown mixture of interests. Provided relatively small units (mouzas or paras) are involved, one possible approach is for an assistant to quickly compile a stratified list of all households within the village by talking with 1-2 older residents: asking them to name household heads, fathers names, and main occupation, with perhaps a wealth or household viability category as well (these can be pre-defined or defined by the informants).

When a meeting is planned in the village a random selection of say 15 household heads for each of the categories of household (eg landholders and landless separately) can be made from the list. Once one of the selected respondents is found he can help in finding the other respondents and inviting them to the meeting. The group meeting should not last more than about two hours in all and would be led through a checklist of issues and questions. These meetings may need to be held in the evenings.

For the separate group discussion(s) with women a female team member would be needed. One way of bringing together the respondents would be to select the wives of the male respondents. Couples could then come to and leave the meeting together but would divide into their own group meetings at the meeting place. The RRA team would also need to split up for such discussions so that all the meetings in a village are completed the same day.

5.4.6 Transects and Sketch Maps

In order to present land use patterns and to discuss FCD/I impacts with local people, an attempt will be made to use transects, which have proved an effective tool in other RRAs. The method involves taking a cross-section of the protected area and walking the cross-section, recording changes in land use, vegetation, levels, flooding etc and discussing these with local people, either during the actual transect or subsequently during group meetings.

An attempt will also be made to use sketch maps of the protected area, or of the part of the protected area adjacent to the relevant village, for the same purpose. Other RRAs have found such sketch maps, sometimes drawn together with villagers on the ground or on paper, are easily understood and provide a valuable basis for discussing pre and post flood protection conditions in different areas.

5.4.7 Inter-disciplinary activity

The RRAs will involve a substantial effort to integrate the work of professionals in different disciplines. Each team will only have four professional members. They will frequently have to "cover" for unrepresented disciplines. The team members will normally work in pairs, and each day the pairing will change, so that during field work each specialist will work at least twice with each other team member. The team will meet formally on two or three occasions during each RRA to present each member's results so far, and discuss progress, conclusions and newly identified lines of enquiry. It has been found during previous RRAs that this formal interchange is very important in ensuring that a group view of the appraisal emerges. The final report on each RRA will be prepared by all the team. There will be no independent reports by individual members, and unless otherwise indicated, the report's conclusions will be endorsed by all team members.

5.5 RRA PROGRAMME

After selection of the projects it is intended to complete each of the evaluations using the RRA approach, including report production, within three weeks. Team composition would be approximately six professional staff (senior or junior specialists) per RRA. One or two Field Supervisors would participate in each of the five pre-PIE RRAs in order to familiarise themselves with their operating areas for the PIEs, but these personnel will be fully occupied in the PIE programme during the twelve full RRAs. Team membership would be changed between evaluations so that insights from different disciplines and previous RRAs are exchanged. To familiarise other professionals involved in water sector studies with the RRA methodology, it is hoped that officials from relevant Ministries and Departments can be invited to participate in the RRAs. The following stages are expected to be followed.

5.5.1 Review Project Dossier and Organise RRA (Dhaka)

The project dossier will have been prepared by the Junior Specialists before the RRA commences. The RRA team members would review the dossier, examine the relevant reports, maps and documents and discuss the project with BWDB and other concerned staff in Dhaka. Team members would prepare base maps, and revise the standard checklists of questions and proformas for information gathering to reflect the specific requirements of the project in question. Before departure from Dhaka the team would meet together formally at least once to discuss initial reactions to the Dossier and to agree on logistics and RRA organisation.

It is expected that this initial preparatory phase would take 5 to 7 days.

5.5.2 RRA fieldwork definition (field)

The first two days would involve initial discussions with BWDB Divisional and Upazilla officials to determine an overall impression of the project. The project area would be divided into areas of similar land type (level) and team members would develop preliminary project maps for field checking. Likewise they would identify areas outside the project and reportedly affected by it, and possibly other areas outside but similar to the project area at the pre-completion period. They would use this to identify the sets of similar villages from which a sample of villages to visit for group discussions and field surveys can be drawn. The team would collect any unpublished data available here.

Additionally the team would discuss any past and present problems with the project, and use this information plus project maps to determine other field visits - e.g. to major structures, to some of the earthworks, to areas of drainage problems, etc..

5.5.3 Fieldwork in project area

Field visits would follow, to a 'sample' of villages. In addition team members would tour project and non-project areas to observe and assess agriculture, engineering and environmental situations; they would organise discussions with groups of inhabitants broken down by occupational group to discuss, for example: agriculture; other work and income sources; experience in flood and non-flood years; project impacts and opinions about the project; participation in and continuation of the project. Additional group discussions for target groups such as landless labourers and fishermen would be organised.

The time required for fieldwork would differ between the first RRAs and the subsequent "full" RRAs, and would depend to some extent on project scale. As little as 3 days may be adequate for a 1000 ha. project, whereas up to 8 days may be required for the larger project areas.

5.5.4 Other field discussions

In the light of the field visits further discussions with appropriate local officials of particular issues would be held if necessary. In addition discussions would take place with fisheries, cooperatives and irrigation staff,and with local businessmen, traders, contractors and industries, if appropriate.

The team would, if possible, call a group meeting of representatives from Union Parishads and Upazillas within the project, plus someone from each village visited and BWDB officials. At this meeting they would present their preliminary findings. They may subsequently need to revise these in the light of the discussion.

One to four days may be required for this final round of field meetings.

5.5.6 Report production

The team would draft sections of their report while in the field, and reach overall conclusions in the course of team meetings during the field work. This would of course be essential to allow the team to present preliminary conclusions before departure from the project area.

Final report production would be carried out in Dhaka, and up to a week would be required.

5.5.7 General

The above tasks would take 3 to 4 weeks, when travel time is included. Where possible there would be a brief follow up visit during the monsoon/flood season to visually assess operation of the project and any problems, and fill any gaps which become obvious when the report on the RRA was finalised.

5.6 REPORTING

Wherever possible the RRA reports would follow a common format summarising both the background and pre-project analysis and the results and analysis of the RRA data. In part this would form the basis of an assessment of the achievement of immediate project targets, and of an incomplete economic re-appraisal concentrating on agricultural impacts, similar to that used by MPO (1990).

Where possible qualitative results will be summarised through visual means. Maps and cross-sections will be used to summarise agricultural and environmental changes and experiences in past flood years.

In particular the partial economic post-evaluations will follow a common framework, using both standard data derived from secondary sources, and project specific data from both project records and reports and modified and revised based on the RRA fieldwork. A series of tables will be presented standardising where possible the following factors:

Land types - in particular a standard set of land levels.

Project area and **net cultivated area** before and with project (actual areas), broken down by land types and noting losses of land to project works by type.

Standard set of **crop types**, plus additional land uses for mapping.

Cropping pattern - areas of each crop type by land type from RRA, compared with pre-project predictions and pre-project patterns.

Yields under 'normal' conditions broken down by crop type and land type, from RRA.

Yields under flood conditions (preferably more than one year/set of conditions) broken down by crop type and land type, from RRA; also yields in non-project flood conditions if possible.

Approximate estimates of **return periods** of different flood conditions and normal conditions, from RRA and hydrological-hydraulic analysis.

Input quantities broken down by input categories and crop types based on RRA data supplemented by secondary sources.

Input and output prices from RRA data, supplemented by secondary sources.

This would enable estimates of the net economic returns to agriculture under pre-project and with project conditions to be made, but it would not overcome the problem of making a without-project projection. However, it would permit recent years to be put into context: projects may be judged too harshly through discounting if poor performance in flood years happens to have occurred during the early years of their lives and floods of sufficient magnitude to cause those problems are very infrequent. It is more appropriate to separate the technical re-assessment of the actual standard of protection of the project, and of the implementation and O&M of the project, from the economic-agricultural assessment, which calculates **average annual net agricultural impacts** (expected values) based on both 'normal' and 'flood' years.

'**Take up**' periods can be critical since they form the early years of a project, The RRA would try to establish the sequence of change in cropping pattern from pre-project pattern to current pattern so that these years can also be modelled. This might also highlight reasons for slow or rapid changes.

Project costs will be reviewed and re-calculated based on actual records wherever possible, permitting limited economic assessment.

6 PROJECT IMPACT EVALUATIONS

6.1 INTRODUCTION

6.1.1 Expected Study Output

The Project Impact Evaluations (PIEs) are expected to produce quantified estimates of the economic, social and environmental impact of the projects under study, and to contribute to the assessment of engineering and O&M aspects of the projects at a level at least equal to the full RRA studies.

Economic impact will be measured in the form of an economic internal rate of return (IRR) and/or benefit/cost ratio (BCR), in accordance with the criteria laid down by the FAP Study Group on Economics. Economic impact assessment will also include assessment of the success of projects in achieving intermediate targets, including changes in household income, total output and employment, and estimation of changes in the savings and investment behaviour of the affected population and other induced development trends.

Social impact will be measured by taking explicit account of the differential effects of projects on different sections of the population, including large and small cultivators, landless labourers, women and fishermen, both inside and outside the project.

The PIEs will identify the environmental impacts of FCD/I projects. Where possible environmental impact will be costed and included in the measurement of economic impact. It is recognised however that environmental impacts are extremely difficult to evaluate. The shadow project approach (computing project IRR or BCR with and without environmental protection measures), will be tested for inclusion in the economic impact assessment for measurement of such impacts.

The PIEs will assess the adequacy of the engineering design and execution of the projects, and their O&M problems. For these aspects the PIEs will use the same approaches as the RRAs, since their assessment relies primarily on documentary sources, individual testimony (both from officials and from the people affected) and visual inspection, rather than on sample surveys. Engineering and O&M studies will be major contributors to cost assessments for estimation of economic impact, but their output will also have a large diagnostic content.

In addition to the impact evaluation as such, which is described above, the PIEs will seek wherever possible to identify the causes of shortfalls in project performance and to suggest remedies. They will also seek to find the predisposing factors for unexpectedly good performance. Particular emphasis has been laid on this aspect by FPCO. In the case of shortfalls a definitive solution to problems may require detailed engineering and agricultural redesign of the project, which is clearly beyond the scope and resources of the FAP 12 Project. In most cases the study output in these areas will consist of a review and reanalysis of existing data in order to identify problems which can be addressed in more detail by other FAP components.

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6.1.2 Basic PIE Methodology - Detection of Project Impacts

The PIEs will follow a control area approach under which the impact of projects will be measured by their effects on three types of human population groups and the areas they live in. These are:

a) people who live and/or gain their livelihood within the project area, and who are its principal intended (though not necessarily actual) beneficiaries;

b) people who live outside the project area but adjacent to it, who are not its targeted beneficiaries and who may have been adversely affected by it;

c) a control group of people living in an area far enough from the project not to have been affected either way, but which at the time of construction had conditions similar to those in the project area.

Examination of the first two groups, and the areas they live in, will permit assessment of changes over time, both positive and negative. It is quite possible that negative trends might appear amongst the intended beneficiaries, and positive trends amongst the potentially disbenefited group. The positive and negative effects will be measured against the pre-project situation, but observed changes in the areas influenced by the project will require to be assessed relative to general trends which have affected that type of group and area subsequently. This without-project trend is indicated by the control group/area. For example, if a move to irrigated HYV boro has occurred in the project area since the project was completed, this cannot be claimed as a project benefit if it has also occurred in a control area which is similar but not influenced by the project.

