Dissertation submitted for the degree of Doctor of Philosophy in the University of Cambridge

The socio-economic impact of a minor flood control project in rural Bangladesh

by

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Summary of a dissertation submitted by Belinda Dodson for the degree of Doctor of Philosophy in the University of Cambridge

This dissertation examines how the construction of an embankment has altered the life of a village in Bangladesh. Once the academic context of the work has been established, the geographical and historical context of the project itself is outlined. There then follows a discussion of the formulation and execution of the research methodology. This comprised a comparative analysis of the results from a household questionnaire survey conducted in two villages, one inside and one outside the project area, as well as a comparison of the post-project data thus collected with data collected by the project funding agency before the embankment's construction.

The questionnaire itself consisted of two parts. The first examined household composition and economic functioning (including inter alia land tenure, cropping patterns, occupations and employment, income and expenditure, and the material household); the second investigated perceptions of and responses to floods and flood control. The assessment of the embankment's impact thus adopted two complementary approaches: comparing the economic status and functioning of the village having flood protection both with a village without flood protection, and with its own pre-embankment state; and comparing perceptions of the flood hazard held by respondents in with- and without-project villages to see how these have been influenced by the implementation of flood control.

The comparative analysis was conducted at two levels, combining an aggregate, village-level comparison with a comparison disaggregated by household economic status. This was done in order to assess the differential impact of the embankment through the local socio-economic hierarchy. The most important effect of the embankment has been the agricultural improvements it has fostered through its modification of the normal annual flood. The resulting increased agricultural productivity and heightened labour demand have improved the economic lot of most households in the protected village, thereby enhancing their resilience to damage from abnormal flooding. The concluding chapter examines the implications of the research findings for future policy for flood control in Bangladesh, putting the case for small-scale, multi-purpose projects targeted at small- and marginal-landholding households.
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Glossary of local terms

aman  long-stemmed monsoon season rice crop
aus   early monsoon season rice crop, but also applied
to other crops (notably jute) grown in the same
season
bari  homestead
beel  low-lying swampy area
bideshi a person or object from outside the local area; a
foreigner
bidi  cigarette
bona  abnormal flooding
boro  dry season rice crop, now commonly of HYV rice;
also 'big', as in boro khet
borsha normal, annual flooding
bund  embankment, applied to raised field edge
demarcations as well as to flood control
structures
char  alluvial island
chota barsat pre-monsoon rains
chula earthen stove; also 'hearth' used to define a
household unit
dara kamla informal system of labour exchange
deshi local; 'of the country' (used of objects and people)
dokhan roadside stall
ghor  single dwelling structure, one or more of which
make up the bari
gram village
hat   weekly rural market
hoar  deeply flooded basin
khal  water channel; small river
khet field
machan bamboo platform for elevated shelter during
flooding
majhi fisherman
mouza village-level administrative district
nadi  river
nichu low-lying, especially with reference to
agricultural land
para  neighbourhood
rabi  dry season crops of e.g. mustard, pulses, wheat
sari  length of fabric worn as female attire
uchu highest level of (agricultural) land
upazila local administrative district

Important abbreviations

BWDB  Bangladesh Water Development Board
EIP   Early Implementation Projects
EPWAPDA East Pakistan Water and Power Development Board
HYV  high-yielding variety
MPO  Master Plan Organisation
PREFACE

This dissertation examines the impact of a flood control embankment on the life of a village in Bangladesh. It does this primarily by comparing the socio-economic functioning of an embankment-protected village with that of a village without flood protection, but it also incorporates a comparison with the situation prevailing before the embankment's construction.

It claims originality and a contribution to its field on a number of counts. First, the source of the post-embankment data on which the evaluation is based was my own questionnaire survey of village households. I both designed the questionnaire and, with the aid of field assistants, conducted the field survey itself. Only for the purpose of comparison with the pre-embankment situation did I draw on a secondary source of data, viz. the baseline survey included in the feasibility study conducted by the embankment project's funding agency. Second, the project evaluated herein represents a recent and pioneering approach to flood control and rural development in Bangladesh, making an objective evaluation of that approach relevant to the formulation of future planning policy. Third, geography as an academic discipline has only recently entered a phase of reintegration of its human and physical branches, so that research incorporating aspects of society, economy and environment has for some time been neglected. In this light, my work is representative of an emergent 'new thinking' in geography. Fourth, I draw on the work of other authors only in establishing the theoretical, historical and geographical context of the research, providing a full
reference to the work concerned wherever I do so. Finally, not at any stage in the collection and analysis of data nor in the writing of this work did I collaborate with any other person.

Funding for this research came from several sources. I first came up to Cambridge on a Flanagan scholarship, a generous, open award which allowed me complete freedom in my choice of research subject. For fieldwork in India and Bangladesh, I received grants from the Smuts memorial fund. For two years I held an Overseas Research Students' award. The period of research having overrun the prescribed three years, and the Flanagan trustees already having seen fit to discontinue their funding owing to the slow progress of the research, I was fortunate to receive further funding from St. John's College. Were it not for the College's contribution, the work would likely never have been completed.

The reasons for the time taken for completion of this work (1985-9) go beyond my own tardiness. My original proposal was to conduct research into responses to the flood hazard in North Bihar, India, and indeed I spent two months in Bihar conducting a preliminary field investigation. I was subsequently refused the permission of the Indian government to continue my research there. Having failed to obtain the necessary research visa for India, I turned my attention to Bangladesh instead. The Bangladesh authorities were rather more forthcoming in granting research permission, and I was able to proceed with fieldwork.

Once in Bangladesh, I encountered nothing but helpfulness and co-operation. The following people deserve particular mention: Keith
Pitman of the Master Plan Organisation; Bruce Currey of Winrock International, consultants to the Bangladesh Agricultural Development Corporation; Julian Kramer of the Early Implementation Projects; and Dara Shamsuddin and other members of staff in the department of geography at Jahangirnagar University. It was students from that University whom I employed as field assistants, and the successful completion of the field survey owed much to their motivation, efficiency and friendliness.

On a more practical level, I must thank Paul Thornton, director of VSO in Bangladesh, who assisted me with accommodation in Dhaka; and the field staff at Proshika's office near my study area, who put me up during a preliminary field visit. During the field survey, my assistants and I stayed with local families, and I was deeply touched by the warmth and hospitality shown to me. Here, particular thanks must go to 'Bablu's ma', a local woman who took me under her wing. Almost all the respondents to the questionnaire displayed remarkable tolerance and co-operation in answering the long list of questions put to them, for which they deserve thanks.

In Cambridge, my work has profited from the able supervision of first Graham Chapman and then Tim Bayliss-Smith. Tim took over the reins when Graham moved from Cambridge to SOAS, and has supervised the work during its writing up; this he has done with a light but steady hand. Graham's advice during the earlier phases of the work was certainly stimulating (although I think I shall never understand Q-analysis!), and his prodding and urging kept me going at a time when funding and other difficulties were affecting my motivation. I
have also received useful advice from Steve Jones and Benny Farmer.

Peter Linehan has been a helpful tutor, continuing to be so even when his file on me had broken all records for thickness and my stay in St. John's had exceeded all reasonable limits. It remains only to thank my parents, whose support from afar has been invaluable; and Peter Henshaw, whose proof-reading of the manuscript is only the last of his many contributions, tangible and intangible, to the completion of this work.
INTRODUCTION

Human settlement has long been attracted to the world's floodplains. With the attraction of fertile alluvial soil and a secure water supply, however, comes the threat of floods, as the very history of civilisation reveals. Similar struggles have been waged more or less successfully in Egypt along the banks of the Nile; against China's Hwang Ho; and in the Indus, Ganges and Brahmaputra basins of India. The history of ancient India, as documented in sacred texts such as the Rig Veda and the Raghu Vamsa, is centred on her rivers, attaching to them supreme religious significance. Nehru, in The discovery of India, writes:

The story of the Ganga from her source to the sea, from old times to new, is the story of India's civilization and culture, of the rise and fall of empires, of great and proud cities, of the adventure of man and the quest of the mind which has so occupied India's thinkers, of the richness and fulfilment of life as well as its denial and renunciation, of ups and downs, of growth and decay, of life and death. (1946, p. 31)

In no part of the world, perhaps, is this 'story...of life and death' more graphically represented than in that part of ancient (and colonial) India which constitutes modern Bangladesh, the focus of the present study. Here the inhabitants have evolved an almost amphibious existence in adaptation to the annual flood, building mounds on which to construct their dwellings above the normal flood level; moving about in boats during those months of the year that much of the country is submerged; cultivating rice varieties adapted to the depth of normal local flooding; and developing a productive
indigenous fishing technology. This set of adaptations to the physical environment is easily upset when abnormal flooding occurs. Again, through the ages, the inhabitants have adopted protective and preventive measures against abnormal flooding. With lower population densities, settlement could simply avoid the areas of highest flood risk. Embankments were constructed to contain flooding, and canals dug to assist drainage. These canals also formed part of the indigenous irrigation technology, which allowed the cultivation in some areas of a dry season rice crop to supplement the high risk monsoon season crops. The construction and maintenance of such works requires a degree of social organisation, and so control measures alternately expanded and disintegrated with the rise and fall of the local 'kingdoms' and the larger empires which comprise the region's history (Mukerjee, 1938).

Today, the construction of flood control, drainage and irrigation works in Bangladesh is largely planned and funded by the foreign governments and aid agencies upon which the country depends. This study looks at one such project, an embankment along the eastern (left) bank of the Bangshi river in Tangail District. An attempt is made to assess the impact of the embankment on the functioning of the local society and economy. This is done by comparing the situation in a village protected by the embankment both with that in a nearby unprotected village; and also with that prevailing in the now-protected village as it was before the construction of the embankment. Particular attention is paid to the differential impact on the various economic strata of the local society, as a particular
concern of the project funding agency is the targeting of their projects to the very poorest groups in society. The fundamental hypothesis here is that although it is the poorest groups who may be most vulnerable to a natural hazard, in this case flood, a reduction in hazard does not necessarily provide most benefit to these poorest groups.

Before the actual research methodology is outlined in detail, an account is presented establishing the context of this work within geography and within the broad fields of natural hazards and development research. Such an account is felt to be essential, as the formulation of the hypotheses, the development of the methodology, and indeed the very selection of the particular project as one worthy of in-depth study and evaluation reflects the author's personal academic stance. This is followed by a chapter presenting an historical account of planning for the water sector in the region up to Bangladesh's Third Five Year Plan (1985-90). The third chapter provides a description of society, economy and environment in Bangladesh. This completes the background to the formulation and execution of research methodology, which are covered in chapters four and five. Chapters six through to nine assess, through analysis of the data collected in the field, the influence of the project on various aspects of the local socio-economic system; and chapter ten contains concluding remarks and recommendations for future planning policy.
CHAPTER 1

THEORETICAL CONTEXT

1.1 Geographical research: traditions and trends

The motivation behind the present work is similar to that which led W.H. Saumarez Smith, a young Indian Civil Service officer in the 1930s, later to publish a collection of the letters he had written home describing his work as the Subdivisional Officer of Madaripur in Faridpur District in then East Bengal. In the introduction to the collection he writes:

A reason why the letters may be of some interest to a wider circle of readers than students of the British Raj is that Madaripur lies in what is now Bangladesh. Nature and man have combined to make Bangladesh one of the most afflicted countries in the world. In the years which have passed since I worked there, the political system has changed out of recognition. The terrain has not. Greater knowledge of the natural conditions in which Bangladeshis live may lead to greater interest; and greater interest to greater sympathy. (Saumarez Smith, 1977, p. 1)

An interest in 'nature and man' has been something of a rarity in much recent geography, but it is in the more deeply-rooted tradition of geography as the study of people relation to their environment that the present study of flood control in Bangladesh is rooted. Without wishing to invoke an over-simplistic environmental determinism, surely one must recognise that 'there is no such thing as a physical geography of Bangladesh divorced from its human geography, and even more so the other way round' (Stoddart, 1987, p. 333).

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Stoddart's observations on Bangladesh form part of his general indictment of contemporary geography, in which he laments its fragmentation into specialised sub-disciplines, each closer to neighbouring disciplines than to geography's 'central intent and indeed self-evident role in the community of knowledge' (1987, p. 329). This fragmentation of the discipline owes its origins in part to the reaction against the environmental determinism which characterised geography until as late as the middle of this century. This determinism, in turn, stems from geography's beginnings: the description of the new lands (and peoples) discovered in the European age of exploration. While the geographer's role was a descriptive one, the environment's controlling power over man could all too easily be assumed, giving a geography which in hindsight seems ethnocentric and even racist.

Geography subsequently developed into regional synthesis, with the delineation of regions based on environmental and human (essentially economic) features becoming the geographer's central role. This task remained basically one of description and, in the usually assumed coincidence of the boundaries of physical and economic regions, environmental determinism persisted, albeit in implicit rather than explicit form. Geography continued with its 'complacent environmental determinism' (Farmer, 1983a, p. 70), but for such works as Forde's *Habitat, economy and society* (1934). Corbridge (1986, p. 248) sees Forde's work as a 'theoretically informed, empirical "field" geography'. Surely this is the sort of geography...
that should be revived, particularly in geographical studies of development, if we as geographers are to 'claim the high ground' as Stoddart (1987) urges us to do.

The determinism debate seems trite when compared with the subsequent debates that have shaken geography, yet its effects have been far-reaching in discouraging geographers from involvement in what should be the core of the discipline: man-environment relations. To avoid entering the determinism-vs-possibilism fray, geographers chose to restrict themselves to the study of either man or the environment, readily defining themselves as either human or physical geographers. Certain geographers succeeded in continuing with research in the best of the classical tradition - Farmer with his work on South Asia, for example (1957, 1977).

Two forces served to further geography's subdivision: the end of the imperial era, with the independence of colonies in Africa and Asia; and the emergence of the 'new geography' in the 1960s, with its emphasis on quantification, modelling and systems theory. With the demise of colonialism came a shift in attitude in the ex-colonisers, as the newly independent nations asserted that colonial government rather than environmental limitations had been responsible for their underdevelopment. Environmental determinism came to have imperialist and even racist overtones, and to uphold its tenets meant the certain loss of academic credibility. To avoid this risk, those geographers working in the newly-labelled 'Third World' steered clear of the man-environment interface; others chose instead to remain safely at
home in an environment tame and familiar. With the end of empire, there came too a loss of the informal geography practised by colonial administrators, who were often avid collectors of a myriad of information on the societies and environments in which they found themselves.

The influence of the 'new geography' or 'quantitative revolution' is rather more difficult to assess. What might have served to integrate the human and physical branches of the discipline through a common methodology seems to have driven them ever further apart. Methodology came to transcend subject matter, and geographers seemed more concerned to display competence in quantitative techniques than to fulfil their traditional role of describing and explaining the world about them. The search for quantifiable generalisation caused geographers to overlook the world's infinite variety. Those geographers who had persevered through the determinism debate were alienated anew (see e.g. Farmer, 1973; Brookfield, 1984)).

Quantitative geography, and the positivist philosophy with which it was associated, soon came to have its challengers - from without and within - and again the discipline was subjected to internal dissent. Yet few of the challengers called for the reintegration of geography, arguing instead for a human (and humanist) geography founded in behaviouralism, phenomenology or even existentialism (Gale and Olsson, 1979; Relph, 1981; and Samuels, 1981 are examples); a human geography thus ever more removed from the physical environment, and ever closer to the other social sciences. Physical geographers
retreated into their safe, scientific world, but for the occasional token gesture of applied research.

The most concerted challenge to positivism, and to geography more generally, came from the radical geographers, christened thus by Smith (1971). This challenge is seen by some as constituting a 'second revolution'. The radicals adopt a Marxian framework of analysis in studying geographical (really social) problems, dealing only rarely with environmental issues. Corbridge (1986) is surely correct in viewing much of this radical research as merely replacing environmental determinism with economic determinism. Where radical geographers have treated relations between man and nature, they have done so warily, usually within the broadest theoretical terms rather than in an empirical fashion (e.g. Smith, 1979; Smith and O'Keefe, 1980). Again, this development in geography has led towards the periphery rather than the core of the discipline; towards further fragmentation of the discipline and away from that eclectic integration that should be the geographer's hallmark.

Where does all this leave geography as we enter the 1990s? What, therefore, is the academic context in which my own work is located, and where do I see it making its contribution to the field?

Geography, according to the diagnosis of Stoddart (1987, p. 328), among others, is in a state of malaise; geographers are 'despondent, morose, disillusioned, almost literally devoid of hope, not only about Geography as it is today but as it might be in the future.' Johnston (1984, p. 443) describes his colleagues as 'parochial' and
'myopic', the very antithesis, surely, of what a geographer should be. Geography, claims Stoddart (1987, p. 330), has been largely 'abandoned and forgotten', and 'we have lost sight of the world in which we live'. David Smith, an active participant in the quantitative and radical 'revolutions', finds that he 'no longer care[s] very much about geography', dismissing most geography as 'inconsequential claptrap' (1984, p. 132). Ironically, while Smith now seeks to shed the label of 'geographer', Harold Brookfield, self-confessed 'outside man' to the quantitative and radical revolutions, finds that the label, which he too once sought to shed, now fits well his varied endeavours (Brookfield, 1984).

That this is so, and that Stoddart's call to return to a more traditional geography seems timely rather than revolutionary, indicates that geography is undergoing something of a sea-change. There are signs of the beginnings of integration rather than separation of sub-disciplines; of a revival of regionalism (albeit in modified form) (Johnston, 1984; Scargill, 1985); and of the emergence of what might be termed 'neo-environmentalism'. These trends have entered geography from other, related disciplines - in the case of 'neo-environmentalism', particularly from development studies. Geographers, noticing that outsiders to the discipline have usurped much of the geographer's traditional role, have perhaps at last stopped behaving 'like a persecuted religious minority' (Farmer, 1973) obsessed with justifying their academic existence.

It is in this emergent, 'neo-classical' geography that the present
work seeks its place. 'Neo-classical' because it is a return to 'geography - a geography, the geography' (Stoddart, 1987, p. 329).

The work is located firmly in the man-environment paradigm, seeing that paradigm not as one sub-discipline within geography but, with Brookfield, as 'the real "mainstream" of geography', albeit a 'braided [rather] than a meandering mainstream' (1984, pp. 37-8).

This is not to say that the mainstream has remained unperturbed by the ripples in other channels. The study of one aspect of man-environment relations in particular, that of natural hazards research, has seen debates and disagreements paralleling those in the discipline as a whole. It is to these debates that this discussion now turns; as it is with man's relations to an especially hazardous environment that this work is concerned.

1.2 Natural hazards research

Geographers - or, more particularly, British geographers - have tended to neglect research into natural hazards, largely as a result of the increasing fragmentation of their discipline into specialised sub-disciplines, with a clear demarcation of the human/physical divide. Natural hazards straddle this divide, their study being worthless without the adoption of an integrative approach. This neglect does not mean that hazards research is without a long history. In the Scottish Geographical Magazine of May 1924, there appears in a letter from the president and vice-president of the Geographical Society of Geneva, Messrs Gautier and Montandon, the
suggestion that 'relief measures by charitable organisations such as
the Red Cross would be much facilitated if certain preliminary
scientific work could be carried out, and if "natural catastrophes"
of all kinds were sufficiently studied from a historical and
geographical point of view' (p. 170). Such a call might equally well
be made today, in a world where modern technology has failed to
reduce the vulnerability to hazard of much of the world's population
(or has even, some argue, exacerbated it).

From a perusal of the relevant literature, it would appear that until
the mid-1970s hazards research was the preserve of a small group of
North American geographers, centring on Gilbert White. White's
published works on floods and floodplain management date back to
1936, and his work on environmental hazards in more general terms to
1968 (Kates and Burton, 1986). The year 1976, which saw many
disasters across the globe, marked the beginning of an exponential
growth in the number of publications on natural hazards (cf. inter
alia O'Keefe et al., 1976; Quarantelli, 1978; Whittow, 1980; Cuny,
1983; Hewitt, 1983; Wijkman and Timberlake, 1984). The journal
Disasters first appeared in 1977. This growth has been accompanied by
an increasing divergence in terms of ideology, with viewpoints today
being polarised between a technocratic environmentalism at the one
extreme and, at the other, a 'radical' or 'political economy'
interpretation. The ensuing debates parallel the debates in
geography on environmental determinism and radicalism.

The dominant view of hazards, as typified by the White school, is
characterised by an acceptance of natural disaster as a result of 'extremes' in geophysical processes, and the imperfect prediction of these extremes by the human occupants of the hazard zone. The 'geography' of hazard is seen essentially as synonymous with the distribution of natural extremes, and the significance of the human element is confined to perceptions of and responses to the extreme event. The response deemed appropriate is to select a 'technical fix' in order to avert disaster. When applied in a Third World situation, there is usually implied a transfer of technology and/or expertise from the developed world to the affected developing nation. This view dominates hazards research publications; in fact, the main areas of expertise that fall under the umbrella term 'hazards research' are the physical sciences and engineering, with the role of the social sciences tending to be restricted to studying crisis behaviour and emergency measures.

The beginnings of challenge to the dominant view came when some researchers began to view hazards in the framework of human ecology. From a human ecological viewpoint, the fundamental flaw in the traditional paradigm lies in its hazard specificity, with different research (and policy) criteria applied to different hazards. There was a perceived need to modify the paradigm to one in which 'hazards are seen not as separate discrete phenomena but as an integral part of an ongoing system', with the human use system and the natural system given equal weight (Burton and Hewitt, 1974).

The dominant view took up some of the ideas expounded by the human
ecologists, yet without immediately undergoing any major realignment. Criticism grew, particularly after the publication in 1974 of the work edited by Gilbert White, *Natural hazards: local, national, global*. Eric Waddell (1977), in a review article 'The hazards of scientism' in (significantly) the journal *Human Ecology*, asserts that while White claimed the framework of the book (and of the collaborative research it documents) to be an ecological one, it is in fact 'a resolutely deterministic one where the active forces are vested in nature and the passive in man' (p. 69). Particularly attacked was the application of a standardised methodology across a range of cultures, from the United States to Bangladesh. Waddell sees the mainstream of hazards research as reminiscent of the development literature of the 1950s 'in its espousal of an uncritical and elitist Western world view' (p. 76).

Similar criticism followed the publication of the companion volume *The environment as hazard* (Burton, Kates and White (eds), 1978). Here Hewitt (1980) found that the human ecological perspective was paid little more than lip service. A review of Burton, Kates and White's book by William Torry (1979) marked a new stage in the debate, with a call for a shift to a more radical paradigm 'if there is to be a better understanding of the principles of association between local hazard/disaster causality and global, national and regional political and economic integration' (p. 380). Walker (1979), in another review of *The environment as hazard*, identifies the fundamental weakness of the book as its consideration of the human element solely in terms of models of bounded rationality. Such models, developed in cognitive
psychology and much favoured by economists, are scarcely adequate for a genuinely human ecological analysis of hazards.

What, then, would constitute a genuinely human ecological paradigm? Ben Wisner (1981), in a review of Whittow's *Disasters* (1980), offers this analysis:

> If it is true that the poor are being "marginalized" and thus made more vulnerable to natural hazards, a human ecological perspective would suggest that it is something about the daily life of the poor, the political, economic, social, and cultural structures that delimit and limit that life, that needs understanding and public pressure toward changing. The structural changes required to reduce vulnerability to coastal flood in Bangladesh, drought in Kenya, earthquake in Guatemala, or hurricane in Honduras go much further than "prediction, alleviation and relief". (pp. 133-4)

Whittow's book stands firmly within the dominant view; Wisner, along with Hewitt, has moved from the traditional paradigm to the emergent alternative paradigm. Hewitt has become one of the most vociferous opponents of the mainstream in hazards research, with his views clearly expounded in his editorial introduction to the 1983 *Interpretations of calamity*, where he writes:

> ...I find much that is fascinating and useful within the dominant view. In criticising it, I have criticised most of my own past work, which largely pursued the dominant view. Yet I believe that this perspective, which pervades natural hazards research, is the single greatest impediment to improvement in its quality and effectiveness. The perspective functions as though "objective", "general" and "rigorous", but its rigour and generality are achieved through an extreme, opportunistic narrowing of interpretation and empirical interest. (pp. 28-9)

Yet Hewitt is somewhat sceptical of the worth of a Marxist paradigm as a viable alternative to the dominant view:
Some of the more incisive criticism of hazards work in the dominant mode has been Marxist. It seems to me...that like so much else in modern states, the dominant view of hazards differs little across the broadest spectrum of political affiliations. (p. 8)

Hewitt identifies the essential misconception of the dominant view as the separation of environmental hazards from the spectrum of 'normal' man-environment relations, and its consequent failure to perceive the significance of the existing socio-economic order as an agent in creating hazard. Susman, O'Keefe and Wisner's paper in Hewitt (1983) pursues this theme:

...the increasing numbers of disasters and relatively constant geographical conditions make it clear that vulnerability is increasing due to human changes, and in the largest fraction of the earth's inhabited area these changes are closely bound up with 'development' or its failure. (p. 267)

Exceptional among work conducted within the radical paradigm is that of Michael Watts in his analysis of drought in northern Nigeria (Watts, 1983a, b and c). Watts does not restrict himself to a disavowing of the conventional view of hazards and the expounding of an alternative (Marxist) theoretical framework; but both bases his wider analysis on and applies his revised framework to an empirical case study, viewing the response of Nigerian peasants to drought in the context of social relations of production, yet without disregarding environmental constraints.

In summary, there can be identified four schools of thought on natural hazards research. The 'mainstream', despite its challengers, continues to dominate both academic research and public policy,
continues to dominate both academic research and public policy, placing emphasis on the geophysical process and seeking solutions in the 'technical fix'. A second gives itself the label of 'human ecology', yet in reality differs little from the mainstream. It pays lip service to the importance of society, economy and culture, but concerns itself with these only in terms of perception of and response to the geophysical process - the human and physical systems intersecting rather than interacting. A 'radical' approach has emerged in opposition to the mainstream, interpreting hazards in terms of political economy and calling for socialist economic transformation to reduce hazard vulnerability. Finally, there is the true 'human ecology' paradigm, as advocated by Hewitt, placing hazards research squarely within 'normal' man-environment relations, and thus within the everyday functioning of society and economy. This paradigm is only now coming to pose a serious challenge to the dominant view, a development brought about as much by real events (famine in Ethiopia, flood in Bangladesh) as by academic revisionism. It is notable in such works as Famine (Harrison, 1988) and Famine: social crisis and historical change (Arnold, 1988).

My own view is that the debate around the issue of natural hazards has tended to obscure the issue itself. Rationality and objectivity have been lost in the ideological battle that has developed, and research efforts are channeled into academic argument rather than empirical research and practical action. This study of flood control in Bangladesh is undertaken from a 'human ecological' perspective (as defined by Hewitt, 1983). The very nature of the flood problem in
Bangladesh disposes it towards this type of analysis - the flood hazard being so all-pervasive in the day-to-day functioning of the society and economy, and so frequent in its realisation in recurrent flood disasters. Floods in Bangladesh cannot be divorced from the realities of everyday life in a perilous environment, where social, political and economic uncertainty compound the inherent natural hazards of flood, cyclone and drought. Any study of floods in Bangladesh cannot, therefore, be divorced from the context of the economic development of the country, nor can it commence without establishing its place within the wide range of ideology and approach adopted in geographical studies of development.

1.3 Geographers and development

Nowhere has the separation between human and physical geography had more unfortunate consequences than in geographers' involvement - or rather lack of involvement - in development. Where they could form that essential link between economic theory and development projects on the ground, geographers, with few exceptions, have instead retreated into their individual specialisations. Thus even within geography there has been a split into the 'two cultures' identified by Chambers (1983). The human geographers have allied themselves with the 'political economists'; the physical geographers with the 'physical ecologists'. As it is from economic geography that development geographers have emerged, the environment has been neglected in geographical studies of development.
While colonial rule operated, and the rulers assumed that rule to be benevolent and progressive, problems of 'underdevelopment' (though unlikely to have been thus termed) could be and were readily attributed to environmental constraints (e.g. Gourou, 1953). The blame for economic 'backwardness' was also often placed on the 'backward' practices of the native inhabitants, in 'the racist belief...that the natives were inferior, stupid, lazy, improvident and dissolute' (Chambers, 1983, p. 40). Environmental explanations for poverty thus came to have colonial and racist associations, and were rejected not only by academics, but also by the development planners of the Third World in their strategies for post-independence economic development.

Early models of development for the newly-independent ex-colonies were based on the European post-war experience. Technology and capital were the inputs assumed necessary to effect the transformation from a state of underdevelopment, through the process of economic growth, to a state of development (generally equated with increased urbanisation and industrialisation). Environmental limitations were assumed to be surmountable through appropriate technological interventions, and theoretical economists held centre stage in both academic studies of development and development planning.

By the 1960s, studies of development had spread into disciplines other than economics, and development theories were correspondingly criticised and modified. Sociologists, in particular, came to extend
the definition of development beyond the strictly economic realm, introducing the concept of social modernisation as a necessary ingredient to the development process. Their fundamental tenet was that the diffusion of western political and cultural values through 'increasing interaction between less and more developed areas (would)...lead to the onset of development in the former areas' (Browett, 1980, p. 61). Geographers contributed enthusiastically to modernisation theory, with its obvious spatial ramifications, but theoretical space became more important than the real environment in the formulation of the new development models.

Modernisation and growth theories came increasingly under attack as the predicted 'diffusion' or 'trickle-down' of benefits failed to occur, and development theory underwent certain fundamental shifts. Geographers contributed to the disavowing of the diffusionist paradigm (Brookfield, 1975; Mabogunje, 1980), and to the expounding of alternative theories, with development geography at once being altered by and contributing to the paradigm shifts within the geographical discipline as a whole. As geography became increasingly fragmented, so too did geographical studies of development become increasingly divided among divergent ideologies. For the most part, geographers in their work on development moved closer to economics and sociology and away from man-environment relations.

Geographers participated in the growing critique of development theory from a Marxist and neo-Marxist perspective; indeed, radical geography owes its origins largely to geographers' involvement in
issues of development and their questioning of the prevailing orthodoxy in the 1960s (Peet, 1977). Corbridge (1986) provides a comprehensive critique of radical development geography, accusing it of 'closing as many doors as it once opened' (p. 8). He criticises particularly its spatial over-aggregation and its lack of effectiveness in countering any but the most simplistically deterministic theories on environment-development relations. Among the more sophisticated approaches to those relations Corbridge cites Farmer's work on South Asia (1957, 1977, 1983b); Chambers et al. in Seasonal dimensions to rural poverty (1981); and Chisholm's emphasis on the possible role of climatic change in world development (1982).

Chambers (1981, 1983) has himself been instrumental in reintroducing environmental considerations to the agenda of development studies and development planning, both through his own work on seasonality and by drawing attention to the divide between academics concerned with development (the 'political economists') and development practitioners (the 'physical ecologists'). Of the political economists he writes:

In the political economy cluster, rural poverty is seen as a consequence of processes which concentrate wealth and power. Although within this cluster there are many schools of thought and assertion, their differences are exaggerated by sectarian concepts and jargon and by polemical style so that it is easy to overlook the extent to which they overlap. (Chambers, 1983, p. 37)

The physical ecologists attribute underdevelopment to the physical factors of population growth and pressures on fragile environments; the physical weakness of the poor owing to disease and malnutrition;
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The physical ecologists attribute underdevelopment to the physical factors of population growth and pressures on fragile environments; the physical weakness of the poor owing to disease and malnutrition;
and environmental limitations such as climate and soil. Each group is guilty of partiality in its explanations, a partiality which obscures the true complexity of underdevelopment, and thus inevitably fails in finding solutions. Inspired largely by Chambers, there has emerged a growing body of literature on the relationship between environmental seasonality and rural poverty (see e.g. *IDS Bulletin* 17(3), edited by Richard Longhurst and entitled 'Seasonality and poverty'), with the result that the gulf between the 'two cultures' is beginning to narrow.

If geographers are to have an effective role in this 'new' development theory and planning advocated by Chambers, they will have to be equipped to deal with political economy and physical ecology with equal facility. There is evidence of the beginnings of such a new orthodoxy in development planning within international agencies, national governments and non-governmental organisations. The publication of the Brundtland report, *Our common future* (World Commission on Environment and Development, 1987), marked the (belated) return of the environment to the development agenda, clearly establishing the links between environment and development and making recommendations about the measures required to achieve sustainable development. If man-environment relations are at once the true mainstream of geography and at the heart of the development process, it follows that development should be a primary research interest in geography.

Research into development could be a particularly fruitful area for
co-operation between human and physical geography, as advocated by Bell and Roberts (1986) in their discussion of dambo utilisation in Zimbabwe. If geographers are indeed as morose and disillusioned as Stoddart (1987) describes, a solution could be that prescribed by Knight (1986) i.e. for geographers to address some real problems:

The fact of the "starving millions" is a problem for geographers... The fact that volcanoes, hurricanes and floods still bring misery and death in an age when we can fly to the moon is a problem for geographers. These aren't academic puzzles that can be analysed at leisure in the depths of the more obscure journals. These are problems that kill people every day. (p. 333)

The flood control project studied here is an example of the type development planning advocated by Chambers. It is targeted at the poorest groups within the rural economy. Its objective, along with the protection of life and property, is increased food production to meet the basic needs of the local population. Local participation has been encouraged at all stages of its planning, implementation and maintenance. The funding agency responsible for the construction of the embankment has embarked on a co-operative scheme with a non-governmental organisation to organise the local people to make the fullest possible use of the embankment. The project site was selected on grounds of both technical and socio-economic feasibility, deliberately avoiding areas of excessively skewed landholding distribution in order to avoid furthering the concentration of wealth and power. The Swedish and Dutch development agencies which jointly fund the project have encouraged a shift in official development planning in Bangladesh from an 'economic growth' to a 'basic needs' philosophy, at the same time not losing sight of the severe
environmental constraints to development under which planners in Bangladesh operate. In a country branded a test case for development, the project represents an experimental approach; a test case on a local scale. It is hoped that the evaluation of the project undertaken here will contribute towards the general evaluation being undertaken by the funding agencies in order to assess the replicability of their projects as an appropriate model for development in Bangladesh.

Before the actual project evaluation can commence, it is essential to establish the context in which the project is located - not just its physical context, but the place it occupies in the history of water management in the region and in the social, economic and agricultural systems that constitute modern Bangladesh. It is to these matters that discussion now turns.
CHAPTER 2

HISTORICAL CONTEXT

2.1 A brief history of the region

Bangladesh has been described as 'one of the most afflicted countries in the world' (Saumarez Smith, 1977, p. 1). Its afflictions are not only the recurrent ravages of floods, cyclones, droughts, and on occasion even earthquakes, but also the social and political turbulence which have dogged the nation throughout its brief history, and the area itself long before Bangladesh attained its nationhood.

Politically, Bangladesh is an independent republic within the Commonwealth. The nation as it exists today is but half the area of colonial Bengal; that it came into existence at all is the result of a quirk of history, it having no more claim to sovereignty than many other cultural regions within South Asia which are contained within larger political units. Even more tenuous than its claim to nationhood, however, was its appendage to Pakistan at partition in 1947, as Bengali history, language and culture are quite distinct from those of the Punjabi and frontier tribes which were melded into the West Pakistani 'nation'.

It has long been the fate of Bengal to be governed by bideshis (outsiders), and to be caught up in religious conflict. O'Malley (1917) provides an account of the region's early history. For centuries before the Muslim invasion of the subcontinent, control of
Bengal fluctuated back and forth between Hindu and Buddhist rulers. During the years of Muslim rule in India, Bengal was governed successively by governors appointed by the emperors in Delhi; by independent kings after Bengal broke away from the empire in the fourteenth century; by Afghan chiefs; and by Nawabs of the Moghul empire when Bengal was once more brought under the control of the central government during the rule of Akbar. Bengal proved difficult to govern even then, and 'several chieftains, Hindu as well as Musalman, enjoyed semi-independent power, secure in the protection afforded by the swamps and morasses of the lower delta' (O'Malley, 1917, p. 147).

Links with the capital at Delhi further declined with the general disintegration of the Moghul empire after the death of Aurangzeb, and there ensued a period of successive revolts and rebellions over Bengal's leadership. It was this disarray which prevailed when British traders arrived in the seventeenth century, and which afforded Robert Clive his opportunity to secure British mercantile interests. Although smacking of cultural arrogance, there is probably much truth in Alfred Lyall's assertion in The rise of British dominion in India that the inhabitants of Bengal 'were becoming a masterless multitude swaying to and fro in the political storm, and clinging to any power, natural or supernatural, that seemed likely to protect them' (Lyall in O'Malley, 1917, p. 153). As is well known, Bengal was an essential stepping-stone from which Britain extended its influence over the entire sub-continent, first under the auspices of the East India Company, and later as a
fully-fledged colonial power. Also well known are the circumstances of the withdrawal of British colonial government in 1947; the partition of colonial India into the sovereign states of (Hindu) India and (Muslim) Pakistan, divided by hastily drawn boundaries; and the war of secession of the eastern wing of Pakistan in 1971 to form the modern state of Bangladesh.

This potted history may seem of little relevance in a study of flood control in Bangladesh, but an appreciation of the magnitude of the environmental hazards confronting the region makes it clear that greater political stability, and longer indigenous rulership, might have brought greater success, or at least greater investment of effort, in managing the environment. The successive political divisions of the region, with political, cultural, religious, and physical boundaries rarely coinciding (and being themselves in constant flux over the historical period), have meant a lack of continuity in environmental management in both administrative and spatial terms. As empire succeeded empire and local ruler succeeded local ruler, the construction and maintenance of water works such as canals and embankments will alternately have advanced and declined. The same can be said even of recent history, with government succeeding government, as the planning chronology of the water sector reveals. In terms of 'natural regions', however defined, Bangladesh is an incongruity, there being no identifiable 'natural boundaries' which separate it from neighbouring India (making the delineation of the India/Bangladesh border the source of ongoing dispute). Its major rivers have over 90% of their catchments outside the country,
Fig. 1 Map showing the catchment areas of the major rivers of Bangladesh
in India, Nepal and China (fig. 1), making environmental planning even at the national level a piecemeal exercise.

2.2 The history of water sector planning

The artificial control of water resources in India dates back as long as history. Loveday (1914) notes that water control in India was 'mentioned by Strabo with wonder, and in later times it was the special pride of the Muhammedan Emperors' (p. 24). Yet such records tell chiefly of irrigation, and little mention is made of physical attempts to control flooding in the pre-colonial era. There were locally-constructed earthen embankments, and the most flood-prone areas of Bengal were left largely unoccupied (Mukerjee, 1938).

The East India Company undertook limited irrigation works, viewing these as a protective measure against the famines which periodically affected the country. Flood control seems to have been essentially neglected under the East India Company, despite flooding in Bengal having been a major contributing factor in the 1770 famine.