6.2 SAMPLE SURVEY METHODOLOGY

6.2.1 Introduction

It is highly desirable to use probability sampling in the PIEs, at least for the main sample of farm households which will produce data on the agricultural impacts which are the principal focus of study. This is because probability sampling confers the ability to measure sampling errors and hence to test statistically the significance of observed trends and differences between areas and groups. Sections 6.2.2 to 6.2.9 review the likely implications of probability sampling in terms of sample size for given levels of precision and confidence, and for resources required, and present the Consultants' preferred sample design.

6.2.2 Stratification

Sample stratification in the PIEs will be primarily for the purpose of defining domains of study for which separate estimates of population characteristics are required. The other usual objective of stratification, to reduce the variance of the characteristics under study, will be of secondary importance, though clearly it is likely that there will be some benefit in this respect from stratifying for definition of domains.

The primary division of the PIE samples will be between the within-project area (i.e. potential beneficiaries), adjacent areas outside the projects (potentially disbenefiting) and control area (to provide evidence of the without-project trend). Each of these will require to be treated as a separate domain of study when setting sample sizes.

Both within-project and control areas will be further stratified by pre-project depth of flooding; at least two, and possibly three, strata will be required. It would be desirable to set sample sizes at levels which could support statistical testing of estimates at this level of stratification, but the precision and confidence levels attainable will not be high under the available resources.

6.2.3 Approach to Sample Size Determination

Under the classical theory of probability sampling, sample size is determined by three factors:

- the inherent variability of the variable under study, measured in terms of the coefficient of variation V;
- the acceptable margin of error in estimating a population parameter (or the minimum size of difference between parameters which it is required to detect) measured as D, the proportion of the mean level of the parameter;
- the required level of confidence that the true value of the population parameter being estimated lies within the specified margin of error. This is measured in terms of K, the standard normal deviate.

The required sample size N is then given by:

$$N = K^2V^2/D^2 \qquad \text{Eq.(1)}$$

(see, for example, Casley and Kumar,1988, p.86)

This approach to deriving sample size requirements rests on certain assumptions, the most important of which is that the variables to be studied should have distributions which are approximately normal (in the statistical sense). Many agricultural variables as observed in the field are typically highly skewed and therefore non-normal, but this can often be overcome by well known approaches such as taking logarithmic or other transformations.

A second problem is that required sample size can only be set for only one level of variance in any given sample, whereas the PIEs will collect data on many different variables with differing variances. In these circumstances the best that can be done is to derive the sample size for the required levels of confidence and precision in the most important variable, accepting that this size will unavoidably be too small to give the same precision and confidence for some of the variables under study, and unnecessarily large for others. In the context of agricultural impact of projects aimed at increasing output in a land-scarce system, output per unit area has to be regarded as the key variable.

The variance of output per unit area (V) would best be indicated by a previous probability sample in the intended survey area, but this is not available for the PIEs since a previous intensive evaluation of high quality is grounds for non-selection. A good substitute is a probability sample under similar conditions. Failing this, a value of 0.5 for V is often used, and on empirical grounds seems to be a safe estimate for many agricultural variables in developing country situations. For the particular requirements of proportions data (e.g. percentage of farmers adopting HYV), which will be of great importance in PIE results, V has a **maximum** value of 0.5 when respondents are equally divided. Therefore, in the absence of strong evidence to the contrary, V=0.5 has been assumed for PIE sampling.

The values of D and K are assigned by the survey designer depending on the required (or acceptable) levels of precision and confidence in the estimated values. For example, D=0.1 indicates an acceptable margin of error of 10 per cent of the mean (or 10 percentage points in the case of proportions data). In the case of differences between groups or areas, the minimum difference which can be detected is twice the margin of error on the individual group means; thus if group means are estimated within +/- 10 per cent, the minimum statistically detectable difference between them is 20 per cent.

For all sample data there exists a non-zero probability that the true population level of the parameter being estimated lies outside the limits set by D. The probability that the true value lies within the limits is expressed in terms of K, the standard normal deviate.

It has been suggested to the Consultants by MPO that the classical approach to sample size determination outlined above, which is based on standard authorities including the World Bank's M&E manual, is somewhat conservative. MPO has argued that with appropriate use of nonparametric tests, which have the advantage of not requiring the assumption of normality, any sample of size 30 or more (that is, large enough to avoid small-sample bias) should be adequate. The Consultants have considered this view, but have preferred to retain the more traditional methodology. In reality, the first-approximation sample size from the classical approach, at minimum levels of confidence and precision, corresponds almost exactly to that suggested by MPO (Section 6.2.6). Both approaches, however, may need to take account of finite population effects and cluster effects, both of which can cause major variation from the first-approximation sample size. These will now be discussed.

6.2.4 Finite Population Effects

In cases where the sample size determined from Equation 1 is found to be a relatively large fraction of the population under study (say, 10 per cent or more) the precision and/or confidence which can be obtained is greater than indicated by the initial levels of the parameters of the sample size equation. The gain is normally expressed as the finite population correction (fpc), which indicates the permissible reduction in sample size to obtain the originally specified levels of precision and confidence. However, it is envisaged that PIEs will be conducted on medium to large projects where the fpc is unlikely to be significant, and therefore no allowance will be made for it.

6.2.5 Cluster Effects

Equation (1) assumes simple random sampling (SRS), but this is unlikely to be feasible for the PIEs. It will probably be necessary to use cluster sampling, in which several interview respondents will be selected from each of a first-stage sample of villages or other suitable units. Having respondents clustered in this way reduces problems in assembling sample frames and in actually conducting the surveys, but data from cluster samples usually show positive intra-cluster correlation; that is, members of the same cluster tend to be more similar to each other than to members of other clusters. This is not surprising, since cluster members share common conditions, but it means that the cluster members are not fully independent observations, and therefore the precision of the estimates obtained is lower than would be the case for a simple random sample of the same size.

Consequently, a cluster sample has to be larger than an SRS sample to obtain the same accuracy. The loss of efficiency z depends on the size of cluster m and of the intra-cluster correlation coefficient ∂, the relationship being

$$z = 1 + \partial(m-1) \qquad \text{Eq.(2)}$$

The size of ∂ for PIE variables and areas is not known, but for agricultural applications Casley and Kumar (op cit, p.93) suggest a likely value around 0.2. With a cluster size of 5 this gives z=1.8, that is, the sample size for a given precision and confidence is 1.8 times that given by equation (1), while for a cluster size of 10, z=2.8. The cluster effect thus has a very serious influence on sample size.

6.2.6 Required Sample Size

Table 6.1 shows the sample size N, for V=0.5 and D=0.1, under various levels of confidence. The last column shows N for a cluster sample with m=5 and ∂=0.2.

Table 6.1 Sample Sizes Required under Various Levels of Confidence

K	Confidence Level		Sample size	
	1-tailed	2-tailed	SRS	Cluster
1.96	97.5	95.0	96	173
1.64	95.0	90.0	67	121
1.28	90.0	80.0	41	74
1.15	87.5	75.0	33	59

Source: Consultants

6.2.7 Sample Frames

Probability sampling requires that every member of the population under study has a known non-zero probability of inclusion in the sample. If population members are excluded, generalisations made from sample data cannot be applied to them. The normal approach to meeting this requirement is to select sample members from a sample frame, that is, a complete list of the relevant population members. For the PIEs, assuming that cluster sampling is adopted, this will require an up-to-date list of villages or other suitable units from which to draw the first stage sample. For the second-stage sample a similarly accurate list of farming households will be required, but only for those villages selected in the first-stage sample.

It is not envisaged that there will be great difficulty in obtaining a suitable first-stage sample frame from administrative records. It will however be desirable to obtain not only a list of village names and locations, but also their relative population sizes. This is because the first-stage sample should preferably be drawn with probability proportional to size (PPS), to avoid biasing results towards smaller villages. A possible source would be the mouza household lists maintained by the Union councils which are updated in between censuses.

Alternatively, the last national census could be used. The decennial National Census was held on 15 March 1991, but unfortunately data from this will not be available in time for use in the PIEs. The previous census was in 1981, and the number of households in each village is readily available from this source, so where there is reason to believe population growth has not differed between villages in a given area, this source will be used. Another alternative would be the voters' lists. These ought to be completely up to date in the period immediately following the National elections, and would be a satisfactory proxy for population size (and hopefully numbers of households), but media reports indicate they may not have been updated.

There may be more serious problems in obtaining second-stage sample frames, both in terms of data availability and of the time required for its assembly. Institutions conducting surveys in Bangladesh, including BIDS and IFDC, have generally conducted a household listing exercise to provide a second-stage sampling frame. This has many advantages, including the ability to differentiate main household occupations and farm sizes for subsequent use in sample selection. The latter would be especially valuable because it would permit the use of linear systematic sampling (LSS) by farm size, ensuring a good coverage of a key population characteristic.

The method is however relatively labour-intensive, typically requiring about 8 person/days per first-stage unit. With the large number of first-stage units required to minimise second-stage cluster sizes, the resource requirements are likely to be prohibitive. Increasing the cluster size worsens the problem because the loss of efficiency (and hence the increase in total sample size required for a given accuracy) is more rapid than the reduction in number of clusters.

The mouza land tax lists maintained by the Union councils may provide a suitable alternative. These may be a few years out of date, but they could be checked and updated, and occupations ascertained (at least for the landless labourer group), with the help of locally knowledgeable informants such as the Union Secretary. This would require much fewer resources than household listing from scratch. This approach was successfully used in the Chandpur evaluation. Some illustrative resource requirements for this approach under different cluster sizes are shown in Table 6.2.

In the event that it is not possible to obtain satisfactory explicit second-stage sample frames, it will be necessary to assess the various possibilities for use of implicit frames. For example, in areas of well-nucleated settlement the grouping of houses may provide an implicit frame. If so, it would be possible o obtain a satisfactory probability sample by taking the nearest farm operator's household to a randomly selected point along a randomly selected route from a defined starting point.

6.3 SUPPLEMENTARY SAMPLING AND NON-INTERVIEW DATA

6.3.1 Requirements for Supplementary Samples

In addition to the main sample of farm households, it will be necessary to interview supplementary samples of landless labourers, fishermen, traders and transport workers, and to provide resources for separate interviews of female members of households in these groups.

For most of these groups probability sampling will not be feasible due to the difficulty of obtaining good sample frames. Therefore, the interviews while questionnaire-based will be of purposively selected respondents in situations judged representative on field inspection. The exception is female members of farm households, for whom the sample will have the probability characteristics already discussed.

6.3.2 Size of Supplementary Samples

The numbers of respondents for the supplementary samples will closely follow those outlined in the Consultant's Technical Proposal, but with the definitive addition of a sample of fishermen and fish traders:

- 30 landless labourers in each of the 'project' and 'control' areas (total 60);
- 15 traders/businessmen/transport workers in each of the 'project' and 'control' areas (total 30);
- 10 fishermen and fish-traders in each of the 'project' and 'control' areas (total 20).

The total size of the supplementary samples, excluding women, will therefore be about 110 per PIE. For interviews of women, it is proposed that interviews of female household members be conducted on a 25 per cent randomly selected subsample of farm and landless labourers' households and on all fishermen's households where these are accessible; much PIE fieldwork will be during the flood season when professional fishermen migrate to preferred areas.

6.3.3 Non-Interview Data Collection

Many of the subject areas covered by the PIEs contain considerable scope for collection of data by non-interview methods such as soil and water sampling, food sample analysis, etc. However, the large number of projects which FAP 12 is required to cover, the short timespan within which the studies have to be completed, and the large resource demands of physical sampling programmes for collection and analysis, place severe constraints on the extent to which such methods can be used.