Emphasis on irrigation in other areas of the country rather than in flood control in Bengal persisted after the British government assumed control from the Company. Bengal, being relatively less famine-prone than other regions, was perceived as a granary from which surplus food could be exported. (The 'Greater Bengal' of this time included today's Bangladesh, West Bengal, Bihar and Orissa.) The threat of flood in Bengal was so overshadowed by that of countrywide
famine caused by drought, that there was no comprehensive flood control policy, nor indeed any serious attempt to assess the magnitude and consequences of flooding. Any efforts at flood control in Bengal were at the whim of local colonial officials such as the aforementioned Saumarez Smith (1971), who executed flood control works in his subdivision of Faridpur.

On the partition of India (and of Bengal) in 1947, East Bengal became the eastern wing of the new nation of Pakistan, and planning for the water sector passed into the hands of the Pakistani government. Much has been written of the economic neglect of East Pakistan relative to the country's western sector, and an investigation into flood control would seem to reinforce this view. In the First Five Year Plan of Pakistan (1955-60), flood control did not receive priority in planning for the water sector, being seen rather as but part of large, multi-purpose, high-technology schemes to provide hydro-electric power or irrigation. These were geared towards urban-based economic growth as much as, if not more than, rural development. Those whom the floods most affected, the rural population of East Pakistan, were bypassed in the planning process, despite their constituting the vast majority of the population of East Pakistan, itself more populous than West Pakistan.

It was only after the disastrous floods of 1954 and particularly 1955 that the issue of flood control per se began to receive attention from the government of Pakistan (Chaudhury and Siddiqui, 1984). As India was similarly affected, the ensuing investigation into the
causes and effects of these floods was a co-operative effort between the two governments. Little was achieved, however, beyond meetings. Under the East Pakistan Flood Commission, set up in 1955, a few short-term flood protection and drainage projects were implemented, but only a perfunctory investigation of the long-term issues was carried out, and this Commission did not formulate any comprehensive planning strategy. Unfortunately, many of the official documents relating to flood control (and water sector planning in general) in East Pakistan are unobtainable, having been either lost or destroyed, and it is therefore difficult to get a clear picture of the 1947-71 period (Chaudhury and Siddiqui, 1984).

Sources which are available are the reports of the various international missions to Pakistan which concerned themselves with the flood problem. Again the now notorious 1955 floods were necessary to motivate the international community into action. In 1956, the United Nations set up a Technical Assistance Mission for the study of floods and related issues in Pakistan. The Mission, which became known as the Krug Mission, submitted its report in 1957. Here for the first time were the unique flood problems of East Pakistan truly appreciated. The Mission saw that artificial retention storage was impracticable, and suggested embankments, diversions and channel improvements as appropriate water control measures. A primary recommendation of the report was for international co-operation, not just between the countries which together form the giant catchment of the Ganges, Brahmaputra and Meghna Rivers, but also between these nations and the developed
world, which could provide the technical and financial assistance deemed necessary.

The other main suggestion of the Krug Mission was the establishment of an authority in East Pakistan to deal specifically with development in the water sector. This suggestion was taken up, with the East Pakistan Water and Power Development Authority (EPWAPDA) coming into being in 1959. EPWAPDA hired as general consultants the US firm International Engineering Company (IECO), which immediately set about drawing up a Master Plan. EPWAPDA's aims, as stated in IECO's Master Plan (1964), were to:

1. protect lives, land and property by embankments;
2. reclaim low areas and improve drainage;
3. provide irrigation for multiple cropping;
4. protect against saline water intrusion in coastal areas;
5. improve inland water navigation; and
6. generate hydro and tidal power.

Even as IECO were working on their Master Plan, other international hydrology experts were visiting East Pakistan to assess the situation. General John R. Hardin, one-time Chairman of the Mississippi River Commission, published a report in 1963, and this was followed in 1964 by the report of Prof. J. Thijsse, a Dutch hydrologist. In their reports, both Hardin and Thijsse reached a
consensus with the findings of the Krug Mission, recommending embankment construction and channel improvement as alleviation measures. Each emphasised the complexity of the flood problem, with the sheer magnitude of the rivers in an unstable deltaic environment; each also recognised the profound importance of floods in economic terms.

IECO took five years (1959-64) to prepare their Master Plan, which outlined a 20 year programme covering the period 1965-85, and involving 51 major projects incorporating flood control, drainage and irrigation. These projects were to be phased, with flood control and drainage as a first stage, followed later by irrigation. It was envisaged that some 2,000 miles of embankment would provide protection from flooding to eight million acres by 1985, by which date four million acres would be irrigated. Embankments along both sides of the three major rivers - the Ganges-Padma, Brahmaputra-Jamuna and Meghna - were to be completed by 1975. Other projects included large-scale polderisation, the construction of gravity canals, and the installation of drainage-cum-irrigation pumps. The Plan also advised the immediate commencement of a programme of systematic and scientific hydrological data collection and processing. This Master Plan was never actually accepted by the government, but its recommendations formed the basis of the Five Year Plans of 1965-70, 1970-5 and 1973-8, its influence thus extending into the post-liberation period (Khan, 1985).

No sooner had the Master Plan been published than it was subject to a
review by the World Bank (1966), which expressed 'serious reservations'. The main criticism was that the Plan went far beyond EPWAPDA's capability and resources. The Plan's over-ambitious proposals were due, in the World Bank's view, to IECO's having over-estimated foodgrain requirements and under-estimated agricultural production potential without major projects. In addition, the Plan ignored the recommendations of the Krug Mission in failing to take adequate account of the international dimensions of the problem, not including India in the planning process at all. The World Bank report also pointed out the foolhardiness of a poor country entering into the major investments involved, considering the paucity of hydrological data then available. Further criticisms were the inadequate consideration given to the question of land acquisition for major schemes; the spurious nature of economic feasibility assessments, which were said to underestimate costs and exaggerate benefits; and the failure to take adequate account of inland water navigation. The World Bank called for a re-think, advising caution, and suggesting the implementation of rather more modest schemes first. Certain large water control schemes were already under way by this time as part of the Second and Third Five Year Plans - the Brahmaputra Right Embankment Project and the Coastal Embankment Project, for example (Chaudhury and Siddiqui, 1984). These schemes had been proposed initially in the Krug Mission Report.

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By the late 1960s, flood control had become a major national issue at the highest level, with East Pakistan seeing the government's efforts as inadequate, reflecting a general bias in favour of West Pakistan.
Wolpert (1982) saw this as an important factor behind the ensuing confrontation:

[In 1966] the East was ravaged once again by floods, which destroyed the homes of an estimated 13 million Bengalis. Washington had provided over $14 million that year for "salinity control and reclamation", bringing the decade's total US Agency for International Development support for West Pakistan for minor irrigation schemes alone to $56.7 million. But no US funding for flood-control works was expended in the East. (pp. 132-3).

Government response to the growing discontent in the East was to set up yet another body, the Central Flood Control Board, which was constituted in 1969 (Chaudhury and Siddiqui, 1984). This proved no more than a token gesture, as the activities of the Board did not proceed beyond discussion and review. With the visit of an ad hoc group of consultants to the country in 1970, it looked at last as though the situation might change. The consultants agreed that an Action Programme was necessary, and called for the immediate implementation of certain urgent projects. While urging action in the short term, they emphasised the need for a coherent long-term policy. Particularly stressed were the need for rigorous hydrological data collection and analysis to resolve certain technical issues, and the importance of in-depth planning by region within the country. Positive action on these recommendations was never taken, prevented by the deteriorating political situation which culminated in the war which saw the emergence of independent Bangladesh.

In newly-independent Bangladesh, the immediate priorities were the
resettlement of those displaced by the war and the repair of the economic infrastructure. Providing the food requirements of a disrupted population was a more important mandate than flood protection. In addition, 'technical data of the land and water resources of Bangladesh had matured to the extent that a different program was called for' (Khan and Romm, 1978). The World Bank reviewed its earlier proposals in the light of changed economic and political circumstances, recommending small schemes that would be quick-yielding in terms of food production. Integrated agricultural development was seen as the key to food self-sufficiency for the new nation - the cultivation of high-yielding varieties (HYVs) with the associated inputs of artificial fertilisers and irrigation, in conjunction with flood control and drainage schemes (Khan, 1985). Priority, recommended the World Bank, should be attached to schemes small- to medium-sized, low-cost and labour-intensive (Chaudhury and Siddiqui, 1984). Projects for large-scale protection from deep flooding were felt to be over-ambitious, and a call was made for simple technologies such as low embankments and gravity drainage to be implemented on shallow-flooded land, where large returns could be obtained from minimal investment.

These planning principles found their way only gradually into official planning. The primary objective of the First Five Year Plan was to achieve food self-sufficiency by the end of the planning period (1978) - an ambitious target. Planning for the water sector was constrained by existing commitments to projects proposed under the Five Year Plans of Pakistan, some harking back to the Krug
Mission of 1956. Work on the Coastal Embankments, Chandpur, Meghna-Dhonagoda and Pabna projects continued despite the government stressing small-scale, quick-yielding projects in its planning rhetoric. On the whole, flood control was given low priority in the Plan, with much attention being paid to the cultivation under irrigation of high yielding varieties of rice. Included in the Plan were: irrigation using low-lift pumps and tubewells; the embankment of coastal areas; urban protection works for flood control; channel improvements; large-scale multi-purpose projects; and continued river studies. Rather than the truly integrated planning advocated by the World Bank, this was a piecemeal affair, a mixture of high- and low-technology, and of large and small scale - the situation, it is true, being forced by circumstance rather than deliberately planned. Flood control seems to have been seen as a thing apart, with the Ministry of Agriculture responsible for irrigation and drainage schemes, while the Ministry of Flood Control and Water Resources was responsible for the 'planning, designing, programming and execution of large-scale surface water development projects' (Government of Bangladesh, First Five Year Plan, 1973).

Not until the formulation of the Second Five Year Plan (1980-5) was the new planning philosophy to come fully to the fore. In the intervening period a Two Year Plan was implemented - continuity in planning being disrupted by continuing political instability and changes of government. 'Economic pragmatism' was the stated philosophy of the Two Year Plan, and it was intended as a stop-gap measure, with a coherent long-term planning policy awaiting political
stabilisation (Government of Bangladesh, Two Year Plan, 1978). Again integrated rural development was given emphasis, with a reduction in mass unemployment and poverty being seen as an important goal. In its actual physical planning for water resources development, however, the Two Year Plan departed little from the First Five Year Plan. It attached priority to those large-scale schemes that were already approaching completion. The institutional separation of flood control and irrigation persisted, with flood control and irrigation being combined only in the large multi-purpose schemes, and small-scale irrigation continuing as the responsibility of the Ministry of Agriculture.

In the Second Five Year Plan, the turnaround in planning policy was at last fully effected. Development planning began to come more in line with development theory of the time, and physical planning with planning rhetoric. Bangladesh had initially been saddled with projects and programmes based heavily on the 'economic growth' theory of development of W.W. Rostow and the Harvard economists, reflecting Pakistan's reliance on the United States for economic aid. Economic necessity forced the government, after Bangladesh's war of liberation, to acknowledge the importance of the provision of basic needs to a large, growing, impoverished population. However, the necessary economic pragmatism could only be finally realised in practical terms (in the water sector at least) by 1980 when, after a difficult decade, planners began to pick up the threads from 1970. The economic programme outlined for 1980-5 took full cognizance of the 'new thinking about rural development' in which 'local level
planning as well as execution is of crucial importance' (foreword to the Second Five Year Plan, 1980).

This new thinking was evident in planning for the water sector. Gone were the grandiose schemes of the 1960s and IECO, with their highly centralised institutional structures and heavy dependence on large inputs of (foreign) capital and technology. In their place came local rural development projects, which were to incorporate irrigated agriculture, small-scale drainage, and flood control as integral components. Flood control, instead of being seen as high-technology and capital-intensive, the preserve of the 'engineer-sahib', became a core activity of the Rural Works Programme, where low-technology and labour-intensive schemes were assigned priority. Although the Rural Works Programme had been operational during the First Five Year Plan and Two Year Plan periods, its activities in flood control, drainage and irrigation had always been seen as secondary to the big projects. Now its activities were seen as central to water resources development.

The Second Five Year Plan recommended that short gestation period and quick-yielding, more cost-effective projects should be taken up to help increase food production in the shortest possible time. Whereas flood control had largely been considered as separate from, and less important than, irrigation in earlier plans, now integrated flood control, drainage and irrigation (FCDI) projects became a central feature of planning for agricultural development. The activities of the Bangladesh Water Development Board (BWDB) and the Bangladesh
Agricultural Development Corporation (BADC), the agencies of the Ministry of Flood Control and Water Resources and the Ministry of Agriculture respectively, were to be more co-ordinated in the Second Five Year Plan period, where previous plans had put flood control entirely in the hands of BWDB and minor irrigation in those of BADC. The Plan saw the need for the formulation of a national water plan to provide a coherent, integrated framework for the activities of the increasing number of government agencies and non-governmental organisations involved in the water sector.

To develop the National Water Plan, the government approved the establishment of a Master Plan Organisation (MPO) within the newly styled Ministry of Irrigation, Water Development and Flood Control. MPO was indeed set up, with the assistance of funding from the United Nations Development Program, to advise the Ministry and the Planning Commission on all aspects of water resources planning; and Harza International Engineering Company were appointed as official consultants (Khan, 1985). While the full impact of the new water planning agency will be seen only in the Fourth Five Year Plan (1990-5), its influence was already evident in the current (Third) Plan.

In the Third Five Year Plan, for the first time in Bangladesh's planning history, a long-term strategy for water resources development was outlined in practical terms. This long-term view did not mean that the short term was neglected. Rather, the short-term issues were clarified by their integration into a more comprehensive
planning strategy. Priority for the Third Five Year Plan period was
given to the maximisation of utilisation of existing facilities, and
the speedy completion of unfinished projects. In developing new
projects, the policy of short gestation, cost-effective and
labour-intensive projects was continued, with particular emphasis on
the local beneficiaries of such projects in all stages of planning,
implementation and maintenance. A departure from previous plans was
the inclusion of soil conservation and afforestation as part of the
strategy for effective water resources development, with an
acknowledgement of the need for a multi-disciplinary approach in the
implementation of this strategy. The further integration and
coop-eration of the various agencies in the water sector was strongly
advocated, with a call being made for the clear definition of
leadership and responsibilities.

To certain critics, the formation of MPO with its foreign consultants
and reliance on external capital and expertise might seem a negative
development. While the ultimate goal might well be the planning of
all the country's resources by and for Bangladeshis, it is
unrealistic to suggest that Bangladesh could 'go it alone' in the
management of its water resources. MPO has now submitted its Master
Plan to the government of Bangladesh, thus providing a framework for
all future water sector planning in the country, but the practical
execution of that planning, with the unavoidable dependence on
foreign funding, will of necessity be in the hands of foreign experts
for at least the foreseeable future.
In its planning recommendations, MPO has certainly been sensitive to the real needs of the country and sympathetic to the government's objective of attaining food self-sufficiency. While I have not seen its final report, its interim reports clearly expound its development philosophy. Particular attention is paid to equitability in the distribution of benefits from water sector schemes (e.g. in MPO's Second Interim Report, 1984, and Draft of the Master Plan, 1986). MPO has undertaken an assessment of the impact on equity and production in the short and long term of alternative technologies for flood control, drainage and irrigation. The irrigation technologies under consideration include traditional technologies, shallow tubewells (both manually and pump operated), deep tubewells and low-lift pumps. Flood control and drainage schemes are similarly being evaluated on a range of scales from major projects to small 'local participation' schemes. 'Local participation' is seen by MPO as one possible means of alleviating the problem of the increasing gap between landholders and the landless, often exacerbated rather than ameliorated by the implementation of water sector schemes. As yet, 'local participation' remains much discussed but seldom implemented. Further suggestions by MPO include the use of embankment sides for social forestry; the use of borrow-pits and project canals for fisheries and irrigation; and the preferential sale of irrigation equipment to landless groups. The timber and fuel wood, fish, and water thus provided could form a major source of income for the rural poor. Planners are here up against a host of tenurial and organisational problems, which may prove insurmountable, but
experimentation and evaluation are essential if the optimum water sector planning policy is to be selected from the many available options.

The state of water sector planning in Bangladesh, then, would appear to be fundamentally sound. Planning encompasses a range of technologies at a range of scales, but within an integrated and comprehensive framework. Flood control and drainage are now seen as complementary to irrigation, and planning at last acknowledges the full complexity not just of the hydrology of the country, but also of the socio-economic milieu. Solutions to problems are sought not by the 'instant cure' formula, where a sufficient dosage of capital/technology/labour is seen as a panacea, but in a formula of thorough and painstaking research. Hydrological data are being continuously collected and analysed. Projects are being implemented, then monitored and evaluated in terms of their effect on poverty reduction as well as on agricultural productivity. However, the attainment of this maturity in planning marks a beginning rather than an end. 'A plan is only as good as its implementation', notes the Minister for Planning in his foreword to the Third Five Year Plan. The implementation of the Master Plan for Water will be a lengthy, indeed unceasing, process, in which all the participants, from the local to the national and international level, have important roles to play.

The flood control and drainage project which forms the subject of the present study is representative of the new thinking in water sector
planning, which has brought flood control into the mainstream of agricultural development planning, and down to the local level. This assessment of its impact on the local society and economy, particularly in terms of equity and production, will be of value to planners in their overall assessment of the relative merits of the various types and scales of water sector schemes. The project is on a small scale, and has been planned and implemented with the participation of local beneficiaries. It is therefore very much in line with current planning policy. Previous evaluations have been biased towards minor irrigation, and there have been very few evaluations of flood control and drainage projects (Jones, 1984). This study hopes to make a contribution towards the redressing of the balance.
CHAPTER 3

SOCIO-ECONOMIC AND ENVIRONMENTAL CONTEXT

3.1 Characteristics of the rural society and economy

Basic socio-economic statistics are a sufficient indicator of the enormity of the development challenge in Bangladesh. The sheer size of the population is staggering, particularly in relation to the limited land resource. The census of 1981 gives a figure of 89.9 million people, representing a population density of 625 persons/sq.km. The population today is estimated at over 100 million, which means that population density is now over 700 persons/sq.km. Khan (1986) gives the country's land area as 14.29 million hectares, of which 8.4 million hectares (60%) are cultivated, this representing all of the effective cultivable area. Each cultivable hectare thus supports around 12 people. The 1981 census puts the proportion of the population living in rural areas at 89%; the proportion of the labour force engaged in agriculture at 74%. The population per cultivable hectare is thus a highly meaningful statistic, as the vast majority of the population is directly dependent on agriculture for a living. Stoddart (1987) presents the implications of Bangladesh's population size and rate of growth in terms of the man to land ratio: 'in 1900 each person had an area measuring 59 x 59m to support him; today that has shrunk to 30 x 30m; and by 2020 it will be only 25 x 25m' (p. 332).

Statistics at the national level conceal the disparities that exist
within the society in terms of landholding. In addition to the
decreasing amount of land per person in national terms, there is a
continuing trend towards increased polarisation in landholding, as
large landowners consolidate their holdings with land purchases, and
poor households are driven by worsening circumstances to sell their
meagre holdings (De Vylder, 1982). Land is often sold as a distress
response, after a flood or drought, for example. Distress sales of
land were widespread during the 1974 floods and resultant famine,
particularly among the smaller landowners (Alamgir, 1980). Mortgaging
land is another common distress response in rural Bangladesh, again
most prevalent among those with the smallest total landholdings. The
growing numbers of landless and landpoor are forced to make their
living either through agricultural or other forms of waged labour, or
through sharecropping.

With access to land being the over-riding factor in determining the
structure and functioning of the rural socio-economic system, an
understanding of the complexities involved in that access is
essential to an understanding of the broader system. Landholding
classes are rarely neatly demarcated into the categories of landlord;
owner-cultivator; sharecropper; and landless. A large landowner may
rent out some or even all of his fields; the rental may be on a
monetary or sharecropping basis. The landowner might thus be both
landlord and owner-cultivator. A farmer owning too little land to
support his household may rent in additional land, making him both
owner-cultivator and sharecropper. If unable to obtain access to
additional land through rental, a farmer may be forced to seek work
as an agricultural labourer on other farmers' land. Thus occupation categories are linked to landholding categories. The frequent use of the term 'subsistence economy' in reference to Bangladesh can give the misleading impression of households living off their own land and labour, whereas in reality most households depend on earning at least part of their income through labour on others' land, either as wage labour or through sharecropping.

The relative advantages to the parties concerned of wage labour and sharecropping are more complex than might at first appear. A detailed exposition of some of that complexity is given by Hartmann and Boyce (1983). To the landowner, cultivation using wage labour might be more profitable, as the wages paid are likely to be less than the fifty per cent of the crop that would be allocated to a sharecropper. However, costs of inputs such as seed and fertiliser must then be borne by the landowner, whereas in the usual sharecropping arrangement in Bangladesh such costs are met by the sharecropper. Whoever pays for the inputs bears the risk of losing his investment should crops be damaged by flood, drought or pest. When this risk falls on the sharecropper, the landowner suffers only the loss of potential yield, and not the loss of expenditure on seed, fertiliser, irrigation and labour. Also, a labour force requires supervision by the landowner, whereas if he rents the land out on a sharecropping basis his only responsibility is to divide the harvest at the end of each season.

Yet if inherently risky, sharecropping is a more secure means of
existence than wage labour. Hartmann and Boyce's description is again representative of the overall situation: 'The rewards of sharecropping may be meagre, but the rewards of wage labour are even less... Sharecropping not only pays better than wage labour, but also offers more security' (1983, pp. 195-6). The 'security' of sharecropping is that it is a contract made for at least a season; agricultural labourers usually work on a daily basis, not knowing from one day to the next for whom they will be working, if at all. I saw this situation depicted in mime by a landless labourer in my study area, who enacted for me his daily ritual of walking from place to place in search of work, his hard day's labour if he were hired, and his hunger and despair if he were not. The decision as to whether renting in land as a sharecropper or seeking employment as an agricultural labourer represents the most viable option for survival is based on several factors, most important among these the availability of household labour and the vital assets of plough and draught animals. Having to hire extra labour and pay for ploughing substantially reduces the potential profit from sharecropping, and so precludes many households from taking it up, forcing them instead into the insecurity of the labour market. Such, then, are some of the complexities of access to land in Bangladesh, this access having ramifications throughout the rural society and economy.

The basic operational unit of the rural socio-economic system is the household, and it is at the household level that the survey forming the basis of the present study was conducted. The definition of household used in the survey was that used by Alamgir (1980):
members who ate from the same kitchen and operated productive assets as a single unit' (p. 102). Potentially, a household includes the traditional patrilineal extended family: father, mother, sons and their wives and children, and daughters until they marry and leave home. In practice, the extended family usually subdivides into smaller nuclear family units, with sons separating their households from their fathers' often within a few years of marriage—purportedly because of difficulties in a wife's relations with her husband's mother. Both in Alamgir (1980) and in Abdullah and Zeidenstein (1982) one encounters the assertion that it is in households with more than average resources (especially in terms of landholding) that the household tends to remain 'joint'. Thus even at the household level, access to land is an important determinant of size and composition.

The physical homestead or bari, although perhaps appearing to comprise a discrete social unit, in reality often contains several separate households. Even when sons separate their economic identity from that of their father, setting up separate kitchens (called by the name of the clay oven, the chula), they usually continue to live in the same bari. Yet by eating apart and operating productive assets separately, they constitute separate households. The description of rural settlement which follows is based on the author's personal field experience, as well as on the descriptions of Hartmann and Boyce (1983), Abdullah and Zeidenstein (1982) and Ralph (1975).

The bari is not a single dwelling except in the poorest and smallest
of households. More usually it consists of a square or rectangular courtyard with a surface of cow dung and mud, surrounded by a number of ghors or huts, the material of their construction depending on the economic status of the household. A landless family might occupy just a single hut of jute stick walls and thatched roof, cooking being done in the open; a slightly better off family might have separate huts for dwelling and cooking, the former being more sturdily constructed, perhaps with walls of bamboo matting; households of some means may have two or three ghors, some with a tin roof; and the wealthiest households may have some or all of their several huts constructed entirely of tin, or of tin and wood (fig. 2 and fig. 3). Another indicator of the wealth of a household is the height of the plinths which raise the dwellings above the level of the courtyard (and thus further above flood height): wealthier households can afford the construction and maintenance of a plinth of two feet or more; poor households may have plinths of barely six inches, and these often severely eroded by monsoonal rain and flooding. The entire bari is sited either on naturally higher land (in short supply in this floodplain environment) or, as was more usually the case in the field area of this study, on artificially constructed mounds. In the flood season, these appear as islands above the water surface, the baris concealed by the clumps of bamboo and trees (for fruit, timber and fuelwood) which surround them.

Just as each bari comprises a number of households, so too do the baris themselves form part of larger assemblages known as paras (the closest translation is perhaps 'neighbourhood'). The baris in a para
Fig. 2 House types in rural Bangladesh

Fig. 3 Plan of a rich farming household's homestead
may be linked by ties of religion, kinship, occupation or dependency, or a combination of these. Each of the villages studied here had, for example, a distinct majhipara or fishermen's neighbourhood, where the Hindu fishing community had their homes. A number of paras form a gram or village, which may or may not coincide with the revenue villages known as mouzas which were demarcated by British colonial officials for administrative purposes. Of the villages studied here, one (Sutanari) was an official mouza, and the other (Geraki) formed part of a larger mouza. Both villages were defined as gram by their inhabitants, and as such each was seen as a distinctive socio-economic unit with which people identified.

While the gram is perceived by its inhabitants as a discrete unit, it certainly does not appear so in physical terms, especially to those unfamiliar with the Bangladeshi environment. Johnson (1982) describes this phenomenon:

...one is immediately struck by the marked contrast between the open paddy fields and the tight clusters of homesteads often almost completely obscured by trees. The European or even the Indian or Pakistani might assume the clusters to be villages, but in Bangladesh, population density and the need for homesteads to find flood-free sites results in continuous settlement along features such as levees, thus forming amorphous masses of homesteads rather than the coherent villages familiar in less flood-prone regions. Often the natural landscape provides inadequate dry sites for settlement and sites for groups of homesteads have to be built up, leaving around them a depressed 'borrow pit'. (pp. 24-5)

A small cluster of dwelling units, then, can represent a single bari, a group of baris, or a small para; a larger cluster can be a para, a gram, or parts of two or more separate grams. The resulting
complexity, with spatial, administrative, social and economic boundaries not necessarily coinciding, accounts for the wide disparities one encounters in estimates of the total number of villages in Bangladesh. One would obtain vastly differing figures if one counted the administrative revenue villages; counted spatial aggregations of dwellings e.g. from aerial photographs; or could actually enumerate the number of grams as locally defined.

Beyond the village level, the administration of Bangladesh is arranged in a hierarchical structure. Villages are grouped into unions, which comprise perhaps 10 or 20 mouzas. Unions are in turn grouped into upazilas; upazilas into subdivisions; and subdivisions into districts. The flood control project studied here fell in Azgana Union in the upazila of Mirzapur; and the village used as an experimental control for comparative purposes was in Fatehpur Union of the same upazila.

3.2 The physical environment

Just as the society and economy of Bangladesh are dominated by the rural sector, so is the rural sector dominated by the cultivation of a single crop: rice. The various fields a farmer might own will be variously suited to the cultivation of each of the three main rice crops, depending on those fields' hydrological characteristics and on the availability of supplementary irrigation. Two of the rice crops are rain-fed: aus and aman, with the latter growing in the standing
water of monsoon season flooding. The third crop, known as boro rice, is grown under irrigation in the dry season. A cash crop of jute can be grown in the aus season instead of rice, and in the rabi season, between the aman harvest and the sowing of the next rice crop, oilseeds, pulses and assorted other crops are commonly grown.

To understand the complexities and intricacies of the cropping rotations encountered in reality requires an understanding of the country's hydrology and climate, and of the variations in hydrology at the micro-level, along with an appreciation of the physical requirements of the different crops and rice varieties. As it is hydrological rather than purely climatic conditions which chiefly determine cropping patterns, cultivation practices and productivity, it is on aspects of hydrology that emphasis will be placed here.

Bangladesh is comprised of the composite delta of the Ganges, Brahmaputra and Meghna rivers (see fig. 1). The Ganges begins in the Himalayas and drains a large part of the North Indian plain before entering Bangladesh. The Brahmaputra's source lies in Tibet, and it drains the northern side of the Himalayas, flowing west-east, then turning southwards and entering Bangladesh through Assam before joining the Ganges. The Meghna is the smallest of the three in terms of length and catchment area, but it drains the region having the world's highest rainfall. The Meghna meets the Ganges-Brahmaputra at Chandpur, their combined flow discharging into the Bay of Bengal through a vast number of distributaries.

The deposits of these rivers form the giant alluvial plain that is
Bangladesh, its surface criss-crossed by an intricate web of smaller streams and channels (locally termed khals). The generally flat topography means that rivers do not flow in clearly defined channels, but meander over the plain, forming new channels as old courses become silted up. The inhabitants of the plain are at the mercy of the rivers, which here erode and there deposit; here wash away a farmer's field and there form a new char (island) whose ownership will be the subject of bitter dispute; here deposit fertile silt and there useless sand.

Hydrological characteristics closely reflect Bangladesh's climatic conditions. Straddling the Tropic of Cancer and at a longitude of ninety degrees east, Bangladesh has a climate that can be defined as tropical monsoon. It has distinct seasons, but these are distinct in terms of the amount of rainfall in each rather than temperature variations. Temperatures rarely drop low enough to prohibit plant growth, and so moisture availability (both in and on the soil) becomes the determining factor in agriculture, and thereby in the functioning of the whole rural socio-economic system.

The seasonality of rainfall is such that ninety per cent of the annual rainfall falls between mid-April and early October (Brammer, 1971). There is a further concentration of rainfall within this period: April and May being the months of the chota barsat (little rains), brought by the infrequent and highly variable thunderstorms of the pre-monsoon season; June to October being the true months of the south-westerly summer monsoon. The monsoonal rains defy adequate
description; even statistics cannot impart a true sense of their intensity. Johnson, in his account of the country's climate, falls back on literary description:

All last night the wind howled like a stray dog, and the rain still pours on without a break. The water from the fields is rushing in numberless, purling streams to the river. The dripping ryots are crossing the river in the ferry-boat, some with their tokas on (conical hats of straw or of split bamboo), others with yam leaves held over their heads. Big cargo-boats are gliding along, the boatman sitting drenched at his helm, the crew straining at the tow-ropes through the rain. The birds remain gloomily confined to their nests, but the sons of man fare forth, for in spite of the weather the world's work must go on. (Tagore, 1893, in Johnson, 1982, p. 25)

Data supplied to me by MPO in 1986 give the mean annual precipitation as 2,320mm, with regional variations showing a range from 1,820 to 2,830mm. Locally, these variations are even more spectacular: from 1,100 to over 3,000mm. The amount of rainfall received increases eastwards across the country, with the highest figures being recorded in the north-east. Temporal variations are no less significant than spatial variations. There is significant variability not only in the amount of rainfall received at a given place from year to year, but also in the timing of the onset and cessation of the monsoon. Particularly unreliable are the chota barsat of the pre-monsoon season, varying from year to year in timing, amount and spatial distribution. The variability in precipitation parameters has obvious consequences for groundwater recharge, streamflow and flood depth.

Relative to rainfall, other climatic factors are of lesser importance, particularly as far as agriculture is concerned. Brammer

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(1971) and Johnson (1982) each provide a thorough description of Bangladesh's climate. The highest temperatures occur during the pre-monsoon season of March to May, the months of the chota barsat. High water vapour and cloud content during the monsoon months of June to September serve to keep temperatures rather lower than they would otherwise be. Temperatures remain high in October and early November, when the skies clear with the end of the monsoon, but continuing evaporation of floodwater keeps humidity levels high. Temperatures then show a slight yet significant fall for the 'winter' months from December until February, when they again begin to rise.

Three distinct seasons are generally demarcated on the basis of temperature and rainfall. The cool, dry season lasts from November to March; the hot, pre-monsoon season of the chota barsat for April and May; and the hot, wet, monsoon season from June to October. There can also be identified hydrological seasons broadly corresponding to the climatically defined seasons: a dry season where groundwater is the source of streamflow and crop moisture; a pre-monsoon season where groundwater is recharged and streamflow supplemented by some rainfall; and the monsoon season where the groundwater reservoir is filled and the water from excess rainfall and streamflow covers the land surface. The agricultural calendar can be better understood in reference to these hydrological seasons than to the climatic seasons per se, with the aus, aman and boro rice crops broadly coinciding with the pre-monsoon, monsoon and dry seasons respectively.

Certain important features of the hydrological calendar derive from
climatic conditions outside Bangladesh. The Ganges and the Brahmaputra begin to show a rise in water level without there necessarily having been any rainfall in or even near Bangladesh, as the spring snowmelt begins in their Himalayan headwaters. The shorter Meghna river reflects more closely (and more immediately) local rainfall conditions.

Measurements by MPO (1986) show that 813,000 million cubic metres of water flow into the country through the main rivers from June to September in an average year. Monsoonal rainfall within Bangladesh adds to this a further 115,000 million cubic metres of streamflow. This amount of water is far in excess of the bankfull capacity of the country's rivers, and water spills over the banks to submerge the surrounding countryside. As the period of high river flood levels coincides with the period of heavy monsoon rainfall, runoff is impeded, and water backs up over the floodplain land adjoining the rivers. With the combination of overspill, drainage congestion and heavy rainfall, Bangladesh for some months of every year becomes effectively an extension of the Bay of Bengal, with much of the country under water, and boats the only practical means of transport, except on the few embanked roads and railways.

Locally, flood depth is influenced by micro-scale variations in topography. Most of the country does indeed lie less than 20m above sea level; the highest part of the floodplain is a mere 90m above sea level; and the overall gradient is less than 0.2m/km (Khan, 1985). Yet with an agriculture dependent on flooding, and crop rotations
determined by flood regime, height differences of a metre or less can become all-important. Brammer (1971) provides an account of the typical floodplain topography of Bangladesh, its process of formation, and its influence on soil types and agriculture.

Processes of erosion and deposition by meandering rivers in shifting channels give rise to a landscape of curved ridges and saucer-shaped basins, together with abandoned portions of old river courses. The soil survey team directed by Brammer found that, contrary to commonly held belief, this landscape did not annually receive new alluvium over its entire surface. Fresh alluvial deposits were in fact restricted to narrow belts adjoining river channels; further away from the rivers, soils were found to have well-weathered topsoils, suggesting some age. These findings helped elucidate the processes of flooding that were operating: alluvial deposition occurring where flooding was by sediment-laden river water; soil formation processes continuing undisturbed by new accretions beneath the clear floodwaters of excess rainfall and drainage congestion.

That the extensive flooding is an annually recurrent, normal phenomenon means that the conventional definition of a flood is inapplicable in the Bangladeshi context. It is this very flooding which has physically created Bangladesh, and it is not an exceptional event but an essential part of the normal cycle of the seasons when the rivers overtop their banks and flood the surrounding land. The country's agriculture is adapted to and indeed dependent on the annual deluge of the monsoon rains and the associated flooding:
Man here is essentially a child of the rivers. His crops and farming practice are clearly adjusted to the timely inundations of red [silt-laden] water; and...if the rivers do not rise in flood, and submerge the country, he will be a fish out of water indeed. (Mukerjee, 1938, p. 28)

An analogy of the occurrence of flooding in Bangladesh is with snow in, say, Canada or Scandinavia: it is expected to occur in due season and in due quantity, and becomes noteworthy only when it either exceeds or fails to meet normal vertical (depth), horizontal (spatial coverage) or temporal (beginning, end, duration) limits. Just as the Eskimo has several words for snow, so does the Bangladeshi have different words to describe what to an outsider would be simply a 'flood': borsha describes the normal, annual flood which commences and recedes in due time and attains normal height; an abnormal flood is termed bona. Borsha describes flood as resource; bona, flood as hazard.

A number of different factors can define bona. A flood may occur during the proper time but exceed the upper limit, overtopping homestead land. Alternatively, a flood may attain no great depth, but be either too early or too late, and thus be just as damaging as the far deeper flood occurring within the normal flood season. A third category of bona would be a flood occurring in season and attaining no great height, yet rising at too fast a rate, or flowing with too great an intensity. Conversely, a hydrological flood can represent a drought in agricultural terms if it arrives too late, recedes too early, or remains below a critical lower depth limit.

In this unique and complex physical environment, there has evolved
over centuries of cultivation a unique and complex agricultural system. An understanding of that system is essential to an understanding of the aims and the impact of the embankment project.

3.3 Agriculture in Bangladesh

To appreciate the significance of climate and hydrology for agriculture in Bangladesh, one must look at how the different crop rotations grown across the country are adapted to local hydrological and climatic conditions. The description which follows is based chiefly on that of Johnson (1982), as well as on my own field observations.

The major rice crop in terms of both area under cultivation and production has traditionally been the aman rice crop of the monsoon season. A number of different varieties of aman have developed over the ages, through biological selection and adaptation; through deliberate selection and experimentation by Bangladeshi farmers; and, in recent decades, by scientific developments in agronomy (Brammer and Clay, 1987). The primary two-fold distinction is between broadcast and transplanted aman varieties. Traditional broadcast aman varieties include the remarkable long-stemmed, deepwater or 'floating' rice. This can grow at an average rate of 2.5cm or more in a day, sometimes as much as 30cm in 24 hours, producing a stalk up to 7m in length (Johnson, 1982). A farmer's decision to grow broadcast or transplanted aman in a particular field depends on a
combination of the timing of onset, rate of rise and final depth of the annual flood.

If pre- and early monsoon rains are sufficient to moisten the soil for ploughing and planting, yet floodwaters do not rise so early and so quickly as to drown newly-established seedlings, then transplanted aman can be grown. This is transplanted from earlier prepared seedbeds in May - June and harvested in October - December, depending on the variety. While it grows in standing water, transplanted aman does not have the ability to grow at the rate or to the height of the broadcast deepwater aman, and it is therefore grown on land where flood depths are not excessive (i.e. 1m or less). The 'improved' varieties of aman are particularly susceptible to flood damage. Excessive depth of flooding in the area of the country where the study project is located precludes the cultivation of transplanted aman.

On land subject to early or deep flooding, a farmer will instead cultivate broadcast aman. This is less demanding in terms of field preparation requirements, save that the plants must be well established before the onset of floods. The seeds are broadcast in April, and with good rain in the chota barsat and early monsoon, the plants can be ready to grow apace with the floodwaters' rise beginning in May - June. Different varieties have differing growth potential, with the true deepwater aman varieties giving lower yields than those varieties which show less spectacular growth. A farmer has to play off potential yield against flood risk in deciding which
varieties to plant. The broadcast aman is harvested along with the transplanted aman in October - December. Some land in Bangladesh (such as the local depressions known as hoars in the Sylhet District) experiences flooding too deep for even the deepwater varieties of rice, and can support only dry season crops.

The next most important traditional rice crop is the aus crop of the early monsoon season. This also has broadcast and transplanted varieties, both being sown in March - April and harvested, depending on variety, between June and August. Although requiring a good supply of moisture from rainfall, aus paddy does not require standing floodwater for growth as does the aman, being in fact intolerant of flooding beyond a critical depth (about 1m) and duration (Khan and Romm, 1978). High-yielding varieties and locally improved varieties of aus have been developed, the former being especially sensitive to excessive inundation. Owing to its particular hydrological requirements, aus is usually grown on higher land than aman, where flooding arrives comparatively later, giving the aus time to mature, and attains only shallow depth.

It is possible to follow an aus crop with a transplanted aman crop in the same field in certain cases, where the pre- and early monsoon rains are sufficient to water the aus, yet the floodwaters' rise is sufficiently late and slow to allow maturation of the aus and transplantation and establishment of the aman. A more usual practice is to broadcast aus and aman together in the same field in March - April. The aus is then harvested before the flood attains excessive
depth, and the aman is left to grow over the flood season, being harvested after the recession of floods in October - November. Although giving lower yields than would be the case with single cropping of either the aus or aman, this practice is an effective form of insurance against the failure of one of the crops. If early flooding swamps the aus, the aman may thrive; if late monsoon floods are either excessive or deficient for the aman, this may be compensated for by a good earlier harvest of aus.

Land suitable for the cultivation of aus is also suited to the cultivation of jute, which grows in the same early monsoon season as the aus rice crop, and has similar hydrological requirements. It requires good pre- and early monsoon rainfall, but prefers not to grow in standing water (yet being slightly more flood-tolerant than aus paddy). The cultivation of jute is often something of a gamble, as to environmental uncertainties are added the uncertainties of the market, jute being sold as a cash crop, and utilised in the manufacture of rope, sacking and matting.

In the post-monsoon period, the rate of flood drainage becomes a vital factor in agriculture. The ideal is to have soils which are quick-draining, yet retain sufficient moisture for crop growth. This latter characteristic is especially important in the absence of supplementary irrigation. Where these hydrological conditions are met, rabi season crops can be grown. Rabi crops are of great variety: wheat, oilseeds (notably mustard), pulses, vegetables and tobacco are the most important. They are sown after the floods have
A dry season boro rice crop is part of the traditional crop rotation, grown in marshy areas or near streams where it could be irrigated by traditional methods. Traditional varieties of boro rice are transplanted in December - January, before low-lying fields have completely dried out, and harvested in April - May, maturing early enough to avoid damage by all but the most early flooding. It is in boro rice cultivation that the 'green revolution' has had its most significant impact on Bangladesh's agriculture. The reason for this lies in the growth characteristics of the high-yielding hybrid varieties of seed: in order to produce high yields, hybrids have been bred with the specific intention of reducing vegetative growth in producing stalks and leaves, quite the opposite of the desired characteristics in the monsoon season rice crops. The high-yielding, dwarf varieties of boro rice can be grown only in the dry season, thus requiring artificial irrigation. Hence the emphasis in Bangladesh's agricultural development planning on the dissemination of irrigation technology. Even the high-yielding varieties of boro cannot escape the threat of floods: maturing later than the traditional boro varieties, they are particularly at risk from early
flooding during their maturation and harvest in May - June. The development of quick-maturing boro HYVs is a major thrust of Bangladeshi agronomy.

The particular hydrological requirements of the various crops grown in the country give rise to crop rotations corresponding to the local hydrological regime ('local' here can mean a difference even between adjacent fields). Broad regional patterns can also be observed, corresponding to regional topography and the associated flooding characteristics. In the deepest flooded areas, such as the low-lying hoars of the Sylhet Basin, water levels rise too early and too high for even the deepwater aman, precluding the cultivation of a monsoon season rice crop. Drainage is then too slow for the cultivation of dryland rabi crops, and a single boro crop, often a traditional variety, is all that can successfully be cultivated. In slightly less deeply flooded areas, a broadcast deepwater aman crop can also be grown, giving a boro - aman rotation. This was a common rotation in the project area before the construction of the embankment (Miah, 1983).

Where depth of flooding is less extreme, an aus crop can be grown together with a broadcast aman crop or, provided that the flood rises neither too early nor too rapidly, before a crop of transplanted aman. If, in addition, such land has suitable drainage and moisture retention capacity, a rabi crop can be introduced into the rotation. A broadcast aus/aman-rabi rotation was another common earlier practice in the project area and its environs (Miah, 1983). Land with
a shorter flood season, particularly where floods arrive late, cannot support two monsoon season rice crops. Such land is suitable for the cultivation of transplanted *aman*. Suitable drainage and moisture retention will allow the cultivation of a dryland *rabi* crop. Land with too shallow flooding cannot support the *aman* rice, and here an *aus* - *rabi* rotation might be found. As these examples show, the influence of hydrology on cropping patterns is not a matter simply of flood depth, but of the interaction of the depth, rate, and timing of onset and cessation of flooding. Where artificial irrigation can be applied to overcome natural limitations of water supply, a crop of HYV *boro* can be inserted into the rotation, displacing an *aus* or late *rabi* crop.

Add to this complex relationship between cropping pattern and hydrology the variability from year to year in the depth and duration of flooding, and it will be seen how difficult are the decisions facing a farmer in optimising his production through appropriate crop selection, and how vulnerable is the entire system to perturbations in the hydrological regime. The dependence of Bangladeshi agriculture on flooding can also be appreciated. This dependence makes total flood exclusion inappropriate, yet flood control all-important, posing a considerable engineering challenge. The object must be to contain flooding within the normal limits of depth, duration and spatial coverage or, where this is not feasible, to adapt the agricultural system to make maximum use of the flood as resource and to minimise risk. It can also be seen in the relationship between hydrology and agriculture how flooding imposes a
double constraint: abnormal flooding causes flood damage in real terms; normal flooding constrains farmers to a limited number of cropping options. Modification of the normal flood is therefore every bit as important as the control of abnormal flooding. Appropriate flood control measures include submersible embankments and embankments with inlet pipes. These delay the arrival of flooding, but then allow the flood to attain normal depth. The embankment in the study area is of the latter type, and is aimed more at modification of the normal borsha than at bona prevention, although it plays an important role in preventing damage from the early flooding characteristic of the project area.

This is not to say that the project is irrelevant in the context of extreme flood events, but that it is an inherent part of the ongoing rural development strategy rather than a disaster prevention measure per se. Its role is analogous with that of irrigation in a dry area. Just as an irrigation scheme might be an effective response to the inherent dryness of an area, but can be of no avail when the water source dries up altogether, so is the embankment studied here a response to the 'floodiness' of the area, without being able to prevent damage from the extreme flood event. Nevertheless, it is important to consider the role of such a minor flood control project within the larger context of the major flood events which periodically affect Bangladesh, particularly in the light of the recent (1988) devastating flooding in the country.
3.4 Floods in Bangladesh

To understand the significance of floods, and to obtain a true picture of their frequency of occurrence (when each successive flood event seems to be reported in the media as being the 'worst ever'), it is necessary to look at the historical record. The early record of flood events is surprisingly sparse, giving rise to the assertion that flooding has been becoming progressively more severe, although this apparent trend is no doubt attributable in part to improved record-keeping. Alamgir (1980) cites the Indian historian Majumdar in giving the year of the earliest recorded flood in Bengal as 1585. Walford (1878) provides descriptions of the Bengal floods of 1768, 1770 and, repeated here, of 1787-8:

...from the latter part of March to the latter half of July [the rains] had continued with such violence as almost to render cultivation impossible...early in September the waters were out again as wide as ever... About 1st October a tremendous storm of rain and wind swept all over the western districts of Bengal, which ended in a cyclone of unexampled extent, which seems to have swept across almost the whole of Bengal. (p. 461)

Alamgir (1980) gives 1814 as another year of severe flooding, and Ralph (1975) gives 1833-4 as the year of 'the next great flood' (p. 10). Between them, Alamgir and Ralph go on to list 1916, 1918, 1922, 1926, 1931, 1932 and 1938 as years of severe flooding. Both point to the increase in flood frequency beginning in the 1950s. Documenting floods preceding those of 1974, Alamgir gives 1954, 1955, 1956, 1962, 1963, 1968, 1969 and 1970 as years marked by exceptional flooding; Ralph adds 1966 to this list, but adds that 'Between 1960 and 1974,
various sources list different years as being those of abnormal flood... (and) almost every year is considered by some organization to be severe.' (p. 11). The floods and resultant famine of 1974 stand out as particularly severe, and exceptional flooding occurred again in 1978, 1984, 1987 and 1988.

The essential problem in identifying years of abnormal flooding is one of definition. Just as meteorological drought can be distinguished from agricultural drought, so in Bangladesh can hydrological flood and agricultural flood be distinguished, and what is an exceptional flood in hydrological terms does not necessarily cause the most economic damage. Different organisations, then, identify different years as being flood years, each defining a flood according to its own terms of reference. Problems of definition become irrelevant; however, when a flood occurs as in 1988. The 1988 floods would appear to surpass those of 1974 and 1955, the other major flood events of this century (well documented in Alamgir, 1980; Sen, 1982; Currey, 1981). It is interesting to compare the floods of 1955 with those of 1974, and these in turn with the 1988 flood, as their hydrological dissimilarities have important consequences for the type and extent of damage that was caused in each case.

In both 1955 and 1974, it was flooding of the Brahmaputra-Jamuna which was largely to blame, although high water levels in the other major rivers were a compounding factor. Currey (1981) provides this account:
The 1974 flooding of the Brahmaputra was more damaging than the famous flood of 1955. Although in 1974 the flood peak was 0.5 feet lower than in 1955...[the flood] was above the danger level for 44 days compared with 26 days in 1955; there were also six steeply rising flood peaks in 1974, not one slow rise as in 1955. (pp. 126-7)

The 1974 flood was more damaging, in agricultural terms, not because of greater flow, but because of its timing and duration. Successive flood peaks coincided with critical stages in the agricultural calendar: the first peak, in June, with the harvest of the boro crop and the growth of the aus; the next with the aus harvest; that of late July with aman seedling establishment; the next with the transplanting of the aman; and two further peaks with the growth and maturation of what little aman had managed to become established. In addition to damage to standing crops, the 1974 flood was characterised by particularly severe erosion of the Brahmaputra's right bank, and the deposition of infertile sand on its left. This meant that agricultural activities were disrupted long after the floods had receded.

The 1955 flood peak in late July - early August, while hydrologically of greater magnitude than any of the six 1974 flood peaks, caused less agricultural damage and thus had less of an impact on both food supply and labour demand. Boro and most aus crops were unaffected. Damage to recently transplanted aman and disruption to further transplantation meant a shortfall in aman production, but this led to intense suffering on only a local scale, and the food shortage did not reach famine proportions.
I have been able to piece together a picture of the 1988 floods from
the television and newspaper coverage of events; from reports in
letters from friends among the residents of my field area; and from
discussions with researchers who were in Bangladesh at the time,
particularly Paul Thompson of Middlesex Polytechnic. In areal
coverage, the floods of 1988 were at least on a par with the flood of
1955, exceeding the extent of the 1974 floods. They recall the
floods of 1788 (as described by Walford, 1878 and Ralph, 1975): boats
again plied the streets of Dhaka, and in the countryside people had
to shelter on boats, rafts, bamboo platforms (machans) and
embankments. In hydrographic profile, they resembled the floods of
1955 more than those of 1974, comprising a single flood peak after a
slow, steady rise rather than a number of successive peaks. Coming
in late August and early September, they were a full month later than
the 1955 flood peak, again more like the flood of 1788 (see Walford,
1878, above). Both transplanted and broadcast aman were destroyed,
but boro and aus crops had already been harvested. The flood's
recession came too late to replant any transplanted aman seedlings,
and so there was virtually no aman to be harvested. Stored rice from
the boro and aus crops was also damaged. Farmers planted rabi crops
immediately after the flood's recession, but these suffered damage
from a severe cyclone which hit the country in November. Food was
therefore scarce until the harvest of the boro crop in June 1989.

A massive international relief effort was immediately got under way,
with the British government alone promising over £7 million in
immediate emergency aid. Without this international assistance,
widespread famine would have been inevitable, with no region of the country escaping damage, and both food availability and labour demand having been affected. In 1788, some 60,000 people died as a result of the floods and consequent famine, and the resultant shortage of cultivators meant that some land which had been cleared for cultivation returned to jungle (Taylor, 1840). In 1974, the official death toll was 26,000, although unofficial estimates put the figure much higher (Sen, 1982). Only by the effective response of the international donor community, the government of Bangladesh, and the non-governmental agencies working in the country was disaster on a similar scale averted in 1988.

In claiming that the 1988 floods are the worst ever, and that the floods get worse every year, commentators are ignoring the historical record, as by all accounts the floods of 1788 were at least as bad; and, in their impact on agriculture, the floods of 1974 were just as severe. Such exaggerated claims also give rise to false assumptions about the causes of flooding. The simple facts of the country's geography are sufficient explanation: that it is a low-lying delta created by three of the world's major rivers; that these rivers drain vast catchments on either side of the world's highest mountain range; that the rainfall pattern is so markedly seasonal; that the rivers' catchment includes the area having the world's highest annual rainfall; that the period of highest rainfall coincides with the period of maximum snowmelt in the mountain headwater catchments; that the period of greatest river flow coincides with the period of heaviest local rainfall in the delta region. It is only the usual
time gap between the flood peaks in each of the rivers which in normal years keeps flooding at a manageable level, and it requires only a minor temporal variation for the flood peaks to coincide, with catastrophic results.

Prevailing popular perception is that deforestation in the Himalayas is entirely to blame for the recurrent flood disasters, by increasing the silt load of the rivers, and that afforestation will provide a solution. While deforestation might well be an exacerbating factor, the silting up of river channels is the very basis of delta formation, and even if fully forested the Himalayas would still be being eroded and the delta built up by sedimentation through natural processes of degradation and aggradation. The severity of the floods of 1788 bears testimony to the temporal scale of the environmental processes operating, and shows the futility of seeking explanations in recent and human-induced phenomena alone.

Is there, then, no potential for positive human intervention in the system? Quite the contrary; rather, human intervention should be at a realistic level. Technical and financial constraints along with the logistical difficulty of co-ordinating efforts over such a vast area will lead to the inevitable failure of over-optimistic attempts at flood prevention. While the floods themselves cannot feasibly be prevented, the worst effects of flooding can be guarded against. Effective protection against flood damage must incorporate both physical and socio-economic measures, and must be adapted to deal with flooding over a range of severity. Greater elevation of
homesteads and wider availability of boats would help to safeguard lives and protect possessions at the times of most severe flooding, these being traditional protection measures with which all Bangladesh's people are familiar but which not all can afford. In times of less severe flooding, small-scale local flood control projects can reduce the damage to crops. Any strengthening of the agricultural economy is bound to make the country more resilient to flood damage, or at least more able to recover from such damage. Here, too, small-scale flood control can play a role by locally altering the hydrological regime to improve cropping in years of normal flooding. Moving to irrigated boro cultivation reduces dependency on the monsoon season rice crops, thereby reducing the effective flood risk. Neither technically nor financially daunting, these simple measures are far more likely to yield positive results than the grandiose schemes of dams, barrages, embankments, canals and large-scale environmental engineering envisaged by some as an appropriate solution.

The embankment studied here represents the approach of one agency to the flood problem in Bangladesh. Local in scale and simple in technology, it was designed to strengthen the local economy and thereby to reduce vulnerability to the major floods whose prevention is beyond its design capability. It represents a planning philosophy which has but recently entered official planning policy; a policy of integrated rural development, incorporating all aspects of water resources development, and focused at the local level in the rural economy. An evaluation of the project is timely, as the group of
projects of which it is part are essentially pioneering this new approach to development in Bangladesh.
CHAPTER 4

FORMULATION OF FIELD METHODOLOGY

4.1 Scale considerations

A study of flood control in Bangladesh could have been at any scale ranging from the national, or even international, to the local, just as the flood control measures which have variously been proposed range from topographical restructuring of the whole country (Allinson in Faaland and Parkinson, 1976) to small, local embankments. In defining the parameters of scale within which one is going to work, enthusiasm has to be tempered with realism; research objectives have to be restricted to practical possibility without their being unduly compromised. While ultimately the scale of the research survey is controlled by the available resources of time, money and manpower, there is still considerable leeway within these constraints: research methods, especially sampling technique, can be selected and adapted so that a fixed allocation of these resources can be used in a variety of ways. That it was decided in this case to study the effects of a minor flood control project at the local scale was the outcome of a number of considerations both academic and pragmatic.

Resources of time, money and manpower were indeed constrained. The research was conducted by the author operating quite independently of any larger team or broader project, except for field assistants who conducted interviews and acted as interpreters. The research was funded by a University grant and private scholarship; there was no
financial backing or sponsorship from any government, international organisation, aid agency or company. While this independence had its advantages - there was no 'hidden agenda'; no pressure to conform in methods or findings to any pre-determined formula - the absence of financial or logistical backing effectively ruled out research over a large geographical area and a long period of time. A further limitation on the time available for fieldwork arose from the nature of any PhD: the pressure to produce a finished product within a limited number of years. Unforeseen hindrances had repeatedly delayed the commencement of fieldwork, and the short time remaining had to be used efficiently. This made a local focus appropriate if research methods were not to be forced into the unsatisfactory alternative of depending too heavily on secondary sources.

An alternative approach would have been to cover a larger geographical area - an entire administrative district, perhaps, a larger project, or a number of different projects - but to limit the number of respondents by adopting some means of sampling. A number of factors mitigated against this. The nature of flood control in Bangladesh, where projects are funded and administered by a large number of different governmental and non-governmental agencies, means that discrete pockets rather than contiguous areas are flood-protected. Project boundaries rarely coincide with, or even acknowledge, administrative boundaries, so that to assume an administrative unit as the study area was clearly inappropriate. Regional variation in the flood problem, as outlined earlier, means that flood control projects range in design function from minor flood
modification to total flood exclusion, making project-to-project comparisons fraught with potential pitfalls. To focus on a single project encompassing a discrete area, and to evaluate it on its own terms, seemed appropriate.

The scale of the research was effectively determined by its content and context, although a single project can cover an area of anything from a few hundreds to hundreds of thousands of acres. Clearly the largest projects could not have been adequately studied and evaluated by a single researcher operating with limited resources, and it would be practicable to study a small- or medium-sized scheme. The sheer logistics involved in travelling across rural Bangladesh, particularly during the flood season, were a further consideration in opting to work at the local scale.

To these practical considerations were added more academic and methodological criteria. One of the primary objectives of the research was to assess the differential impact of flood control through the various strata of the rural economy, the hypothesis being that certain of these strata were more vulnerable to the flood hazard and yet benefited less from flood control measures. It was therefore relevant to study a project that had been specifically targeted at what were held to be the most vulnerable socio-economic groups. Commonly, though not invariably, it is the smaller projects that are thus targeted; and it seemed that only in minor projects was any degree of local participation in project formulation and implementation ever actively encouraged. A paramount concern was
that the research should be relevant to current planning policy for the water sector, that the results might be of practical use to the Government of Bangladesh and to the various agencies involved in flood control. With the emphasis in official planning on minor projects, which are supposedly easier to implement and quicker to yield tangible benefits than the large-scale projects favoured by planners in earlier decades, an evaluation of a minor project was timely.

The chosen field methodology was an important factor in determining the scale of the exercise (although this was a two-way interaction, with the scale factor influencing the selection of the methodology). It was from the outset intended that the research should be conducted in a sensitive manner and in a spirit of co-operation with the chosen respondents, i.e. adopting some of the tactics of the anthropologists' 'participant observation'. Although the actual means of data collection was to be by structured questionnaire, it was hoped that by living with the respondents in their villages and taking an active interest in their daily lives, the researcher and field survey team would establish a rapport with the respondents which would facilitate the completion (and lessen the inevitable tedium to both interviewer and interviewee) of the interviews with household heads. It was thought that informal interaction might yield further insights to those which emerged from the formal questionnaire, as well as to improve the likelihood of accurate and honest responses by gaining the trust and confidence of the respondents. This strategy would have to be implemented over a small
area if it was to be fully effective.

The ultimate determinant of scale was the broad range of socio-economic activity over which flooding, and thus flood control, yields influence, from settlement pattern to crop rotation. For a single researcher to cover this range in any detail, a local focus was inevitable.

4.2 Means of data collection

Once a realistic scale had been determined, the next task was to decide the actual means of data collection to be adopted. The nature and context of the research obviously ruled out certain methods. The high rate of illiteracy among the respondents, and the language barrier between respondents and researcher, meant that the information would have to be elicited through intermediaries. This imposed certain constraints on field procedure. The most important consideration, however, was to select the data collection process that would best and most efficiently yield the particular data required.

As flooding impinges on every aspect of life in rural Bangladesh, the data required in order to evaluate the effects of flood control are correspondingly wide-ranging. The influences of flooding (and thus the effects of flood control) are often complex and indirect, and therefore not obvious to an outsider; other influences are so much part of the day-to-day existence of those affected that they do not
regard them as significant or noteworthy. To obtain an objective view, the investigation had to go beyond either the researcher's personal observations, or direct questions to the villagers on the effects of floods and the changes wrought by flood control. Both these methods would, however, yield valuable information, the latter particularly in assessing villagers' perceptions - all-important in understanding their conscious changes in economic behaviour in response to the perceived changes in their environment.

Any objective assessment of the changes effected by the flood control project would have to be based on more substantive evidence. A comparison would have to be made between the society and economy of a flood-protected area and those either (or both) of the same area before flood control had been introduced or (or and) of an otherwise comparable area without flood protection. (As it turned out, I was able to combine a 'with - without' with a 'before - after' comparison, owing to the availability of pre-project data for the area with flood control.) Data on a comprehensive range of subjects would have to be gathered in order to make the comparison valid and complete: social organisation; land tenure; cropping patterns and agricultural practices; agricultural production; labour and employment; and the household economy.

Apart from deciding what data were to be collected, it was also necessary to determine from whom these data could be obtained. As is typical of peasant societies, the household is the basic unit of both social and economic organisation in rural Bangladesh. In the words of
That the household is the primary unit of rural society and economy had two important implications for the conduct of the research. Firstly, it meant that a survey aimed at the household level would be appropriate: households would form the sample units, and the heads of households would be the respondents (the head being the senior male member of the household). Secondly, the importance of the household as the primary functional unit meant that it was in itself worthy of study and analysis: household size, age and sex composition, kinship ties, and the spatial expression of the household in the bari (homestead) would all be investigated to see whether the implications of flood control extended to this level.

The selection of the household as the unit on which the investigation was to be based still left open a number of options as to the actual means of data collection. The data to be collected ranged from straightforward factual information (household size; landholding size) to attitudinal information (opinion on the benefits of flood control). With the wide range of subjects to be covered and the importance of consistency to enable a comparison to be made between protected and unprotected villages, a structured questionnaire was selected as the most appropriate means of data collection.
Certain alternatives to the structured questionnaire were considered. One option was to adopt participant observation as the primary source of data, living with the villagers and participating in their social and economic activities in order to obtain an understanding of those activities. This was judged to be impracticable on two fundamental points. Firstly, a female researcher would have found it well nigh impossible to participate in agriculture in a society where women's activities are essentially restricted to the homestead and its immediate environs. As changes in agricultural practices and production formed the very premise of the research, this effectively ruled out participant observation as a feasible option. The second major drawback to participant observation was the length of time it would have taken if it were to be properly executed. With the research being based on a comparative analysis, it would have been necessary to spend at least one full agricultural year in each of two villages, one protected and one unprotected from flooding. All the practical difficulties of entering into true social and economic participation would have been duplicated, and the inevitable degree of personal involvement would have made any objectivity in the final comparison impossible. Participant observation as a technique would have been inefficient, being highly demanding in terms of time and of the researcher's resilience and powers of observation. By definition, it would yield results which would be subjective and largely descriptive. While it was ruled out as a suitable basis for the research, certain of the tenets of participant observation were adhered to in the researcher's
conduct in the field: learning some of the language; adopting local
dress and eating habits; living with a local family.

Another technique, or rather set of techniques, that was considered
was the 'rapid rural appraisal' advocated by, inter alia, Robert
Chambers (1980) of the Institute of Development Studies at Sussex
University. Critical of what he calls the 'quick-and-dirty' method of
'rural development tourism' as well as the 'long-and-dirty' exercises
in paper generation practised by many development professionals,
Chambers proposes an approach that is
'fairly-quick-and-fairly-clean', where multiple methods are adopted
in order to maximise the efficiency of the data collection process.
Among the many techniques suggested by Chambers, those that could
have been employed instead of the questionnaire survey adopted here
included using direct personal observation; identifying and talking
to key informants; holding group interviews; and using guided
interviews instead of a formal questionnaire. While rapid rural
appraisal has an important role to play in certain situations, it was
rejected as a suitable primary means of data collection in this
case. Again a primary drawback was its unsuitability for the purposes
of a comparative analysis, with the lack of structure and rigidity
inherent in such a rapid appraisal making a direct comparison between
two villages a tricky exercise. Certain of Chambers's
recommendations with regard to conducting effective development
research would, however, be adopted - particularly his advice to
listen and learn; to offset the biases of much development research
(which sees only 'the prosperity after harvest of a male farmer on a
project beside a main road close to the capital city); to be aware of and learn about indigenous technical knowledge; and to try and adopt an unimportant attitude. These suggestions were particularly relevant to the informal conversations the researcher was able to have with the respondents during social intercourse outside the formal interviews.

The formal, structured questionnaire was ultimately selected as the most appropriate and efficient means of data collection, the advantages of consistent format and rigid structure far outweighing the many difficulties involved in designing a questionnaire and conducting a questionnaire survey. With the questions to be asked being explicitly stated, the potential for misunderstanding and ambiguity was reduced, and the danger of the omission of important questions, as might arise if using just a generalised question checklist, was eliminated. The rigid structure facilitated the ultimate data analysis, enabling a direct comparison to be drawn between protected and unprotected situations, and an evaluation thus to be made of the impact of the flood control project. A formal questionnaire also set realistic limits to the potentially enormous number of questions on floods and flood control which might have been asked of a Bangladeshi farmer in an informal interview.

The identification of the formal questionnaire survey as the data collection method, and of the household as the sample unit for the survey, still left the task of defining the household in precise terms, so that interviewers could identify households in the field in
a consistent manner. Casley and Lury (1981) discuss the difficulties of definition in household surveys across different socio-economic contexts, a definition of a household appropriate for use in one society not necessarily being directly transferable to another. Three main features are, however, generally considered definitive in deciding what constitutes a household: a common source of the major part of income; sleeping under one roof or within a single compound; and a common source of food. The definition adopted for use in this survey was that successfully employed by Alamgir (1980) in his work on famine in Bangladesh: 'members who ate from the same kitchen and operated productive assets as a single unit' (p. 102). As discussed in the earlier section on Bangladeshi society, a household as thus defined does not always occupy a distinct, separate bari, but may share a bari with related households. In some instances, however, a single bari does constitute a single household comprising members of a patrilineal extended family. Deciding on a workable definition of a household before embarking on the field survey was therefore important if confusion and inconsistency were to be avoided.

4.3 The mode of comparison

Another issue to be resolved before embarking on the fieldwork was to decide exactly how the effects of the flood control project on the local society and economy were to be assessed. What was to provide the basis for the comparison that would have to be made in order to evaluate the impact of the project?
Both the 'before - after' and the 'with - without' modes of comparison have their associated problems. A 'before - after' evaluation requires there to have been a detailed baseline survey prior to the project's implementation, ideally using the same questionnaire as the post-project survey. Many flood control projects in Bangladesh are implemented without there having been any comprehensive socio-economic survey beforehand, being based purely on physical criteria. Even in cases where a suitable baseline survey was conducted, as in the project studied here, there are often unintended effects of a project, and these, being unforeseen, are not included as matters for enquiry in the pre-project survey. An additional weakness of a 'before - after' comparison is that it is not always possible to distinguish between changes effected by the project and the inevitable changes over time resulting from other, wholly unrelated, factors.

A 'with - without' project evaluation is also fraught with difficulties. The main difficulty is the identification of an area outside the project on which to base the comparison. The without-project area has to be identified as having been socially, economically and environmentally similar to the project area as it was prior to the project's implementation. As it is impossible to control for the effectively infinite number of variables involved, or to obtain all the data on which to base any assessment of comparability, the ultimate selection of a without-project area has to be based in most cases on informed guesswork. A further
complication lies in the fact that comparability with the project area almost invariably entails proximity to the project area, and the very existence of the project may have led to changes in adjacent territory. These peripheral effects of a project may be either positive or negative - the spread of improved agricultural techniques a possible positive effect; exacerbated riverbank erosion a negative effect. Glaring instances of such project-induced changes would obviously rule out the affected areas as suitable for selection, but the effects are often difficult to detect.

The project evaluation method in this study was initially planned as being based on comparing with- and without-project situations. I discovered, however, that the agency responsible for the project selected for evaluation had conducted a fairly comprehensive baseline survey. This was, in fact, a major factor in the decision to study the particular project. The availability of pre-project data meant that the comparison could combine the 'with - without' and 'before - after' project approaches, thus being more likely to yield a valid evaluation of the project. The core of the research remained the 'with - without' project comparison, but this could then be checked against the 'before - after' comparison to either reinforce or refute the conclusions drawn.

The choice of which households were to be interviewed was based not on any formal sampling technique, but on the identification of two appropriate case study villages, one in the project area and one outside it. The decision to carry out the survey in this manner was
based on a number of considerations. Such village-based studies are common in development research, and indeed in other types of research in the Third World — many anthropological studies, for example, being based on in-depth investigations into single village communities.

To some extent, the broad scope of the enquiry made the adoption of a case study approach inevitable. To establish the necessary rapport with the respondents to conduct effectively such an in-depth survey demanded that the researcher and field assistants be accepted by the local (village) community. It was enough of a problem that two separate villages would have to be studied, and thus that the delicate process of establishing mutual trust and respect between researcher and respondents would have to be repeated; to hope to extend this process over a wider area was simply unrealistic. Another factor influencing the decision to opt for a case study approach was the unavailability of any appropriate data on which any formal sampling might have been based. In the absence of such data, to select two single villages for comparison seemed as valid a sampling method as any.

A further difficulty with using formal sampling would have been the delineation of the without-project area with which the project area was to be compared. The project area itself could be readily physically defined as the area protected by the embankment, but any delineation of an equivalent area outside the project would have had to be done by fairly arbitrary means. The comparison of two carefully selected villages would mean that the units of analysis

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were comparable in terms of both socio-economic and physical delimitation.

The final determining factor was the nature of the baseline survey that had been conducted by the project agency, and which was to form the basis of the 'before - after' comparison. This had covered two villages in the project area, and not the project area as a whole. For the purposes of comparison, then, it was appropriate to study one of these villages, as this meant automatic control for a whole range of factors, an otherwise impossible task.

All households within each case study village were interviewed in order to avoid any further biases or omissions in the data. There remained the risk inherent in any case study that the villages selected would not be truly representative of the areas they were supposedly representing, yet it was felt that this risk was far outweighed by methodological and practical advantages.

4.4 Formulation of the questionnaire

A copy of the questionnaire can be found in Appendix 1. The numbering in the text refers to the numbering on the questionnaire.

The formulation of a suitable questionnaire was a difficult task, the effects of floods (and thus the impact of flood control) pervading every aspect of life in the Bangladeshi countryside. A fundamental principle in questionnaire design is to minimise the number of
questions to be asked, yet any investigation of the complex system of relationships between environmental and socio-economic factors involved in flooding in Bangladesh would require that each respondent be asked a great number of questions, on matters ranging from his rice harvests and land ownership to recall of flood events of his childhood. A lengthy questionnaire was unavoidable if potentially important relationships were not to be overlooked. This made it all the more important that the researcher and interviewers should gain the trust of the respondents before placing demands on their time and patience.

The questionnaire consists of two separate parts. The first part is much like any socio-economic survey of a rural area in a developing country, asking for personal details of the respondent and his household before going on to enquire about land ownership and agricultural practices; labour and employment; and the material household. The second part of the questionnaire enquires directly about flooding and its effects; local responses to flooding; and the perceived results of the flood control project. Both parts of the questionnaire were devised with the intention of later making a comparison between the responses from a village with flood protection and those from one without. Other considerations borne in mind when drawing up the questionnaire were that the questions should be expressed in straightforward terms which could be easily understood by the respondents, and in a style which would be directly and easily translatable by the interpreter-interviewers.
The first part of the questionnaire, the socio-economic survey, is divided into six sections. Section 1 asks about the respondent's personal details, along with some details of the members of his household. Question 1.1 asks the respondent's name, 1.2 his age, and 1.3 and 1.4 his religion and caste respectively. The names were used to identify each household, and could be checked against administrative lists held by mouza officials, thus ensuring complete survey coverage. It was important to know the respondent's approximate age when considering his recall of earlier severe floods, which respondents often dated by their relative age or size at the time. A comparison of the age structure of the two villages might also, it was thought, yield insight into certain socio-economic processes. A respondent's religion, too, has important socio-economic implications, with Hindus occupying a particular socio-economic niche in this predominantly Muslim society.

A respondent's occupations are asked in questions 1.5 and 1.6, dual occupations being common (e.g. farmer and agricultural labourer). It was considered likely that different occupational groups would have differing perceptions of flooding, being affected in different, perhaps even opposite, ways - a flood beneficial to fishermen might be harmful to farmers. That being so, flood control would be perceived differently, and this made it important to obtain accurate and complete data on the occupational structure of the two villages. The comparison between the two villages in terms of their occupational structure also yielded further insight into the economic status and functioning of each.
Question 1.7 asks the respondent's educational status, whether primary, secondary or tertiary. Again, this was done for its broader socio-economic implications.

The questions included on the household members ask their sex, age, relation to the head of the household and level of education. The number of household members was not asked directly, but was obtained simply by summating the individuals, the recall of the respondent being more likely to be accurate if prompted by inquiry about individuals, particularly if the household size were large. The composition of the household warranted attention because of the importance of the household as the primary unit of the rural society and economy.

Section 2 of the questionnaire enquires about land, including tenurial arrangements and land quality. This information was central to the whole investigation, as it is access to land which is the very basis of the rural system, determining a Bangladeshi's ranking in the social and economic hierarchy of his village. Ten questions were devised to elicit the required data on land tenure, and the answers were recorded in tabular form (see pages 3 and 4 of the questionnaire). Respondents were asked the names and sizes of all the fields that they either owned or rented. Field names often gave valuable additional information: the name of the landlord or a previous owner (e.g. Alirkhet means 'Ali's field'); the location of a field relative to the owner's bari (north, south, east or west; near or far) or to natural features (e.g. Gangerpar khet means 'riverbank
field'). The field name was also useful in referring back to specific fields in the later sections on land quality and agriculture, and for cross-checking if field size data were found to be suspect.

Further questions in this section enquire whether a respondent rents out any of those fields which he owns and, of both fields rented in and fields let out, the terms of the rental agreements. From these data, the relative importance of fixed rental, where the tenant pays a fixed amount of money or produce to the owner for a specific time period, and sharecropping, where the tenant pays a specified proportion of the crop to the land's owner, could be assessed. One question of particular importance in view of the changed circumstances brought about by the flood control project was that on recent sales and purchases of land. This revealed any tendencies towards land ownership polarisation, with the comparison between the two villages revealing significant differences. Landless respondents were asked whether they had ever held rights to any land, and why these rights had been relinquished. A common response to want or distress in Bangladesh is to mortgage land, so the final question of the section on land tenure asks about land mortgaging.

The latter part of section 2 is concerned with land quality. For each of the fields owned or rented in by a respondent, it was important to know certain of its physical characteristics. Question 2.11 asks which fields are embankment-protected, as certain farmers in the village with flood protection owned fields outside the
A question about each field's general suitability for agriculture follows, with an instruction to the interviewer to include the local terminology in order to avoid losing any subtle distinctions in translation. More detailed characteristics are then enquired into: the relative height of the land (obviously important in determining flood depth and thus suitability for certain crops); whether a field could support one, two or three crops in an agricultural year; the land's fertility; and drainage characteristics (again with important implications for flood depth and duration).

In section 3 the questionnaire turns to agriculture. Question 3.1 asks the crop type and variety grown on each of a farmer's fields in each of the agricultural seasons. For each crop/field/season combination thus listed, a series of questions then enquires about the following: average crop yield; the application of artificial and organic fertilisers; the use of pesticides and herbicides; and the application of artificial irrigation. Much of the ultimate evaluation of the project rested on the comparison of these agricultural data for the two villages, as it is on its impact on the agricultural system that any flood control project in Bangladesh should be judged. A particular focus of interest was the extent of cultivation of high-yielding varieties of rice, which are grown in the boro season (the dry months of winter and spring) under irrigation, yet are still at risk from early flooding at the time of their harvest.

Aspects of work and employment are investigated in section 4. The
first question in this section asks a respondent to list his activities month by month over a typical year. With agriculture so dominating the local economy, the seasonal pattern of activity is essentially dictated by the agricultural calendar, but there were important differences between the two villages in the exact timing of the sowing and harvesting of certain crops. The activities of household members were included here. It was of interest to see the activities engaged in during lulls in agricultural activity, such as when the floodwaters preclude any work in the fields. It was also interesting to compare the activity calendars of different occupational groups. Any changes that had been effected by the introduction of flood control were the primary focus of attention.

The next part of this section enquires into employment, asking of each respondent whether he or any member of his household is in anyone's employ, and whether he himself employs any labourers. Questions on the terms of employment were put to both employers and employees (some respondents falling into both categories) — whether the contract is on a permanent, seasonal, or daily basis; whether payment is in cash or kind; the amount paid; whether an employer provides meals to his labourers. Employers were asked whether they experienced any seasonal shortages of labour; labourers whether they experienced seasonal difficulty in finding work. With changes to the cropping pattern, and thus to the seasonal activity pattern, come changes in the seasonal and overall demand for labour. Such changes were of particular interest, as the evaluation was particularly concerned with the distribution of the project's impact through the
socio-economic hierarchy; and increased overall demand for labour would mean an improvement in the lot of the poorest groups, who depend on agricultural labour for their living.

Section 5 asks about the household economy, with special emphasis on the food economy. Respondents were asked how they met their household food requirements - through their own production; by cash purchases; from payment in kind; or by exchange with fellow villagers. The influence of the embankment on household food self-sufficiency was of particular concern. Details of food purchases were asked: the type of food purchased, whether staple (e.g. rice) or non-staple (e.g. meat); the amount of food purchased; where purchased; and the cost of food purchases. Similar questions were asked on the sale of agricultural produce: what was sold; where it was sold; and how much was earned from these sales. To complete this rudimentary picture of the household budget, further questions in this section ask about the sale of any other goods or services; the amount of produce given in rental and labour payments; and any sources of assistance in the form of donations or loan of money or food.