FPCO and the Panel of Experts have therefore recommended that FAP 12 should not seek to involve itself in non-interview data collection in fields where other specialist FAP components, in particular FAP 16 (Environment) and FAP 17 (Fisheries) are going to operate. The role of FAP 12 will therefore be to signal areas of need for physical data collection for the attention of the relevant specialist components, rather than undertaking such collection itself.

One area where physical data collection needs can be foreseen and no specialist FAP component exists is nutrition. While a statistically valid and seasonally comprehensive programme of food analyses is beyond the scope of FAP 12, it is hoped that it will be possible to include collection of basic anthropometric data on children under 10 years old, the population group nutritionally most at risk. The measurements would be taken by female interviewers at the same time as interviewing female household members.

6.4 RESOURCE IMPLICATIONS FOR DATA COLLECTION

6.4.1 Resources Available

The FAP 12 budget provides for a total of 78 months of enumerator time and 28 months of field supervision time. Assuming 20 field days per month, this will provide a total of 1560 enumerator/days and 560 supervisor/days. Of the total enumerator/days, 20 per cent will be reserved for interviews of women, which will be conducted with the female members of a subsample of households which are being interviewed for other purposes. Because of this duplication the resources involved are deducted from the total in determining feasible sample sizes. The total remaining is 1248 enumerator/days and 560 supervisor/days.

6.4.2 Resources Required

Even the lowest levels of precision and confidence shown in Table 6.1 would require a sample of about 60 per domain of study; that is, in the case of the farmer samples, 60 respondents for each of the within-project, adjacent and control areas, or a total of 180 per project. Adding the supplementary samples of landless labourers, traders and fishermen gives a total requirement of 290 interviews, or about 195 enumerator/days, per PIE. Supervisor time would be required at a ratio of about 1:4, or about 50 days per PIE.

The FAP 12 Terms of Reference specify a total of 6 PIEs, for each of which a total of 208 enumerator/days would be available after deducting the resources for interviews of women. This is a barely adequate margin over the net requirement of 195 days for interviews, and leaves no resources for compiling sample frames. As shown in Table 6.2, a minimum of 72 days per PIE would be required for this purpose, about 50 days of which would be enumerator time.

6.3.3 Modification to Survey Scope

The Consultants therefore propose that the number of PIEs should be reduced to 5. This would make 250 enumerator/days and 112 supervisor/days available per PIE, which should be adequate though still leaving little margin for slippage. This modification, which has been extensively discussed with FPCO, the Panel of Experts, and representatives of the FAP Regional Studies, can be accommodated without sacrificing either the regional or typological balance of the PIE programme.

Table 6.2 Effects of Cluster Size on Total Survey Resource Requirements

1. Basic Parameters

Coefficient of Variation (V)	= 0.5
Confidence Interval (D)	= 10 per cent of mean
Confidence Level	= 87.5 per cent (one-tailed)
fpc assumed not applicable	
N under SRS therefore	= 33 per domain
Intracluster correlation coeff.(∂)	= 0.2
Time to list 1 first-stage unit	= 2 person/days
Time required for 1 interview	= 0.67 " "

3 domains of study for probability sampling, plus 110 other interviews.

2. Resources Required for Cluster Sampling

a) Cluster Size (m) = 5

z = 1+∂(m-1) = 1.8

N under cluster sampling therefore	= 59 (say 60) per domain
Total N = 180 = 36 clusters of 5	
Listing 36 first stage units	72 days (incl. supervisors)
180 probability sample interviews	120 days
110 case study interviews	73 days
	---
	265 days per PIE
	---

b) Cluster Size (m) = 10

z = 1+∂(m-1) = 2.8

N under cluster sampling therefore	= 92 (say 90) per domain
Total N = 270 = 27 clusters of 10	
Listing 27 first stage units	54 days (incl. supervisors)
270 probability sample interviews	180 days
110 case study interviews	73 days
	---
	307 days per PIE
	---

c) Cluster Size (m) = 25

z = 1+∂(m-1) = 5.8

N under cluster sampling therefore	= 191 (say 200) per domain
Total N = 600 = 24 clusters of 25	
Listing 24 first stage units	48 days (incl. supervisors)
600 probability sample interviews	400 days
110 case study interviews	73 days
	---
	521 days per PIE

Source: Consultants

6.5 SUMMARY OF PIE DATA COLLECTION APPROACH

To summarise, the proposed overall approach is as follows:

a) the farmer sample should be selected by probability sampling. Sample size should be 60 for each of the within-project/adjacent/control areas, or a total of 180 per project;

b) supplementary non-probability samples of landless labourers (60 per project), traders/businessmen/transporters (30 per project) and fishermen and fish traders (20 per project) should also be drawn;

c) a separately interviewed subsample of female members in 25 per cent of households should be covered in each PIE;

d) the sample design should be two-stage, with mouzas or some similar unit as the first stage and households as the second stage. The number of households selected per first-stage unit should not be more than 5;

e) selection of first-stage units should be with probability proportional to size. The second-stage sample should preferably be selected by linear systematic sampling on the basis of size of farm operation, but if farm size data are not available the second stage should be a simple random sample of cultivating households.

The implications are summarised in Table 6.3, which compares the present proposals with the original proposals presented in the HTS Technical Proposal in mid 1990. It will be noted that although the number of PIEs has been reduced, the work-load, in terms of interview numbers, has been significantly increased, both for the household survey and for the supplementary interviews. It is believed that this increase in interview numbers can be handled with the given resources, as the reduced logistical requirements of a sixth PIE offset the increased workload at the remaining five.

6.6 QUESTIONNAIRE DESIGN AND ADMINISTRATION

PIE data will be collected primarily through formal questionnaire surveys addressed to rural households. A total of 78 person/months of interviewer time has been budgeted for the purpose, along with 28 person/months of field supervisor time. It is likely that some of the junior specialists will also need to be deployed for purposes of field supervision.

The questionnaire design for the interviews is modular to provide greater flexibility in survey execution . Each module is capable of being administered and analyzed separately, and at the same time, the module design permits cross module data analyses. Draft modules were field-tested in the course of the pre-PIE RRAs, while at the same time the modules suitable for each of the projects taken up for study were identified. The questionnaire modules to be used in the PIEs are included in Appendix G.

In addition to the large sample survey, a number of case studies will probably need to be conducted, particularly for areas of data requiring in depth or supplementary information. Examples of these include analysis of costs, returns and labour use in various non-farm activities, assessment of nutritional impacts and the impact on the environment.

Table 6.3 Summary of Proposed Sample Sizes and Resource Requirements

Item	Proposed in HTS Technical Proposal	As Now Proposed
Number of PIEs	6	5
a) Sample Sizes for Main Farm Household Survey		
- within project area	50	60
- adjacent to project area	30	60
- control area	30	60
Total Farm Household Interviews per PIE	110	180
Total Farm Household Interviws - all PIEs	660	900
b) Sample Sizes for Supplementary Interviews		
- landless labourers (project and control areas)	60-70	60
- traders, businessmen, transporters (project and control areas)	15	30
- fishermen	15	15
- fish traders	0	5
- women	0	75
Total Supplementary Interviews per PIE	90-100	185
Total Supplementary Interviews, all PIEs	600	925

Source: Consultants

7 OTHER METHODOLOGICAL ISSUES

7.1 FLOOD LOSS ASSESSMENT

7.1.1 Common principles to flood loss assessment

Flood protection projects are concerned with reducing the risk of flood losses. Pre-project appraisals of FCD and FCDI projects in Bangladesh have tended to ignore the potential benefits from reducing flood damage, although in other countries this is regarded as a major benefit from flood protection. Systematic approaches to assessing potential flood losses must take into account the likely range of flood events, and couple these with floodplain land uses and the economic losses associated with flooding of the land to estimate potential flood losses in a particular floodplain. Methodologies already exist for evaluating these impacts. The problem is in adapting them to Bangladesh conditions within a tight timetable. These methods are data intensive, depending on data on:

- land levels and uses in the project area over time;
- damageability in value terms of different land uses - different crops, homes, infrastructure - according to different flood characteristics, principally depth;
- hydrological-hydraulic predictions of stage, and hence depth of flooding, for a series of discharges;
- and estimates of the annual exceedance probabilities of those discharges, which may be complicated by local rainfall risks, drainage systems (or the lack of them), minor channels and local topography; and by the implications of flood timing on crops.

The characteristics of these methods are that they estimate losses or impacts from a range of different flood magnitudes, with different exceedance probabilities, and from these calculate average annual losses. The economic loss estimates, based on standard or average sets of loss data, usually relate damage to depth of flooding, although data sets reflecting other factors such as flood duration and whether a warning is received are also available. In agriculture, in particular, it is also appropriate to look not only at expected economic returns (with flood risks) but also at changes in land use and cropping patterns which may be induced by flood protection, since these net impacts are potential benefits from flood protection.

7.1.2 Property loss valuation methods

The resource values of goods lost in floods may not be their replacement value. The replacement or new purchase value is appropriate for consumables like food, but not for durable goods like beds, and perhaps houses, which eventually must be replaced because they are worn out. A simplifying assumption used for household durable goods in Britain is to take "average remaining values". If the age profile of ownership for a particular good is uniform and it has negligible scrap value this simplifies to taking 50% of the new price as the economic loss when a good must be replaced. This avoids counting someone's gain in buying something new to replace an old item as a loss due to flooding.

By comparison, repairs are taken to leave a good equivalent to that owned before the flood and so the full value of repairs is a resource loss attributable to flooding. In Bangladesh flooding may destroy houses, and housing materials have relatively short lives. Thus if straw is replaced on average every two years with negligible residual value, then if the flood destroys even a moderate number of straw houses they will average out at one year old, and half of the replacement cost may be taken as the average value of such losses.

7.1.3 Agricultural loss assessment

In agriculture the appropriate comparisons are between expected values of economic gross margins in flood prone and flood protected conditions. This requires an estimate of the cropping pattern under flood prone conditions and of the flood risks, an estimate of the output and inputs under different flood events (each with an estimate of its exceedance probability), and estimates of the economic value of output and inputs.

Multiplying the values by the quantities, and subtracting the costs of purchased/imputed inputs from the value of outputs, for the average cropping pattern gives a series of economic gross margins for each type of flood condition. This can be expressed as a 'return probability curve' analogous to a loss probability curve, from which an expected value or average annual economic gross margin can be calculated. The difference between this and the economic gross margin in a flood free year is the average annual loss for that cropping pattern from flooding.

The same calculations can be done for the cropping pattern with flood protection (drainage problems, and embankment failures mean that expected values should again be taken). The difference between average annual gross margins with and without protection represents the potential economic benefit from flood protection, which may well be different from the loss due to flooding if flooding is a constraint on the choice of crops grown.

7.1.4 Other flood impacts

Indirect flood impacts can be more complex to evaluate (Parker et al, 1987). Businesses are likely to suffer financial losses in floods, but these may not be a loss to the national economy. Losses of trade are complicated by several factors. Turnover is not an appropriate measure of losses since, if stocks have been lost this will already have been counted as direct damage (double counting should be avoided). Loss of value added by a business is more appropriate. However, business may simply be transferred between companies within the economy in which case there is a distributional impact but not an economic loss to the national, or state economy (the boundary of the analysis must be defined). Likewise trade or production may be deferred in time until after flooding - again there may be no or a small economic loss.