When obtained directly from a respondent, data on earnings and expenditure are notoriously unreliable, with the respondent's faulty recall and possible reluctance to divulge income, owing to his suspicion about the researcher's motives, leading to all manner of inaccuracies and inconsistencies. There being no alternative source or more feasible means of collection of these data, it was decided
that a further section should be included in the questionnaire in order to provide, through a household's possessions, some index of its economic status. This forms the sixth and final section of the first part of the questionnaire. A number of household possessions is listed, ranging from basic essentials such as clothes and cooking pots to luxury items such as the ornate sari and jewellery which are typically found in the wealthiest households. The material household was taken to include the ownership of animals, agricultural implements and stored agricultural inputs of seed and fertiliser, as the household as economically functioning unit is one and the same as the social household unit. Other items on the list include furniture such as beds, chairs and tables (even these being luxuries in a rural household in Bangladesh); means of transportation such as the bicycle and the boat (the latter being all-important in this environment); and that much-prized consumer durable, the radio. Here too are households asked about the size and construction materials of their houses, further significant indices of economic status. Somewhat incongruously tacked on the end, but following logically after the questions on the ownership of plough and draught animals, is a question asking whether a respondent hires a plough and/or draught animals to plough his fields, with the ownership of both being restricted to just a few farmers. With this question, the first part of the questionnaire, that dealing with the basic socio-economic functioning of each village, comes to an end.

The second part of the questionnaire concerns itself directly with villagers' perceptions of and responses to flooding and flood
control. The first section considers the physical nature of floods and the respondents' past experiences of severe flooding. For the purposes of this research, floods were divided into the categories of 'normal' and 'abnormal', as in fact they are by rural Bangladeshis themselves (see discussion in chapter 3). For the normal flood, borsha, and the abnormal flood, bona, respondents were asked the frequency of occurrence, area of local inundation, depth of inundation, and flood duration. The number of times a respondent's bari had been flooded was asked, as each bari is sited on naturally high or artificially raised ground with the intention of avoiding flooding, and any inundation of the bari therefore represents a flood of depth greater than that normally expected.

Further questions in this section ask respondents to recall the most severe flood of their experience, and to relate any second-hand knowledge they might have of other severe floods, gained perhaps from tales related by older villagers. Flood warning being an important part of any effective flood protection strategy, respondents were asked whether they ever received warnings from any source before the arrival of severe flooding. They were also asked whether they themselves were able to predict flood severity by any means. The final question in this first section asks respondents to rank floods relative to the other two most common sources of agricultural damage, drought and pest attack.

The next section enquires into flood damage. Five categories of damage are considered: to the homestead and household possessions; to
crops; to agricultural activity and other labour; to agricultural inputs; and to the fields themselves. Again, a distinction was drawn between *borsha* and *bonna* when asking a respondent to give the type of damage suffered by himself and his household in each damage category.

In the third section of this second part of the questionnaire, the response and protective measures adopted by respondents are investigated. Respondents were asked not only how they currently protected their fields, homes and household members from flood damage, but also whether the protective measures they would adopt today differed in any way from those they had adopted in the past. Of particular concern was whether households in the protected village had come to rely entirely on the embankment to save them from harm.

For each of the types of damage listed in the previous section, respondents were asked to describe the steps they would take to recover from the damage, and whether there had been any change in the ways in which they react to and recover from flood damage.

The questionnaire goes on to ask about any contributions to or receipts from any mutual assistance within the village community after a flood, as well as any relief provided by the government or other external agency. External assistance is further investigated with questions on the nature of flood relief, its appropriateness to local needs, and changes over time in the type and amount of relief received. The remainder of this section demands that a respondent exercise his imagination to contemplate certain damage scenarios.
First, he is asked to describe the likely effect on himself and his household in the situation of a recurrence of a flood such as the worst he has ever experienced. Particularly, might such a flood mean that he would be forced out of his present occupation, and perhaps even out of the village, in order to survive? The final question in this section asks whether a respondent can imagine a worst-case scenario of a flood so bad that it would force him to take the drastic survival measures mentioned in the previous question.

Only in the very last section of the questionnaire are there any questions on the flood control project per se. Obviously, most of these questions applied only to the villagers in the protected area. Respondents in the unprotected village were asked only whether they would be in favour of such a project in their own area; whether any such project had ever been mooted; and what they perceived as the likely effects of such a project. In the flood-protected village, respondents were asked a series of questions on the construction of the embankment and its effect on their lives. Respondents were asked if they considered the embankment to provide adequate protection against flooding, and whether it had yet been breached. As a stated intention of the project agency was to involve the local beneficiaries in all stages of the project, respondents were asked whether they had been informed or consulted about the project during its planning. Always a contentious issue in such projects is the acquisition of land for the construction of the project, and so a question was included to ascertain the extent of land loss and the compensation granted to farmers who had lost land. Further questions
investigate possible negative effects of the project, both to farmers and to people who earn their livelihood through other occupations. Finally, respondents in the with-project village were asked for their general remarks on the embankment's impact and effectiveness.

This extensive questionnaire, designed to give as comprehensive an account as was feasible, was bound to test the patience of both interviewer and interviewee. Yet it was felt that any further paring of the questionnaire would have produced major gaps in the enquiry. The questionnaire as it finally appeared had, in fact, already been streamlined from earlier versions by eliminating certain superfluous questions; replacing long, involved questions with shorter, simpler questions; and replacing multiple questions with single questions which yielded effectively the same information. The questionnaire was tested both in mock 'field' situations enacted by researcher and supervisor (the latter proving particularly adept at playing the role of a Bangladeshi peasant), and in a real field situation. At each stage, modifications were made in an attempt to facilitate and improve the data collection process. The practical implementation of this process in the field forms the subject of the next chapter.
CHAPTER 5

THE CONDUCT OF FIELDWORK

5.1 Project selection

The first step in the selection of a project suitable as the subject of the proposed research was to investigate the various agencies involved in funding and implementing water sector projects in Bangladesh. This yielded information on the types of projects that were in existence, how they were funded and implemented, and where they were located. The Master Plan Organisation held records on the various agencies involved in the water sector. These were found to cover a wide range: large international organisations, such as the United Nations Development Program (UNDP); the national development agencies of countries in Europe, North America, and the Arab world; and non-governmental organisations (NGOs), themselves of a range of size, type and philosophy. In theory, their efforts are co-ordinated through the Bangladesh Water Development Board, but in practice each agency forms its own policy objectives and project planning criteria within the generalised framework of national planning policy.

A group of projects which appeared well suited to the research objectives in terms of scale and planning philosophy were the so-called 'Early Implementation Projects' or 'EIPs', funded jointly by the Netherlands Technical Assistance Programme and the Swedish International Development Authority. The EIPs came about as the result of a 1974 agreement between the governments of Bangladesh and
the Netherlands, calling for the early implementation of small-scale flood control, drainage, and irrigation projects to meet the demand for urgency in the First Five Year Plan. Initially, projects were justified in terms of the anticipated cost-benefit ratio, and were selected on their technical feasibility. There was no specific reference to social development objectives, nor to the integration of the schemes with more comprehensive rural development. When early project evaluations showed negligible impact on local employment and wage rates, and even adverse effects on certain groups, project selection criteria were reassessed. With the Swedish International Development Authority coming in as joint funders in 1980, the EIP objectives were restated thus:

- To increase agricultural production, as well as direct and indirect employment, through small-scale, labour-intensive water sector schemes, thus contributing to an improvement in the standard of living with special emphasis on the target group, who are identified as landless labourers and marginal farmers.

- To promote planning, implementation, follow-up and maintenance procedures to achieve technically sound, economically feasible and socially beneficial water sector projects. (EIP, 1984, p. 11)

To meet these objectives, the aid money now covers technical consultancy costs and pre-project socio-economic feasibility studies, as well as post-implementation evaluations. Being aware that benefits are likely to be unevenly distributed because of the skewed distribution of land ownership, EIP avoid areas where the land ownership pattern is grossly inequitable. People's participation is
encouraged at all stages of a project's planning, implementation, operation and maintenance, with EIP co-operating with local NGOs for the organisation and education of the target group.

EIP schemes can be found in virtually every district of the country, being of a variety of types in response to the widely varying local conditions (fig. 4). In coastal districts such as Khulna and Pathuakhali, EIP are involved in polder construction to deal with the particular problem of coastal flooding; in the low-lying areas of Sylhet district, there are EIP schemes to improve drainage from the basins known locally as hoars; in other inland districts, EIP have built closure dams and embankments to control flooding, and re-excavated khals to improve local drainage. With their wide geographical coverage, range of project types, manageable scale and planning philosophy of group targeting, the EIP schemes met all the demands of the research objectives.

EIP staff at their headquarters in Dhaka were enthusiastic at the idea of an outside evaluation of one of their projects (an enthusiasm not shared by all other agencies), and were prepared to allow a wholly independent evaluation without specifying any demands of their own. At the same time, they were willing to provide data from their baseline surveys, where these had been carried out, as well as from their technical reports and project evaluation studies. On the basis of these reports, particularly those of Akbar (1981) and Uddin and Khan (1984), one project was chosen as being best suited to the research: the Pathakhali-Konai embankment scheme in the upazila of
Fig. 4 Distribution of Early Implementation Projects in Bangladesh
A consideration in choosing to work on the Pathakhali-Konai project was its accessibility from the capital, Dhaka, where I was based when not in the field. The EIP offices were located in the capital, as were all the necessary resources such as libraries, photocopying facilities, and the hydrological data base held by MPO. It would be necessary to return to Dhaka from time to time during the fieldwork to bring back completed questionnaires and pick up new batches of questionnaires, as well as to consult EIP and MPO about any technical queries that arose in the field. A respite from fieldwork was also found to be essential in maintaining the efficiency and morale of both researcher and field assistants. While accessibility was important, it would have been undesirable for the project area to be too close to a major urban centre, with all the distortions this would have introduced into the local economy. Although less than eighty kilometres from Dhaka as the crow flies, to reach the project area entailed a three to four hour bus journey, followed by a short walk and a ferry crossing. This effective distance meant that the area was far enough removed to remain essentially rural in socio-economic terms, yet not so distant as to make return visits to Dhaka inconvenient. Chambers (1983) criticises the urban, tarmac and roadside biases of much rural development research; the selection of the Pathakhali-Konai project was an attempt at overcoming some of these biases, yet without choosing an area too remote.

Another factor in the choice of project was the age of the project.
It was obviously necessary to study a project which had had sufficient time to make its effects felt, and having been completed in early 1983 and withstood four flood seasons, including the severe flooding of 1984, the Pathakhali-Konai embankment met this criterion. With a project of longer standing, problems would have arisen with regard to respondents' recall, and it would also have been more difficult to ascertain the pre-project conditions, necessary for the selection of a comparable without-project village. Pathakhali-Konai was one of the earliest EIP projects to have been fully planned and implemented under joint Swedish-Dutch funding and the changed planning philosophy that this brought about, and this too contributed to its selection for evaluation.

A recent addition to the scope of EIP's work had been the introduction of a 'Rehabilitation, Operation and Maintenance' (ROM) phase to their projects. Seeing the danger of project structures falling into disrepair without the involvement of the local community in project upkeep, EIP has set up links with social development organisations such as co-operative movements and missionary groups, so that through such organisations the target group in project areas might be educated and organised so as to gain greater benefit from the projects. Through the active NGO Proshika, EIP was using Pathakhali-Konai as one of its trial ROM schemes. This made an evaluation all the more timely and appropriate, as Proshika had just submitted a feasibility study of proposed follow-up operations in the project area.
It was also considered important that the project selected for evaluation should not be a special case, representing a response to an exceptional set of physical conditions, but that it should be in an area representative of as wide an area of the country, and as large a segment of the rural population, as possible. The soils and hydrology of the area in which the Pathakhali-Konai project is located are described in detail in a later section; they create an agricultural environment typical of much of Bangladesh, where young alluvial soils which are moderately to deeply flooded can be double- or triple-cropped. Interesting though it may have been to study a project in an environment of more unusual characteristics, such as the hoars of Sylhet where flooding is so deep and drainage so poor that cultivation can be altogether precluded, the findings of the evaluation would then not have been replicable, and the relevance of the research to future planning policy would have been limited. No project can be described as 'typical', each being planned and designed in response to a particular set of local conditions including socio-economic as well as physical factors. But if any local environment can be considered 'typical' of Bangladesh, it is the active floodplains of the major rivers, which bear the highest densities of both population and cropping. On such land, too, are the greatest potential benefits from flood control.

Over-riding almost all the aforementioned considerations, however, was the existence for the Pathakhali-Konai project of pre-project data, EIP having commissioned a baseline survey of the local society and economy (Miah, 1983). This covered almost all of the topics to be
investigated - demographic structure, household composition, literacy and education, occupations, access to land, land sales and purchases, the agricultural calendar, adoption of new agricultural technology, employment, income and expenditure, house types, plough ownership - as well as some beyond the scope of this study but nonetheless of interest, such as disease and mortality. On no other project was such a comprehensive data base available, and with the opportunity this presented for combining a 'before - after' and a 'with - without' comparison, the choice of project was made.

5.2 Project history

The Pathakhali-Konai embankment scheme is located in Tangail district, some forty kilometres south-east of the district headquarters (Tangail), and just north of Mirzapur, headquarters of the upazila bearing the same name. The project consists of an earthen embankment along the left bank of the Bangshi river, which here flows north-south along the western edge of the Madhupur hill tracts before swinging eastward. The embankment extends for nine kilometres from Tarafpur in the north to Trimohan in the south (fig. 5).

Before the construction of the embankment, floodwater would enter the area through an offshoot of the Bangshi known as Pathakhali khal which, as Konai nadi, rejoins the main stream further along its course. Bank overspill from the Bangshi itself, as well as runoff
Fig. 5 Map showing project structures and enclosed area
from the neighbouring Madhupur hill tracts, also contributed to the local flooding. The area was characterised by rapid inundation of high flow velocity (EIP/BWDB, 1985). Early flooding was a common occurrence, and extensive deposits of infertile sand were often left when floods retreated. Flooding might cause damage to standing crops of boro rice, to aus rice and jute, and to broadcast and transplanted aman rice crops, depending on the timing and depth of inundation. In addition, the sand deposits were detrimental to the area's overall fertility, rendering some land quite useless for agriculture.

As early as 1977, EIP had identified this as a suitable project area. Local farmers had in fact approached BWDB at their own initiative to suggest the construction of an embankment. In 1979, the western end of Pathakhali khal was closed by a low earthen dam, but this did not withstand the 1980 flood season. The raising of the dam and its extension into a full-scale embankment was proposed in 1981, approved that same year, and executed in the dry season of 1982-3 (EIP/BWDB, 1985). As is the standard procedure with all EIP projects, the actual construction of the embankment was organised and supervised by local BWDB staff, using local labour.

Since the completion of the EIP embankment, a three-kilometre extension has been constructed under a World Food Programme (WFP) food-for-work project, completed in the 1985-6 dry season. I noticed while in the field that this extension was already in a poor state of repair after just a single flood season, being of apparently poor design and constructed of inferior, sandy material. Rumours
concerning the misappropriation by local officials of the food allocated for the WFP project were circulating in the area at the time that I was in the field. These rumours are substantiated in a report by Proshika (1986), which further asserts that the embankment extension was not constructed to the original design specifications.

Further components of the project include ten pipe inlets which allow controlled water flow into the embanked area. These inlets were installed by EIP as an integral part of the original project design. Through their consultants Northwest Hydraulics Ltd, the International Development Administration (IDA) and Canadian International Development Agency (CIDA) have become involved in the area, installing a flow regulator at the outlet of Konai nadi into the Bangshi river. This was the first stage of a scheme planned to include the extension of the embankment as far as the regulator; the re-excavation of Konai nadi and some of the khals in the area to improve drainage; and the installation of a further flow regulator at the outflow of Bardam khal (Northwest, 1986). CIDA, IDA, EIP, BWDB and WFP were all to be involved, the latter again to be responsible for the embankment extension through food-for-work.

As mentioned earlier, the project is pioneering the new Rehabilitation, Operation and Maintenance programme implemented by EIP. The activities planned for this phase are long-term and ongoing, with EIP and BWDB gradually relinquishing their role and entrusting much of the day-to-day upkeep of the project to the local beneficiaries. Proshika, an NGO active throughout Bangladesh,
compiled a feasibility study on follow-up socio-economic activities in the project area (Proshika, 1986). Their report presents a comprehensive set of recommendations for maximising the potential benefits to the target group.

In this report, Proshika urge that responsibility for the maintenance of the project should rest with the target group, and not with the officials of the local administration, who are likely to represent the interests of the local rural elite. In order to motivate and mobilise the landless and land-poor to maintain the embankment and related project structures, Proshika acknowledge that these groups will have to develop a strong vested interest in the project's maintenance, an interest that will be established only by the formalisation of land rights to allow them to cultivate the embankment sides and the 'borrow pits' (the depressions left where material was extracted for the embankment's construction). Embankment sides could support trees for fruit and fuelwood, food crops such as pulses and vegetables, and fodder crops for animal grazing. Boro rice could be grown in the borrow pits, and where these flood too deeply for cultivation, the target group could use them for pisciculture.

These proposals will require delicate negotiations if they are to be successfully implemented, as large landowners, often the previous owners of the land acquired by BWDB for the construction of the embankment, had assumed control of the embankment sides and borrow pits. Other problems of management arise in connection with the use
of the embankment sides, where cultivation must be strictly monitored if it is not to exacerbate rather than arrest the deterioration of the embankment through erosion. Proshika's report includes proposals for homestead production and small businesses which could generate employment and income for the target group. Their suggestions for homestead production include the rearing of poultry and small livestock, the processing and preserving of fish and fruit products, and beekeeping. Opportunities for small businesses include boat operation, petty trading and rickshaw operation. To implement these suggestions will require considerable investment of effort in organising and training members of the target group. They will need to be provided with the necessary credit and other inputs in addition to skills training.

Proshika's report was presented to EIP in 1986, but follow-up activities were seriously disrupted by the floods of 1987 and 1988. Their very involvement, however, is an indication of EIP's commitment to the long-term future of the project.

5.3 A general description of the field area

The project is located on the eastern edge of the Jamuna floodplain. To the east lie the Madhupur hill tracts. In this deltaic environment, this weathered terrace of mixed clay compounds forms a quite distinct physiographic unit, and clearly demarcates the eastern edge both of the Jamuna floodplain and of the project area.
The floodplain itself displays the typical features of an anastomosing delta: meandering, shifting river channels on an alluvial plain of almost level relief. The seemingly flat plain conceals a really quite complex topography, with oxbow lakes and other features marking residual channels, marshy basins known as beels, and a micro-relief of gentle undulations. The project area is not flat, but slopes imperceptibly from north-east to south-west. Beyond the project area, to the north-west of the Bangshi river, the land shows a slight rise, culminating in a low, sandy ridge before sloping away again to the Langli river. This major tributary joins the Bangshi at Chakaleshwar, just to the south-west of the point where Pathakhali khal, before its closure, branched off from the Bangshi. To the south, the land across the river from the project rises to form the ridge of higher ground on which the town of Mirzapur is situated (fig. 6).

The hydrology of the area is controlled by the Bangshi and Langli rivers. A gauging station at Mirzapur has recorded their combined flow since 1958, and MPO have analysed flow data to try and assess the impact of the embankment (EIP/BWDB, 1985). Their calculations using data to 1984 (i.e. only two flood seasons after the project's completion) showed no significant change in the maximum water level attained. The project area is seasonally flooded to depths of 1.8 to 3.6m, this range of depths being typical of the surrounding area (EIP/BWDB, 1985). The water level in the Bangshi starts to rise in April-May, and the flood peak is usually attained in late August or early September. A notable feature in the behaviour of the Bangshi is
Fig. 6 Map of the project's location showing the two study villages
that daily rises in its level of 0.8 to 1.0m are not unusual (EIP/BWDB, 1985). These rapid rises in water level, along with a tendency to early flooding, add to the inherent flood risk. It is in delaying the onset of flooding and reducing the daily water level rises that the embankment has had its most significant impact on the hydrology of the project area.

On the basis of a small number of random auger samples within the project area, conducted in my presence by Hugh Brammer, retired Director of the Soil Survey Project for Bangladesh, a description of the soils in the area can be made. These sample data are supplemented by my own surface observations made in the field, and by references to the soils typology in the report of the Soil Survey Project for Bangladesh.

The soils fit into the category defined as grey floodplain soils in the Soil Survey classification. Fresh silty or sandy deposits form the surface layer, where soil formation processes have not yet had time to operate. These deposits cover a layer of grey Jamuna alluvium which displays extensive mottling, suggesting that the soil is relatively well aerated. At the time that the soil samples were taken, early December, the layer of Jamuna alluvium contained a perched water table, being quite saturated while layers beneath remained dry. The Jamuna alluvium overlies a layer of sandy material with a high mica content, beneath which is a base of older alluvium, being a rather darker grey, and also displaying mottling. The soil stratification displays the sedimentation history of the region, with
successive deposits varying in thickness, composition and texture depending on the discharge and sediment load of the river system in each flood season - one year might bring a thin layering of silt, another a thick deposit of sand. Conventional soil analysis relies much on the geological parent material of a soil; here there is no parent material per se, the alluvium reaching to great and indeterminate depth. Together, the area's hydrology and soils determine its agricultural potential.

Under traditional practices of agricultural management, much of this area could be double or triple cropped, with two monsoon rice crops, or an early monsoon jute crop, followed by a dry season rabi crop. The rice crops would be likely to be grown together in a mixed crop of aus and broadcast aman, with early and deep flooding precluding the transplantation of aman later in the season (Miah, 1983). Local variations in micro-relief would produce variations on this rotation, aus crops being excluded on land too deeply flooded, and even aman crops being excluded on the deepest-flooded land, where there might be a single cropping of a local variety of boro rice.

A number of natural limitations operated in the local environment to prevent agricultural productivity from attaining its full potential: lack of water in the dry season; deep and often sudden flooding in the monsoon season. Until fairly recent agricultural innovations, the use of traditional methods of irrigation to supplement residual soil moisture was essentially the only positive intervention a local farmer would have been able to make to improve agricultural
productivity. In recent decades, however, technological innovations in Bangladesh's agriculture have provided the local farmer with further opportunities for positive intervention in the agricultural system. The first of these has been the advent of the 'green revolution', with the introduction of high-yielding varieties of rice and the widespread adoption of chemical fertilisers. The second innovation, and one which was essential if the first was to be at all effective, has been the introduction of improved water resources management through irrigation and flood control. Irrigation and HYV cultivation have become widely disseminated throughout the region in which the project is located, but flood control is restricted to limited areas, with important implications for the nature of the agricultural change that has occurred. The influence of flood control on the local agricultural system, discussed in detail in a later chapter, has been profound, and holds the key to understanding the wider economic impact of the embankment.

As with any system of agriculture, that prevailing here has its own associated patterns of activity and appearance, producing a unique agricultural landscape. The fields themselves are a patchwork of fragmented holdings, each field being levelled and surrounded by a low ridge of earth (bund) which serves as both boundary marker and water retainer. All available land is given over to cultivation; there is no common land or wasteland visible. The appearance of the landscape changes with the season and corresponding crop stage. At the height of the flood season, the water casts up a glare broken only where the deepwater aman thrusts itself above the surface, or
where there are floating clumps of water hyacinth. As the floods recede, raised paths and bunds are the first to emerge, often in some disrepair after their submergence. Mud and water hyacinth cover much of the surface. While some farmers are harvesting the aman, which now lies untidily on the ground, and clearing or ploughing in the water hyacinth, others are already sowing rabi crops, and the glistening mud is soon replaced by the green of new growth. While the rabi crops are in the fields, nurseries of bright green boro and then aus seedlings are carefully tended near the baris. Seedlings are transplanted once the rabi crops are harvested. The green of the growing rice crop deepens and darkens as it matures, until it turns into the gold of ripened paddy, first the boro and then the aus. Fields of ripening paddy are interspersed with the dark green of growing jute or the slow-maturing aman. The harvest of the boro and aus often becomes a race against the rising floodwater as the landscape again becomes submerged.

Such is the agricultural landscape that prevails on the floodplain of the Bangshi, as on the Jamuna floodplain as a whole, and indeed in those parts of the Ganges and Meghna floodplains where similar conditions of soil and hydrology are found. Yet this account of soils, hydrology and agriculture does not complete the field area description, little attention having been paid to man's place in this environment, but for his role as agriculturalist.

The area is densely settled, with a continuous pattern of baris and paras dotting the floodplain. Within the project area, ten villages
are locally distinguished: Tarafpur, Latifpur, Takia Kadma, Salimnagar, Jugirkopa, Trimohan, Goraki, Geraki, Bardam and Seoratail (fig. 6). Of these, the first four fall only partially within the project area, their remaining areas falling in the hill tracts and thus being unaffected by flooding. The embankment passes through the village of Trimohan, and in 1986 did not yet extend to the furthest limits of Jugirkopa. The heart of the project area, then, comprises the four villages of Geraki, Goraki, Bardam and Seoratail.

As is typical of the floodplain areas of Bangladesh, the villages throughout the study area are not discrete, nucleated units, but amorphous groupings of baris, one village merging indistinguishably into another. Both within the project area and away to its north and west, ground naturally high enough to remain above normal flood level is all but non-existent. For the most part, baris are constructed on artificial mounds of earth, some of which have been repeatedly extended over generations to become quite large in size. The resulting settlement pattern is random and dispersed.

That roads are submerged or impassable for much of the year reduces any significance they might otherwise have in concentrating settlement. The embankment itself forms a 'road' which is passable throughout the year, and it forms an essential route along which people from an extensive area walk to and from markets at Patharghata, Geraki and Mirzapur. There is no bridge across either the Bangshi or the Langli river, and for much of the year it is necessary to cross these rivers by boat. Locally, precarious bamboo
bridges are erected across the smaller khals and nadis. During the dry season, many of the smaller streams dry up altogether, and even the larger rivers can be waded across.

During the flood season, boat transport comes into its own, and all manner of craft ply the waters which cover the area, as they do much of the country. A wealthy household might own a wooden boat (noka) to carry themselves from their bari to market to buy or sell produce; to their fields to inspect the growing aman; and to other baris and villages to pay social calls on friends and relatives. Boatowners can earn money by ferrying their neighbours on their daily rounds, carrying children to and from school and men to and from market or workplace. Each homestead mound becomes an island, and boats are the only link between them. Boat ownership is particularly important to households which earn their livelihood by fishing, as fishermen have to cover an extensive area to ensure a sufficient catch. The embankment is as much a hindrance to boat navigation as it is an asset to travel on foot or bicycle, blocking former east-west navigation routes across the area. Not all households can afford a wooden boat, and poorer households might construct rudimentary rafts of bamboo or banana stalks to provide a degree of mobility. The poorest households have to rely for boat transport on the goodwill of others, or remain isolated on their bari islands.

The importance of Mirzapur as the main town in the area has established Trimohan as a nodal point where boatowners provide a ferry service across the Bangshi. Trimohan is also the embarkation
point for the 'launches' which transport goods and passengers upriver along the Bangshi to Patharghata and along the Langli to Fatehpur. These launches are powered by adapted diesel irrigation pumps. Fatehpur is the site of a daily market serving the north-western sector of the study area, the sector from which the without-project village was ultimately selected (see fig. 6). Villagers throughout the area use Mirzapur as a market centre, this being the major market town and the headquarters of Mirzapur upazila. Within the project area, Geraki is the site of a weekly market (hat) each Monday, serving most of the needs of the local population. Another hat takes place each Wednesday at Patharghata, serving the north-eastern sector, but also visited on occasion by the inhabitants of the wider area, including the people of the with- and without-project villages of this survey.

The Geraki hat represents an interesting unforeseen effect of the embankment. Prior to the construction of the Pathakhali khal closure dam, there was no suitable raised site on which a weekly hat could be held throughout the year. The embankment provided just such a site, and becomes each Monday a bustling collection of stalls where villagers and travelling vendors buy and sell agricultural produce and other wares. Permanent stalls (dokhans) have been set up both here and at other points along the embankment, where can be purchased soap, cigarettes, batteries and all manner of other goods.

A visit to hat or market town is for the men of the area an at least weekly or fortnightly occurrence, but a far more rare occurrence for
the rural women. A woman will seldom leave the confines of her own bari and those immediately adjacent to it, which are likely to be occupied by her sisters- or cousins-in-law. For a man, his daily round outside the flood season is likely to include (if he is a landowning farmer) his bari; his fields, which may be quite scattered; and the baris of friends or relatives where he might stop to smoke a bidi (locally made cigarette), exchange gossip, and discuss the weather and the state of his crops. The daily round of a landless labourer will be quite different, involving often lengthy walks in search of employment. This can extend to neighbouring villages and even beyond, perhaps outside the local area altogether on a seasonal basis. Labourers from the plains commonly move to the Madhupur hill tracts during the flood season, when agricultural activity on the plains is restricted to watching the progress of the aman crop and checking the spread of water hyacinth. Physical limitations to mobility are thus but one aspect of the pattern of movement across the area, with social, cultural and economic influences being equally important.

Some of the features described here are illustrated in plates I to X, inserted at the end of the text. While superficially constant, this life and landscape are in reality continually adapting to wider economic change, such as innovations in agriculture. The origins of change are essentially beyond the control of the local inhabitants, but processes of adaptation to change are a function of local social and economic forces. The resilience of the Bangladeshi is attributable not to conservatism but to adaptability: a flood control
embankment becomes the site for a market; an irrigation pump becomes a boat engine; the major rice-growing season of the monsoon becomes secondary to irrigated dry season cultivation. It was important in conducting this research to resist the assumption of a static, unchanging rural system, and to view the changes brought about by the embankment against a backdrop of wider change.

5.4 Selecting with- and without-project villages

The decision to reject formal sampling in favour of the selection of two case study villages meant that this selection had to be made with particular care. Several factors had to be taken into account if the two villages were to be both representative of the with- and without-project areas and comparable with each other. A field visit, perusal of census data and consultation of maps and aerial photographs were all necessary before the selection of suitable villages could be made.

Even the selection of an appropriate village inside the project area was not without difficulty. The main factor in its selection was that it had been one of the two villages surveyed in the pre-project feasibility study, but other factors were also taken into consideration. Field and map observations showed several villages to be only partially affected by the project, with some of their land falling on the higher ground to the east or beyond the embankment's extremities. Such was the case with the second village in the
pre-project survey. Only four villages were incorporated in their entirety: Geraki, Goraki, Bardam and Seoratail. Bardam was rejected on the grounds that its number of households was too large to be manageably surveyed. Goraki seemed somewhat exceptional in its relative affluence (judged on purely subjective grounds), perhaps owing to the political clout of the village council chairman. This left a decision between Geraki and Seoratail, and the former was selected on the grounds of its centrality within the project area, being at the very point where the original closure dam had been constructed; its manageable size in terms of both physical area and number of households; and, ultimately, the availability of pre-project data for comparative purposes.

Once Geraki had been established as the with-project village, a without-project village had to be identified as having been socially, economically and environmentally comparable to Geraki as it was prior to the project's implementation. Data from the 1981 population census showed Sutanari, a village to the north-west of the project area (see fig. 6), to be of similar size in terms of number of households, total population and physical area. It was essential to look to the north and north-west of the project area for the control village, the region to the east being higher and thus physically quite dissimilar; that to the south and west being likely to have been affected by the downstream hydrological changes which inevitably result from embankment construction. Field and map observations revealed further physical similarities between Geraki and Sutanari: both were on the outside of a river bend; both lacked any significant
areas of high ground; both were subject to moderate to deep flooding. It was felt that these physical and demographic similarities outweighed the one perhaps significant dissimilarity which emerged from the census data: the greater proportion of Hindus in Sutanari's population. From the available data, no other village appeared better to meet the criteria of socio-economic and environmental comparability.

Impressions gained from census data and cartographic information were reinforced by field observation. During a preliminary visit to the field area, discussions were held with local people: officials at upazila headquarters in Mirzapur; the Proshika field officer at Patharghata; a village schoolmaster; officials at Azgana Union headquarters; local farmers; villagers attending a beekeeping course run by Proshika; a boatman; an out-of-work agricultural labourer. None, when the method and purpose of the survey had been explained, was able to provide a more suitable suggestion, nor any reason why Sutanari could not be assumed as an appropriate without-project case, but for the already known factor of the Hindu to Muslim ratio. Personal observations also revealed no obvious exceptional features about Sutanari that made it in any way unrepresentative of the without-project area, or dissimilar to Geraki in any way attributable to factors other than the project.

The field trip which finalised the selection of Geraki and Sutanari as the two case study villages also provided the opportunity to conduct a field trial of the questionnaire. This all but completed
the preliminaries. The only remaining preparation to be made before the actual survey could commence was the selection and training of field assistants.

5.5 Selection and training of the field team

The two factors of language and scale meant that field assistants would have to be appointed to help in carrying out the questionnaire survey. I was able to learn some of the Bengali language before travelling to Bangladesh, and to pick up more of the language, including local expressions, while in the field, but this was by no means adequate to conduct the actual interviews. Even if a researcher were fluent in the local language, to interview almost 300 household heads, with each interview lasting no less than an hour and some up to two or three hours, would involve a long and arduous period in the field if it were to be done by a single individual.

My affiliation to the department of geography at Jahangirnagar University meant that it was possible to use undergraduate students as field assistants. Discussions with others who had conducted field research in the country, along with a realistic appraisal of the nature and scale of the survey to be conducted in the limited time available, led to the ultimate selection of a field team of nine—one student acting as my personal interpreter and the others working in pairs to conduct interviews. The students selected for the team comprised a mixture of geography and English students, and they were
chosen specifically so that their pooled knowledge combined the subject matter of the questionnaire and the language in which it was written.

I was aware when recruiting field assistants of those other attributes of a field assistant essential for an efficient and accurate survey: honesty, diligence and personability. It was emphasised to field assistants that they would have to be prepared to accept basic living conditions in the field, adopting the living standards of the local population.

Once a team had been selected, I spent two days training them in general interviewing technique and familiarising them with the questionnaire. Training included practical exercises as well as instruction, thus ensuring that the field assistants fully understood the concepts, definitions and structure used in the questionnaire. It covered the desired style of interviewing and the manner in which answers were to be recorded.

In many questionnaire surveys of this sort, the questionnaire is itself translated from the original into the local language, the questions asked and the answers recorded in the local language, and the answers later translated back into the original language. The demands of this process in terms of time and money, not to mention sheer logistics, made it impracticable in this survey. The questionnaire forms were in English, and the field assistants were left to translate them themselves. Each member of the field team had to prove his ability to do this confidently and accurately before his
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inclusion in the team was assured. Answers were to be recorded in English except in certain specified questions where it was felt that translation might have caused the loss of subtle distinctions in the responses. It was repeatedly stressed during training that answers should be recorded in Bengali rather than left out altogether when translation difficulties presented themselves. Only once I had full confidence in the team's ability to conduct the interviews and record the responses with accuracy did we leave for the field to begin the actual survey.

5.6 Field procedure

In keeping with the philosophy behind the research, we travelled to the field area not in private vehicles, but using local transport: a bus as far as Mirzapur, then hiring a local boatman to ferry us across the Bangshi river, before walking along the embankment to the village of Geraki, the flood-protected village where it had been decided to begin the survey. We carried with us questionnaire forms, clipboards and writing implements, along with the clothing and bedding required for a stay in the field of some weeks.

Our arrival in the village was not totally unannounced, as I had made tentative enquiries about accommodation and facilities during the preliminary field visit. Rumours about the identity and purpose of these visitors to the village must have been circulating during the weeks since that first visit, and despite our efforts to make our
arrival, low-key and inconspicuous, the excitement generated by the arrival in the village of ten strangers, including one foreign woman, was considerable. We were guided to the bari of the Shikdar family, where the head of the household was a village elder of some stature, although he held no official political office. His approval and acceptance of our objectives and methods would be essential to the whole exercise, and so our first task was to explain our intentions to him. Once he understood the purpose of our visit, he not only gave his approval for the survey to go ahead, but invited the entire field team to reside in his bari for the duration of our stay. No other single household had the facilities to accommodate all ten members of the team; the Shikdars, being relatively wealthy, had in their bari a separate building of considerable size set aside for receiving and entertaining guests. This was to be our 'base camp'.

A woman from a poorer neighbouring bari offered to provide us with food, and for a small daily fee she purchased the necessary supplies and cooked our meals on her chula. Our material requirements thus seen to, and our 'adoption' by a host family effected, we were free to set ourselves up to begin the survey.

Our host was not the only person who had to be convinced of the nature and integrity of our motives in conducting the survey if it were to be successfully completed. If we were to obtain honest and accurate responses to our questions, our purpose had to be made clear to all the village's inhabitants. This would be done with each respondent at the beginning of each interview, but if potentially harmful rumour and speculation were to be avoided, it was important
that the purpose of our visit should be made clear from the outset. It proved unnecessary to call a formal meeting, natural curiosity bringing the village men to Shikdarbari to observe and quiz the new arrivals to their village. The obvious esteem in which our host was held was clearly influential in persuading the other villagers of our integrity, and as soon as the survey objectives had been explained to them, villagers were enthusiastically volunteering to be interviewed.

A daily routine was soon established, the time of interviewing being adjusted around the activities of the respondents. This sometimes meant that a single interview took more than one sitting. The villagers' rest periods were our periods of greatest activity: mid-morning, early afternoon and evening. Interviews took place in the bari courtyards, interviewers and interviewee either squatting on the floor or sitting on the low stools found in the better-off households. The working pairs were decided each morning, deliberately not being kept constant so as to reduce the problems of staleness and complacency on the part of the interviewers. Usually, one of a pair would act as the interviewer, translating the questions from English and posing them to the interviewee in Bengali, while the other acted as scribe, translating the responses from Bengali into English and entering them on the form. Interviewer and scribe would swap roles either after each interview or between the morning and afternoon session. The name of the scribe was always recorded on each questionnaire so that he could be consulted about any queries which arose during the daily checking of completed questionnaires. I
acted as general supervisor and co-ordinator, as well as conducting some interviews myself and engaging in informal discussion with villagers to supplement the information obtained from the formal interviews.

At the end of each session of interviews, the team would gather at Shikdarbari for a rest and a meal, using the opportunity to compare notes and to leave completed forms for checking. Queries were immediately referred back to the interviewing pair and, where necessary, to the respondent concerned. A list of households had been obtained from the mouza council office and the respondents' names were checked against this to ensure complete coverage of village households. Once early teething problems had been resolved, progress was rapid. An interviewing pair could stop at virtually any bari and find a respondent who was available for interviewing. As the survey progressed, and complete village coverage was approached, progress became slower as household heads who had not yet been interviewed had to be deliberately sought out. The mouza list proved to be out of date, some names being of persons deceased or no longer resident in the village. The complexities of the Muslim naming system, especially the fact that many villagers were commonly known by names other than their given names, added to the problems. Finally, however, every name on the list had been accounted for, and the with-project village survey was complete.

The field period was broken by a much-needed break, when the entire field team returned to Dhaka. Completed questionnaires were
deposited, and a fresh batch of forms picked up in preparation for the survey of the without-project village, Sutanari. On our arrival in the second village, the whole process of introduction had to be repeated. It was considerably more difficult to explain the purpose of the research to the villagers in Sutanari, this being the control village in the research design, the village deliberately chosen because it had no flood control project. The villagers here were slower to accept the team and to understand the purpose of the survey, and tact and diplomacy had to be exercised in order to obtain the necessary co-operation. Although initially suspicious, the people of the village eventually came to accept the field team's activities.

We were again accommodated by a village family, that of Kamal Uddin, in a similar arrangement to that which we had enjoyed in Geraki. The Union headquarters at Fatehpur provided a list of households, and this was used to check off at the end of each day the households that had been interviewed. The system of pairing scribe and interviewer which had proved itself in Geraki was again employed, and I again assumed the role of supervisor, co-ordinator and occasional interviewer. The confidence and experience gained by the team in doing the first survey in Geraki meant that the survey proceeded smoothly in Sutanari despite the villagers' initial reluctance. Had the villages been surveyed in the reverse order, teething problems might well have been exacerbated by the Sutanari respondents' initial recalcitrance, thus threatening the entire exercise. As it was, the team's diligence and perseverance saw to it that the survey was
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- 135 -
efficiently completed in the second village, as it had been in the first.

This formal account of field procedure reveals little of the actual interaction between the field team and the respondents, or of the degree to which I was able to observe and participate in village life. That the survey was conducted in an atmosphere of trust and cooperation was largely attributable to the team's successful application of the principles of field conduct upheld and advocated by Chambers (1980): to listen to and learn from villagers, both during interviews and in informal conversation, and above all to adopt an unimportant attitude. I was repeatedly impressed by the way the team members behaved towards the villagers, not in an arrogant or superior fashion, but with respect and humility. The image of wealthy, educated city-dweller was shed; in attitude, lifestyle and dress, the students became as any other village youths. I, too, was able to enter into this spirit, and there was thus established a relationship which quite reversed that in the usual (First World) researcher - (Third World) respondent situation.

I accompanied my assistants from bari to bari on their daily rounds of interviews. Conversation often extended beyond the formal questionnaire, and the village men would return the questions of the questionnaire with questions of their own about life in Britain. After the evening meal, when the day's work in the fields had ended and the day's interviewing was complete, some of the village men would crowd into our hut with the entire field team, I being the only
woman permitted to participate in these sessions. Talk would continue long into the night, the Bengalis having a great love of discussion and argument. Often, music would take the place of conversation, with villagers bringing in drums, flutes, cymbals and a harmonium, encouraging the team members to join in the playing and singing. Outside the doorway and windows, hidden in the shadows, the women watched and listened, excluded from active participation in the entertainment.

This social interaction served to break down the barriers of language, class and culture, making the whole process of data collection much easier than might otherwise have been the case. Villagers were relaxed when it came to the formal interviews; the morale and motivation of the field team was kept high; and I came to feel a genuine affection and respect for the people whose lives I was studying. I had been able to practise participant observation to some extent, not through my own efforts alone, but through the friendliness and hospitality of the people among whom I found myself.

5.7 The timing of fieldwork

The length of time that has elapsed between the conduct of fieldwork and the completion of writing up provides an opportunity to consider the implications for the research of the timing of the fieldwork, in terms of both seasonality and annual variability. The timing of the
Fieldwork was determined largely by matters of pragmatism, fieldwork commencing as soon as the necessary methodological groundwork had been laid and logistical arrangements finalised. I spent the period September to December 1986 in Bangladesh. September was spent in general familiarisation with and reconnaissance of the country in general and the water sector in particular; project and village selection was finalised by mid-October; and the survey itself occupied the remainder of the field period, being completed by mid-December.

As it turned out, the timing was particularly appropriate. The period in the field spanned the period of transition between the maximum flood extent and the commencement of the dry season. To have conducted the survey entirely during the flood season would have slowed the exercise significantly, with the floods hampering mobility in the field. To have avoided the flood season altogether would clearly have been inappropriate, as the nature of flooding in Bangladesh is such that it has to be witnessed to be fully appreciated and understood. Ideally, the field period should have occupied a full year to permit the observation of the full range of seasons and the implications of seasonality for the local society and economy. Owing to various constraints, the time available for fieldwork was limited, and it was fortuitous that the four months spent in the field gave some idea of the major seasonal contrasts which characterise life in rural Bangladesh.

In terms of annual variability, too, the timing of the fieldwork
proved, again quite fortuitously, to be appropriate. The year 1986 was unmarked by any exceptional events of either natural or human cause. In many of the years of its short history, Bangladesh has been severely disrupted by either natural calamity (flood, drought, cyclone) or social and political unrest. In 1986 there was neither catastrophic flood nor government overthrow; if anything, it was a year unusual in its environmental and social stability. Several researchers of Bangladesh have had their freedom of movement limited and even their personal safety threatened by political disruption (e.g. Ralph, 1975); others have had to cope with severe constraints on their mobility when the country has been affected by severe flooding (Paul Thompson, personal communication in 1989). Far more important than their effect on researchers is the effect of political and environmental calamities on the people of the country. To have attempted to conduct this research in the wake of floods such as occurred in 1988 would not only have yielded results distorted by exceptional circumstances, but would also have been an affront to a traumatised population. The same would have been true to a lesser extent of 1987, when flooding was also exceptional. The year 1986 was as close to an 'average' year as Bangladesh ever comes, being neither exceptionally 'bad' nor exceptionally 'good'. The implications for the research were two-fold: firstly, the data yielded by the survey can be reasonably assumed to represent the 'normal' situation rather than one in any way distorted; and secondly, the work of the field team was facilitated by both ease of physical mobility and ease of social access to the rural population.
Could any four months in any year of the period 1984-1988 have been chosen for fieldwork, even with the advantage of hindsight, those of September to December 1986 would have been as valid a choice as any.
CHAPTER 6

SOCIO-ECONOMIC ANALYSIS I:

LAND TENURE AND SOCIAL COMPOSITION

6.1 General considerations

Designed to be as comprehensive as was practically possible, the questionnaire examined many facets of the local society and economy, from educational status to livestock ownership. This broad scope of enquiry was essential if the full impact of the embankment was to be properly assessed. Thoroughness has its drawbacks, however. The quantity of data generated when such a long list of questions is answered in detail by 288 respondents is considerable (constituting, in its raw state, some 24kg of paper), and several months of data coding and manipulation were required just to prepare it for computer analysis. Certainly there was far too much information to attempt analysis without the aid of a computer. The qualitative nature of much of the data posed something of a problem in compiling a database for each of the two villages, but the problems proved surmountable. Where quantification or numerical coding was either impossible or inappropriate, answers were simply entered onto the computer in alphabetic form, abbreviated or standardised as necessary. Simple Fortran programmes were then used to obtain output lists of the various data items and to calculate e.g. the frequencies with which certain responses were encountered in either village. The Statistical Package for Social Scientists (SPSS-X) was also used.
The adoption of village case studies, with 100% of the households in each village being interviewed, simplified the procedure of data analysis - statistical tests of significance were not required and a simple comparison between the two villages was sufficient to determine the differences and similarities between them, and thus to evaluate the impact of the embankment.

Assessment of the embankment’s impact on the local society and economy hinged on proving the protected village (Geraki) to be measurably different in socio-economic terms from the unprotected village (Sutanari). In order for the embankment to be deemed a success in the light of the development philosophy shared by the funding agency and myself, there had to be evidence not only of improvement in the overall village economy, but also of equity in the distribution of any project benefits. The evaluation which follows looks, therefore, at the picture at household as well as at village level; at the distribution of any benefits that have ensued from the construction of the embankment as much as at the identification and description of aggregate benefits.

In the predominantly agricultural economy which prevails in rural Bangladesh, economic improvement can result only from agricultural improvement, and it is on its impact on agriculture that the embankment is ultimately judged. Yet if agricultural change is the mechanism by which the embankment has operated to induce a broader economic transformation, the evidence that such a transformation had indeed occurred had to be sought in other spheres besides the purely
agricultural. If only the aggregate were considered important, then increased productivity and profit from agriculture would have been a sufficient indicator of economic improvement, even if this had meant a further concentration of land ownership and wealth in the hands of the few and the impoverishment and dispossession of many poorer households. In the analysis which follows, the important criterion is rather whether the presence of the embankment allows more households to earn a basic living - farmers from their agricultural production, fishermen from their catches - without having to resort to indebtedness, the sale of productive assets, or working as agricultural labour in order to ensure their households' survival. 'Improved household livelihood' is therefore the test applied to the embankment, and a range of economic indicators is employed to assess the relative economic status of households in the two study villages.

The basic determinant of a household's economic status in this context is, of course, the area of land to which the household has access through ownership or rental, relative to the size of the household. The type and number (which can be several) of occupations practised by the household head and other members is another important indicator of where a household fits in the socio-economic hierarchy, as the head of a poor household might practise two, three or even four distinct occupations to maintain some income in this insecure and highly seasonal economy. The employment status of a household is another, related, economic indicator: whether a household employs agricultural labour; is employed as agricultural
labour; is agricultural employer at some times and agricultural labourer at others; or is neither employer nor labourer, operating the household's land with household labour only. Sources of income and expenditure are here, as anywhere, a fundamental economic index, and so too is the material household comprising the homestead (bari) and its contents. It has even been suggested by some authors that the very size and composition of a household may reflect its economic standing, with wealthier households tending to remain together in the traditional joint family units while poorer households tend to divide into nuclear family units (Alamgir, 1980; Abdullah and Zeidenstein, 1982). With so many parameters to consider, any of which might have provided a key to proving a distinction between the two villages and thereby the effect of the embankment, a wide range of topics is necessarily encompassed.

In the analysis which follows, a comparison is drawn between the protected and unprotected situations within each of the broad themes of the enquiry: land tenure; village social composition; occupations and employment; income and expenditure; and the material household. Where relevant and possible, the pre-embankment situation is also considered, using the data from Miah's 1982 pre-project survey. With access to land being the primary determinant of household economic status, all other aspects of the household economy are related back to landholding. Carried out in this way, this comparative analysis of economic conditions in Geraki and Sutanari provides the answers to the two fundamental questions on which the project evaluation rests. First, has the embankment had a positive influence on the local
socio-economic system? And second, has that influence on the socio-economic system been egalitarian or class-specific in its impact?'

6.2 Land tenure

The economic importance of access to land for a household in rural Bangladesh, discussed in chapter 3, makes an understanding of land tenure in the two villages fundamental to an understanding of their economic structure, functioning and strength. It also means that landholding is the most appropriate basis on which to divide households into socio-economic classes, and it is only by defining such classes that the distribution of the embankment's impact can be assessed. Miah, author of the report (1983) of the pre-project survey, cites works by Alamgir (1978) and Hossain (1981) in justifying his identification of 'social classes' on the basis of landholding status, and indeed scholars of the Bangladesh economy have come to accept as standard the use of landholding as the basis for class differentiation. What have not yet been standardised are the limits of the landholding size categories that should be used; for purposes of continuity and to facilitate comparative analysis, the categories used here are the same as those used by Miah. These are: landless (owning no land at all); marginal (less than one acre); small (one to less than three acres); medium (three to less than seven acres); and large (seven acres and above). Operational holdings (i.e. the land which a household actively cultivates, including both owned and rented land) are used instead of just land that is owned, as it is a household's operational holding which is more important in the day-to-day functioning of the local economy.
Both in the pre-project survey and in the survey on which this work is based, certain limitations in the data on land tenure proved unavoidable. Simple definitions of ownership, tenancy, mortgaging and sharecropping do not always apply in the economic and cultural milieu under study, but it would have required a far more detailed and painstaking investigation into tenure arrangements if all their subtleties and complexities were to be uncovered. (Grierson (1885) attempted such a task in Bihar, and succeeded in describing a great variety of tenurial status, including some arrangements peculiar to 'lands which are generally subject to inundation' (p. 328); such a systematic analysis has not, to my knowledge, been undertaken in Bangladesh, and would make a useful focus for further study.) In fitting respondents' descriptions of their tenurial arrangements to standard definitions, and even in the very phrasing of the survey questions, mistakes and misunderstandings no doubt arose. Differences in definition will have led to inaccurate reportings of their holdings by some respondents. Another source of inaccuracy will have been the inherently sensitive nature of the information - landholding forms the basis of taxation in rural Bangladesh, so some respondents will no doubt have understated their holdings, while other respondents will have overstated their holdings in order to pretend to higher economic and therefore social rank. A third likely source of inaccuracy in the reported data is simply the difficulty that certain respondents will have had in bringing to mind all of their several parcels of land, many of them very small, and with a household's landholdings generally being highly fragmented and
Problems of inaccuracy in the reporting of land tenure data are compounded when one attempts a comparative analysis, comparing the land tenure situation in one village with that in another, and comparing data from one's own survey with data from a previous, independent survey. Each type of comparison has its own particular set of problems. In a 'before-after' comparison, the questions in one survey are often phrased somewhat differently to those in the other; respondents may interpret the motives of the two surveys differently and therefore divulge and withhold different information accordingly; the different timing of each survey within the agricultural year may have a bearing on the completeness and accuracy of respondents' answers to questions on tenure. For these and other reasons, it is not always easy or even possible to identify the causes of observed change, or indeed to determine whether observed change represents real change or is simply the result of the lack of perfect compatibility between the two data sets. Simply asking respondents how their holdings have expanded or declined does not present a solution, as this requires respondents to recall sales and purchases, expiry and renewal of tenancies, mortgage payments and defaults; easy enough perhaps for a small landholder who owns few fields and whose circumstances have been little altered, but almost impossible for a medium or large landholder who has various tenurial arrangements with several different tenants, and who may in addition have bought and sold parcels of land in an attempt to consolidate and upgrade the quality of his landholding. Furthermore, the necessary
level of data aggregation in a survey report, with individual cases being combined into categories, makes it impossible to trace changes to individual respondents, and one is forced to deduce from the expansion and contraction of the number of households in the various landholding categories how change might have arisen.

Problems of a different nature are encountered in a 'with - without' comparison. Although one is able to control error to a certain extent by having the same interviewers ask the same questions at the same time of year in the two villages, there are too many factors determining the prevailing pattern of land tenure in any village for a simple comparison to reveal the influence of a single factor (in this case a flood control embankment). It is unrealistic to assume that the two villages at any stage in their past shared similar levels of land ownership and tenancy, and thus to attribute inter-village differences to some recent intervention. Land tenure is in a permanent state of flux even without the operation of any external forces of change, the traditional laws of inheritance creating a tendency to ever-increasing fragmentation of fields and ever-decreasing average holdings. A sudden increase in the number of marginal landholders may be due to no more than the death of a small landholder and the division of his land among his sons.

These problems notwithstanding, an analysis of land tenure arrangements was important on two counts: to provide a basis for the socio-economic classification of respondents; and to act as a barometer of the health of each village's economy. A socio-economic
classification was essential if the distribution of change through the hierarchical social system was to be properly assessed - it matters little whether one village has more or fewer respondents within a particular landholding category, but it matters much if households in the same landholding category are better off in other terms (e.g. income, employment, material possessions) in one village or the other or, in the case of the flood-protected village, before or since the coming of the project. Likewise, in using land tenure as an economic barometer, the relative numbers of households in the different landholding categories matter less than the means by which households find themselves in a particular landholding category - whether by simple inheritance or by the letting, sale or mortgaging of land assets.

The proportions of households in the different landholding categories, and the associated distribution of land among those categories, are given for the with-, without- and pre-project situations in tables 6.1 and 6.2. At first sight, the figures seem to indicate a deterioration in the land situation, with a decline in the number of small and medium landholders in Geraki since the embankment and an expansion in the number of marginal-landholding and landless households. I believe this apparent trend to be spurious, for a number of reasons. Firstly, it must be noted that the very number of households underwent an expansion between pre- and post-project surveys, from 128 to 145, the result both of natural and social processes operating in the village (the division of extended family units into nuclear family units upon the death of the head of the
Table 6.1 Distribution of households by landholding category (%)

<table>
<thead>
<tr>
<th>Size of holding (acres)</th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-embankment Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless</td>
<td>-</td>
<td>21.5</td>
<td>15.4</td>
</tr>
<tr>
<td>Marginal 0.00-0.99</td>
<td>36.1</td>
<td>37.1</td>
<td>21.9</td>
</tr>
<tr>
<td>Small 1.00-2.99</td>
<td>27.8</td>
<td>35.0</td>
<td>43.8</td>
</tr>
<tr>
<td>Medium 3.00-6.99</td>
<td>11.8</td>
<td>11.2</td>
<td>14.8</td>
</tr>
<tr>
<td>Large 7.00+</td>
<td>2.8</td>
<td>1.4</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Table 6.2 Distribution of land by holder's landholding category (%)

<table>
<thead>
<tr>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-embankment Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal</td>
<td>14.8</td>
<td>13.1</td>
</tr>
<tr>
<td>Small</td>
<td>36.8</td>
<td>41.4</td>
</tr>
<tr>
<td>Medium</td>
<td>32.2</td>
<td>37.1</td>
</tr>
<tr>
<td>Large</td>
<td>16.4</td>
<td>8.3</td>
</tr>
</tbody>
</table>

(pre-project data from Miah, 1983)
household, for example) and of the slightly divergent definitions of a household unit in the two separate surveys. Each of these will have led to expansion in a lower landholding category at the expense of a higher landholding category. Secondly, the aforementioned problems of data incompatibility must be borne in mind. All of the observed change could have resulted from these factors and not from any sudden transformation in the pattern of land sales and letting. Likewise, in comparing with-project Geraki and without-project Sutanari, no blame should be attached to the embankment when attempting to explain the lower incidence of small landholders and higher incidence of landlessness in the protected village: the pattern of land tenure is rooted so deeply in the unique social history of each village as to render direct comparison between them invalid. The significance of this classification by landholding status is simply to assign households to socio-economic categories; the true test of the embankment's influence in this sphere comes in comparing the specific tenurial arrangements, and particularly the recent history of those arrangements, within each landholding class.

Three aspects of a household's tenure situation are important as indicators of economic wellbeing: whether the household's land is owned or rented; whether the household has recently bought or sold land; and whether the household has had to mortgage any portion of its landholding. These factors must be considered not in isolation but in an integrated fashion - tenancy is not in itself an indication of poverty, but it is so if, following land sale or mortgaging, it replaces the more secure ownership of land; land sales do not
indicate distress if the sale is of a small portion of the holding of a large landowner, but do if of the entire holding of a marginal landowner.

The relative importance of tenancy in with-, without-, and pre-project situations is shown in table 6.3. The figures indicate only tenancy in the true sense (here almost invariably on a 50% sharecropping basis), and not mortgaging, which is dealt with separately. Whilst the data limitations already discussed make direct comparisons not entirely valid, there is surely some significance in the far lower incidence of tenancy in Geraki relative either to Sutanari or to its own pre-embankment situation. Translated into actual household numbers, the figures show that just seven households in Geraki rent in any land, compared with twenty-two tenant households in Sutanari and fourteen in Geraki before the embankment. The lower incidence of tenancy in Geraki exists not only in terms of the number of tenant households but also in the amount of land involved - the average area of land rented by a household is 0.62 acres in Sutanari but only 0.29 acres in Geraki (no figure was available for pre-project Geraki). Also, Geraki's tenant households tended to rent just a single field from a single landowner, while tenant households in Sutanari commonly rented more than one field, often from more than one landowner. The report of the pre-project survey did not present tenancy data in terms of area or the number of fields, but if the apparent reduction in the number of tenant households is indeed valid, then it is likely that the area of land rented by each household has similarly declined, especially with the
### Table 6.3 Proportion of tenant households within each operational landholding category (%)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Owner-cum-tenant</th>
<th>Tenant only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geraki</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal</td>
<td>5.7</td>
<td>1.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Small</td>
<td>10.0</td>
<td>10.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Medium</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Large</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>All landholders</td>
<td>6.2</td>
<td>4.4</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Sutanari</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal</td>
<td>13.2</td>
<td>7.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Small</td>
<td>24.0</td>
<td>22.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Medium</td>
<td>25.0</td>
<td>25.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Large</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>All landholders</td>
<td>18.2</td>
<td>14.9</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Pre-embankment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Geraki</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal</td>
<td>10.7</td>
<td>10.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Small</td>
<td>12.5</td>
<td>12.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Medium</td>
<td>21.0</td>
<td>21.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Large</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>All landholders</td>
<td>13.2</td>
<td>13.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*(pre-project data from Miah, 1983)*
Evidence from the 'with-without' comparison as corroboration.

Much can be inferred about the reasons behind a household's renting land by considering the landholding status of the tenant households. Categorisation of households by their owned rather than operational holdings is obviously the more appropriate for this purpose, but unfortunately the pre-project survey report provided only an operational landholding categorisation. This restricts somewhat the scope for analysis, but some conclusions can nevertheless be drawn by considering the pattern of tenancy by landholding class in with-, without-, and pre-project situations (Table 6.3 again). In all three cases, it is the small landholding category that contains the highest number (although not necessarily the highest proportion) of tenant households. However, both the number and the proportion of tenants among small landholders is significantly less in post-embankment Geraki than in either of the other two cases. Nowhere do large landholders, who would certainly possess the means to rent land, actually perceive the need to do so, and only in Sutanari and in pre-embankment Geraki are there any tenants among households in the medium landholding category. Tenancy among marginal landholders is, as in the other landholding categories, significantly lower in post-embankment Geraki than in either Sutanari or pre-embankment Geraki.

Without further information, and particularly information on land ownership, it is impossible to assert whether the lower incidence of tenancy in post-embankment Geraki is due to the absence of perceived
need for more land or to the want of the physical and economic means
to rent and cultivate land. It is probably safe to assert that the
absence of tenancy among medium landholders, something that
distinguishes Geraki from either the pre- or without-project
situation, is a reflection of absence of need rather than want of
means, as it is hard to imagine why a medium-landholding household
could not embark on a sharecropping tenancy if it so desired. The
same assertion cannot be made for small and marginal landholders,
where lower tenancy in Geraki could have been an indication either of
more households' needs being met off their existing holdings or of
fewer households having the wherewithal to expand their farming
operations. The later, with- and without-project survey included the
circumstantial information necessary to interpret the tenancy data
more fully, information that had been lost in the process of data
compilation for the final report of the pre-project survey. The most
significant conclusion that can be drawn from the data presented in
table 6.3 is simply that the apparent decline in tenancy in Geraki
has been a general decline affecting all landholding categories, and
has not been achieved through large decreases in some categories
masking stable or increased tenancy in other categories.

Considering tenancy on the basis of land ownership categories (table
6.4) is far more enlightening, but a comparison between Geraki and
Sutanari has to suffice as a surrogate for a 'before - after'
comparison. Another advantage of using a 'with - without' comparison
is that it makes it possible to cross-reference data so that not just
a household's landowning status but also other factors such as the
<table>
<thead>
<tr>
<th>Land Ownership Category</th>
<th>Lessor</th>
<th>Tenant</th>
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<tbody>
<tr>
<td><strong>Geraki</strong></td>
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<td>Landless</td>
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<td>7.1</td>
</tr>
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<td>3.7</td>
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<td>11.1</td>
<td>7.5</td>
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</tr>
<tr>
<td>All landowners</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sutanari</strong></td>
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<td></td>
</tr>
<tr>
<td>Landless</td>
<td>-</td>
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<td>7.1</td>
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<tr>
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<td>0.0</td>
</tr>
<tr>
<td>All landowners</td>
<td>10.4</td>
<td>14.4</td>
</tr>
</tbody>
</table>
size of the household and the age, sex and occupation of the household head can be considered, all of which can be important in determining whether a household lets out or rents in land. It had been hoped that it would prove possible to establish the precise landlord-tenant linkages that existed in each village, but this was not so - a respondent might profess to rent land from another who did not himself admit to letting out any land and vice versa. Nor, in either Geraki or Sutanari, did the sum of land let out tally with that of land rented in, either in terms of area or in terms of field units. This bore out the anticipated problems of accuracy and honesty in respondents' replies, as well as of divergent interpretations of the different types of land tenure. Some of the tenure arrangements were indeed quite complex - a person might mortgage a piece of land for a lump sum of money, and then rent back the same piece of land on a sharecropping basis, thus becoming effectively both owner and tenant of the same piece of land.

These limitations notwithstanding, the tenancy data can still be assumed valid in terms of the broad trends revealed. Even if landlord and tenant could not be paired in many cases, at least the relative proportions of lessor and tenant households made sense at the level of the inter-village comparison: the higher proportion of tenant households in Sutanari relative to Geraki was matched by a relatively higher proportion of lessor households. There was too much valuable information to be gleaned from a socio-economic breakdown of lessor and tenant households for data inconsistencies to preclude such an analysis altogether.
Comparing tenancy in Sutanari and Geraki on the basis of the type of household that lets or rents land shows up interesting similarities and differences. It proved easier to deduce the motives behind the letting out of land than it did those behind the renting in of land. For example, each village had among its lessor households a number that were headed either by widows or by men too old to practise farming, a state of affairs that might be found in a farming community anywhere in the world. In this category were three of the seven lessor households in Geraki and five of the thirteen in Sutanari. One respondent in each village, both medium landowners, declared that they let some of their land to sharecroppers because the size of their landholding relative to the size of the household meant both that they had land surplus to their subsistence requirements and that they had not enough family labour to run an efficient farming operation. Each village also had one respondent who let a marginal holding in order to concentrate on an alternative occupation to agriculture - one a night watchman, one a small businessman.

That left six households in Sutanari and two in Geraki for whom there appeared to be no explanation but sheer poverty driving them to rent out some or all of their fields. All but one of these eight households was in the category of marginal landowner; the exception was a small landowner in Sutanari. Both of the concerned households in Geraki and four of the six in Sutanari let not just some land but their entire holdings, thus becoming landless in the operational
classification and having to live entirely off fishing or agricultural labour. Poverty can work in a number of ways to push a household into renting out its land: by depriving a household of the physical means of cultivation (draught animals and agricultural implements); by precluding the purchase of other inputs essential for successful agriculture (fertiliser, irrigation, seed); by depriving household members through malnutrition and illness of the physical strength adequately to perform agricultural tasks; and by putting a household in a position of economic weakness such that it feels unable to bear the economic risk inherent in agriculture in a hazardous environment. Considering the individual circumstances of each lessor household in the two villages suggests that these negative conditions are more prevalent, or at least more acutely felt, in the unprotected situation: Sutanari had more households who chose to let out their land by what seemed to be force of circumstance rather than genuine choice.

The different patterns of tenancy in the two villages are more difficult to explain. As with lessor households, Geraki's lower incidence of tenant households is evident in all landholding categories, reflecting how the embankment has worked to effect general change while keeping the fundamental characteristics of the local society and economy intact. Predictably, it was, in both villages, the landless along with the marginal and small landowners who were found to be tenants; households whose own holdings could not support them and who had therefore either to seek other employment or to expand their landholding through sharecropping. The single medium
landowner who was also a tenant was a respondent in Sutanari with a very large household of fourteen members and holdings of just 3.08 acres, just barely putting him in the medium landholding category.

As with the letting of land, land rental can be an indication of either weakness or strength in a household economy, and it is impossible to tell which without considering the wider economic circumstances of that household. For a man who inherited no land from his father and has had to support his family by working all his life as an agricultural labourer, to embark on a sharecropping tenancy may be a step up the economic ladder; but for a man who through misfortune or mismanagement has had to sell or mortgage his inherited land and resort to sharecropping, tenancy is definitely a step down. Tenancy on its own therefore tells us little, but can, when considered alongside information on mortgaging and land sales, provide important insight into not just the present functioning of the socio-economic system, but also the processes of change operating within that system.

The most striking difference between Geraki and Sutanari with respect to the tenancy situation remains the sheer difference in numbers of tenant households. Other important differences begin to emerge as soon as one begins to consider the individual circumstances of each tenant household. Of the seven households in Geraki renting land, only one had arrived in a position where it had to rent land as a result of the recent loss of land through sale or mortgaging; in Sutanari, six households of the twenty-two that rented land had
recently sold or mortgaged fields which they had previously owned and cultivated. Thus while it was the same landholding categories in either village that contained the tenant households, many of Sutanari's tenant households had only recently, and through adverse circumstances, found themselves in those categories. Similarly, in considering operational landholding categories, it was only by tenancy that many Sutanari households arrived in a particular category, landless households becoming marginal landholders; marginal landowners becoming small landholders; and so on. In Geraki, a categorisation of households by landowning differed little from a categorisation by operational landholding, but in Sutanari the land ownership and land operation categorisations were quite distinct.

In terms of age, sex and occupation, the heads of tenant households were drawn from similar backgrounds in both Geraki and Sutanari: almost all were aged between thirty-five and fifty, male, and gave farming as their primary - in many cases their only - occupation. There being no significant difference between Geraki and Sutanari in the number of people fulfilling these criteria, the difference in the level of tenancy could not be put down to any social parameter, and the explanation had to be sought in the village economy. A simple landholding breakdown did not provide the answer - villagers in Sutanari were, if anything, slightly better off in terms of the distribution of land assets, with fewer landless households and more small-landholding households than Geraki. One might therefore have expected a lower incidence of tenancy in the unprotected village. That this was found not to be so points strongly to a prevailing
instability in Sutanari's economy, creating a situation where households have to juggle their economic options in order to sustain their livelihood. Some households choose to let out their land, others to rent in more land, and the whole land tenure situation is thus in a state of permanent flux. In the protected situation, as subsequent analysis of other aspects of the land tenure situation and indeed of the wider local economy confirmed, there appears to exist a greater economic stability and security, creating an environment where households are able to support themselves without having to resort to what amounts to financial speculation through the letting or renting of land.

Such a conclusion is confirmed by looking at land sales and mortgaging. If the economic signals from land tenure are often ambiguous, the same is less true of the sale and mortgaging of land—except for sales of land by the larger landowners, who often purchase better land in exchange, these transactions are almost always signals of distress in the household economy. Sales and mortgaging were reported in both Geraki and Sutanari. Both, however, were more prevalent in the unprotected situation, mortgaging spectacularly so in terms of both household incidence and land area; sales not in terms of the number of households affected, but certainly in the number of fields and the area of land transacted. Twelve households in Sutanari and fifteen in Geraki had sold land in the five years preceding the survey (excluding land given up for the embankment). The average area of land sold was over three times larger in Sutanari than in Geraki - 0.68 acres relative to 0.20 acres. Thus although
slightly fewer households in Sutanari had sold land, those that had
had sold considerably more land. This was true in both absolute and
relative terms, as each village had sellers from all landholding
categories in much the same proportions as it had households in those
categories. This meant that most of the sellers in either village
were drawn from households already in the category of marginal
landholders, and the fewest — only one or two in each case — from the
category of medium or large landholders.

With most of the land sellers in either village being marginal
landholders, and with larger areas of land being sold in Sutanari,
the net effect of those sales was more drastic in Sutanari than in
Geraki. Three Sutanari households had descended to a condition of
landlessness following land sales, but only a single household in
Geraki had met this fate. In Geraki, the small amounts of land sold
were generally insufficient to cause the demotion of a household to a
lower landholding category, but almost half of Sutanari's selling
households were thus demoted, one falling from the medium to the
marginal landholding category. For households in Geraki, the sale of
land appeared to represent an interim measure, albeit a desperate
one, from which households might hope to recover; in Sutanari, land
sales seemed to reflect households' resignation to irreversible
economic decline.

The role of the embankment in strengthening household economies and
thereby helping them to avoid the sale of land could be deduced
simply by comparing the situations in Geraki and Sutanari, but was
also cited specifically by some of the respondents themselves. Two respondents in Sutanari mentioned that their land sales had been in response to damage caused by the 1984 floods, while not a single household in Geraki cited flood damage as the reason behind its sale of land. Inasmuch as a comparison with the pre-embankment situation was possible (the pre-embankment survey report was highly imprecise in defining the period covered by its land sales data), there seemed no indication of any major change in the incidence of land sales. This suggests that the embankment has served to preserve the status quo, preventing Geraki from suffering the economic decline that appears to have afflicted Sutanari rather than effecting any dramatic improvement in absolute terms.

An assessment of land mortgaging removes any doubt concerning the influence of the embankment in stabilising the land tenure situation. If land sales on their own indicated greater economic distress in the unprotected village, land mortgaging levels confirmed this to be so. Mortgaging is a measure slightly less drastic than the outright sale of land, but often results ultimately in the forfeit of land when households fail to meet mortgage payments. It is a typical and traditional response to duress in the household economy, such as occurs after drought or flood, so that its presence in an economy is almost invariably a sign of economic hardship (Alamgir, 1980).

The difference between Geraki and Sutanari in the number of households mortgaging land is striking: thirty-three households in
Sutanari as against just five in Geraki. This is perhaps the strongest evidence from the study of land tenure arrangements of the embankment's positive influence in the local economy. Factors other than sheer numbers distinguish the mortgaging situation in Sutanari from that in Geraki, however. Of Sutanari's thirty-three mortgaging households, six were included among those who had recently sold land, but none of the mortgagers in Geraki had also sold land. After the effect of land sales had been taken into consideration, mortgaging brought a further three households in Sutanari, but only one in Geraki, into a state of effective landlessness. All of Geraki's mortgaging households had just a single field mortgaged, whereas households in Sutanari commonly had three or four and in one case as many as seven fields mortgaged. This made the average area of land mortgaged far higher in Sutanari: 0.80 acres to Geraki's 0.35 acres. Geraki's mortgaging households were found in the lower categories of land ownership, the small and marginal landowners, but in Sutanari they spanned the entire range of landowning status, many thus being downgraded in status between the ownership and the operational landholding classification. Not even large landowners were immune, as three of Sutanari's medium-landholding households would, with their mortgaged fields included in their landholding, have been categorised as large landowners. Almost every aspect of the mortgaging situation provided evidence of greater economic weakness and instability in the unprotected village.

It had proved impossible to trace the links between lessor and tenant households, and the same was again true when it came to linking buyer
to seller and mortgager to mortgagee. Very few households in either village confessed to having recently purchased land or to have acquired usufruct on land through a mortgaging arrangement; so few that it was unrealistic to attempt any sort of socio-economic breakdown of these households. It was, however, likely that the situation in both Geraki and Sutanari resembled that described in the pre-project survey report, where the purchaser almost invariably occupied a superior position in terms of landholding than the seller. The pre-project report did not discuss mortgaging in any detail, but it is difficult to imagine the mortgaging situation being in any way different to that for land sales - it is always going to be the poorer households who need the money and the wealthier households who can afford to pay it.

Although the details of the arrangement were not explored, at least some of the mortgaged land in Sutanari was mortgaged not to an individual household in the village but to a local co-operative society who had obtained the necessary funding by loan from the Gramin Bank. One of these was a 'youth group', another a women's group. These groups did not farm the land themselves, but let it to farmers in the village in the usual sharecropping arrangement, often to the very farmers from whom the land had been obtained in the first place.

This 'renting back' arrangement was common in Sutanari, even between individual households, but was not found at all in Geraki. Here again was evidence of fluidity in land tenure in the unprotected situation,
that fluidity being indicative of a prevailing economic instability. In the case of the co-operative societies, this provides a window of opportunity through which people can gain access to land who might otherwise be excluded from that access, but for many households, the situation leads only to a weakening of their economic position.

What a simple areal analysis of land tenure cannot reveal is the manner in which land of differing agricultural potential is distributed, i.e. whether the larger landholders have not simply more land but more land of better quality. This phenomenon was noted in the pre-project report as being present to a degree before the embankment - there was no direct relationship between landholding class and land quality, but it was observed then that the large landholders in the sample held no land in the lowest (i.e. most flood-prone) or highest (often the least fertile) land elevation categories. The post-project survey data showed any such tendency to have been by then significantly diminished, and large landholders to possess substantial areas of land in the upper- and lowermost elevation categories. As there had not been widespread land transactions, the best explanation for this is perhaps the reclassification of much land into a higher elevation category with the reduction of flood risk. Large landholders still owned proportionally less low-lying land than did any of the other landholding categories, but the effect of the embankment seems to have been to make the land elevation distribution at least appear slightly more equitable. Far less equitable is the distribution of land according to its fertility - in both pre- and post-project
situations, this was weighted in favour of the larger landholders.

In the village without flood protection, the pattern was distinct from either pre- or post-project Geraki. Large landholders held substantially more of the highest land than did any other landholding category, but when it came to land fertility, they in fact had a lower proportion of their holdings in the optimal categories. Quite what this indicates is far from obvious — perhaps that lower flood risk is held to compensate for loss of fertility; perhaps that sand deposition has diminished fertility on what were once the optimal lands; perhaps neither of these, but simply a pattern passed down in the inheritance of land, a pattern which land transactions have not yet altogether counteracted.

As all the information was based on respondents' own perceptions, perhaps the land quality data in both Geraki and Sutanari reflected no more than errors and inconsistencies in those perceptions. It is, in any case, inappropriate to base assessment of the embankment's influence in this sphere on the 'with - without' comparison, as the two villages cannot be assumed to share the same distribution of land fertility and elevation, or to have done so at any time in the past. The 'before - after' comparison is the more appropriate basis for judgment, and it indicates no further concentration of the best land in the hands of the already better-off large landholders. Instead, as the later section on agriculture reveals, the embankment has assisted farmers from all categories of landholding status to overcome the natural limitations of their land, especially in terms
of land height, thus reducing the once over-riding importance of the quality of a farmer's land to his household's wellbeing. The simple pattern of land ownership and rental, and the recent historical evolution of that pattern, is far more telling than any analysis of the distribution of land by land quality.

While by no means straightforward, the economic signals emanating from the prevailing patterns of land tenure in the two villages are certainly clear. Geraki is marked by an unusual stability in land tenure, with a low incidence of tenancy, barely any mortgaging, and only small areas of land being involved in land sales. In Sutanari, all is activity and change, with a high incidence of tenancy, significant areas of land being bought and sold, and a large proportion of all landowners having surrendered some of their land under mortgage agreements. At the time of the survey, the distribution of land in Geraki was no more egalitarian than that in Sutanari, but it seemed to have attained a more or less stable state, so that the concentration of land in the hands of fewer households at the cost of the dispossession of other households had been, if not entirely arrested, then at least significantly slowed. In Sutanari, this process was proceeding apace, so that it is likely that, since the survey, the distribution of land ownership has become progressively more skewed, with the incidence of landlessness soon coming to outstrip that in Geraki.

As far as tenancy is concerned, the higher incidence in Sutanari suggests a lack of security in the local agricultural economy, moving
respondents variously to let out or rent in land according to their individual circumstances and their predictions about short-term agricultural prospects, much as individuals in a developed capitalist economy might choose to buy or sell shares on the stock exchange. In Geraki, most landowners consider their household needs to be adequately met from the produce off their own holdings and tend not to enter into speculative land tenure arrangements. Those lacking land assets sufficient for subsistence generally seek to make up the deficit through alternative occupations instead of land rental. With no other difference in their socio-economic fabric adequate to account for the fundamental distinction between the two villages in the way that land in each is held, the presence of an embankment in Geraki is the most plausible explanation.