In Britain, where floodplains are small and alternative outlets or manufacturers are often many, indirect losses to the national economy tend to be restricted to cases of losses to foreign competitors and where there is a monopolistic supplier, and hence direct losses are greater than indirect losses in average conditions. In Bangladesh flooding is more widespread and industries may have fewer firms implying higher indirect losses. However, floodplains in Bangladesh are less industrialised and so this type of impact appears not to be a first priority for study.

Disruption of transport, particularly roads, can be another important indirect loss. In this case the economic costs are resource costs (mainly fuel) and lost time involved in detoured journeys or slower journeys for normal users of detour routes. However, journeys may be lost altogether in which case the economic loss, if any, is to the end users. Secondary disruption to economic activities of businesses and households may be involved and should be assessed using the same approach as for businesses directly affected by flooding. Tracing which businesses are affected by secondary impacts may be difficult, and the alternative of regional or national economic modelling of secondary effects depends on the availability of suitable input-output data and models. Such methods may be appropriate where flooding is particularly severe or affects a wide area, but are not feasible in this study. They may be addressed by the Special Study on Macro-economic Modelling.

Other impacts of floods which may be counted as economic losses are extra (marginal) costs incurred by organisations or individuals in making good production, since this involves the use of additional resources. This is particularly so in economies where time is at a premium. Also emergency costs, such as rescue and temporary accommodation, and costs of emergency repair work to roads and embankments, can be taken as an economic loss associated with flooding. However, relief payments are not economic losses, since these transfer payments redistribute the burden of direct losses and are not resource losses.

7.1.5 Flood loss (depth-damage) data sets

It may appear desirable to estimate potential flood losses based on past damages in a floodplain, but this is a relatively inaccurate and inefficient method because actual financial damages have to be converted to economic losses. Further, the flood experience may be old, causing problems of recall and index number problems where relative prices or ownership of goods have changed. More important, a particular event will only give data for losses to a single combination of depth, duration, velocity and timing of flooding. This precise combination is unlikely to be repeated again. If losses are to be estimated for a series of possible floods of different return periods, then more generally applicable data sets are needed. Such data sets can be used to model losses in any flood event, and may be applied wherever similar land uses are threatened by flooding.

In principle data sets should be developed for each land use which has different damageability characteristics, which requires that a land use classification be developed. For example, this might distinguish houses by building construction type and size, since damages will be associated with this, and/or by socio-economic class since this will correlate with the quantities and qualities of goods at risk from flooding. Likewise crops and varieties will need to be categorised by damageability and any knock-on impacts on the post-flood crop sequence.

Damages may be dependent on several aspects of flooding. Depth of water is clearly critical but other factors may also be important: high velocity floods tend to be more damaging, long duration floods tend to cause more disruption and indirect losses, and the timing of flooding may be vital to crop damages. Because damages can be intuitively linked to depths, and because the main output of hydraulic analyses tends to be different depths of flooding for different return periods, it is more important that data sets are built up for a range of standardised depths (this aids computations and comparisons).

Other factors can be simplified into categories such as high and low velocity floods, each with a set of depth-damage data for each land use item, and likewise for long and short duration floods, and floods before or after a given date. The result is a small matrix of depth-damage matrices, but usually it will be possible to say whether a catchment experiences slow or fast floods, or whether a particular event will be short or long, or the likelihood of this; and so the relevant data set for a particular location or set of events can be identified and used.

A **synthetic** data set is one synthesised from several data sources rather than simply averaged from past records. This is more appropriate because past records do not reflect the range of flood levels possible, or identify critical depths at which damages increase substantially (or stop rising). However, the synthetic data will still make use of past flood experience, by using expert opinion, or by mixing average loss data from actual events with hypothetical figures for other possible depths.

These data sets are for standard depths, with the assumption that losses can be interpolated on a depth-damage curve joining these depths. The depths do not relate to any particular flood events, but represent the range of conditions possible in floodplains within a county or region. The same principles, but different data sets and data sources, are applicable in Bangladesh.

7.1.6 Physical data sets

To assess potential flood losses in a given floodplain specific information is required on that floodplain. Standard methodologies normally require two sets of spatial inputs: a land use data base which defines what is at risk in the floodplain, and a flood data set giving the magnitude and return period of different events.

The land use data set forms a simple geographical data base which is then linked to the hydrology-hydraulics and loss data sets. The obvious requirements are coordinates or grid references, land use category (the same categories as used in the depth-damage data sets), elevation and number of properties or area as appropriate. Hence the same type of land use but with a different elevation, or spatially removed from identical land uses, is coded separately since in both cases the predicted flood levels are likely to differ. Clearly this data base requires suitable base maps and contour/ elevation information plus field visits to check this and map current land uses.

The output of hydrological-hydraulic analysis, which forms the input to estimation of potential flood losses, is a data set giving flood levels for a series of return periods or exceedance probabilities (that is floods of different magnitudes); these must be for points along a river or across a floodplain. It may also be necessary to categorise the type of flood involved (eg short or long duration, fast or slow) so that the appropriate flood loss data bases can be used.

7.1.7 Modelling and levels of analysis

The modelling involved in the flood loss or protection benefit assessment is to interpolate and extrapolate a flood surface for the floodplain, specifically for each of the land use items and for each return period.

The appropriate economic loss figures are then interpolated for the predicted flood level in that land use from the relevant depth-damage curve. Clearly a large number of calculations are involved each for a relatively simple case. Hence there are considerable advantages in computerising this process.

The hydrological analysis assigns probabilities to a series of events being achieved or exceeded (exceedance probabilities) and the remaining parts of the analysis estimate losses associated with these events. However it is not known when these events will happen, merely that a flood of x metres which would cause y damages is likely to be achieved or exceeded once during say 50 years on average. The summary measure of potential flood losses used is, therefore, the average or expected value of flood losses in a year based on the whole series of events modelled, and this is simply the area under the loss probability curve where probabilities are expressed as exceedance probabilities. A constant stream of annual average benefits over the expected life of a project is assessed and the discounted sum is the net present value of benefits.

Assessing agricultural benefits from flood protection (rather than direct flood losses) is slightly less straightforward in that estimates of the with and without protection cropping patterns distributed over the floodplain are required. Once this is done all that is required is a modelling of flood and drainage conditions, and associated losses in both with and without protection conditions so that a comparison of expected gross margins can be made.

7.1.8 Limitations on application in FAP 12

The methodologies for reliable and systematic assessment of flood protection benefits are complex and data demanding. They have not previously been used in Bangladesh. Consequently these methods would not be suitable for RRAs other than in a very crude form, but could be tested in some of the PIEs, concentrating on increasing the sophistication of agricultural yield estimation to allow for different flood risks as well as 'normal' monsoon conditions so that expected values are taken, on estimates of flood damage averted (based on control area experience) to homesteads, and possibly including estimates of impacts on trade, business and infrastructure.

Information concerning flood years will be collected - so that data on flood damages and on variation in crop yields, prices and costs both with and without a project are obtained. In both RRAs and PIEs advantage can be taken of the relatively recent 1987 and 1988 floods to obtain estimates of conditions in control areas and project areas, and on project performance, during events of more or less known return period and flood levels. This will permit comparison with "normal" monsoon conditions, since the impact of FCD projects is expected to comprise both general induced changes and developments in agriculture and other aspects of the rural economy, reflecting both normal and abnormal monsoon conditions, and different losses under different flood conditions compared to without project conditions.

The application of these methodologies may be hampered by any delays in the development of standardised economic assessment guidelines under FAP, and in the availability, and appropriateness for flood loss assessment, of the regional hydrological-hydraulic models. For these reasons it may only be possible to test this type of economic assessment on PIE projects where regional models are available.

7.2 ENVIRONMENTAL EVALUATION

7.2.1 APPROACH

(a) Role of Environmental Evaluation

Environmental evaluation has been undertaken by FAP 12 to provide a second overall perspective on project evaluation, complementing the economic analysis. The environmental approach, because it includes ecological aspects, is much more holistic than the conventional economic approach. On the other hand, it is much less quantitative and precise, which perhaps fits better with the PIE and especially RRA methodologies. The other project components (agriculture, livestock, engineering, sociology) contribute to both the economic and environmental overall evaluations.

(b) Objectives of the Environmental Evaluation

The overall goal of the environmental evaluation is to assess the environmental consequences of project implementation in the cases of the 17 FAP 12 projects (Figure 4.1). This is not always the same as evaluating the projects as they were originally planned, as implementation has often been incomplete or thwarted by actions such as public cuts in embankments.

In order to achieve this goal, the environmental component of FAP 12 has the following aims:

- to establish a consistent methodology for application to the 17 projects, related so far as possible to the overall FAP approach being developed by FAP 16;

- to classify and, where necessary, map the 17 project areas in terms of the agroecological divisions established by FAO (1988);

- to assess current environmental status and trends in the 17 project areas;

- to evaluate environmental status and trends in these areas prior to project implementation, to establish the **Without Project** scenario;

- to identify the key project activities that have affected the environment and the critical environmental issues on which these activities have created significant **environmental impacts**, either positive or negative;

- to evaluate in broad terms the degree of impact in terms of both **on-site** (project area) and **off-site** (external) consequences of the projects and also in terms of the different social groups affected;

- to identify any mitigatory or enhancement measures needed to correct or improve environmental trends;

- to assess the need for any further more detailed environmental evaluation or for an environmental monitoring system to be established.

(c) Methodology and Terminology

This section is primarily concerned with the environmental methodology and terminology used in FAP 12, with specific environmental issues and with impacts discussed within the relevant FAP 12 Project Reports. Environmental assessment is a relatively new technical discipline and consequently there is currently a proliferation of often spontaneous methods and terms. FAP 16 has initially suggested the terms **pre-feasibility EIA** and **feasibility EIA**; it is recommended that FAP 16 reconsiders these terms. They would cause confusion because the term **EIA** should be restricted to the ultimate level of full environmental impact assessment; "Feasibility EIA" is in fact tautology. Standard terms have already been established by agencies such as ODA and ADB for lower levels of assessment, as discussed below.

In FAP 12, terminology and methodology follow so far as possible those established by ODA, at a level commensurate with the RRA and PIE techniques employed.

(d) Levels of Environmental Evaluation

FAP 12 is concerned with the environmental evaluation of existing projects, rather than with the more common assessment of project pre-feasibility or feasibility plans. FAP 12 is also based on a Rapid Rural Appraisal (RRA) approach for the 17 projects, with somewhat more detailed Project Impact Evaluations (PIE) in 5 of these.

Figure 7.1 illustrates the general relationship of environmental activities to the different stages of a development project. FAP 12 is in effect carrying out environmental audits of operating projects, but at a much less intensive level of investigation than an **environmental audit** normally requires, so that **post-evaluation** is the preferred term. Thus at the RRA level of enquiry, post-evaluation can achieve little more than a level equivalent to **initial screening and scoping** in pre-project environmental assessment. In the five PIE projects, post-evaluation is able to refine the RRA findings to achieve the level of a pre-project **initial environmental examination** (as defined by ADB and others), termed an **environmental appraisal** by ODA (1990).

These two levels are explained further below. The terms screening and scoping can apply equally to post-evaluation, while the slightly more detailed PIE level is defined here as **preliminary environmental post-evaluation (PEP)**. Should any of the 17 projects appear to be causing unacceptable negative environmental impacts requiring urgent, detailed attention, it would be recommended that they be subject to an environmental audit, presumably through FAP 16. This would be the post-evaluation equivalent of a full **environmental impact assessment (EIA)**.