The broader socio-economic analysis which follows serves both to verify and to explain how flood control has enhanced Geraki's economic security. Land tenure was a necessary starting point for this broader analysis as it provides the means whereby the distribution of embankment-induced change is assessed, the distribution of benefits being considered as significant as overall economic improvement if the embankment's impact was to be judged positive.
6.3 Village social composition

Questions concerning household members asked their age, sex, level of education and relation to the head of the household. The head was also asked his own age and educational status. From these could be deduced the size of each household and whether it consisted of a nuclear or extended family, as well as the size and the age and sex composition of the total population of each village. It is worth repeating here the definition of a household used in the survey: 'members who ate from the same kitchen and operated productive assets as a single unit' (Alamgir, 1980, p. 102). The investigation of the demographic characteristics of each village was conducted partly to identify any social changes which might have followed embankment-induced economic change, but primarily simply to obtain a better understanding of the functioning of the socio-economic system. Demographic data had been included in the pre-project survey, so that the comparison between Geraki and Sutanari could be considered alongside the before- and after-project comparison for Geraki. As it was, neither the 'with - without' nor the 'before - after' comparison revealed any differences significant enough to suggest embankment-induced social change.

A population of 967 in 143 households in Sutanari and of 926 in 145 households in Geraki gave them an average household size of 6.8 and 6.4 respectively; the figure for pre-embankment Geraki was 7.1. The apparent reduction in household size in Geraki is not necessarily valid, as the pre-project survey used a slightly different and less
rigid definition of a household to that used here. This problem of
definition arises again when considering the relative proportions of
nuclear and extended family households. Here again, Geraki and
Sutanari display striking similarity — 66.2% of households were
comprised of nuclear family units in Geraki compared with 63.6% in
Sutanari — but there is an apparent discrepancy with pre-project
Geraki, where only 47% of households were nuclear. Even if the
figures are an accurate reflection of change in Geraki, the
similarity between Geraki and Sutanari makes it impossible to deduce
any role for the embankment, rather than broader socio-economic
processes operating in the country at large, in effecting the
change.

What does emerge clearly from pre- and post-embankment surveys is a
correlation between household size and composition and economic
status, with the households owning the most land tending to be
comprised of large, extended families (see tables 6.5 and 6.6). Bearing in mind that the pre-project figures for Geraki are based on
only a sample rather than the entire population, the broad
correspondence between the before- and after-project situations in
the relative proportions in each landholding class of nuclear and
extended family households does indicate at least that the embankment
has not been the agent of any major social restructuring. In fact,
it seems that the embankment may have served to slow the process of
household fragmentation which is associated with economic decline.
Among households in the category of small landholders, where one
might expect the tendency towards household fragmentation to be most
Table 6.5 Distribution of household size within each landholding category (%)

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<th>Number of household members</th>
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<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
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<td>Large</td>
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Table 6.6 Distribution of household type within each landholding category (%)

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<tr>
<th>Village and household type</th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-embankment</th>
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<tbody>
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<td></td>
<td>N</td>
<td>E</td>
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</tr>
<tr>
<td>Landless</td>
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<td>77</td>
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<td>Marginal</td>
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<td>Small</td>
<td>41</td>
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<td>71</td>
<td>19</td>
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<tr>
<td>Large</td>
<td>0</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>

N: nuclear
E: extended

(pre-project data from Miah, 1983)
marked, the greater proportion in Geraki live in extended family households, as was the case in pre-embankment Geraki, while in Sutanari the greater proportion are nuclear family households. This may indicate that a small farm in Geraki provides a more reliable livelihood than the equivalent landholding in Sutanari, thus testifying to the success of the embankment in improving agriculture.

An interesting aberration in Sutanari was its greater proportion of female-headed households, where the former male head had either died or deserted his family and left the village. (This does not include cases where the husband was a migrant worker, remitting a portion of his salary to his family.) There were eight such households in Sutanari and only three in Geraki. While this observation is of little significance in an objective analysis of inter-village differences, it did contribute to the subjective impression of an air of poverty and misfortune in the unprotected village, and of a greater social and economic stability in Geraki.

There were no major differences between Geraki and Sutanari in terms of the age and sex composition of their populations, nor would a population pyramid constructed for either village reveal any particular quirks or irregularities - both would display the broad base and narrow apex typical of populations in underdeveloped economies and the higher proportion of males reflecting the society's cultural bias which favours their survival. Again a comparison with the pre-project survey is possible. The percentage of the population
under the age of ten was found in the later survey to be 30% in both Geraki and Sutanari; in the pre-project survey, the corresponding figure for Geraki was 46%. So large is the discrepancy between these values that it suggests an error in the pre-project data, perhaps arising out of sampling, or perhaps in later computations. Certainly there was no corresponding bulge in the 10 - 15 age group in the later survey in Geraki, and it was noted in the original report (Miah, 1983) that the figure was exceptionally high relative to the national average of 30%. The figures for sex ratio similarly display strong similarity between Geraki and Sutanari in the post-project situation (109 and 110 respectively), but discrepancy with the pre-project figure (105). Sampling error may again be to blame and, as a result, no demographic change can be inferred.

While the demographic analysis revealed no major differences between the two villages, this does not preclude the possibility of the embankment having some influence on village social structure over the longer term. The embankment had been in existence for only four years at the time of the post-project survey, and the many other forces which shape social structure are both so deep-rooted and so slow-acting that it would be unrealistic to expect noticeable change over so short a period. It is a pity that inconsistencies in the data, particularly in terms of definitions, prevent a true comparison of the situation in Geraki after the embankment with that which prevailed before, as more reliable data may have revealed the beginnings of certain adjustments in the society in response to embankment-induced economic change. As part of a project monitoring
process, the demographic data collected are still of worth, with the size and composition of the household having proved a useful economic indicator.

Information gathered on literacy and education is also of more use as part of a long-term monitoring process, although there are items worthy of note here. The level of literacy in both villages was similar - 23% and 26% of those of schoolgoing age and above in Geraki and Sutanari respectively, compared with a figure of 22% for Geraki found by Miah in his 1982 survey. Interestingly, the 1986 survey reveals Geraki to have a significantly lower level of literacy among household heads than does Sutanari (16% to Sutanari's 24%), despite the roughly equivalent literacy levels of the two villages in aggregate terms. An investigation into the relative education level of different age brackets reveals that this gap between Geraki and Sutanari is partly made up by the literacy rate among its young - in Geraki, 27% of children in the 5 - 15 age bracket were in education, the same figure as for Sutanari. This suggests that there had been a significant recent improvement in access to education in Geraki, while the improvement in Sutanari had been rather more gradual. The road facility provided by the embankment, giving easier access for the children of Geraki to the secondary and tertiary education facilities provided in Mirzapur, may be of some significance here. Economic improvement effected by the embankment may also have reduced the opportunity cost for some households of sending children to school; children who would otherwise have been of more worth working on the family land or being hired out as agricultural labour to other
farmers. (There is no real cost of sending children to school, each village having access to free primary schooling in the local area.)

A positive correlation between the education level and the landholding status of households is evident from the post-project survey data in both villages, as well as in the data from the pre-project survey. There is also a marked difference in the education levels of men and women, with very few of the adult women in either village having any education at all. Among the children, too, the proportion of males in school is higher than that of females. However, both the economic and the sex factor in determining access to education are less significant in the lower age brackets, indicating a gradual expansion in the reach of education across cultural and economic barriers. Again, proof of any role for the embankment in aiding the spread of education must await a later survey, when embankment-induced change has had the chance to filter its way through the whole of the local socio-economic system.

A fundamental factor in understanding Bangladeshi society is religion. It is to the divisions between Hindu and Muslim that the country owes its very existence, and religion is an important influence in the functioning of village society and economy. The country's Hindu minority may have low visibility at the national scale, but in Geraki and Sutanari it plays an important part in village life. The Hindu community fills a distinctive occupational niche, with many of them being fishermen, an occupation traditionally associated with their caste designation (the fishermen caste is known
as Jele, with the associated clan name of Rajbongshi). This is not to say that all Hindu households in both villages are fishing households, however, nor even that all the fishing households are Hindu - there was found a number of Hindu households with farming as their primary economic activity and Muslim households with fishing as their primary economic activity. There was, however, in each of the study villages, an area known as the majhipara (fishermen's neighbourhood) occupied solely by Hindu households, most of these engaged in fishing as a primary occupation.

As had been indicated in the census data consulted in the process of village selection, the proportion of Hindu to Muslim households was found to be greater in Sutanari (50.4%) than in Geraki (39.3%). With religion being such an important determinant of occupation, such a breakdown of households by religion was essential if data collected on occupations and associated factors, such as incomes and land tenure, were to be properly interpreted and the impact of the embankment properly understood. Had the embankment, say, benefited agriculture but disrupted fishing activity, there might have been a connection between a respondent's religion and his perception of the embankment as either a positive or a negative influence on his livelihood. Any inter-communal tensions that might have existed between the two religious communities might thus have been exacerbated. That this was not the case, and that Hindu-Muslim relations in Geraki were instead found to be amicable, is an indication, albeit an indirect one, of equity in the distribution of project benefits across different occupation groups. Relations
between Hindu and Muslim in fact seemed better in the flood-protected village than in the unprotected village. It might be argued that the economic strengthening fostered by the embankment has had some role to play in this social stability, while economic deterioration in Sutanari has led to increased competition for resources and a resultant widening of social divisions.

Such deductions must, however, remain in the realm of conjecture until such time as more substantive evidence of embankment-induced social change has emerged. On their own, data on social parameters shed little light on the influence of the embankment, but they were important in providing insight into basic village social organisation, which in turn explains village economic organisation, the household forming the basic unit of both society and economy. More significant than any social or demographic characteristic of households is the way in which they function as economic entities, and particularly how they deploy their human resources to maximum economic advantage.
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CHAPTER 7

SOCIO-ECONOMIC ANALYSIS II:

EMPLOYMENT; INCOME AND EXPENDITURE; THE MATERIAL HOUSEHOLD

7.1 Occupations

In the rural Bangladeshi society and economy, a man's occupation can indicate many things: his religion; his wealth; his standing in the community. The range of employment is limited, and primary occupations are essentially restricted to those of farmer, fisherman and agricultural labourer. The number as well as the nature of occupations practised by an individual is significant. Only the wealthier households, with access to sufficient land, can support themselves by farming alone; the heads of poorer households often have to combine two or three different income-earning activities in order to provide for themselves and their families. A seasonal component comes into play here, too: for the better-off households, the income from agricultural surplus may be sufficient to tide them over the inactive months of the monsoon, but the cessation of agricultural activity means that poorer households have to seek other employment during the monsoon season. A household head may thus practise only one occupation at a given time, but two or three different occupations over the year. Multiple occupations are not always a sign of poverty, however, as large landowners may play only a supervisory role in farming their land and engage in some form of trade or other business as their primary occupation. Service-holders
such as teachers or clerks might also own some land and retain an interest in farming. Conversely, having a single occupation can be an indication of poverty if, for example, that occupation is agricultural labourer, or if the single occupation represents the absence of any other employment opportunity. The occupational structure of a village can thus become far more complex than the limited employment options would seem to suggest.

It is in the level of multiple occupations rather than the occupations or combinations of occupations themselves that the two villages display divergence (table 7.1) Most striking is the disparity in the number of respondents practising three different occupations: only two household heads in Geraki (1.4%), but twenty-four (16.8%) in Sutanari. The proportion of respondents engaged in two separate occupations was roughly equivalent in the two villages at just over half, which left Geraki with a significantly higher proportion of its respondents making a living from just a single occupation.

This divergence is not in itself a sufficient indicator of Geraki being better off than Sutanari in economic terms, but further analysis of occupation type shows that the flood-protected village does indeed enjoy economic superiority. Geraki's higher proportion of single-occupation respondents was found to be due primarily to its having a higher proportion of respondents able to support their households from their farming activities alone, and not to any expansion in the occupational categories of fishing and agricultural
Table 7.1 The incidence of multiple occupations among respondents in with- and without-project villages

<table>
<thead>
<tr>
<th>Number of different occupations held</th>
<th>Proportion of respondents (%)</th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44.1</td>
<td>32.9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>54.5</td>
<td>50.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.4</td>
<td>16.8</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2 Pattern of occupations among single-occupation respondents in with- and without-project villages

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Proportion of respondents (%)</th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>farmer</td>
<td>68.8</td>
<td>68.1</td>
<td></td>
</tr>
<tr>
<td>agricultural labourer</td>
<td>6.2</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>fisherman</td>
<td>14.1</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>10.9</td>
<td>10.6</td>
<td></td>
</tr>
</tbody>
</table>
labour such as might accompany economic decline and the accompanying increase in landlessness. The two villages in fact display remarkable convergence in the pattern of occupations within the single-occupation group of respondents (table 7.2). The major difference is simply that there are sixty-four such households in Geraki and only forty-seven in Sutanari, where holding multiple occupations is a common survival mechanism in a fragile economy.

Unfortunately, the level of data aggregation in the pre-project survey does not allow a comparison in these terms with the situation in Geraki before the embankment. Nevertheless, the comparison between with- and without-project villages indicates that the embankment has induced economic improvement without altering the basic structure of the local socio-economic system. That more household heads in Geraki than in Sutanari can support their families on the earnings from a single occupation can also be seen as evidence for the embankment's having reduced the flood risk factor, as in many cases it is not simply poverty but the threat of damage or disruption to their agricultural livelihood which causes farmers and agricultural labourers to take on extra occupations.

Further examination of the data on occupations reveals more evidence of the relative economic advantage of Geraki over Sutanari (table 7.3). Looking at single- and multiple-occupation respondents together, Geraki is seen to be the village with the higher proportion of respondents engaged in farming as their primary occupation, while Sutanari has the higher proportion of respondents engaged primarily
Table 7.3 Pattern of occupations in with-, without- and pre-project situations

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-project Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>farmer</td>
<td>65.5</td>
<td>60.1</td>
<td>80.5</td>
</tr>
<tr>
<td>agric. labourer</td>
<td>5.5</td>
<td>9.1</td>
<td>2.3</td>
</tr>
<tr>
<td>fisherman</td>
<td>20.7</td>
<td>22.4</td>
<td>15.6</td>
</tr>
<tr>
<td>other</td>
<td>8.3</td>
<td>8.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Secondary occupation</td>
<td></td>
<td></td>
<td>(secondary or tertiary)</td>
</tr>
<tr>
<td>farmer</td>
<td>12.4</td>
<td>20.2</td>
<td>3.9</td>
</tr>
<tr>
<td>agric. labourer</td>
<td>22.8</td>
<td>18.2</td>
<td>35.2</td>
</tr>
<tr>
<td>fisherman</td>
<td>4.1</td>
<td>2.8</td>
<td>11.0</td>
</tr>
<tr>
<td>other</td>
<td>16.6</td>
<td>25.9</td>
<td>26.5</td>
</tr>
<tr>
<td>total</td>
<td>55.9</td>
<td>67.1</td>
<td>76.6</td>
</tr>
<tr>
<td>Tertiary occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>farmer</td>
<td>0.0</td>
<td>2.1</td>
<td>-</td>
</tr>
<tr>
<td>agric. labourer</td>
<td>0.0</td>
<td>8.4</td>
<td>-</td>
</tr>
<tr>
<td>fisherman</td>
<td>1.4</td>
<td>2.8</td>
<td>-</td>
</tr>
<tr>
<td>other</td>
<td>0.0</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>total</td>
<td>1.4</td>
<td>16.8</td>
<td>-</td>
</tr>
<tr>
<td>Total in occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>farmer</td>
<td>77.9</td>
<td>82.4</td>
<td>84.4</td>
</tr>
<tr>
<td>agric. labourer</td>
<td>28.3</td>
<td>35.7</td>
<td>37.5</td>
</tr>
<tr>
<td>fisherman</td>
<td>26.2</td>
<td>28.0</td>
<td>26.6</td>
</tr>
<tr>
<td>other</td>
<td>24.9</td>
<td>37.8</td>
<td>28.1</td>
</tr>
</tbody>
</table>

(pre-project data from Miah, 1983)
in agricultural labour or fishing. As a corollary, farming occurs as a secondary or even tertiary occupation with greater frequency in Sutanari, while Geraki in comparison has more households engaged in agricultural labour as a subsidiary occupation.

The two villages have almost equal proportions of their respondents engaged in 'other' occupations as their primary economic activity, although Sutanari is the village with the higher proportion of its respondents in the 'other' category when it comes to subsidiary occupations. Comparing the range of 'other' occupations practised in each village shows up some interesting similarities and differences, yielding further evidence of change in the socio-economic system of the flood-protected village. Certain 'other' occupations are common to both villages, each having at least one carpenter, fish trader, teacher, shopkeeper, boatman and maker of fishing nets, a range of occupations as could be found in any village in Bangladesh having a fishing community of any size. Further occupations common to both Geraki and Sutanari, but perhaps more restricted on a national scale, are those of irrigation co-operative manager and construction labourer, dependent respectively on the distribution of irrigation projects and proximity to an urban centre. Another similarity between the two villages, and again something of a standard practice in the country at large, is for women who find themselves in the role of household head (perhaps through being widowed) to earn a living by working as domestic servants in the wealthier households.

Important differences between the two villages then arise. In
Geraki, the remaining occupations in the 'other' category, be they primary or secondary occupations, tend to be in salaried posts, in occupations involving some skill as craftsman or artisan, or in small enterprises set up in response to local market demand. Among those in salaried posts, Geraki has a factory worker in the town of Tangail, a bank clerk in Mirzapur, and a migrant worker in the Middle East. Geraki's craftsmen and artisans include a weaver, a potter, a maker of bamboo matting and fencing, and an electrician. The list of small entrepreneurs is yet more impressive, with people displaying no little ingenuity in perceiving an income opportunity. One man gathers sand from the local khals and rivers and sells it for use in the local construction industry; another grows tobacco and makes and sells bidi (cigarettes); someone cultivates rice seedlings in excess of his own requirements and sells them to other farmers; another man buys confectionery in Mirzapur and then hawks it from village to village.

Sutanari has its craftsmen, artisans and service-holders in the 'other' category of occupations, but it lacks either the number or the range of small entrepreneurs. In fact, only a single Sutanari respondent can be considered to fall into this category: a widow who keeps poultry and sells eggs and chickens to other village households. This absence of entrepreneurs must be due either to the absence of a local market or to the unavailability of capital to make the initial investment in such an enterprise, or perhaps to a combination of the two, each being indicative of a weaker economy in Sutanari. Making up the remainder of the considerable number of
Sutanari households that engage in 'other' subsidiary occupations is a large number of paddy huskers, an occupation of such low prestige and poor financial return that it can be regarded as an indicator of economic distress. Paddy husking is 'one of those marginal occupations that many rural families pass through on their way to total destitution. It has rather easy entry, and it is a rather lowly paid occupation...' (Sen, 1982, p. 72). Sen observes that paddy husking is done almost exclusively by women, forced into the occupation by the death of the male earner. In Sutanari, however, the occupation was by no means restricted to female-headed households. Instead it was practised most often by the poorer farming households to supplement their income from agriculture, the women still doing most of the actual husking work, but the male household head purchasing the raw paddy and reselling it as husked rice in the local market. Admittedly paddy husking is done mostly as a secondary or tertiary occupation in Sutanari, rather than as a primary or even only occupation as in the households mentioned by Sen, but the mere fact that households engage in an occupation of such low prestige and minimal return on investment is indication enough of a fragile local economy. The complete absence of paddy husking in Geraki is further testimony of its economic superiority over the unprotected village.

This comparison of occupation patterns in Geraki and Sutanari has already provided several indications of a more robust local economy in the embankment-protected village. Fewer household heads are obliged to practise multiple occupations; more households are able to
base their livelihood on the produce and earnings from their agricultural activities; fewer households have to depend on being employed as agricultural labour; several small enterprises are supported; and no household has had to resort to an occupation of destitution such as paddy husking. But to what extent is this attributable to the embankment? Data from the pre-project survey allow an assessment of change over time in the two villages, thus giving some idea of the relative significance of the embankment among other agents of change. (For the purpose of this assessment, the pre-project data for Geraki have to be taken as being representative of 1982 Sutanari as well.)

In drawing a comparison with the pre-project situation in Geraki, it should be borne in mind that the pre- and post-project survey data sets are not entirely compatible, owing to the slightly different definitions used in the two surveys. The pre-project survey's less rigid definition of a household has already been discussed. It was also never made clear in the pre-project survey upon what criteria occupations were designated as 'primary' or 'secondary' - whether according to income earned, time spent, or simply the personal perception of each respondent. In the post-project survey, the respondents' own perceptions were taken as valid, the difficulties of obtaining accurate income or time-budget data being deemed too great. Another insurmountable problem in this 'before - after' comparison was the impossibility of distinguishing the seasonal and year-to-year fluctuations inherent in such an economy from longer-term change, including that resulting from the embankment.
The main trends revealed by the comparison are nevertheless likely to be genuine, even if data limitations will have caused some to be exaggerated and others dampened. The pre-project data are included in table 7.3.

The most noticeable trend affecting both Geraki and Sutanari in the period since the pre-project survey was conducted has been the decline in farming as a primary activity. In most cases, farming has not been dropped altogether, but has rather been demoted to the status of secondary activity. Two separate processes seem to have been operating to effect this change. The first is the expansion of employment opportunities outside agriculture and fishing as the villages become increasingly enmeshed in the wider national and even international economy. Pre-project Geraki had only one salaried person; post-project Geraki had five and Sutanari four, with Geraki's complement including a migrant worker in the Middle East. Four respondents in pre-project Geraki claimed some form of business activity as an occupation; post-project Geraki and Sutanari had six small businessmen apiece, most of these owners of small shops in the nearby towns of Mirzapur and Fatehpur respectively. An occupation which seems to have become more prominent since the pre-project survey is that of fish trader, with a number of people in either village now making a living not by fishing themselves, but by purchasing the catches of local fishermen and selling fish as far afield as the urban markets of Dhaka and Tangail. Thus for many households where 'other' occupations have replaced farming as their primary economic activity, this represents an improvement in their
The second process contributing to the decline in farming as a primary occupation has been the economic decline affecting some households. This is evidenced by the promotion particularly of agricultural labour but also of fishing to the status of primary occupation from that of subsidiary occupation. In both Geraki and Sutanari, a substantial proportion of the expansion in farming among secondary occupations has been due to household heads once primarily farmers, who worked only sometimes as agricultural labour, coming to rely primarily on employment as agricultural labour for their livelihood, demoting farming to the status of secondary occupation.

Both processes have operated in each of the study villages, as they have in villages throughout the country, but the extent to which each had progressed differed between Geraki and Sutanari. In Geraki, the decline in the number of primarily farming households seems to have been due to the two processes operating in almost equal measure, with as many respondents moving into 'other' occupations as their primary economic activity as into agricultural labour and fishing. In Sutanari, not only has the apparent decline of farming as a primary activity been more pronounced, but it has also been attributable largely to the second, more negative process of change, with agricultural labour or fishing replacing farming as the primary occupation in many households. This suggests that economic decline has been more pronounced in the unprotected village, and that the embankment has contained the process of impoverishment which forces
households into the agricultural labour market.

Further evidence backing up this conclusion is found in the lower proportion of respondents practising more than one occupation in Geraki relative either to its own pre-embankment condition or to Sutanari at the time of the post-embankment survey. Comparing Sutanari with pre-embankment Geraki suggests that the incidence of multiple occupations increased over the period 1982-6 in the unprotected village while it decreased in the protected village. Furthermore, the level of multiple occupations in Geraki was artificially elevated at the time of the pre-embankment survey, as labour had already been recruited to begin construction on the embankment (note the high percentage in the 'other' subsidiary occupation category in the pre-embankment figures in table 7.3). This means that the increased incidence of multiple occupations in Sutanari has probably been even larger than the figures suggest, while the apparent decrease in Geraki represents little or no change from the situation prevailing before construction work on the embankment commenced.

The 'before - after' comparison of occupations thus appears to reinforce everything that was said in the earlier 'with - without' comparison, and testifies to the success of the embankment in strengthening the local economy (or at least in preventing its weakening). With all the data shortcomings, not least the need to use pre-embankment Geraki as a surrogate for Sutanari, the 'before - after' comparison must be regarded with some circumspection, and the
simple comparison between post-embankment Geraki and Sutanari remains the more reliable basis for asserting an improvement in Geraki's economy. Yet even this 'with - without' comparison is not without its limitations. The discussion has not yet taken full account of the religious element in determining occupation, nor of the influence of landholding status on occupation choice. The important issue is not simply whether there are more labourers or fishermen, or more people with multiple occupations, in Sutanari relative to Geraki, but whether there are more labourers or fishermen or more people with multiple occupations in a particular socio-economic group in Sutanari relative to the equivalent group in Geraki.

With its higher proportion of Hindu households, Sutanari could have been expected to have had a higher incidence of fishing as either primary or secondary occupation. This was by no means the case, with the difference in the overall number of fishermen instead being less than two per cent. Nor was there any significant difference between the two villages in the status of fishing as primary or subsidiary occupation (table 7.3 again). The higher incidence of multiple occupations in Sutanari can thus be seen to be due to factors other than religious composition, giving weight to the thesis that the inter-village differences are indeed attributable to economic change wrought by the embankment. A breakdown of occupation by religion in Sutanari revealed another interesting insight: the religious basis for the determination of occupation seems to have broken down somewhat, with there being a significant number of Muslim fishermen while more than half of the Hindu respondents did not list fishing as
one of their occupations. That Muslims engage at all in an occupation which, to them, is of low prestige, almost an 'occupation of destitution' as is paddy husking, is further evidence of insecurity in the local economy. The relatively low percentage engaged in fishing among Sutanari's large Hindu population suggests perhaps that the village has historically had a Hindu majority, who therefore enjoy a higher level of affluence and greater access to land for farming than in villages where Hindus are in the minority.

The correlation between landholding status and occupation is further proof of the greater economic strength of Geraki relative to Sutanari, and suggests improvement in Geraki itself since the embankment (table 7.4). The number of occupations held by each respondent is again a useful economic indicator. In comparing the incidence of multiple occupations by landholding class in the two villages in the post-embankment situation, one major difference is immediately apparent: among small landholders, Geraki has the majority earning their livelihood in a single occupation (farming) alone, whereas in Sutanari fully two-thirds of the small landholders are obliged to supplement their income from agriculture with earnings from a subsidiary occupation. This situation in Sutanari closely resembles that in pre-embankment Geraki, so that both the 'before - after' and the 'with - without' comparisons point to improvements in agriculture, making it a more reliable basis for a household's livelihood. Among the larger landholders, subsidiary occupations are practised not to meet basic needs but to generate extra income, those occupations being largely in business enterprises. For this group,
<table>
<thead>
<tr>
<th>Location</th>
<th>Landless</th>
<th>Marginal</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraki</td>
<td>61</td>
<td>12</td>
<td>56</td>
<td>76</td>
<td>75</td>
</tr>
<tr>
<td>Sutanari</td>
<td>64</td>
<td>4</td>
<td>34</td>
<td>81</td>
<td>50</td>
</tr>
<tr>
<td>Pre-embankment Geraki</td>
<td>77</td>
<td>32</td>
<td>30</td>
<td>68</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Single Occupation</th>
<th>Multiple Occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraki</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landless</td>
<td>61%</td>
<td>39%</td>
</tr>
<tr>
<td>Marginal</td>
<td>12%</td>
<td>88%</td>
</tr>
<tr>
<td>Small</td>
<td>56%</td>
<td>44%</td>
</tr>
<tr>
<td>Medium</td>
<td>76%</td>
<td>24%</td>
</tr>
<tr>
<td>Large</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Sutanari</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landless</td>
<td>64%</td>
<td>36%</td>
</tr>
<tr>
<td>Marginal</td>
<td>4%</td>
<td>96%</td>
</tr>
<tr>
<td>Small</td>
<td>34%</td>
<td>66%</td>
</tr>
<tr>
<td>Medium</td>
<td>81%</td>
<td>19%</td>
</tr>
<tr>
<td>Large</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Pre-embankment Geraki</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landless</td>
<td>77%</td>
<td>23%</td>
</tr>
<tr>
<td>Marginal</td>
<td>32%</td>
<td>68%</td>
</tr>
<tr>
<td>Small</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>Medium</td>
<td>68%</td>
<td>32%</td>
</tr>
<tr>
<td>Large</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

(Pre-project data from Miah, 1983)
the embankment has meant little change, with most households being able, both before and since the embankment, to depend entirely on agriculture for their basic livelihood.

Most of the marginal farming households in both Geraki and Sutanari are engaged in at least one extra occupation in addition to their farming activities, as they were in pre-embankment Geraki. The proportion of respondents with more than one occupation among marginal landholders has, however, increased markedly since the pre-embankment survey in both the with- and without-project situations. With the difficulty of supporting even a small household off a marginal landholding, this is as likely to reflect improvement in alternative employment opportunities as any deterioration in their agricultural livelihood - certainly in Geraki, where all other evidence points instead to agricultural improvement. The broad similarity between Geraki and Sutanari in the proportion of marginal-landholding households in multiple occupations (although with Sutanari still having slightly more households in the multiple-occupation category) suggests that what changes there have been, have been due to processes operating at the larger scale and not to any influence of the embankment. Among landless households, most in Geraki and Sutanari are in single occupations as agricultural labourers or fishermen, just as they were in Geraki before the embankment.

The most conclusive evidence, from an examination of occupations, of the embankment's positive influence on the local economy remains the
Table 7.5 Occupation characteristics among landholders of varying status

Percentage of each category who are: farmer only farmer-cum-labourer

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th></th>
<th>Sutanari</th>
<th></th>
<th>Pre-embankment</th>
<th>Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marginal</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>Marginal</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>56</td>
<td>76</td>
<td>75</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>farmer only</td>
<td>40</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>58</td>
<td>24</td>
</tr>
<tr>
<td>farmer-cum-labourer</td>
<td>40</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(pre-project data from Miah, 1983)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
greater proportion of landholding households, and particularly of small farming households, in Geraki that are supported from agriculture alone, relative to the situation either in the unprotected village or in Geraki itself before the embankment (table 7.5). A direct result of the increased security in farming has been a marked decrease in the proportion of landholders who work as agricultural labourers (also in table 7.5), Geraki having fewer labourers in each landholding class than either Sutanari or pre-embankment Geraki. To make up its complement of agricultural labour, Geraki has a higher proportion of its landless households engaged in agricultural labour. This represents an improvement in the economic fortunes of the landless, who can avail themselves of income-earning opportunities previously taken up by marginal and small farmers.

The overall indications from the investigation of occupations, both at the aggregate level and when disaggregated according to landholding status, are of economic improvement for all socio-economic groups in the village protected by the embankment. This is borne out by the decline in the practice of multiple occupations by landholding households, particularly those in the category of small landholders; by the decline among all landholders in the numbers working as agricultural labourers; and by increased employment in agriculture among landless households. Both a 'with - without' and a 'before - after' comparison display these trends, indicating that the embankment has not merely arrested decline but caused an actual improvement in Geraki, giving greater security to
the agricultural livelihoods of those with land and increased agricultural employment opportunities to the landless.

7.2 Employment status

Further verification of economic improvement in the flood-protected village is found in an analysis of household employment status. For a farming household to be able to employ labour to assist in its agricultural operations, without household members having to compensate for the cost of hiring that labour by working as agricultural labourers themselves, is indicative of a strong household economy. Likewise, if a farming household does not employ agricultural labour but has members who are obliged to supplement household income by working as agricultural labour, this is indicative of a weak household economy. Between these two extremes fall a number of households who need neither to employ nor to be employed as agricultural labour, or who both employ and are employed as agricultural labour.

A household's employment status, like most other aspects of the household economy, has much to do with its size in relation to the size of the land to which it has access for farming. In this study, landholding size on its own is used as the basis for disaggregation in order to determine the relationship between employment status and economic status and to see how this relationship has been influenced by the implementation of flood control. It was felt that to include
household size in the analysis would have made it unnecessarily complicated. Household size was in any case closely related to landholding size; the two study villages were broadly similar in their demographic composition; and there would have been problems in determining the relative role of household members as assets (free farm labour) or liabilities (mouths to be fed). There was the additional advantage in using landholding status alone of consistency and therefore of comparability with other parts of the broader study, such as the section on occupations.

Nowhere in the pre-project survey was information on employment expressed in these terms, so the basis of the analysis has to be a comparison between Geraki and Sutanari. The crucial question in deeming the embankment a positive influence in this sphere is whether Geraki has a higher proportion of landed households that are either employers only, employer-cum-labourers, or neither employers nor labourers, and fewer that are labourers only. The results obtained from the survey on employment status are presented in table 7.6. The percentage of landholding households found to be employers only is seen to be almost the same in the two villages: 49% in Geraki; 52% in Sutanari. When it comes to households that are labourers but not employers, Sutanari is seen to be the village with the higher number of respondents falling in this category. Sutanari also leads Geraki in the number of employer-cum-labourer households, but Geraki has a significantly larger proportion of its farming households neither labourers nor employers of agricultural labour.
Table 7.6 Employment status of landed households in with- and without-project villages

a) All landholders

<table>
<thead>
<tr>
<th></th>
<th>Employer only</th>
<th>Labourer only</th>
<th>Employer -cum- employer nor labourer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraki</td>
<td>49</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>Sutanari</td>
<td>52</td>
<td>25</td>
<td>14</td>
</tr>
</tbody>
</table>

Percentage of each category that are:

<table>
<thead>
<tr>
<th>Employer only</th>
<th>Labourer only</th>
<th>Employer -cum- employer nor labourer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraki</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>Marginal</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Small</td>
<td>54</td>
<td>7</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>100</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

b) Breakdown by landholding category

<table>
<thead>
<tr>
<th>Employer only</th>
<th>Labourer only</th>
<th>Employer -cum- employer nor labourer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sutanari</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>Marginal</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Small</td>
<td>12</td>
<td>68</td>
</tr>
<tr>
<td>Medium</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

Percentage of each category that are:

<table>
<thead>
<tr>
<th>Employer only</th>
<th>Labourer only</th>
<th>Employer -cum- employer nor labourer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sutanari</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Marginal</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Small</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Medium</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
While these figures provide conflicting evidence, there is much in them that points to a more equitable economy in Geraki. At the extremes of the socio-economic hierarchy are the wealthy households which are employers only and the poorest marginal farming households which are labourers only; Sutanari has slightly more in the first category and significantly more in the second, indicating a more polarised socio-economic structure. In the category which represents household self-sufficiency in labour terms, with household members providing all the labour for farming operations on the family land, the number in Geraki far exceeds that in Sutanari. Unfortunately, no information was obtained from employer-cum-labourer households as to whether they were net employers or net labourers, so it is impossible to judge precisely their relative economic status. It is, however, reasonable to assume them to be of equivalent economic standing to the 'neither employer nor labourer' households. Sutanari's small superiority in numbers in the employer-cum-labourer category is thus negated by Geraki's greater superiority in the number of labour self-sufficient households. With a lesser number of labouring households and a greater number of households in the intermediate categories taken together, Geraki can be seen to provide a more secure agricultural livelihood for the smallest among its landholders than can Sutanari.

This is borne out by an analysis of employment status by landholding category (also in table 7.6). In both villages, virtually all the medium and large farmers were found to be only employers of labour, with insufficient household members to provide all the labour
required on the family land and sufficient earnings from agriculture to support all household members without their having to seek work themselves. Only two households in Sutanari were the exception, both being medium farmers with extended families large enough to provide all the farm labour required. The noted differences between the two villages are therefore contained almost entirely within the categories of marginal- and small-landholding households: the higher proportion of households self-sufficient in labour terms and the lower proportion of 'labourer only' households in Geraki, and the greater proportion of 'employer only' households in Sutanari. Greater socio-economic polarisation can thus be seen to exist even within the lower two landholding categories in Sutanari, as evidenced by the more marked divergence between the employment status of marginal and small landholding categories in that village. The figures show no simple correlation between landholding size and employment status, but it can at least be claimed that households in the category of marginal farmers, containing fewer labouring households, are better off in the flood-protected village.

While the analysis of employment status by landholding class provides evidence of a higher degree of economic equity in the flood-protected village, it gives little indication of the embankment's effect on general economic improvement. It certainly appears, though, that there has been an improvement in the economic fortunes of the poorest households in Geraki while, among the equivalent group in Sutanari, households have become increasingly economically marginalised, their livelihoods from agriculture becoming weakened, forcing an increased
reliance on agricultural labour for a living. Considering occupations along with landholding class contributes further to an understanding of who employs and who labours, and thus of the full economic impact of the embankment.

Of the landed, 'employer only' households, exactly half in Geraki have their household head engaged in a second, non-agricultural occupation in addition to farming. In Sutanari, this proportion is closer to 60%, which serves to explain why Sutanari has a higher proportion of its small farming households in the 'employer only' category - not because farming is more profitable, but because so many small farmers are engaged in additional occupations, most notably fishing, thus being unable to devote sufficient time to agricultural operations. Among the landed but 'labourer only' households, further indication of a less secure agriculture in Sutanari is found in the higher proportion of multiple-occupation households it has in this category. Whereas only three of Geraki's twenty-one such households are engaged in another occupation on top of farming and agricultural labour, the heads of eleven of the thirty such households in Sutanari are engaged in a third or in one case even a fourth occupation (farming, agricultural labour, fishing and carpentry).

A similar situation is found in the employer-cum-labourer and 'neither employer nor labourer' households. In Geraki, of the twelve households which both employ and are employed as agricultural labour, all but one are involved exclusively in the two occupations of
farming and agricultural labour; but the seventeen such households in Sutanari include six that are obliged to supplement their farming and labouring income with a third occupation, commonly fishing or paddy husking. In those households neither employing nor employed as agricultural labour, Sutanari has only two (of eleven) engaged exclusively in farming, all the others being engaged in fishing as their other, often primary, occupation. Geraki has twelve of its twenty-five such households earning their living solely through agriculture.

Thus it can be seen that Geraki provides its inhabitants with a more secure income from agriculture, so that it is possible even for households with access to only a small amount of land to earn their livelihood through farming and working as labour on the farms of others. In an economy where agricultural subsistence is, for many households, an ambition rather than the status quo, it is significant that there are only two Sutanari households that can live off their own agricultural production operating entirely with household labour and without having to seek any alternative source of income, relative to twelve such households in Geraki. Even without other factors pointing to Geraki's economic superiority, this would be sufficient indication of the reinforcement provided to Geraki's agricultural economy by the implementation of flood control.

Other aspects of the employment situation were investigated along with the employment status of each household. Respondents working as agricultural labour were asked whether they did so only seasonally or
throughout the agricultural year. This revealed that Sutanari had a higher proportion of year-round labourers while most labourers in Geraki worked only in seasons of peak labour demand such as the boro harvest, confirming the finding that Sutanari had a larger proportion of households dependent largely or exclusively on agricultural labour for a living. This might, of course, have indicated higher demand for agricultural labour in Sutanari, but this was found not to be the case, with more Geraki farmers reporting difficulty in recruiting agricultural labour and more Sutanari labourers reporting difficulty in finding employment. (Study of the different agricultural systems prevailing in the two villages also revealed Geraki's to be the more demanding in terms of labour input; see following chapter.)