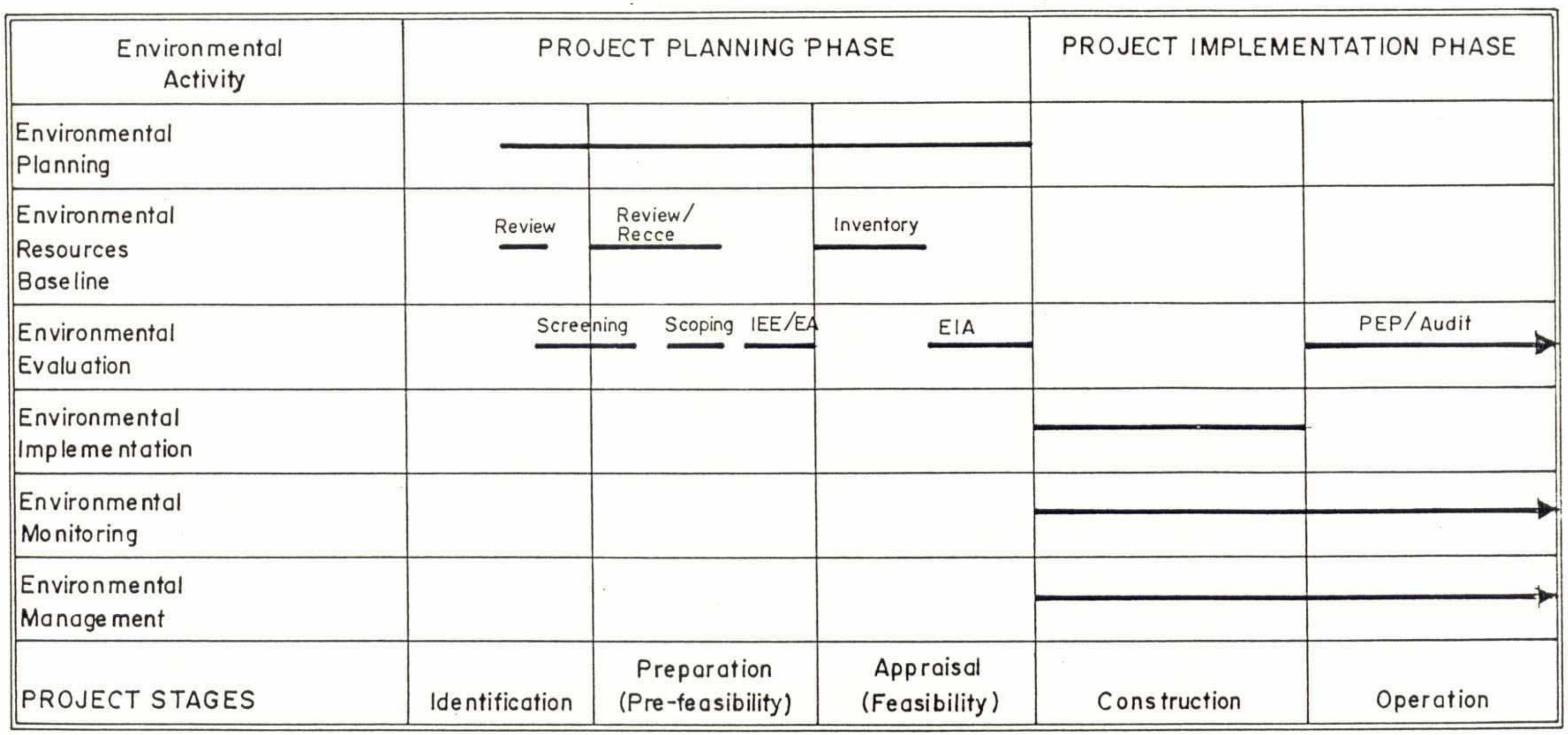
(e) Coordination with FAP 16

In July 1991 both of the FAP 12 environmental staff visited the FAP 16 Project and attended its initial workshop at which **Guidelines for Environmental Impact Assessment** (ISPAN, 1990) were presented by FAP 16 for discussion and comment by other FAP components. This was a successful workshop, providing a useful forum for discussion of FAP 16's outline approach.

The FAP 16 Guidelines are concerned with pre-project impact assessment and do not touch upon post-evaluation. FAP 12 recommended that the Guidelines should take advantage of the excellent agroecological spatial framework provided by Dr. Hugh Brammer (FAO, 1988), one of Bangladesh's rare comprehensive databases. The Guidelines do not at present highlight the immense importance in Bangladesh of the external (or off-site) impacts of development.

The main difficulty in coordinating FAP 12's environmental approach is that due to its late start, FAP 16's Guidelines are clearly in only an embryonic stage, as the above comments illustrate. It is not possible, therefore, to adopt FAP 16's terminology and methodology in detail, because they do not exist yet in final form. However, the FAP 12 approach outlined here fits broadly into established environmental frameworks, upon which it is assumed that FAP 16's approach will also be based.

FIGURE 7.1 ENVIRONMENTAL ACTIVITIES AND PROJECT STAGE

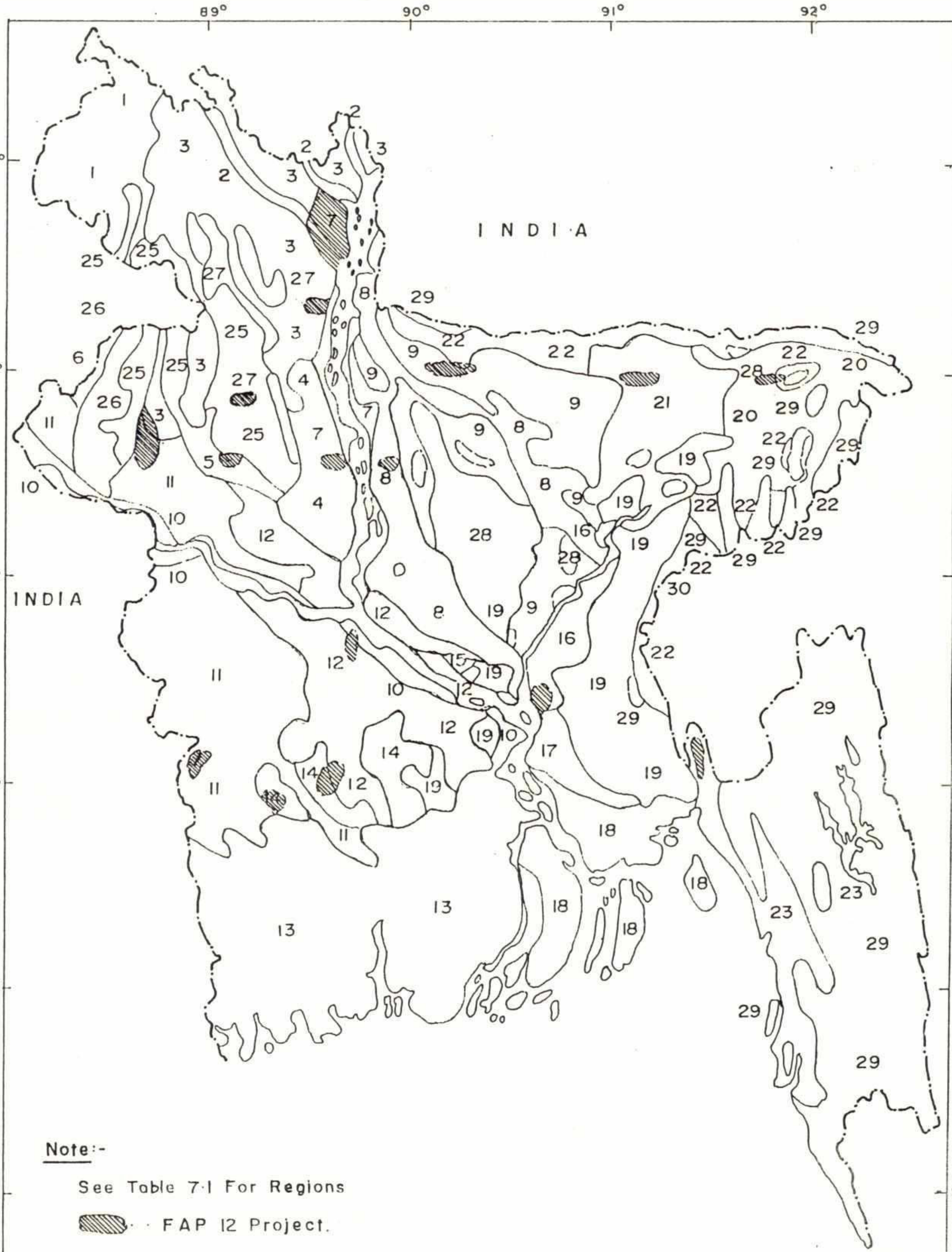


Screening - assessment of the need for environmental assessment and at what level
Scoping - identification of key issues for environmental assessment
IEE/EA - Initial Environmental Examination/Environmental Appraisal
EIA - Environmental Impact Assessment
PEP - Preliminary Environmental Post-evaluation

Source: Consultants

Figure: 7·2

AGROECOLOGICAL REGIONS (GENERALIZED)



Note:-

See Table 7·1 For Regions

FAP 12 Project.

Source: FAO, 1988

7.2.2 ENVIRONMENTAL STATUS AND TRENDS

(a) Agroecological Divisions

FAO (1988) has mapped agroecological divisions at three levels:

- agroecological regions
- agroecological subregions
- (agroecological)land types.

There are 34 agroecological regions, in each of which a particular broad pattern of physiography, soils, climate and agricultural activity occurs (Figure 7.2 and Table 7.1). These equate with **agroecological zones**.

Subdivision of the agroecological regions (AER) is based on separation of areas in which a dominance of particular physiographic units creates significant differences in the general depth of flooding and consequent agricultural activities. These are the **agroecological subregions** (AES), of which 88 were mapped.

The most detailed division is the **land type**, representing a specific physiographic component of the landscape which relates directly to flooding depth and so to agricultural activity. These are defined in Figure 7.3. It is apparent from Figure 7.3 that any village in Bangladesh is likely to have several, even all, of the six land types within its limits. Thus for any practical application above village level, land types have to be amalgamated into composite units in which one range of inundation predominates e.g. high-medium highland; lowland-very lowland.

Useful tools for effective amalgamation of land types are the 1:50,000 scale topographic maps and especially the **soil associations** mapped by FAO at 1:250,000, but available in the relevant regional soil survey reports at much larger scales. Contours on the topographic maps are usually too coarsely spaced, unless the project concerned has carried out a more detailed topographic survey. The soil associations, by definition, group soil, physiographic and, therefore, land use into units of like inundation.

FAO also superimposes climate variations on this essentially physiographic framework, creating **agroclimatic zones**. For most project areas, however, climatic variation within them is not significant. The agroclimatic zone, therefore, should generally be used only to summarise agroclimatic conditions for the project area as a whole.

At the more detailed level of FAP 12 post-evaluation (PIE), the agroecological divisions have to be defined and mapped, and environmental impacts assessed within each separately. The exact nature of these divisions will vary from project to project. In each, however, they are termed **agroecological units (AEU)** in order to avoid confusion with the established FAO terms.

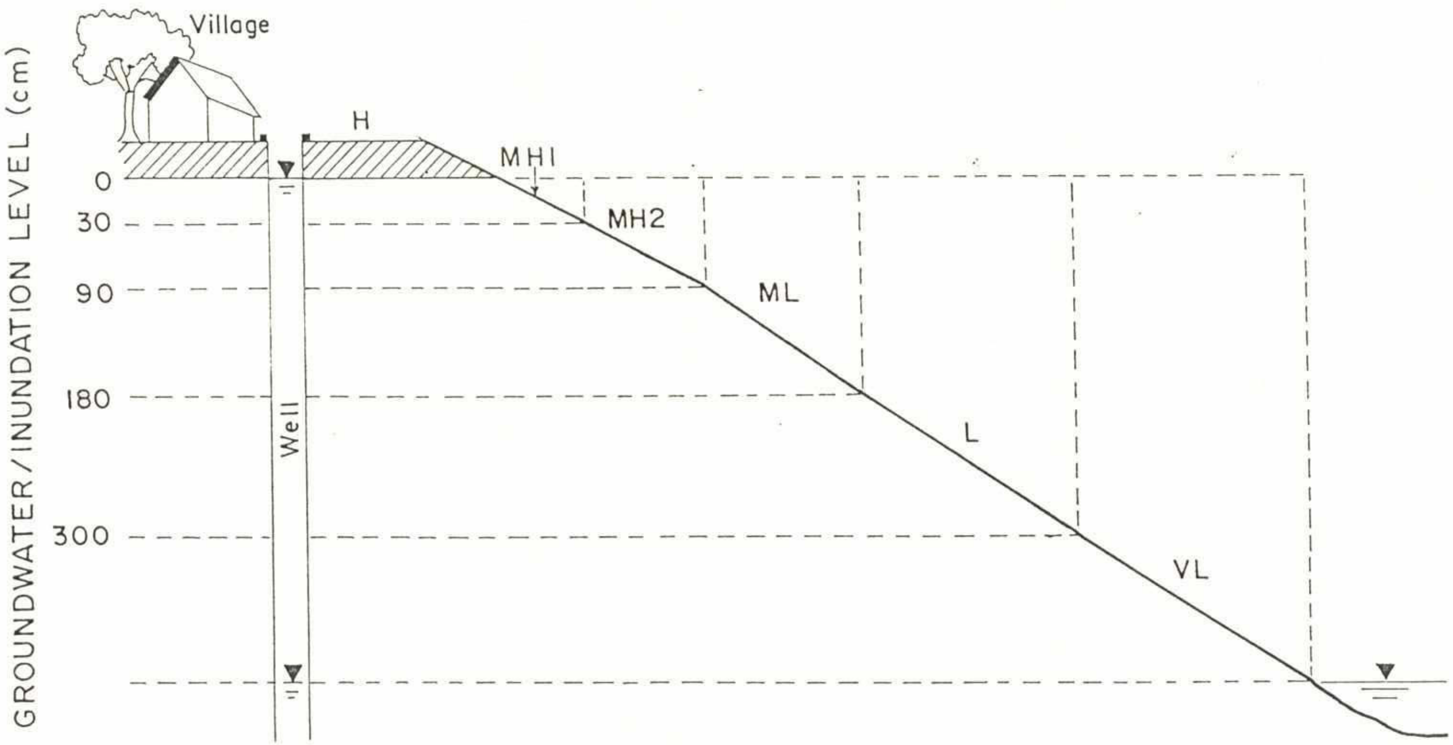
By definition, agroecological units of any kind are dynamic, because they represent the interactions of human activities and natural resources and human activities change over time. This is especially relevant to FAP 12 because major human interventions such as embankment construction, empoldering and accelerated or constrained drainage will all influence the critical agroecological factors of timing, duration and depth of inundation. The FAO agroecological framework is largely based on work that pre-dates most FAP 12 projects.

Table 7.1 : Agroecological Regions of Bangladesh

1	Old Himalayan Piedmont Plain
2	Active Tista Floodplain
3	Tista Meander Floodplain
4	Karatoya-Bangali Floodplain
5	Lower Atrai Basin
6	Lower Purnabahaba Floodplain
7	Active Brahmaputra-Jamuna Floodplain
8	Young Brahmaputra and Jamuna Floodplain
9	Old Brahmaputra Floodplain
10	Active Ganges Floodplain
11	High Ganges River Floodplain
12	Lower Ganges River Floodplain
13	Ganges Tidal Floodplain
14	Gopalganj-Khulna Bils
15	Arial Bil
16	Middle Meghna River Floodplain
17	Lower Meghna River Floodplain
18	Young Meghna Estuarine Floodplain
19	Old Meghna Estuarine Floodplain
20	Eastern Surma-Kusiyara Floodplain
21	Sylhet Basin
22	Northern and Eastern Piedmont Plains
23	Chittagong Costal Plain
24	St Martin's Coral Island
25	Level Barind Tract
26	High Barind Tract
27	North-eastern Barind Tract
28	Madhupur Tract
29	Northern and Eastern Hills
30	Akhaura Terrace

Source: FAO, 1988.

Figure: 7·3 SCHEMATIC PRESENTATION OF THE RELATIONSHIP BETWEEN GROUNDWATER LEVEL AND INUNDATION LEVEL BY LAND TYPE.



LAND TYPE			NORMAL INUNDATION LEVEL (cm)
H	—	Highland	Not inundated
MHI	—	Medium Highland I	< 30
MH2	—	Medium Highland 2	30 – 90
ML	—	Medium Lowland	90 – 180
L	—	Lowland	180 – 300
VL	—	Very Lowland	> 300

Source : FAO, 1988

88

It does, therefore, provide a picture of pre-project agroecological conditions. This has then to be updated to contribute to the post-evaluation, by the identification through the RRAs and PIEs of significant changes in flooding, land use and settlement patterns.

The location of the 17 FAP 12 sites in relation to the AERs is shown in Figure 7.2. For application in each project area, it is necessary to refer to the relevant regional volume of the FAO Report.

(b) Pre-project Environmental Status and Trends

A basic indication of pre-project environmental status can be gleaned, as noted above from the agroecological information.

This will show the general physical condition of the area and in particular the distribution of inundation depth, which in turn will relate directly to the different forms of land use practised at that time. On a macro-scale, the accounts of the agroecological regions given in FAO Report 2 are in fact environmental evaluations in themselves, presenting a comprehensive picture of physical issues and basic agroeconomic information on land use, irrigation, drainage and infrastructure, as well as identifying development constraints and ecological hazards.

More precise information might come from official statistics and reports on the project area from that time, although Bangladesh is notorious for its lack of reliable basic data. The ecological baseline is particularly devoid of data relating to biological issues.

This general lack of data in most FAP 12 areas prevents a clearcut pre-project environmental baseline being established, and therefore, any subsequent trends also. At RRA and PIE levels of investigation, this is less serious than it would be for more detailed studies and planning exercises. It is a major problem to be faced by any attempt at full EIA or environmental audit in Bangladesh.

In most FAP 12 areas the main sources of any pre-project environmental data are the original project proposal and any related project planning or preparation reports or material. Since none of these include specified environmental considerations, environmental information generally has to be inferred from what is discussed in them. This again is sometimes useful for socio-economic issues but rarely for ecological and especially biological aspects.

(c) Current Environmental Status and Trends

The supply of basic and systematic environmental data has not significantly improved at the present day in most FAP 12 areas.

The advantage of the present situation, however, is that at least it can be observed directly, in the field. The FAO agroecological data is then especially valuable, as it enables field examination to compare present and likely future inundation conditions, and therefore land use, with the pre-project situation. This is a very general exercise, however, without going back to the original soil and land use surveys themselves, which is perhaps too detailed for the RRA and PIE techniques being applied.

The main source of information concerning current environmental status and trends must usually come from the RRA and PIE activities themselves. These include the field observations noted above and the review of any recent reports or hard data, but rely especially on consultations with concerned groups of people, and in particular the local people.

7.2.3 ENVIRONMENTAL ISSUES AND IMPACTS

(a) Environmental Issues

Environmental post evaluation is essentially concerned with the environmental changes that have occurred as a result of the project. These changes can be best identified and quantified in terms of specific environmental issues.

Evaluations of environmental issues and the impacts affecting them usually adopt a framework under three broad headings:

- **physical/chemical**
- **biological**
- **human**

The first two of these together constitute ecological issues or impacts, while the first and third form socio-physical issues. The three basic categories can be further subdivided into well-defined environmental components: land, water, climate, atmosphere; flora, fauna; social, economic, institutional,human use, cultural. Each of these then consists of a series of specific issues which can be measured or assessed according to selected parameters or indicators.

It is important to stress the inclusion of human environmental issues. Omission of these ignores those issues related to the most important organism in the agroecosystems involved - man himself. Evaluation of development only in terms of physical and especially biological (i.e. ecological) parameters is as unbalanced as the reliance in the past on purely economic project evaluation.

An environmental issue usually comprises more than one environmental parameter. Thus wetland birdlife may be an issue, but a number of often interrelated parameters have to be taken into account in assessing any potential effects of development on this issue. These parameters include the numbers of birds, their biodiversity (number of different species), their health, influences on their breeding patterns, habitats and foodchains. Water quality similarly is often a key environmental issue, but can be assessed in terms of a large number of parameters (salinity, pH, cations, anions, sodium adsorption ratio, BOD, minerals such as iron and selenium, turbidity,odour and so on). Changes in such parameters are key indicators of environmental impacts. Tables. 7.2 and 7.3 provide useful water quality standards for irrigation and drinking water respectively.

Key environmental issues are identified for environmental evaluation purposes because they represent convenient groupings of parameters that can be perceived as indicating environmental improvement or deterioration. Clearly, some issues are of greater importance than others, depending upon the nature of the project and the environmental status of the areas affected. At more intensive levels of environmental evaluation, such as EIA, both issues and the agroecological zones in which they arise can be weighted to reflect relative importance.

(b) Environmental Impacts

Change in any environmental issue that results from a particular activity, such as a development project, is an environmental impact of that activity. Potential environmental impacts are identified and assessed by environmental evaluation during project planning. In the FAP 12 environmental post-evaluation, actual impacts are identified and broadly assessed.

Table 7.2 : FAO Guidelines for Irrigation Water Quality

Potential Irrigation Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
Salinity (affects crop water availability)				
ECw	dS/m	<0.7	.7-3.0	>3.0
(or)				
TDS	mg/1	<450	450-2000	>2000
Infiltration (affects infiltration rate of water into the soil. Evaluation using ECw and SAR together)				
SAR = 0-3 and ECw =		>0.7	0.7-0.2	<0.2
= 3-6 =		>1.2	1.2-0.3	<0.3
= 6-12 =		>1.9	1.9-0.5	<0.5
= 12-20 =		>2.9	2.9-1.3	<1.3
= 20-40 =		>5.0	5.0-2.9	<2.9
Specific Ion Toxicity (appects sensitive crops)				
Sodium (Na)				
surface irrigation	SAR	<3	3-9	>9
sprinker irrigation	me/1	<3	>3	
Chloride (Cl)				
surface irrigation	me/1	<4	4-10	>10
sprinker irrigation	me/1	>3	>3	
			0.7-3.0	>3.0
Boron (B)	mg/1	<0.7		
Miscellaneous Effects (affects susceptible crops)				
Nitrogen (NO^3-N)^6	mg/1	<5	5-30	>30
Bicarbonate (BCO^3)	mg/1	<1.5	1.5-8.5	>8.5
(overhead sprinkling only pH		Normal Range 6.5-8.4		

Notes :
ECw means electrical conductivity, a measure of the water salinity, reported in deciSiemens Per meter at 25'C (ds/m) or in millimhos per centimetre (mmho/cm). Both are equivlent. TDS means total dissolved solid, reported in milligrams per litre (mg/1) = ppm.
SAR means sodium adsorption ratio.