The means and amount of payment for agricultural labour were also enquired of both employers and labourers. In both villages, the majority of agricultural labourers were employed and paid on a daily basis, working for a number of different employers even within a single agricultural season. At the time of questioning, when field preparation for rabi crops was the prevailing agricultural activity, a labourer in Geraki could expect to receive for a day's work a sum of Tk25 in addition to three cooked meals. This rate of pay was reported by labourers and employers alike. In Sutanari, not only was the average reported wage lower, but there was a discrepancy between employers and labourers in their reported wage levels - the going wage reported by employers being on average Tk24; that among labourers Tk22. In addition, two rather than three meals were provided to labourers in Sutanari, or even no meals in cases where
employer and employee were from different religious groups, making the lower cash wage all the more significant. All indications from the labour payment situation are of a higher demand for labour in Geraki, with a labour surplus in Sutanari creating a favourable situation for employers, who can hire labour at depressed wages. This is yet another piece of evidence of the economic improvement resulting from the construction of the embankment.

One aspect of the labour situation which does not show up in a formal analysis of employment arrangements and wage rates is the existence of a labour exchange arrangement known as dara kamla. This arrangement, found in both Geraki and Sutanari, involves farmers working on each other's land not for payment but for labour in return. In this way, farmers with insufficient household labour and unable to afford the cost of hiring labour can co-operate to ensure that the necessary agricultural work on their fields gets done. Ties of kinship and religion, as well as purely practical considerations such as proximity of residence and convenience of field location, determine the composition of the informal co-operatives that result.

The comparison of agricultural employment arrangements in the protected and unprotected situations strengthens the case to prove that the impact of the embankment on the local socio-economic system has been favourable. It reinforces the theory that the embankment's most important effect has been in improving agriculture, and it begins to reveal something of the distributive impact of the embankment through the socio-economic hierarchy, showing that
marginal and small farmers and even the landless have benefited along
with the larger landowners. Although providing at best only indirect
indices of economic wellbeing, the data on employment and occupations
proved possibly more reliable and more revealing than the more
conventional economic indicators of household income and expenditure
which form the subject of the next section.

7.3 Household food expenditure

In any socio-economic system, gathering data on household budgets is
fraught with difficulty. In the developing world, these problems are
compounded and magnified. One cannot, for example, simply ask a
respondent to state his current income.

Will the respondent know what is meant by income? Is it family income? Are gifts and gratuities to be included?
What about income in kind rather than cash? There are scores of different definitions of income - which will
the respondent adopt? Almost certainly the definition will be a simple one that differs from the survey
requirement; and there will be variation in the definition adopted by different respondents. (Casley and
Lury, 1981, p. 95)

Taking such considerations into account, it was decided to
concentrate on income from agriculture and expenditure on food, both
of which were likely to be comprehensible to and estimable by the
respondents, and which in any case make up the bulk of the budget for
most households. It was also for these reasons that emphasis was
placed on a 'with - without' rather than a 'before - after'
comparison, as then at least some standardisation could be
maintained.

The effect that the flood control project has had on food supply was considered to be of particular importance, so the first and most important question put to respondents in the questionnaire section on household budgets asked how they met their household food requirements. It was found that the higher level of household labour self-sufficiency in Geraki was matched by a higher level of self-sufficiency in food terms - twice as many households in Geraki claimed to live entirely off their own agricultural production, without making any significant food purchases, as did in Sutanari. The figures were 10% and 5% respectively (including owner-cultivators and, where land was sharecropped, both owner and tenant if both households were fully provided for from the same land). Households subsisting entirely off their own agricultural production were found exclusively among small and medium landholders. Marginal farmers lack the land resource to ensure an adequate year-round supply of food for their families, and have to buy food to make up the deficit; the wealthier households spend considerable sums on non-staple food items to supplement their own production of basic foodstuffs. Large landholders can also afford to 'play the market' with their agricultural produce, buying food for consumption when supply is high and food prices are low, while holding back their own produce for sale when supply is low and food prices high. The majority of households in either village purchase some or all of their food requirements, either through choice or, more frequently, out of sheer necessity.
Households of different economic status buy different types of food, poor households buying mostly the staples of rice and wheat while the better-off households buy larger quantities of meat, pulses, vegetables, dairy products and spices. A breakdown of the level of expenditure on different foodstuffs can therefore be used to provide an indication of the relative economic status of households in the two study villages (table 7.7). Differences between the two villages are slight yet significant. Geraki has relatively fewer households spending money predominantly on foodgrains and more households whose food budget is made up primarily of non-foodgrains. This largely reflects the higher productivity of foodgrains in the flood-protected village, the result both of higher overall agricultural productivity and of an emphasis in the cropping pattern on food rather than cash crops (see ch. 8 on agriculture). In the light of other evidence of general economic improvement in Geraki, however, it is likely that the higher incidence of households purchasing primarily non-foodgrains is due at least in part to an improvement in the strength of household economies.

A breakdown by landholding category is once again revealing (also in table 7.7). The most significant inter-village differences occur in the categories of small- and medium-landholding households. In these two groups, Geraki not only has more households that are able entirely to subsist; it also has fewer households that need to purchase any foodgrains at all, relative to the situation in Sutanari. Small landholders in particular seem to benefit from the
Table 7.7  Breakdown of food purchases in with- and without-project villages

a) All households

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>primarily foodgrains</td>
<td>43</td>
<td>49</td>
</tr>
<tr>
<td>primarily non-foodgrains</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>foodgrains and non-foodgrains</td>
<td>35</td>
<td>37</td>
</tr>
<tr>
<td>no food</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

b) Breakdown by landholding category

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless</td>
<td>48</td>
<td>43</td>
</tr>
<tr>
<td>Marginal</td>
<td>63</td>
<td>57</td>
</tr>
<tr>
<td>Small</td>
<td>31</td>
<td>55</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>52</td>
<td>57</td>
</tr>
<tr>
<td>primarily foodgrains</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>primarily non-foodgrains</td>
<td>6</td>
<td>35</td>
</tr>
<tr>
<td>foodgrains and non-foodgrains</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>no food</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Marginal</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Small</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>primarily foodgrains</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>primarily non-foodgrains</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>foodgrains and non-foodgrains</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>no food</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- 210 -
better food situation in the protected village: whereas 90% of Sutanari's small landholders must purchase foodgrains, the corresponding figure for Geraki is only 69%; and whereas 55% of Geraki's small landholders can afford to purchase non-foodgrains in order to supplement their basic carbohydrate diet, the corresponding figure for Sutanari is only 39%. Among medium farmers, the most striking difference between the two villages is the higher number of self-sufficient households in Geraki.

The higher level of food self-sufficiency in Geraki remains the most important finding from the data on food purchases, and that this is concentrated within the category of small landholders indicates that embankment-induced improvements, if not distributed perfectly equitably throughout the socio-economic hierarchy, have at least not been restricted to the top end of that hierarchy. Nowhere in the pre-project survey were data expressed in terms of the proportion of households buying different foodstuffs, or even in terms of the number of households buying food; only the average household expenditure on food within each landholding category was provided (table 7.8). The 'with - without' comparison is, however, sufficient evidence of the embankment's role in improving local food supply.

Post-project enquiries into household food budgets also asked respondents to estimate their financial outlay on food. The average food expenditure in each landholding category in Sutanari and Geraki is included with the pre-project data in table 7.8. The correct interpretation of the differences among pre-, post-, and
Table 7.8 Breakdown of household food expenditure by landholding category

Mean annual household food expenditure (taka) in:

<table>
<thead>
<tr>
<th>Landholding Category</th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-embankment Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless</td>
<td>8,880</td>
<td>9,376</td>
<td>3,850</td>
</tr>
<tr>
<td>Marginal</td>
<td>4,862</td>
<td>9,334</td>
<td>4,190</td>
</tr>
<tr>
<td>Small</td>
<td>5,461</td>
<td>6,458</td>
<td>5,946</td>
</tr>
<tr>
<td>Medium</td>
<td>7,333</td>
<td>6,981</td>
<td>14,574</td>
</tr>
<tr>
<td>Large</td>
<td>16,333</td>
<td>6,000</td>
<td>11,873</td>
</tr>
<tr>
<td>All households:</td>
<td>6,285</td>
<td>7,987</td>
<td>6,621</td>
</tr>
<tr>
<td>All purchasing</td>
<td>7,018</td>
<td>8,410</td>
<td>no data</td>
</tr>
</tbody>
</table>

(Pre-project data from Miah, 1983)
without-embankment situations is far from clear, as the relationship between food expenditure and economic status is not a simple linear one. Households spending the least on food are not necessarily the poorest households, but rather those that are able to meet their food requirements from their own production, so that low expenditure on food can be an indication of economic weakness in some cases and economic strength in others. Comparing the average food expenditure within each landholding category in with- and without-project villages nevertheless allows certain conclusions to be drawn about the food supply situation in each village.

In post-embankment Geraki, the lowest average food expenditure is found in the category of marginal landholders. This differs from Sutanari, where the lowest food expenditure is found among small landholders. The two villages have roughly equivalent levels of expenditure among landless households; but whereas marginal landholders in Geraki spend considerably less on food than do the landless households, expenditure levels for these two groups are approximately equal in Sutanari, giving marginal landholders in Geraki a far lower expenditure than their counterparts in Sutanari. Among small landholders, too, food expenditure in Geraki is considerably lower than that in Sutanari. Medium and large landholders in Geraki, however, spend considerably more than the same landholding groups in Sutanari.

The similarity between the two villages in food expenditure in the landless category suggests that a figure of around Tk9,000 represents
the minimum outlay on food required to sustain a household without the means to produce any of their own food. The small difference in expenditure between Sutanari’s marginal and landless households suggests that marginal landholders there produce little of their own food; by the same logic, that marginal households in Geraki spend around half as much as either the landless households in their own village or the marginal landholders in Sutanari suggests that they are able to meet a significant proportion of their food requirements from their own agricultural production. In Sutanari, it is only among small landholders that a similar assertion can be made, but even this category of landholder has lower food expenditure, and therefore probably higher average food production per household, in the protected village. Among medium and large landholders, all of whom have land resources sufficient to produce enough food for household subsistence, and whose food expenditure comprises largely non-staple items, the higher expenditure on food in Geraki suggests the economic superiority of this group of households over their counterparts in Sutanari.

The overall village average of the reported household expenditure on food, if self-sufficient and therefore non-purchasing households are included in the calculation, was Tk6,285 in Geraki and Tk7,987 in Sutanari; excluding non-purchasing households from the calculation modifies the figures to Tk7,018 and Tk8,410 respectively. Without a breakdown by landholding category, lower food expenditure might be taken to imply the economic inferiority of the protected village; but considering food expenditure by landholding class proves that the
figures instead represent a higher incidence of complete or near self-sufficiency among households in Geraki. A 'with - without' comparison shows the effect of the embankment to have been both to reduce the number of households who need to make any food purchases, this change being effected wholly by reductions in the small and medium landholding categories, and to reduce the amount of food that small- and marginal-landholding households need to purchase to make up the deficit between their production and their basic food requirements. For medium- and large-landholding households, the embankment appears to have meant higher disposable income and the ability to add more protein- and vitamin-rich foods to their diet. Considering other aspects of the village economies confirms the conclusions drawn from the food expenditure data. Comparison of cropping patterns in the two villages (see ch. 8) verifies the higher food production in the protected village; and data on inter alia land tenure, occupations and the material household all point to the greater relative economic strength of the protected village, thus refuting the suggestion that lower food expenditure could represent a weaker village economy.

Data on food expenditure from the pre-project survey, despite being expressed at a level of aggregation that conceals certain trends, nevertheless allow something of a 'before - after' comparison to be drawn and the conclusions from the 'with - without' comparison thus to be substantiated. Average annual household food expenditure in the pre-project situation was calculated at Tk6,621, slightly higher than the post-project figure for Geraki of Tk6,285, but much lower
than that for Sutanari at the time of the post-project survey, Tk7,987. As data in the pre-project survey were expressed only in terms of the amount of money spent and not in terms of the number of households making food purchases or the amount of food purchased, it is impossible to deduce whether the changes in food expenditure are due to change in the proportion of food-purchasing households; in the quantity and type of food purchased; or in the price of food. That Geraki has experienced not merely a relative but an absolute decline in food expenditure would seem to bear out its improved food supply and higher level of self-sufficiency, as were revealed by the 'with-out' comparison.

The pre-project survey included a breakdown of food expenditure by landholding class, revealing a relationship between landholding status and both the amount of money spent and the type of food purchased. The nature of the relationship differed slightly from that observed in the post-project situation, however (table 7.8 again): minimum expenditure was found not among marginal landholders but among landless households, with food expenditure showing an exponential increase with landholding status (but for an aberration among large landholders, where the number of cases was too small for an average figure to be wholly valid). Comparing post-project Geraki with this pre-project situation indicates that, since the embankment, landless households have substantially increased their food expenditure; households in the marginal category have slightly increased their food expenditure; small-landholding households have slightly reduced their food expenditure; medium-landholding
households have halved their food expenditure; and large-landholding households have significantly increased their food expenditure. That the decline in food expenditure is found not among the poorest households but among small and medium landholders reflects the relatively higher incidence of self-sufficiency noted in these categories in the 'with - without' comparison; and that the 'before - after' comparison echoes the findings of the 'with - without' comparison confirms the role of the embankment in effecting the improvement. Food expenditure in the marginal landholding category has increased in absolute terms, yet remains relatively less in Geraki than in the equivalent class in Sutanari, suggesting perhaps that the embankment has allowed these households to meet a higher proportion of their food requirements from their own production. Finally, that food expenditure among large landholders in Geraki has increased in both absolute terms and relative to Sutanari confirms that the improvement in the economic fortunes of this category is indeed attributable to the embankment.

The correspondence between the type of food purchased, especially the proportion of foodgrains to non-foodgrains, and a household's economic status was expressed in the pre-project survey only in terms of the average amount of money spent on various foodstuffs by households in each landholding category, and not in terms of the number of households making purchases of particular foodstuffs; the post-project survey, on the other hand, asked only the quantities of the various foods purchased by each household, and not the amount of money spent. This made it impossible to deduce whether change had
occurred in the number of households making purchases or in the relative amounts of different foods purchased. The pre-project data did confirm the strength of the relationship between landholding status and the proportion of foodgrains to non-foodgrains among a household's food purchases, however, thus underlining the significance of the higher incidence of non-foodgrain purchasers in Geraki relative to Sutanari.

The conclusion of improved local food supply in the embankment-protected village is reinforced by evidence from the 'before - after' comparison, with decreased food expenditure in Geraki indicating not economic decline but rather the improved prospects of household subsistence, and particularly of household self-sufficiency in foodgrains, since the embankment. Household food self-sufficiency remains the exception rather than the rule in both Geraki and Sutanari, however, and most households require considerable financial outlay to meet their food needs. It is important, therefore to investigate the sources of income which provide households with the means to make the necessary food purchases. Unfortunately, although not unexpectedly, the reporting of incomes produced data too poor in quality to bear rigorous statistical analysis, owing to the data collection problems, particularly of definition, discussed at the outset of this section. Certain basic observations remain valid nevertheless, and shed further light on the manner in which the functioning of the village economy differs between the protected and the unprotected situation.
7.4 Household income

The preceding analysis of food purchases has shown Sutanari to be characterised by a high proportion of households using market purchases rather than their own production to meet even their basic food requirements. As most households have no significant income source other than the sale of their agricultural produce, a necessary corollary to the higher level of food-purchasing households is a higher level of produce-selling households, and this was indeed found to be the case: 75% of all farming households in Sutanari made sales of their agricultural produce relative to 69% in Geraki. However, these higher levels of agricultural sales represent not the production of a greater agricultural surplus, but rather the different cropping pattern of the unprotected village. The correspondingly high incidence of food-purchasing households shows that agricultural sales in Sutanari are not of food crops in excess of household food requirements, but of cash crops, income from the sale of which is used to purchase household food requirements. Farming households in Geraki concentrate on producing foodgrains, selling only what is surplus to their own requirements, while farming households in Sutanari cultivate a cash crop, jute, using the income from jute sales to purchase rice and wheat. This difference in cropping pattern is evident even without a detailed agricultural analysis, simply by looking at the number of households in each village selling different types of produce (table 7.9). Detailed agricultural analysis (ch. 8) confirms the difference in cropping
pattern and shows the difference to be attributable in large part to the environmental modification effected by the embankment.

This still does not prove the agricultural economy of either village to be weaker or stronger than that of the other. A household's food needs may be provided for as well through purchases using the earnings from cash crop sales as through the household's own food production, and there is nothing inherently better or worse about a subsistence or cash-based economy. In order to prove that households in Sutanari are less able to meet their basic needs on the income from their agricultural sales than are households in Geraki from their own production of foodgrains, it is necessary to consider the larger context, and particularly the data on occupations. The greater need of respondents in Sutanari to seek additional occupations outside agriculture indicates that earnings from agricultural sales are not sufficient to meet the basic needs of most households. The more cash-based agricultural economy in Sutanari can thus be seen to be weaker than the more food-based economy in Geraki.

A breakdown of produce-selling households by landholding status reveals little of any surprise (table 7.10). In both Geraki and Sutanari, 100% of medium and large landholders were found to be sellers of produce. Sutanari had the higher proportion of produce-selling households among small and marginal landholders, but this shows merely that the cultivation of jute extends throughout all landholding classes in Sutanari; the higher incidence of multiple-occupation and foodgrain-purchasing households among small
Table 7.9 Number of households selling various types of agricultural produce

Percentage of farming households selling:

<table>
<thead>
<tr>
<th></th>
<th>Paddy</th>
<th>Jute</th>
<th>Mustard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geraki</td>
<td>43</td>
<td>19</td>
<td>41</td>
</tr>
<tr>
<td>Sutanari</td>
<td>28</td>
<td>55</td>
<td>53</td>
</tr>
</tbody>
</table>

Table 7.10 Breakdown of produce-selling households by landholding category

Percentage selling produce in each category

<table>
<thead>
<tr>
<th></th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal</td>
<td>28</td>
<td>49</td>
</tr>
<tr>
<td>Small</td>
<td>71</td>
<td>84</td>
</tr>
<tr>
<td>Medium</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Large</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
and marginal landholders in Sutanari relative to Geraki puts paid to any suggestion that their higher agricultural sales represent greater economic fortune. Instead, that the inter-village difference in the number of produce-selling households is concentrated within the lower landholding categories serves to demonstrate that this group has not been excluded from embankment-induced agricultural change.

The true nature of change in the level of agricultural sales would be best assessed by a 'before - after' comparison, but again problems arose with data comparability. The report of the pre-project survey stated income only in terms of total and per capita annual income from agricultural and non-agricultural sources, and not in terms of the number of households earning income from a particular source. Average household income from agriculture, including all landholding households in the village and not just those claiming to earn some income from agriculture, was calculated from pre-project data at Tk3,425; the equivalent figure from the post-project data was Tk4,399. Without the necessary pre-project data on the number of produce-selling households it is impossible to discover the true cause of the apparent increase in average agricultural income - whether inflation in agricultural prices; an increase in the amount of produce sold; or a larger number of households selling produce. An attempt was made at a breakdown by landholding class (table 7.11), but the figures were deemed too spurious for any valid comparison to be made. No doubt the pre-project survey had encountered the same problems of missing data as were found in the post-project survey, with respondents either unwilling or unable to provide accurate
income figures. Once again, the 'with - without' comparison has to form the basis for assessment of the embankment's impact.

Household income from agriculture in Geraki and Sutanari is also shown in table 7.11, figures being provided for both the overall village average and the average within each landholding category. If one includes in the calculation of average income all those households who own or rent land and are therefore potential sellers of agricultural produce, then income is found to be slightly higher in Geraki than in Sutanari; and Geraki's advantage increases still further if one includes only those households which do sell agricultural produce. Yet a breakdown of household agricultural income by landholding status shows households in Sutanari to have, on average, higher income from agriculture than households in Geraki in all categories but that of large landholders. Excluding the large landholders, both villages display a marked increase of agricultural income with increased landholding. Pre-project data displayed a similar trend.

The lower figures within each class (except large landholders) in Geraki reflect that village's more food-based agriculture and its consequently lower proportion of produce-selling households. The otherwise broadly similar relationship between agricultural income and landholding status in the two villages shows two important attributes of embankment-induced change: it has not been restricted to one or two landholding categories; and it has not altered the fundamental relationships operating in the local economy. The most
Table 7.11 Breakdown of household agricultural income by landholding category

Mean annual household income (taka) from agriculture in:

<table>
<thead>
<tr>
<th>Landholding Category</th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Pre-embankment Geraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal</td>
<td>708</td>
<td>719</td>
<td>1,235</td>
</tr>
<tr>
<td>Small</td>
<td>3,333</td>
<td>4,249</td>
<td>2,915</td>
</tr>
<tr>
<td>Medium</td>
<td>9,464</td>
<td>14,867</td>
<td>5,430</td>
</tr>
<tr>
<td>Large</td>
<td>27,667</td>
<td>7,000</td>
<td>20,677</td>
</tr>
</tbody>
</table>

All landholding households: 4,399
All households selling produce: 5,865

(pre-project data from Miah, 1983)

Table 7.12 Breakdown of household non-agricultural income by landholding category

Mean annual household income (taka) from sources other than the sale of agricultural produce in:

<table>
<thead>
<tr>
<th>Landholding Category</th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landless</td>
<td>13,045</td>
<td>11,688</td>
</tr>
<tr>
<td>Marginal</td>
<td>10,358</td>
<td>10,840</td>
</tr>
<tr>
<td>Small</td>
<td>550</td>
<td>4,039</td>
</tr>
<tr>
<td>Medium</td>
<td>1,823</td>
<td>7,188</td>
</tr>
<tr>
<td>Large</td>
<td>5,000</td>
<td>1,250</td>
</tr>
</tbody>
</table>

All households: 4,867
All earning households: 10,198

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important difference between the two villages in terms of income from agricultural sales remains, however, the already-noted difference in the number of produce-selling households and the more food-based agricultural economy that the lower number in Geraki represents. For those with sufficient land to generate an agricultural surplus, Geraki's economy clearly still affords the opportunity to make substantial earnings from agriculture.

For most households, income from agricultural sales goes only part of the way to meeting food expenditure; the remainder of household income must come from other occupations. The greater number of household heads who engage in additional occupations in Sutanari relative to Geraki has already been demonstrated and is reflected in the figures for non-agricultural income in the two villages (table 7.12). As with agricultural income, these figures must be treated with some circumspection, as there were many cases of missing data and those respondents that did furnish figures were no doubt often inaccurate in their estimates. While it is easy for a person in salaried employment to state his income, it is almost impossible for a casual agricultural labourer, who works a few days here and a few days there as financial need and employment opportunity dictate, to state his annual earnings with any accuracy. Thus the missing data are likely to have comprised low earnings, causing these to be overlooked while the relatively high annual earnings of salaried employees and more regular labourers were included in the calculation of average non-agricultural income. An example of this was in Geraki, where a number of small landholders either would or could not
state their non-agricultural income, these omissions constituting a significant proportion of the missing data, while the income of a man who had sold his land in order to join the migrant labour force in the Middle East, remitting Tk60,000 each year to his family left behind in the village, was included in the calculation for the landless households. The broad trends revealed by the figures are noteworthy nevertheless, and the inter-village comparison particularly so.

The most immediately striking feature of the inter-village comparison is that the values of the average earnings of those households that actually do have a source of income other than the sale of their agricultural produce are almost identical. This demonstrates that the difference between the two villages in the overall village average for non-agricultural earnings is attributable in large part to the larger proportion of zero values in Geraki i.e. to differences in the proportion of households that engage in occupations other than farming. The figures for non-agricultural income from the pre-project survey were so divergent from the post-project figures as to make realistic comparison impossible; they did, however, suggest that there has been a spectacular increase in non-agricultural income in all landholding categories. The 'with - without' comparison is sufficient to lend weight to conclusions already reached about the functioning of the two villages' economies: that households in Geraki produce relatively more of their own food requirements and therefore have less need to seek income from other sources than do households in Sutanari.
The relationship between non-agricultural income and landholding class is of broadly similar pattern in the two villages, but for the recurrent anomaly among large landholders owing to the small number of cases and the broad limits of the category - in fact, only one large landholder in each village had an income outside agriculture. Households earning significant income from sources other than the sale of agricultural produce are found among marginal landholders and the landless, who have little or no agricultural produce to sell and who must therefore rely largely or entirely on other sources of income; and among medium and large landholders, some of whom are engaged in salaried posts or in lucrative business enterprises. Households with low earnings from non-agricultural sources are found chiefly in the category of small landholders. Such a pattern was evident from the pre-project data, too, where landless and large-landholding households reported the highest non-agricultural incomes and marginal and small landholders the lowest.

Where, then, does the difference between the two villages arise? The answer is to be found, as for several of the other economic parameters considered, in the intermediate landholding categories. In Sutanari and indeed in pre-embankment Geraki, the average non-agricultural income for small- and medium-landholding households, while less than that of the non-farm (i.e. landless) households, is still substantial: in Sutanari, the ratio of the non-agricultural income of a small-landholding household to that of a landless household was of the order of 1:3, and the equivalent ratio was cited
in the pre-project survey as 1:2. Data from the post-project survey show the average non-agricultural incomes of small- and medium-landholding households in Geraki to be exceptionally low, at Tk550 and Tk1,823 respectively, representing ratios of 1:25 and 1:8 with the incomes of landless households. Relative to the equivalent landholding categories in Sutanari, the non-agricultural incomes of small- and medium-landholding categories in Geraki are one seventh and one quarter of the corresponding figures in the unprotected village. This demonstrates quite clearly the lesser importance, in the protected situation, of occupations other than farming. The difference is most notable among the small landholders, which suggests that it is to this category of household that the embankment has meant the greatest change, improving the chances of household subsistence and decreasing dependency on non-agricultural income.

7.5 Household budgets

An attempt was made at a 'balance of payments' analysis, deducting food expenditure from the combined income from agricultural and non-agricultural sources in order to assess the ability of households to meet their basic needs. The analysis was abandoned when the flawed nature of the data became apparent - understated income and exaggerated expenditure led to so many net negative values that calculation of averages became meaningless. It seemed at least that the tendencies to exaggerate or understate were shared by both villages, so that the simple inter-village comparisons of income and
expenditure remain valid. The most telling contrast between the two villages remains the relative importance of non-agricultural income: a 'top-up' to household budgets in Geraki; a mainstay of household economies in Sutanari.

Despite data limitations, the broad patterns revealed in an analysis of household income and expenditure display a logical consistency sufficient for certain conclusions to be drawn concerning the functioning of with- and without-project economies and the economic impact of the embankment. Agricultural income in each village displays, predictably, an increase with landholding status, the difference between the two villages lying in the higher income levels in the marginal, small and medium landholding categories in Sutanari. Sutanari's higher agricultural incomes are a reflection of a larger number of produce-selling households in an agricultural system based more on cash than on food crops. In terms of food expenditure, landless, marginal- and small-landholding households in Sutanari spend more than their Geraki counterparts, while medium- and large-landholding households spend less, still giving Sutanari a higher average food expenditure overall. Lower food expenditure in Geraki, and particularly lower expenditure on staple foodstuffs, shows again the higher food production in the protected situation. Higher average non-agricultural income in Sutanari shows that although the agricultural incomes of most households in Sutanari are higher than those in Geraki, these are still insufficient to meet even the staple food requirements of most households, so that additional income sources must be sought; further evidence of a
stronger agricultural economy in the village with flood protection.

The true significance of the relative values of income and expenditure can be properly understood only when considered separately for each landholding category. Landless households can have no agricultural production of their own, and can therefore neither grow their own food nor earn any income from agricultural sales; all their food requirements must be met through food purchases using income earned in occupations such as agricultural labour or fishing. Relative to the equivalent class in Sutanari, landless households in Geraki reported on average similar food expenditure yet slightly higher incomes, indicating economic improvement for the landless since the construction of the embankment. Marginal households are able to produce some but not all of their household food requirements. The average incomes reported in this landholding category were similar in the two villages, both from agriculture and from other sources, but average reported household food expenditure was substantially higher in Sutanari, suggesting that households in Geraki are able to produce a higher proportion of their household food requirements and therefore have to rely less on food purchases. So for this class, too, the embankment seems to have brought economic improvement.

The most substantial inter-village differences are found among small-landholding households. In this group, Geraki has more households self-sufficient in food, as well as lower food expenditure overall. With households consuming much of their agricultural
produce themselves and selling only the surplus, the agricultural incomes of Geraki's small landholders are relatively low. However, meeting most of their household food requirements from their own production, these households require only minimal food purchases, so that their low agricultural incomes do not mean that they are forced to seek additional sources of income. Small farmers in Sutanari, on the other hand, despite having substantially higher incomes from agriculture than their Geraki counterparts, still find it necessary to supplement their agricultural income with earnings from other activities in order to meet their food requirements. In the medium and large landholding categories, households in both villages are able to generate substantial income from agriculture and other sources, the most important inter-village difference here being the greater proportion of households in Geraki that are self-sufficient in foodgrains, and whose food expenditure is therefore made up largely of non-staple items.

What, though, does this tell of the impact of the embankment? Lower household food expenditure and smaller agricultural sales show how the embankment has fostered a more food-based agriculture in Geraki, while that in Sutanari is based heavily on cash cropping. Sutanari's greater dependence on non-agricultural income indicates that it has a weaker agricultural economy than Geraki's; and both comparison with Geraki's pre-embankment economy and evidence from the agricultural survey (ch. 8) confirm the role of the embankment in improving Geraki's agricultural economy. These changes have been effective not just at aggregate level but at household level too - there is not
just higher production of foodgrains in the protected village but a higher number of households self-sufficient in foodgrains; not just lower average non-agricultural income but fewer households dependent on income from sources other than agricultural sales. Looking at household budgets within each landholding category confirms the relative equitability in the distribution of project benefits, as there has been some form of improvement in the household budget within every landholding class.

Much of this household budget assessment has had to be based on a comparison of the situation in with- and without-project villages, as data from the pre-project survey were not always in a form directly comparable with that in the later survey. Yet wherever comparisons are possible with the situation in Geraki before the project, they serve to reinforce the conclusions of both the existence and the equity in distribution of project benefits. The most important finding to emerge from this analysis of household budgets is the greater number of households - and not just of households with substantial holdings of land - that the embankment has enabled to attain a state of full or near food self-sufficiency.

If investigation into even the seemingly simple concepts of income and expenditure was beset with difficulties in both data gathering and data analysis, then much more so was that into other aspects of the household economy, such as payment of rent and labour costs in agricultural produce rather than cash and the receipt of economic assistance through grant or loan of food or cash. Replies to
questioning on payment in agricultural produce proved to be so incomplete and obviously inaccurate that they were unusable for any meaningful analysis, due perhaps to the inappropriate phrasing of the original question; to difficulty in the estimation and recall of the relevant amounts; or to the inherently sensitive nature of the subject. Enquiries into financial and other assistance in times of hardship were rather more fruitful, although the information obtained was doubtless still far from completely accurate. These limitations notwithstanding, there is likely to be some significance in the fact that around twice as many households in Sutanari (22%) as in Geraki (12%) reported receiving financial assistance; that 'assistance' almost always taking the form of a loan from a village moneylender. Greater dependence on such loans is a clear indication of greater economic hardship, and particularly of greater periodic hardship such as after a natural disaster, so that the embankment's improvement and stabilisation of the local economy is attested to once again.

7.6 The material household

As the problems of missing and unreliable data which bedevilled the investigation into household budgets had been anticipated, there was incorporated into the survey, as a proxy measure of economic status, an investigation of the material household. This was taken to include both the actual dwelling structure and all the possessions owned by a household.
As in any socio-economic system, the type and size of dwelling occupied by a household is a good indication of that household's relative wealth. The size, number and construction materials of the ghors (huts) making up a household's bari were therefore recorded. In terms of the materials of their construction, houses in Geraki and Sutanari displayed strong similarity, with each village having similar proportions of dwellings falling into the categories of modern (made chiefly of corrugated iron sheets), traditional (constructed of natural materials such as jute stalks, bamboo, mud and thatch) and mixed traditional and modern (typically comprising walls of bamboo matting and a corrugated iron roof). About 70% of dwellings in either village were found to be of the latter type, although with varying proportions of traditional and modern materials. The pre-project survey report also had a figure of 70% for the proportion of mixed-material dwellings, and my own personal observation indicated that this situation was typical of the wider local area. The remaining 30% of dwellings in post-project Geraki and in Sutanari were divided roughly equally between the traditional dwellings of the poorer households and the iron-walled and -roofed dwellings of the wealthy households. The close correlation between economic status (as reflected in landholding status) and house materials was borne out in with-, without-, and pre-embankment situations.

Inter-village differences may have emerged had the survey of house construction materials included a breakdown of the intermediate, mixed-material category according to the proportion of different
materials used and the state of repair of the dwelling. From the subjective viewpoint of personal observation, it did indeed seem that shiny, new corrugated iron was more in evidence in the flood-protected village, while in Sutanari much of the corrugated iron was old and rust-riddled. There was, however, no hard evidence in house construction materials of any greater economic wellbeing in Geraki.

Such evidence did emerge from the size of dwellings as indicated by the number of huts occupied by each household (table 7.13). Dwellings of more than two rooms were found with far greater frequency in Geraki; dwellings of only one room were relatively more common in Sutanari. Comparison with the pre-project situation showed change in Geraki to have been recent and rapid, providing firm indication of economic improvement at household level since the coming of the embankment. A breakdown of house size by landholding status (table 7.14) reveals that enlargement of dwellings has not been restricted to the uppermost landholding categories, but has manifested itself even among marginal landholders and the landless. This was further evidence of the relative equity in the distribution of project benefits. In all landholding classes and relative to both without-and pre-project cases, Geraki has a higher proportion of households in the better-off categories with respect to dwelling size.

Similar evidence of Geraki's greater economic wellbeing is found in an assessment of household possessions. The checklist used to establish an inventory of the possessions of each household included
### Table 7.13 Size of dwellings in with-, without- and pre-project situations

<table>
<thead>
<tr>
<th></th>
<th>one room</th>
<th>two rooms</th>
<th>more than two rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-project</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geraki</td>
<td>33</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>Sutanari</td>
<td>43</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Geraki</strong></td>
<td>52</td>
<td>35</td>
<td>13</td>
</tr>
</tbody>
</table>

### Table 7.14 Breakdown of dwelling size by landholding category

<table>
<thead>
<tr>
<th></th>
<th>one room</th>
<th>two rooms</th>
<th>more than two rooms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-embankment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geraki</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landless</td>
<td>73</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Marginal</td>
<td>54</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td>Small</td>
<td>5</td>
<td>36</td>
<td>59</td>
</tr>
<tr>
<td>Medium</td>
<td>12</td>
<td>0</td>
<td>88</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sutanari</td>
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<td>0</td>
</tr>
<tr>
<td>Marginal</td>
<td>53</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>Small</td>
<td>32</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>Medium</td>
<td>6</td>
<td>13</td>
<td>81</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Pre-embankment</td>
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<tr>
<td>Geraki</td>
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<tr>
<td>Landless</td>
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</tr>
<tr>
<td>Marginal</td>
<td>82</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Small</td>
<td>52</td>
<td>48</td>
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</tr>
<tr>
<td>Medium</td>
<td>10</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Large</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

(pre-project data from Miah, 1983)
the full gamut from clothing and personal effects to livestock and agricultural implements, a valid mix of items in a system where the household functions as both economic and social unit. There was no similar inventory in the pre-project survey, so the 'with - without' comparison here forms the basis for analysis. For virtually every important item, there were significantly more owners in Geraki than in Sutanari - more owners of beds and bedding; more households owning a hurricane lamp and not just the traditional oil lamp or kuppi; more owners of radios, including more than one expensive Japanese radio-cassette 'ghettoblasters'. Geraki had more women in possession of precious jewellery and valuable sarias, items often sold in times of penury and whose ownership is therefore indicative of not just present wealth but also stability in the household economy.

The inventory of kitchen utensils would have had to include more detail in order to be used as an indicator of economic status - not just the number of utensils but their material and condition. As it stood, the enquiry into the ownership of cooking pots, storage jars and baskets yielded little information. All households in both villages owned these items, but whereas some households owned utensils made of brass, others had only cheap alloy pots and pans. Unfortunately, such information was not included as part of the systematic survey but, again from my own observation, it seemed that brass utensils were more in evidence in Geraki; and I made this observation having partaken of meals with a number of households of a range of economic status in either village. Like jewellery, brassware is typically sold in times of family hardship, so its
ownership is indicative of stability in the household economy.

No household in either village used any form of stove other than the traditional earthen chula moulded into the floor of the kitchen, so asking respondents to give their stove type yielded no index of relative household wealth. More revealing was the enquiry into fuel use. In both villages, there was a striking correlation between the type of fuel a household used for domestic purposes and its landholding (and thus economic) status: wood is here the fuel of the rich, while the poor burn whatever weeds and crop residue they are able to garner; farming and animal-owning households might use the stalks of jute left once the fibres have been stripped from them, or that ubiquitous developing world fuel, cattle dung. Fuel type was thus found to be a useful proxy measure for economic status. Relative to Sutanari, Geraki had more households burning wood and fewer burning dung and weeds, and this despite higher cattle ownership in Geraki. This was further indication of the greater economic wellbeing of households in the protected village.

The inventory of possessions included bicycles and boats, the only available (and indeed the only feasible) means of personal transport in the local area. The original inventory in fact included the cart, but no household in either village was found to own one, the environment being quite unsuited to their use. Of the two study villages, Sutanari was located closer to a true road usable year-round, so it was not surprising that Sutanari had the larger number of bicycle-owning households, although at twelve that number
was still small. Only since the construction of the embankment and
the path thus provided had ownership of a bicycle become truly
worthwhile to a household in Geraki, so only very few households had
come to own one by the time of the post-project survey. When it came
to boats, by far the most appropriate form of transport in this
environment, ownership in Geraki far outstripped that in Sutanari,
both in overall number and in the number of boat-owning households.
As well as being possibly an indication of greater household wealth
in Geraki, a higher level of boat ownership stands the inhabitants of
Geraki in better stead to survive major flood events.