Source : FAO

Table 7.3 : WHO Drinking Water Standards

		Max. Desirable Concentration	Max. Permissible Concentration
Total dissolved solids	mg/1	500	1500
Colours Pt Co		5	50
Turbidity FTU		5	25
Taste & Odour		Acceptable	Acceptable
Iron	mg/1	0.1	1.0
Manganese	mg/1	0.05	0.5
Copper	mg/1	0.05	1.5
Zine	mg/1	5	15
Calcium	mg/1	75	200
Magnesium	mg/1	30(if SO_4 high)	150
Sulphate	mg/1	200	400
Chloride	mg/1	200	600
pH		7-8.5	6.5-9.2
Phenols	mg/1	0.001	0.002
Anionic detergents	mg/1	0.2	1.0
Mineral Oils	mg/1	0.01	0.3
Total hardness	(mg/$CaCo_3$)	100	500
Lead	mg/1		0.10
Selenium	mg/1		0.01
Arsenic	mg/1		0.05
Cyanide	mg/1		0.05
Cadmium	mg/1		0.01
Total mercury	mg/1		0.001

Note : These have been reviewed in recent years but not significantly changed.

Source : WHO, 1971.

An environmental impact also has both spatial and temporal dimensions. An impact can be assessed, therefore, as the degree of change in a given environmental issue (or parameter) over a specified period of time and within a defined geographical area, due to a particular activity. The degree of change, or impact, is measured against the situation that would have occurred without that activity.

It is important to note that the baseline for comparison is not static (i.e. the present situation at a particular point in time) but is dynamic - it may change in the future even without the proposed activity. This realisation can greatly affect impact assessment. Figure 7.4 illustrates this point, using simple trend lines (which in practice would represent the inevitable periodic variations in any given environmental variable).

As can be seen, an impact may be positive, in which the environmental issue shows improvement, or negative, in which it deteriorates. Popular attention is often focused upon the latter but for balanced environmental assessment it is essential to identify and, evaluate both positive and negative impacts.

The spatial aspect of an impact is important as it dictates the extent (prevalence) of the impact and also indicates in which part of a project area the impact will be felt. Areas that are particularly environmentally sensitive or vulnerable may be affected. The risk of a serious negative impact then arises.

Impacts are not necessarily restricted to the project area(i.e on-site impacts). They may result elsewhere, outside the project area. Downstream locations are often affected by project activities. These are off-site impacts. Impacts may also be indirect. For instance, the actual activities within a project may cause little or no environmental damage in themselves, but they may lead to concentrations of urban settlement which result in negative impacts such as inadequate refuse or sewage disposal.

The timescale over which an impact operates is also clearly important. This can be assessed in terms of either duration or frequency of recurrence, or both.

To summarise, therefore,an environmental impact can be assessed in terms of five basic factors:

- magnitude (degree of impact);
- prevalence (extent);
- duration and /or frequency;
- risk of serious environmental damage;
- importance of the issue affected.

The first three of these assessment factors are essentially the dimensions of the impact, in terms of size, space and time. Risk may be cumulative or catastrophic. **Cumulative impacts** create risk over time (e.g. starvation) or space (e.g. soil erosion). **Catastrophic impacts** may happen in an instant and at one particular spot, such as the collapse of a bridge or the bursting of an embankment, although they would then attain considerable dimensions.

Impact importance will vary with every impact in every area examined and in different parts of that area (hence the importance of a sound agroecological spatial framework to encapsulate such internal variations). It can only be accurately assessed with a knowledge and understanding of the area at the level of assessment involved.

(c) Potential Environmental Issues and Impacts in FCD/I Projects.

Comprehensive lists of the main environmental issues associated with FCD/I projects are presented in Tables 7.4 to 7.6. The environmental impacts which affect these issues, as a result of the FCD/I projects studied by FAP 12, are examined and evaluated in the relevant FAP 12 project reports accompanying this main report.

A valuable overview of the environmental impacts of FCD/I development is provided by Dalal-Clayton(1990). A recent and as yet incomplete environmental appraisal of the South East Regional Study (FAP 5) water resource development proposals (Spooner, 1991) is largely concerned with FCD/I projects. Another recent environmental appraisal evaluates development proposals for minor irrigation (ERL, 1990), which are to some extent interrelated with FCD/I development. To date, the central environmental component of FAP (FAP 16) has not dealt directly with the identification of key environmental issues and impacts, although the 1991 Guidelines (ISPAN, 1991) list FCD/I project activities having potential impacts and also the topics for which information is required, Many of the latter equate to important environmental issues.

There are a number of other publications that relate to either the impacts of FCD/I projects or to the Bangladesh environment. These include : Thompson (1990); Centre for International Development and Environment (1990); Palmer-Jones (1988); MPO (1990); and Ewert and Brockmueller (1990).

(d) Primary, Secondary and Indirect Impacts

FCD/I projects tend to have only two major **primary impacts**:

- their "external" effects on the volume, velocity, timing and duration of river flows, due mainly to flow concentration within embanked active courses;

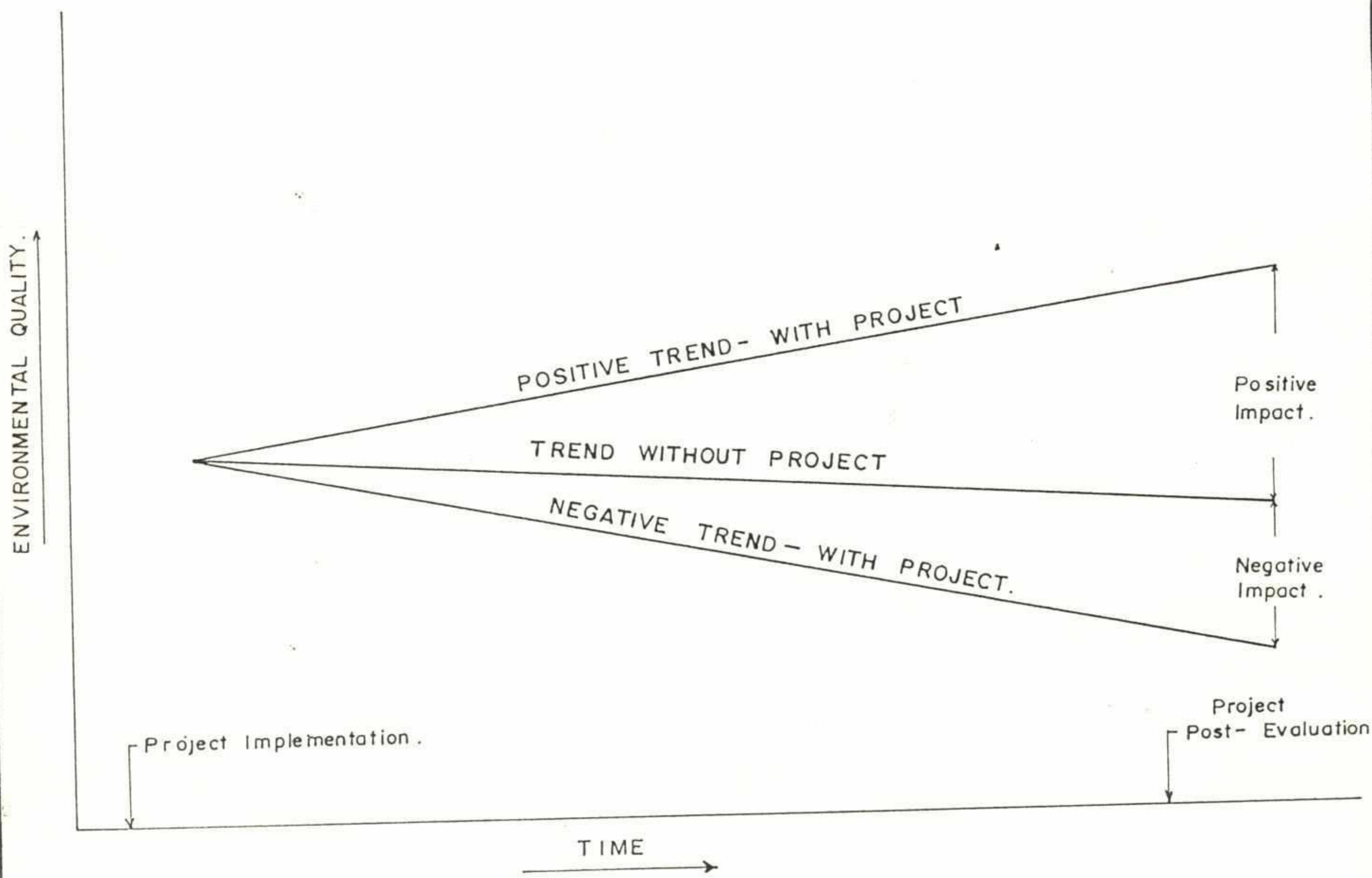
- their effects on the depth, extent, timing and duration of floods, drainage and irrigation supplies within the project area, and in some cases in adjacent or downstream external areas.

All other impacts result from these two, and in particular from the second of them. Most other physical, biological and human use impacts can be considered as **secondary impacts** which result directly from one of the two primary impacts. Most other human impacts are tertiary or even quaternary impacts, or combinations of both, and are best grouped as **indirect impacts**.

There are exceptions and qualifications to all the above and at detailed environmental impact analysis (EIA) or the equivalent post-audit level it might be necessary to provide network analysis to clarify the often complex interrelationships that occur. For the PEP, however, it suffices to highlight any critical interactions in explaining each impact evaluation.

It is important to note that while primary impacts are usually major impacts, indirect impacts (such as on health or safety, for instance) can also be major impacts.

FIGURE : 7·4
ENVIRONMENTAL IMPACT TRENDS



Source Consultants

Table 7.4 : Physical Environmental Issues

WATER
- River Flow
- River Quality
- River Morphology
- Flooding
- Drainage
- Groundwater Levels/Recharge
- Groundwater Quality
- Wetland and Waterbodies Extend/Recharge
- Wetland and Waterbodies Quality
- Marine Siltation/Salinity

LAND
- Soil Fertility
- Soil Physical Characteristics
- Soil Moisture Status
- Soil Erosion
- Soil Salinity
- Acid Sulphate Status
- Microrelief
- Land Capability
- Land Availability

Source : Consultants

Table 7.5 : Biological Environmental Issues

FAUNA
- Bird Communities/Habitats
- Fish Communities/Habitats
- Other Macro-Fauna Communities/Habitats
- Macro-Fauna Communities/Habitats
- Coral

FLORA
- Trees
- Other Terrestrial Vegetation
- Aquatic Vegetation
- Mangroves
- Marine Vegetation (Seagrass etc)

Source : Consultants

Table 7.6 : Human Environmental Issues

HUMAN USE
- Crop Cultivation (inc. irrigation)
- Livestock
- Marine Fisheries
- Capture Fisheries
- Culture Fisheries
- Afforestation
- Agro-industrial
- Transport Communications
- Infrastructure
- Domestic Water Supply
- Sanitation
- Recreation
- Energy

SOCIAL
- Human Carrying Capacity
- Demography
- Gender
- Age
- Health and Nutrition
- Disruption, Safety and Survival
- Land Ownership
- Equity
- Social Cohesion
- Social Attitudes

ECONOMIC
- Incomes
- Employment
- Land Values
- Credit Availability

INSTITUTIONAL
- Institutional Activity/Effectiveness
- Public Participation

CULTURAL
- Historical/Archaeological Sites
- Cultural Continuity
- Aesthetics
- Lifestyle (Quality of life)

Source : Consultants

(e) Socio-Economic Impact Groups

These are sometimes termed "Vulnerable Groups" but this falls into the trap of prejudging all environmental impacts as negative. Most of these groups experience positive as well as negative impacts from the project.

It is important to note where an impact affects a particular group or groups of people, as this gives some measure of the importance and magnitude of the impact: what might be merely an inconvenience for a large landowner could be a disaster for small farmers or the landless. The PEP attempts to identify those Impact Groups specifically affected by each significant impact.

Typical Impact Groups include: the landless; small farmers; large farmers/ landowners; traditional (capture) fishermen; commercial (culture) fishermen; women; children; the aged; providers of services (agroindustrial workers, traders, and most others engaged in rural support services) and employees in the relevant government institutions.

7.2.4 ENVIRONMENTAL EVALUATION

(a) Screening and Scoping of RRA Projects

Environmental post-evaluation of the 12 RRA projects is carried out by screening and scoping, although an attempt is made to progress slightly beyond this initial stage by the allocation of broad, relative quantification values to each of the environmental impacts identified.

Screening and **scoping** are basic procedures in environmental analysis, acting as filters to help identify the level of analysis needed and the significant activities and issues involved. Such sifting procedures are necessary because environmental considerations must include all aspects of an area or project, so that there is a need to organise and concentrate both effort and output on locations, activities and issues of genuine and significant relevance within this wide spectrum.

The locations of the different project activities and their impacts are conveniently compartmented in terms of the agroecological divisions (see Section 7.2.2). Assessment of impacts within this spatial framework will often highlight environmentally critical areas and also possibly areas where no significant impacts are likely, which can then be discounted, allowing concentration on the critical areas. Thus this initial assessment may include a location screening also. However, evaluation at this initial level should be summarised in terms of the area as a whole.

Screening is the initial rapid evaluation of a project and each of its component activities in terms of the environmental changes they cause. Scoping is the main activity within the screening process.

Scoping has been defined as the identification of those environmental issues likely to give rise to significant impacts. This can be achieved by a broad application of the five basic environmental evaluation criteria : magnitude; prevalence; duration and/or frequency; risk; importance.

The main aim in this initial stage is to achieve a comprehensive but rapid review of potential impacts. Assessment of scale can be almost intuitive, so long as it is well-informed and all possible relevant environmental issues are considered. At this broad level, likely significant impacts usually become obvious, if a thorough familiarity with the project is acquired and if environmental coordination with all concerned parties is carried out.

Environmental coordination with concerned parties is of special importance during the initial stage of environmental evaluation, when key issues and the factors and actions likely to affect them have to be identified and their significance gauged, all in a short period of time. Scoping sessions involving interested parties in the community are an important element in the initial stages of environmental assessment and should be similarly included in development project evaluation procedures.

Coordination with four groups of interested parties is usually needed :

- local people, who are certainly the most affected and usually the most knowledgeable about a project and its environmental repercussions;

- local and national environmental organisations (both government and non-government);

- international organisations, where matters of international importance (such as migratory birds) are concerned;

- other technical sectors of the FAP 12 team and other FAP teams, to provide the in-depth expertise required for specific technical issues and impacts.

Such coordination is an integral part of RRA procedures, along with thorough review of existing technical data and information and extensive field observations of the project area in question. The semi-structured, multidisciplinary approach of RRA is ideally suited to initial environmental screening and scoping.

The basic scoping tool is a simple scaling checklist, another common constituent of RRA. This is used to identify, distinguish and organise the main environmental issues raised by a project and then to broadly assess in simple, relative terms the scale of impact that each issue has experienced due to the project. Scaling is carried out in terms of positive (+) and negative (-) impacts, assessed numerically as minor (1), moderate (2), and major (3), or alternatively as nil or insignificant (0).

A systematic way of arriving at such an evaluation, within a specified area (i.e. the study area or a defined agroecological division within it) is to assess values on the scale of 0-3 for each of the five assessment factors noted in Section 7.2.3(b). If any of the five assessments is zero, then there is no significant impact. Otherwise, the mean value of the five gives the overall impact assessment as follows:

Mean Value below 1.5 = Slight Impact (1)
Mean Value of 1.5-2.5 = Moderate Impact (2)
Mean Value over 2.5 = Major Impact (3)

A particular problem for FAP 12 is that many changes have occurred in the project areas which are not in any way due to the project, most notably the impact of tubewell irrigation for HYV Boro. It is then difficult to assess separately those impacts due to FCD/I projects.

(b) Preliminary Environmental Post-evaluation of PIE Projects

As noted in Section 7.2.1 (d), preliminary environmental post-evaluation (PEP) has been defined here as the post-evaluation equivalent of environmental appraisal (ODA) or initial environmental examination (ADB). This is an intermediate level of post-evaluation, a main purpose of which is to identify projects which have had sufficient negative environmental impact as to warrant a detailed environmental audit. In less extreme cases, the PEP should enable a more precise identification of any mitigatory measures required. Alternatively the PEP may show that the project has proved environmentally sound and require little in the way of environmental monitoring and management.

The PEP approach proceeds beyond the screening-scoping activities of the initial RRA and is the environmental element of the PIE. In particular, more detailed and controlled information is acquired locally by systematic and structured interviews and multiple visits while field observations are more intensive along carefully selected transects. The selection of transects is important because the PEP attempts to evaluate environmental impacts in terms of the different agroecological divisions, so that the transects must cross a representative selection of these, enabling contrasts and interrelationships to become apparent. Ideally, RRA field observation would also attempt this coverage, but time and other constraints would limit the intensity and range of coverage during the single visit implicit in RRA.

An important product of the PEP is an agroecological map, probably based mainly on the FAO 1:250,000 scale soil associations map (Section 7.2.2 a). This will define the agroecological divisions within which environmental impacts have been separately evaluated.

It is also evident that coordination with all interested environmental and other relevant parties becomes much more important and, hopefully, productive at the PEP stage. The same groups of people are involved as noted in Section 7.2.4(a) but with the views of local people and the more formal data collection and interpretation of FAP team colleagues becoming the predominant sources.

The initial screening-scoping should have identified the significant environmental issues and impacts. The PEP uses a scaling matrix rather than a checklist, with the vertical axis comprising the issues already established and the horizontal axis consisting of the agroecological divisions.

The matrix could be further refined to differentiate the impacts in terms of each project activity or in terms of affected socio-economic groups. In addition, for each given project area the different agroecological divisions could be weighted in terms of local importance and extent, or each issue could be weighted to reflect its local importance or risk element. A further refinement would be to weight each of the five elements of impact assessment (magnitude, prevalence, duration/frequency, risk and importance - see Section 7.2.3(b).

However, given the considerable scope of FAP 12 in terms of number and geographic dissemination of the PIE projects, the PEP is here restricted to a single scaling matrix rather than a multi-dimensional and/or scaling-weighting matrix.

The rather simplistic scaling or scoring values reflect the essentially qualitative nature of PEP. They do have the advantages, however, of:

- ensuring that each primary impact is individually considered, while taking into account its often complex linkages with other primary impacts and with secondary or tertiary impacts;

- presenting a clear and very concise assessment, which is quickly and easily assimilated by the PEP user, enabling him to agree with or query it;

- avoiding voluminous and repetitious written presentations which soon become confusing, if not impossible, to read.

(c) Mitigatory Measures

FAP 16 rightly includes mitigation, enhancement and compensation under this general heading. Most of the FAP 12 projects have some negative environmental impacts, most of which can be effectively countered or minimised by measures specifically aimed to do this, although often such measures can also benefit the project in other ways (enhancement).

It is almost always more difficult and more expensive to add on mitigatory measures once a project has been appraised and designed, and much more so once it has been constructed. Thus mitigation as a result of post-evaluation is likely to be even more difficult and expensive than if pre-project environmental assessment had enabled it to be incorporated in the project originally.

Mitigatory and enhancement measures differ from project to project and so are discussed in the different project reports. Sometimes the question of compensation may arise, where mitigatory measure are impossible or perhaps only benefit certain sections of the community. An obvious mitigatory measure in some areas for most people living there would be to close the public cuts in embankments, but this might disadvantage others, such as fishermen occupants of adjacent land outside the bund. This might require either secondary mitigatory measures or even direct compensation to placate such groups, otherwise the public cut will simply be repeated during the next period of stress.

(d) Environmental Management and Monitoring

None of the FAP 12 projects underwent any environmental examination or assessment during their planning and design. Similarly there have been no attempts at their environmental management or monitoring. One aim of the FAP 12 environmental component is to identify projects, or types of projects, which require these.

Environmental monitoring and evaluation is a major element of post-implementation environmental management. The latter, therefore, comprises:

- the establishment and operation of any mitigatory, enhancement or compensatory measures, including possible participation in their design;

- the establishment of environmental quality standards (e.g. nitrate levels in beels, ground water depth levels, etc) where necessary;

- the operation of environmental controls, via either regulation or incentives or both;

- promotion of local environmental awareness;

- strengthening of local environmental or related institutions;

- the operation of an environmental monitoring system;

- the completion of periodic environmental evaluations and any environmental post-audit.

Environmental monitoring is defined as the collection of specific information on the characteristics, quantities and functioning of environmental variables in space and time. Evaluation is the interpretation of this information to allocate environmental values to the variables at a particular point in time and so to determine trends in space and time for them.

Where an environmental management plan proves necessary, it should include or be accompanied by a monitoring plan, comprising an environmental monitoring and evaluation system (EMES). The outcome of the monitoring plan should be an EMES that affords effective surveillance and provides reliable information relating to the environmental management of the projects.

Specifically, the monitoring plan should indicate within the EMES:

- the types of monitoring tasks and procedures to be undertaken;

- the location, frequency and schedules for sampling, measuring and testing procedures;

- responsibilities for monitoring;

- any charges to be levied on projects to meet monitoring costs.

(e) Conclusions and Recommendations

The environmental evaluations of the FAP projects will culminate in conclusions regarding:

- which project activities have caused significant environmental impacts;

- what are the most significant (moderate and major) environmental impacts;

- which socio-economic sector(s) of the community are affected by these more significant impacts;

- what impacts occur outside the project area;

- what mitigatory, enhancement or compensation measures , if any, are required;

- whether or not an environmental management and/or monitoring, follow-up is required;

- whether or not there is an immediate need for a detailed environmental audit to be carried out.

Recommendations will then be made in the light of these conclusions.

7.3 LINKS WITH OTHER FAP STUDIES

The Terms of Reference for FAP 12 require the study team to identify survey requirements for the PIEs in consultation with FAP studies 15, 16 and 17, and in general to cooperate closely with the regional studies (Action Plan items 2 to 6), the other socio-economic and environmental studies (FAP items 13 to 17), the Compartmentalisation Pilot project (FAP 20) and the Flood Proofing project (FAP 23), as well as with the special study on economic methodologies.

During development of methodology the FAP 12 team made contact with FAP 1, with the FAP 2 and FAP 5 teams, which had recently started their work, and with members of the teams which were expected to carry out FAP 6 and FAP 17. Contacts were made with the FAP 15 Team Leader, and with the coordinator for FAP items 14, 16, and 23 - all of which were expected to mobilise in late March 1991. None of the other FAP projects with which the team was expected to collaborate (FAP items 3,4,6,17,20) had commenced operations at the time that the FAP 12 Methodology was prepared and in general the FAP 12 team was well into its work programme before most of the other studies were able to provide inputs or comments on the methodological approach. However, the team leaders of FAP items 3 and 6 participated in the meeting on 10 March 1991 at which the proposed methodology was discussed.

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Note : **Evaluation studies of specific projects are listed in Appendix B under the project name.**

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