Also considered as household effects were the agricultural implements
and farm animals in a household's possession. In the poorer
households, the family dwelling serves as storage shed and animal pen
as well as the family's living accommodation, so the inclusion of
farm assets with household goods has a firm basis in reality. In
terms of livestock, there was an interesting difference in the
pattern of ownership in the two villages. Geraki had the greater
number of households owning large livestock (draught and some dairy
cattle); Sutanari had more households owning small livestock (sheep
and goats) and poultry. The same pattern was observable in
exaggerated form if one considered the number of animals instead of
the number of animal-owning households, so that Geraki had not only
more cattle-owners but more households owning more cattle, and
likewise for Sutanari when it came to the other categories of
livestock.
This was in itself a hint at the differences between Geraki and Sutanari in the functioning of their economies. In Sutanari, small livestock or poultry provides a supplementary or fallback source of income to that from agriculture, whereas in Geraki the animals are very much part of the agricultural economy, being used in ploughing, threshing grain, pressing oil and sundry other agricultural tasks. The different function of livestock in each village becomes even more apparent if one considers only bullock ownership, bullocks being the main source of draught power: only twelve households in Sutanari owned bullocks as compared to twenty in Geraki; and the number of bullocks in Geraki relative to Sutanari was more than double. Thus was the greater strength of Geraki’s agricultural economy attested to once again.

Cattle ownership was included in the pre-project survey, and was presented on a per household basis which made direct comparison with the post-project survey possible. Surprisingly, perhaps, the proportion of households owning cattle had remained virtually constant - 55% in the pre-embankment survey, when half the village's households were interviewed, and 56% in the post-embankment survey, which included all households in the village. More remarkably, the number of cattle in the village had similarly remained almost constant - 207 head were recorded in the post-project survey; 103 head in the pre-project 50% sample. While this coincidence of figures perhaps owes much to chance, particularly as sampling error should be taken into consideration with regard to the pre-project figures, it does surely indicate stability in livestock ownership.
If one assumes Sutanari in 1982 to have had a similar level of livestock ownership to Geraki at that time, then cattle ownership can be taken to have declined in the unprotected village, with households selling some or in certain cases all of their animals. Cattle, like jewellery and brass kitchenware, are assets often disposed of by households when they find themselves in economic difficulty, so stability in livestock ownership in Geraki is evidence of the economic stability afforded by the embankment.

Ownership of agricultural implements and stored agricultural inputs similarly attests to a stronger agricultural economy in the protected village. But for irrigation pumps, agriculture remains in both villages completely unmechanised, a result more of environmental than of economic factors. The most important item of agricultural equipment is the simple, wooden plough. Plough ownership among farming households was found to be significantly higher in Geraki (84%) than in Sutanari (64%). This, along with the lower proportion of households owning draught animals, implied that more households in Sutanari would have to hire either plough, draught team, or both, and that indeed was the situation reported.

Some ex-farmers in Sutanari stated that it had been their inability to pay for the ploughing of their fields that had forced them to let, mortgage or sell their land to other farmers while they themselves now had to earn a living as agricultural labour, sometimes on what had been their own land. This is a classic example of what Chambers (1983) describes as the 'poverty ratchet' effect. A household falls...
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on hard times and is forced to dispose of its assets; first its 
draught animals; later its plough; and ultimately the land on which 
it had depended for its livelihood. All evidence pointed to a higher 
incidence of this phenomenon in Sutanari, further indication of the 
greater economic strength and stability of households in Geraki.

Queries into the ownership of irrigation pumps revealed little about 
the relative economic status of the two villages, but did provide 
information about the different modes of irrigation operation and 
management: shallow tubewells in Sutanari, some privately owned and 
others owned and operated on a co-operative basis; co-operatively 
managed deep tubewells in Geraki. No household in either village 
complained of lack or difficulty of access to irrigation, so the two 
villages were assumed to have equivalent status in this respect. Had 
one village had entirely private tubewell ownership, the picture 
might well have been different, with poor households perhaps being 
deprived of access to irrigation.

Other agricultural inputs - seed, fertiliser, pesticides - are 
purchased by farmers on an individual basis. For the most part, 
farmers purchase inputs as and when they are required, which can 
cause problems of supply in seasons of peak demand such as boro 
sowing. Only the wealthier households are in a position to buffer 
themselves against problems of erratic and undependable supply by 
holding their own stocks of seed and fertiliser in reserve, so it is 
significant that Geraki had more households with stored seed and 
fertiliser. (Input use was also more widespread in Geraki, where HYV
In all aspects of the material household, from personal effects to productive assets, Geraki was found to be better off than Sutanari. Analysis of the material household proved to be a useful adjunct to the more conventional economic analysis of household budgets, and provided valuable insight into the relative economic status of the two villages, reinforcing conclusions already reached about the effect of the embankment in fostering a stronger local economy. In a simple village-level comparison, Geraki could in almost all cases be shown to have a greater number of households owning the particular item under consideration, whether in the category of consumer durable (e.g. a radio) or productive asset (e.g. a plough). That Geraki had not merely a greater quantity of any particular item but a greater number of households owning that item indicates that project benefits have penetrated beyond the upper ranks of the socio-economic hierarchy. This was confirmed by an analysis of the material household on the basis of landholding status. In the protected village, the cut-off point between owners and non-owners was generally found to be at a lower rung on the class ladder - all the medium and large landholders in both villages might own a particular item, but Geraki would have more small and marginal landholders owning that item relative to Sutanari.

The availability of pre-project data for cattle ownership makes it possible to draw some conclusions as to how changes in the material household may have been effected, even though cattle ownership
represents a special case and is not strictly analogous with other items in the material household. That cattle ownership has remained constant in the protected village, in terms of both the number of animals and the number of cattle-owning households, suggests that while the embankment may not have caused any improvement in the material household in an absolute sense, it has certainly prevented decline, enabling households in Geraki to retain their possessions whilst households in Sutanari have been forced into selling essential household assets in order to survive.

Plough ownership is a case in point. All medium- and large-landholding households in both Geraki and Sutanari were found to own at least one plough. Among small landholders, however, 20% in Sutanari were without a plough, relative to only 7% in Geraki. Among marginal landholders, 68% in Sutanari households did not own a plough, relative to 36% in Geraki. This demonstrates how it is the small and marginal landholders who are most likely to find themselves in a position where they are forced to dispose of productive assets, thereby initiating a poverty ratchet, while medium and large landholders hardly ever find themselves in such desperate straits, and can generally adopt some less drastic measure to recover from economic misfortune.

Each item in the material household has its own distinctive pattern of ownership distribution, but all basically resemble that of the plough: 100% ownership among large landholders; close to 100% among medium landholders; the level of ownership then dropping off at a
certain stratum of the socio-economic hierarchy, the level of that stratum varying from item to item, but invariably being higher and the drop-off more marked in the unprotected village. Thus 34% of small-landholding households in Geraki own valuable jewellery, but only 20% in Sutanari; 15% of the marginal landholders in Geraki own a radio, but only 9% in Sutanari; 66% of landless households in Geraki own a hurricane lamp, but only 45% in Sutanari; and so on. The apparent effect of the embankment has been to bolster households economically, that bolstering being felt most strongly by the small- and marginal-landholding categories, i.e. those with the more vulnerable household economies. Thus have these vulnerable households been able to avoid having to sell productive assets; and in some cases have even undergone improvement in their household economies to the extent that they have been able to add consumer durables to the material household.

This investigation into the material household probably provides a more complete and accurate picture of the economic differences between the two villages than did the more formal assessment of household budgets. The physical objects constituting the material household are not subject to problems of definition as are the more intangible concepts of income and expenditure; it was far easier for a respondent to acknowledge ownership of a stated item than to estimate his average earnings; and it was more difficult for a respondent to conceal ownership of a physical object than to conceal the size or source of his income, particularly as the interview was usually conducted within a respondent's bari. That this part of the
survey not only showed households in the protected village to be better off than households in the unprotected village in average terms, but also proved the positive effect of the embankment to have been felt throughout the socio-economic hierarchy, is testimony to the embankment's success in the terms set down by the project funding agency and shared by this project evaluation: that not only should the embankment have led to economic improvement overall, but also that there should have been equity in the distribution of project benefits.

Comparison of the socio-economic characteristics of the two villages provides many pointers to a stronger local economy in the village with flood protection: a lower incidence of multiple occupations; a higher proportion of households able to depend on agriculture for their livelihood; better conditions of employment for agricultural labourers; greater household self-reliance in food; material superiority in terms of dwelling structures and household possessions. Wherever they were possible, comparisons with the pre-project situation showed Geraki either to have undergone economic improvement in an absolute sense or at very least to have undergone substantially less economic decline than appears to have befallen unprotected Sutanari. Nowhere was there found any suggestion of the economic advancement, through the influence of the embankment, of the rich at the expense of the poorer classes; in fact it is often the smaller landholders who appear to have benefited most in a relative
sense, theirs being the households that have proved most vulnerable to economic deterioration in the unprotected situation.

While socio-economic analysis provides incontrovertible evidence of the embankment's positive economic influence, it can but hint at the means whereby that influence has been wrought: changes in agriculture. It is these changes which form the subject of the following chapter.
CHAPTER 8

THE IMPACT OF THE EMBANKMENT ON AGRICULTURE

8.1 General considerations

Understanding the true impact of the embankment rests on an understanding of its influence on the agricultural system. Indeed none of the other socio-economic changes which have been wrought can be understood outside this context, as it is changes in cropping practices that have underlain the ramifications of the flood control project throughout the local society and economy. This is not to say that a simple analysis of changed cropping patterns will suffice as an index of the project's success, but rather that a series of questions should be posed concerning the entire agricultural system in order to assess the overall as well as the distributive impact of the embankment. Has it expanded or constrained cultivators' cropping options? Has it led to an increase in overall agricultural productivity? Has it altered the demand for agricultural labour, or the seasonality of that demand? Has it affected rich farmers and poor farmers alike? Above all, has it made food supply more secure?

At the heart of all these questions is an understanding and analysis of the precise changes in cropping patterns (temporal and spatial) effected by the embankment. The necessity of combining a 'before - after' and a 'with - without' comparison is here particularly evident, as it would otherwise have been impossible to separate those changes which had been induced by the embankment from the wider
agricultural change taking place in the country as a whole. With these considerations in mind, it was by deliberate intent that the questions on agriculture comprised the most detailed and comprehensive section of the questionnaire; the section on which interviewers were urged to take especial care to ensure completeness and accuracy.

A number of factors determines a cultivator's choice of crop on each of his fields in a particular season, not all of them directly (or even at all) environmental. Environment remains, however, the ultimate constraining factor in crop selection: the micro-environment of flood timing, depth and duration; of soil fertility, drainage and moisture retention capacity. The expected effect of an embankment would be to raise the effective height of the land by delaying the onset of flooding. To determine whether this had in fact been the case (or rather whether farmers had perceived and responded to such a change by changing their cropping patterns accordingly), a comparison was made between, firstly, the cropping in Geraki now and that in Geraki prior to the construction of the embankment; and secondly, the post-embankment cropping in Geraki and that in unprotected Sutanari. The larger part of the discussion which follows is based on this second, 'with - without' project comparison, but the 'before - after' comparison makes a useful and apposite starting point.
8.2 A 'before - after' comparison

The cropping pattern prevailing in Geraki before the embankment is shown in fig. 7 and in table 8.1. As in the country as a whole, the cultivation of paddy dominates, with aus jute and rabi mustard and pulses being the only other crops of any significance. No one season's rice crop is totally dominant, however: HYV boro occupies about a third (31%) of the cultivated land; mixed aus and aman 45%; and broadcast aman 15% (Miah, 1983). This represents the typical risk-minimising strategy of the Bangladeshi farmer, a type of insurance policy against the destruction of one of the crops through adverse environmental conditions. Should drought or early flooding damage the dry season boro rice, the monsoon season aus and aman might flourish; should the monsoon crops fail, the dry season crop is there as a standby. Two characteristics in particular are indicative of the early onset and depth of flooding which was typical of the area: the total absence of transplanted aman varieties, which are planted later and attain lower height than the broadcast varieties; and the relatively early harvest of aus rice and jute in the first half of July. It was particularly the early onset of flooding which was identified as the chief constraint to improved agriculture, and which the embankment was designed to mitigate.

The post-embankment cropping pattern (also in fig. 7 and table 8.1) reveals a radical transformation. No longer is there any evidence of risk minimisation through the distribution of paddy cultivation across the whole agricultural year. In its place has emerged a
Fig. 7 Cropping patterns before and after the project
Table 8.1 Proportion of cultivable area under different crops before and after the project (%)

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Before</th>
<th>After</th>
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<tbody>
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<td></td>
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<tr>
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</tr>
<tr>
<td>aus+aman</td>
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<td>0</td>
</tr>
<tr>
<td>aman</td>
<td>15</td>
<td>9</td>
</tr>
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<td>HYV boro</td>
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</tr>
<tr>
<td>Other crops:</td>
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<td></td>
</tr>
<tr>
<td>pulses</td>
<td>17</td>
<td>&lt;1</td>
</tr>
<tr>
<td>mustard</td>
<td>21</td>
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<tr>
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<td>6</td>
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<tr>
<td>jute</td>
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<td>8</td>
</tr>
</tbody>
</table>
strategy of productivity maximisation, with paddy cultivation becoming virtually synonymous with HYV boro cultivation. HYV boro now occupies 82.8% of the cultivated land. The cultivation of the low-risk but low-yielding mixed aus and aman has virtually disappeared, as has that of broadcast aman. Aman rice now occupies just 9.4% of the cultivated land, and the area under aus rice has diminished to just 4.5%. That the decline in aus rice cultivation has been so spectacular is due to its being in direct contest for space with HYV boro cultivation, their growing seasons overlapping for the months of April, May and June, whereas transplanted aman can be grown as part of a boro - aman rotation.

It is not only in paddy cultivation that dramatic changes have followed the embankment's construction. The 1982 pre-project survey found the area under the rabi crops of pulses and mustard to be 17% and 21% respectively; in the post-project situation the equivalent figures are 0.3% and 53%. The short growing season of mustard makes it an ideal companion to HYV boro rice in a crop rotation: if planted sufficiently early, it can be harvested in late December i.e. in good time for boro to be transplanted. The longer growing season of pulses means they are more suited to an aus - rabi rotation, and they have followed the demise of aus in the agricultural calendar. What aus cultivation there now remains tends to be of jute rather than rice, with the area under jute showing an increase from just 2% in 1983 to 7.8% in 1986. This suggests that farmers expect their subsistence needs to be met from boro cultivation, with the rabi mustard and aus jute being cultivated largely for the purpose of
income generation. Another crop which has assumed significance is rabi wheat, not found at all in 1982 but now constituting 6.2% of the cultivated area. The over-riding feature of the observed agricultural change, however, has been the emergence of the boro rice - rabi mustard sequence as the entirely dominant crop rotation, replacing the traditional aus and/or aman - rabi rotation.

But do these changes back up the premise of an effective elevation in the height of agricultural land after the embankment? Unfortunately, the pre-project cropping data are expressed in terms of the areal coverage of individual crops, and not in terms of crop rotations. The relationship between crop rotation and field elevation is also expressed in only rudimentary form on the diagram of the cropping calendar (fig. 7 again). It is nevertheless possible to speculate what the likely pattern of cropping would have been in the pre-project situation. The diagram suggests that on the lowest cultivable land (nichu), a cropping of either mixed aus and aman or HYV boro would have been found. Land of intermediate height might have supported a rabi crop of pulses or mustard along with a crop of HYV boro or mixed aus and aman. An aus - rabi rotation would have been typical on fields of higher elevation (uchu).

Data from the post-project survey show the near-total disappearance of mixed aus/aman and broadcast aman crops, suggesting that the lowest agricultural land has indeed undergone an effective elevation. In the post-project situation, this nichu land most frequently supports a single cropping of HYV boro rice. Much land
classified as nichu can now support even a double cropping of HYV boro and a rabi crop, usually of mustard. On medium and high (uchu) land, the HYV boro – rabi rotation has assumed complete dominance, reducing all other rotations to only minor importance. Where aus and aman cultivation persists, it tends to be of the transplanted rather than the broadcast varieties, on separate fields rather than in the traditional intercropping. Overall, the effect of the embankment seems to have been an averaging out rather than a straightforward elevation of land height, with the cropping pattern previously associated only with land of medium height spreading to fields classified as uchu and nichu.

If the correlation of crop rotation with land height has so far produced rather inconclusive evidence as to the precise role of the embankment, a study of changes in the timing of events in the agricultural calendar, also illustrated in fig. 7, provides the necessary corroboration. The large and rapid expansion in boro cultivation being the primary transformation, it is appropriate to start a description of the agricultural year with the transplanting of boro seedlings from their seedbeds out into the fields in early January. The timing of boro sowing has not undergone any modification, but the delay in onset of flooding effected by the embankment means that later-maturing (and thus higher-bearing) hybrids can be grown. Before the embankment, boro would be harvested in May; to have boro in the fields any later meant a high risk of flood damage. Since the embankment, farmers have started cultivating varieties of boro which are ready to be harvested only well into
June. Similar changes have affected the cultivation of *aus* rice and jute. Still sown in March and April, their harvest can now be delayed until late July and even into August, whereas before the embankment, flood risk meant that these crops had to be out of the fields by the end of June. This hastening of harvest caused by the flood threat often meant a loss of production when crops were not given the chance to reach full maturity. The replacement of broadcast by transplanted *aman* varieties is another indication of the later arrival of flooding, as *aman* can now be transplanted out in July rather than sown with the *aus* in March - April.

These changes suggest that the whole cropping calendar has been fine-tuned to suit a modified environment. Mustard cultivation is another case in point. Previously sown in December and harvested in February, preceding the planting of the *aus* crop in March - April, its growing season has been brought forward to October - December to accommodate the *boro* crop. The adaptability and the brevity of mustard's growing season make it the ideal partner to HYV *boro* in a crop rotation, and hence its expansion from 21% to 53% of the cropped area. A factor in all these modifications is the changed hydrological regime following the construction of the embankment, with an apparent lengthening of the flood-free period providing cultivators with that much extra room to manoeuvre in their crop selection. Although this has expanded cropping options, not diversification but rather simplification of the cropping calendar has been the result. It seems that farmers, perceiving that HYV *boro* cultivation has become a less risky investment of capital and labour,
have responded by showing that they are now prepared to make the investment, adopting the modern agricultural technology of hybrid seeds, artificial fertilisers and irrigation.

The impact of the project cannot be viewed in isolation, but must be seen in the light of the ongoing agricultural modernisation affecting Bangladesh as a whole. The provision of irrigation facilities, with deep and shallow tubewells between them supplying water to practically all Geraki's agricultural land, has been essential in allowing the maximisation of benefits from the flood control project. Neither irrigation nor flood control alone would have been sufficient to effect the agricultural transformation which has taken place, but in tandem they have wrought dramatic change. The embankment has meant that the land has been made higher in terms of its flood regime: nichu land has become medium land, and medium land, uchu land. Irrigation has meant an effective lowering of land height, with uchu and medium land now being artificially provided with a year-round water supply which would previously have been available on the lowest of the nichu land. The net result has been a double improvement, creating a new class of land which is cultivable in the dry season without being flood-prone in the monsoon season. The successful cultivation of HYV boro demands both an assured water supply and a guarantee against early flooding, and the expansion in the area under boro from 31% to 82.8% proves that farmers take these conditions to have been met. All other changes - the reduction in aus cultivation; the preference for mustard over pulses as a rabi crop; the supplanting of broadcast aman by transplanted aman - can be
linked to this one major cropping change.

That being the case, it is difficult to assess the exact extent to which change has been the result of the provision of flood control, and to what extent from the provision of irrigation, general advances in agriculture, or simply improved access to new agricultural technology. An answer to this question will have to await the 'with - without' comparison, where wider change can be assumed to have been identical in each situation, and the impact of flood control can be assessed in isolation.

Before this discussion can go on to the 'with - without' project analysis, some of the questions posed at the outset remain to be answered. It was remarked then that a straightforward comparison of cropping patterns before and after the embankment was an insufficient index of its impact, and that issues of productivity and equity should be taken into account.

One means of increasing agricultural productivity would have been to increase the intensity of cultivation, growing three crops in a year where there were previously two, two where there was one. The overall cropping intensity (proportion of cultivated land to total cultivable area, expressed as a percentage) before the project was calculated at 164 (Miah, 1983); since the project, it has remained virtually unchanged, being calculated as 163 from the 1986 data. Without any increase in cropping intensity, the only other way for productivity to increase is through an increase in the yield per acre, and with the conversion from aus and aman cultivation to boro
culivation this has certainly been the case. On much of the land, the increase in paddy production has been as much as three-fold, with a typical pre-embankment yield of mixed *aus* and *aman* being 18 maunds per acre, and a typical post-embankment yield of HYV *boro* being 54 maunds per acre. Changed cropping patterns alone have meant an overall increase in paddy production of 60%, assuming the yields for individual crops to have remained constant at their pre-embankment levels (table 8.2). Not only has the output in normal years thus been increased, but the shift to dry season rather than monsoon season cultivation reduces the likelihood of crop damage by floods, thus stabilising the year-to-year food supply situation.

Comprehensive data on reported crop yields were collected in both the before- and after-project survey (table 8.3). These data indicate that there has been little significant change in crop yields since the implementation of the project, with some yields showing an increase, some a decrease, and others remaining unchanged. The remarkable uniformity in the yield of hybrid seeds is underscored by the consistency in the yield of HYV *boro* at precisely 54 maunds per acre - this despite the extension of *boro* cultivation across a wider range of micro-environments and to a larger number of cultivators. With the shift in emphasis to HYV *boro* cultivation, *aus* and *aman* yields have shown a slight decline as their cultivation becomes increasingly marginalised to less fertile land, and as farmers spend less on these crops in terms of labour and other inputs. The yields of jute and mustard have shown small increases, perhaps as more farmers start to grow improved varieties of these crops.
Table 8.2  Change in agricultural production related to changed cropping pattern (assuming yields to have remained constant at pre-embankment levels)

<table>
<thead>
<tr>
<th>Ave. yield (maunds/acre)</th>
<th>Rice crops:</th>
<th>Other crops:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>aus</td>
<td>pulses</td>
</tr>
<tr>
<td></td>
<td>aus+aman</td>
<td>mustard</td>
</tr>
<tr>
<td></td>
<td>aman</td>
<td>wheat</td>
</tr>
<tr>
<td></td>
<td>HYV boro</td>
<td>jute</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>After</td>
<td>Before</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>19</td>
<td>35</td>
</tr>
<tr>
<td>18</td>
<td>93</td>
<td>43</td>
</tr>
<tr>
<td>22</td>
<td>31</td>
<td>19</td>
</tr>
<tr>
<td>54</td>
<td>64</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Production (maunds)

Total foodgrain production: 6,059 9,727
Total agricultural production: 6,618 10,740

(pre-project data from Miah, 1983)
Table 8.3  Before- and after-project crop yields

<table>
<thead>
<tr>
<th></th>
<th>Yield (maunds/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td><strong>After</strong></td>
</tr>
<tr>
<td>Rice crops:</td>
<td></td>
</tr>
<tr>
<td>aus</td>
<td>13</td>
</tr>
<tr>
<td>aus+aman</td>
<td>18</td>
</tr>
<tr>
<td>aman</td>
<td>22</td>
</tr>
<tr>
<td>HYV boro</td>
<td>54</td>
</tr>
<tr>
<td>Other crops:</td>
<td></td>
</tr>
<tr>
<td>pulses</td>
<td>5</td>
</tr>
<tr>
<td>mustard</td>
<td>8</td>
</tr>
<tr>
<td>wheat</td>
<td>not grown</td>
</tr>
<tr>
<td>jute</td>
<td>10</td>
</tr>
</tbody>
</table>

(pre-project data from Miah, 1983)
Significantly, there is no evidence of any declining trend in crop yields, and there are therefore no grounds for suggesting that the embankment's prevention of alluvial deposition might have diminished fertility.

Overall improvements in agricultural productivity and security do not necessarily imply equal benefit to all socio-economic groups, however, and it is important to look at the disaggregated as well as the general picture in order to assess the distribution of change. Certainly, the post-project situation is one of marked uniformity in terms of cropping pattern, with *boro* and *boro - rabi* rotations being totally dominant on the fields of rich and poor farmers alike. In the pre-project data, a degree of variation in cropping pattern could be discerned between the various landholding classes. Only amongst the large landholders was there 100% adoption of HYVs, the proportion declining with landholding class to 90% of medium farmers, 85% of small farmers and 81% of marginal farmers (Miah, 1983). Despite this, the greatest diversity of cropping pattern was found among large and medium landholders, with small and marginal farmers tending to opt for either a modern, HYV-inclusive rotation or a traditional rotation, thereby concentrating their efforts and resources. By 1986, all but one farmer (a marginal landholder) had started cultivating HYVs. The spectacular increase in HYV cultivation has thus been achieved both by a conversion to HYVs by farmers previously growing only traditional crops and by an expansion in the area planted to HYVs by those farmers already using them.
No clear relationship could be discerned between the landholding class (and thus economic status) of the cultivator and the crop yields obtained, either before or after the embankment. The pre-project data show something of a tendency for the fields of marginal farmers to bear the highest yields, but this trend has been swamped in the post-project situation by a greater uniformity in yield associated with the use of hybrid seeds. One might have surmised that the wealthier farmers with their larger landholdings would have been better able to afford the inputs of fertiliser and irrigation water, giving them higher crop yields, but even in terms of input use no clear trend emerged. No landholding class appears to have been excluded from the embankment's benefits to agriculture, nor does any one class appear to have benefited significantly more or less than any other.

But what of those who own no land at all? How has agricultural change affected the lot of those who are obliged to make their living by labouring on the fields of others? The changes which have occurred in cropping have led to a significantly increased demand for agricultural labour, which must have led to an improvement in the lives of even this poorest class. The pre-project survey gives the labour use per acre for each of the major crops then grown in Geraki (table 8.4). On land where there has been a replacement of aus and aman in the cropping calendar with HYV boro, there will have been a doubling in labour demand, an acre of boro using 83 mandays of labour to the 41 required by mixed aus and aman. Even the secondary cropping changes have contributed to the increased labour demand, mustard
<table>
<thead>
<tr>
<th>Labour use per crop (mandays/acre)</th>
<th>Area under crop (acres)</th>
<th>Total mandays required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Rice crops:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aus</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>aus+aman</td>
<td>41</td>
<td>93</td>
</tr>
<tr>
<td>aman</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>HYV boro</td>
<td>83</td>
<td>64</td>
</tr>
<tr>
<td>Other crops:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pulses</td>
<td>13</td>
<td>35</td>
</tr>
<tr>
<td>mustard</td>
<td>34</td>
<td>43</td>
</tr>
<tr>
<td>wheat</td>
<td>no data</td>
<td>0</td>
</tr>
<tr>
<td>jute</td>
<td>62</td>
<td>4</td>
</tr>
<tr>
<td>Total labour demand:</td>
<td>12,890</td>
<td>19,283</td>
</tr>
<tr>
<td>(excluding wheat)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(pre-project data from Miah, 1983)
utilising 34 mandays per acre to pulses' 13, and jute demanding the
greatest labour input among all the traditional crops at 62 mandays
per acre. Calculating the change in labour demand from cropping
pattern and labour use data gives an increase of 50%. In fact, so
great has become the demand for labour in the boro season that one or
two of Geraki's marginal farmers reported that they find it more
profitable to work as casual agricultural labourers during this
season than to grow boro on their own small parcels of land, where
they concentrate instead on aus and rabi cultivation. A labourer can
now expect not only to find employment on more days of the year, but
also to be able to command higher wages for each of those days.

The after-project situation in Geraki would appear from this analysis
to be an improvement on the before-project situation on all counts
and to all socio-economic groups. It is impossible, however, to
separate out the role of the embankment in effecting this
improvement, and to ascertain how much of the change has been due to
other factors operating at the local as well as the wider scale. The
rest of this discussion is concerned with a comparison of the
agricultural system inside the project area with that in an otherwise
comparable area outside the project, assuming the latter to have been
subjected to the same wider forces of change as the former. It is
this 'with - without' comparison which provides the firmer basis for
a true evaluation of the project's impact on agriculture, avoiding
certain of the methodological pitfalls of the 'before - after'
comparison.
8.3 A 'with - without' comparison

As in the 'before - after' comparison, all ultimately hinges on the differences in cropping pattern between the two study villages. Even at the broad seasonal level, important distinctions in agricultural practice are evident (fig. 8 and table 8.5). While HYV boro cultivation dominates the agricultural calendar in both Geraki and Sutanari, this domination is far more pronounced in the flood-protected village, where 82.8% of the cultivated land is planted to HYV rice in the boro season to Sutanari's 60.4%. Comparison of these figures to Geraki's pre-embankment figure of 31% shows the extent of the conversion to boro cultivation which has characterised recent agricultural development in Bangladesh as a whole, with the active dissemination of the modern agricultural technology of hybrid seeds, artificial fertilisers and irrigation.

Both villages have been reached by national programmes of agricultural development, including credit provision, agricultural extension, irrigation supply and agricultural marketing. That Geraki has 22% more of its area under HYV boro than does Sutanari must, then, be attributable largely to the crop protection afforded by the embankment, which makes the necessary investment in inputs for HYV cultivation an altogether less risky venture. This conclusion is reinforced by the continued presence in Sutanari's cropping system of a small but significant area (4.6%) of low-yielding deshi (local)
Fig. 8 Cropping patterns in with- and without-project villages
Table 8.5 Seasonal cropping breakdown in with- and without-project villages

<table>
<thead>
<tr>
<th>Season and crop</th>
<th>Area under crop (acres)</th>
<th>Geraki</th>
<th>Sutanari</th>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>aus:</strong> total</td>
<td>24.5</td>
<td>55.1</td>
<td>12.3</td>
<td>28.7</td>
<td></td>
</tr>
<tr>
<td>rice</td>
<td>8.9</td>
<td>5.4</td>
<td>4.5</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>jute</td>
<td>15.6</td>
<td>49.7</td>
<td>7.8</td>
<td>25.9</td>
<td></td>
</tr>
<tr>
<td><strong>aman:</strong> total</td>
<td>18.7</td>
<td>5.4</td>
<td>9.4</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>broadcast</td>
<td>0.0</td>
<td>5.4</td>
<td>0.0</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>transplanted</td>
<td>18.7</td>
<td>0.0</td>
<td>9.4</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td><strong>boro:</strong> total</td>
<td>165.5</td>
<td>124.8</td>
<td>82.8</td>
<td>65.0</td>
<td></td>
</tr>
<tr>
<td>HYV rice</td>
<td>165.5</td>
<td>115.9</td>
<td>82.8</td>
<td>60.4</td>
<td></td>
</tr>
<tr>
<td>local rice</td>
<td>0.0</td>
<td>8.9</td>
<td>0.0</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td><strong>rabi:</strong> total</td>
<td>122.5</td>
<td>119.6</td>
<td>61.4</td>
<td>62.3</td>
<td></td>
</tr>
<tr>
<td>mustard</td>
<td>105.8</td>
<td>74.0</td>
<td>53.0</td>
<td>38.5</td>
<td></td>
</tr>
<tr>
<td>pulses</td>
<td>0.6</td>
<td>4.9</td>
<td>0.3</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>wheat</td>
<td>12.4</td>
<td>27.8</td>
<td>6.2</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>potatoes</td>
<td>2.1</td>
<td>5.4</td>
<td>1.1</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>1.6</td>
<td>7.5</td>
<td>0.8</td>
<td>3.9</td>
<td></td>
</tr>
</tbody>
</table>
varieties of boro rice, grown by poorer farmers who are neither prepared nor indeed able to bear the risks involved in growing the input-demanding HYVs. The cultivation of local boro rice has important connotations in terms of harvest timing, too: maturing earlier than the HYVs, it is less vulnerable to damage from early flooding.

In looking at other crops, the 'with - without' comparison again reinforces many of the conclusions from the 'before - after' comparison, while at the same time revealing something of the pattern of wider agricultural change. Consequent upon the expansion of HYV boro has been the demise of aus cultivation. Aus crops, both rice and jute, now comprise just 12.3% of the total cropped area in Geraki, but in Sutanari the area of aus cultivation (mostly of jute rather than rice) remains comparatively high at 28.7%. The diminution in the area under the monsoon season crops of rice and jute is a country-wide phenomenon, a direct consequence of the expansion in boro cultivation, and occurring in this locality with dramatic suddenness with the advent of irrigation. The switch to boro rather than aus cultivation has been more marked in Geraki than in Sutanari, however, with several farmers in the unprotected village still opting for the lower input demands and greater flood tolerance of the aus crops. In Geraki, farmers no longer seem to consider aus a viable alternative to the higher-yielding boro. Here, the ratio of boro to aus is 7:1; in Sutanari, it is a substantially smaller 2:1. Clearly, the embankment has played a significant role in Geraki's cropping transformation, and the nature of that transformation indicates that
it has been effected by an extension of the flood-free period at a critical stage in the agricultural calendar.

Only a very small area of mixed aus and aman persists in either village. In fact, aman cultivation is virtually non-existent in Sutanari, but appears in new guise in Geraki, its transplanted rather than broadcast varieties being found in a rotation with HYV boro (albeit on only very few fields, being restricted to the more elevated land). Earlier onset of flooding in Sutanari precludes the successful transplant of aman seedlings, but the containment of flooding in Geraki is just sufficient to allow the transplanted aman seedlings to establish themselves before the flood arrives. That aman cultivation is barely in evidence in Sutanari is owing to farmers there opting to grow jute in the aus season rather than the traditional mixed rice crop - a preference based on wider market forces as much as on any environmental condition.

When it comes to the rabi crops, trends revealed in the 'before - after' comparison are once again reinforced by the 'with - without' comparison. Mustard dominates rabi season cultivation in both Geraki and Sutanari. The combination of mustard with HYV boro in a crop rotation is evidenced by the fact that the proportion of mustard to boro cultivation is identical in the two villages. With the area under HYV boro being smaller in Sutanari, the area under mustard is correspondingly less: 38.5% to Geraki's 53.0%. The higher incidence of aus in Sutanari means a higher incidence of those crops which fit better into an aus - rabi than a boro - rabi rotation, so that

- 270 -
pulses, wheat and potatoes are all more prevalent in Sutanari than in Geraki. Thus while rabi cultivation is roughly equivalent in the two villages, the type of crop and the location of rabi crops in the agricultural calendar display important differences.

So far, the discussion has centred on single crops, with crop rotations being mentioned only in passing. To make any meaningful assessment of the relationship between cropping pattern and any environmental or economic parameter, not single crops but crop rotations are important. The pre-project survey was deficient in this regard, as data on only single crops were collected and the likely crop rotations could only be surmised. In the post-project survey, farmers were asked to give the sequence of crops on their fields as well as the acreage of individual crops, and it is thus possible to construct a more complete picture of cropping patterns, taking into account the intricate dovetailing of harvesting and sowing times which must be achieved to maximise cropping intensity.

Interesting contrasts are revealed in a ranking of the most common crop rotations in the two villages (table 8.6). The most common rotation in Geraki is a double cropping of boro rice and rabi mustard: the mustard is sown in October - November and harvested in December - January; the boro is sown in seedbeds in November - December, transplanted into the fields in January and harvested in May - June. In Sutanari, this boro rice - rabi mustard rotation is relegated to second place in the ranking by a single-crop rotation of HYV boro rice on its own. The clear implication is that there is not
<table>
<thead>
<tr>
<th>Geraki</th>
<th>Sutanari</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. boro rice, rabi mustard</td>
<td>1. boro rice</td>
</tr>
<tr>
<td>90.4 acres</td>
<td>62.9 acres</td>
</tr>
<tr>
<td>2. boro rice</td>
<td>2. boro rice, rabi mustard</td>
</tr>
<tr>
<td>64.4 acres</td>
<td>58.3 acres</td>
</tr>
<tr>
<td>3. aus jute, rabi mustard</td>
<td>3. aus jute, rabi wheat</td>
</tr>
<tr>
<td>7.8 acres</td>
<td>22.9 acres</td>
</tr>
<tr>
<td>4. aus jute</td>
<td>4. aus jute, rabi mustard</td>
</tr>
<tr>
<td>2.6 acres</td>
<td>12.1 acres</td>
</tr>
<tr>
<td>5. aman rice, rabi mustard, boro rice</td>
<td>5. aus jute</td>
</tr>
<tr>
<td>2.4 acres</td>
<td>5.6 acres</td>
</tr>
<tr>
<td>6. aman rice, boro rice</td>
<td>6. aus jute, rabi potatoes</td>
</tr>
<tr>
<td>2.3 acres</td>
<td>3.4 acres</td>
</tr>
<tr>
<td>7. aman rice, rabi mustard</td>
<td>7. aus jute, rabi pulse</td>
</tr>
<tr>
<td>1.5 acres</td>
<td>2.5 acres</td>
</tr>
</tbody>
</table>
a sufficiently long flood-free season over much of the agricultural land in Sutanari to allow a double dry season cropping. This single boro rotation takes second place in Geraki, being grown on the lower-lying land which before the embankment would have supported a broadcast aman crop.

All rotations other than these two have been reduced almost to insignificance in Geraki's cropping system, none occupying even 5% of the total cultivated area. Continuing to occupy a significant proportion of Sutanari's cultivated area, and ranking third in the hierarchy, is a rotation of aus jute and rabi wheat. Another aus - rabi rotation, of jute and mustard, ranks fourth; fifth place is occupied by a single cropping of aus jute; and aus - rabi rotations are also found in sixth and seventh place. In Geraki, an aus jute - rabi mustard rotation occupies third place; a single jute cropping is in fourth place; but positions five, six and seven are taken up by various combinations of aman, rabi and boro crops.

The importance of considering crop rotations rather than single crops, and the difficulty of the task facing the farmer in deciding which crop rotation is best suited to each field, becomes clearer when one considers the detail of the agricultural calendar in relation to land quality, and in particular to the land's elevation and fertility. To do this, seasonal rotations were ranked for various categories of elevation and fertility, first singly and then in combination, for each of the two villages (tables 8.7, 8.8 and 8.9). This provides an insight into both the general correlation
Table 8.7  Ranking of cropping pattern by elevation in with- and without-project villages

<table>
<thead>
<tr>
<th>Village</th>
<th>Rotation ranking</th>
<th>Area(%)</th>
<th>Village</th>
<th>Rotation ranking</th>
<th>Area(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uchu</td>
<td>1. boro-rabi</td>
<td>50.3</td>
<td>Sutanari</td>
<td>1. aus-rabi</td>
<td>48.3</td>
</tr>
<tr>
<td></td>
<td>2. aus-rabi</td>
<td>20.8</td>
<td></td>
<td>2. boro-rabi</td>
<td>24.8</td>
</tr>
<tr>
<td></td>
<td>3. boro</td>
<td>10.9</td>
<td></td>
<td>3. boro</td>
<td>9.9</td>
</tr>
<tr>
<td>Medium</td>
<td>1. boro-rabi</td>
<td>58.3</td>
<td></td>
<td>1. boro-rabi</td>
<td>51.0</td>
</tr>
<tr>
<td></td>
<td>2. boro</td>
<td>23.3</td>
<td></td>
<td>2. aus-rabi</td>
<td>21.8</td>
</tr>
<tr>
<td></td>
<td>3. aman-rabi-boro</td>
<td>4.5</td>
<td></td>
<td>3. boro</td>
<td>21.2</td>
</tr>
<tr>
<td>Nichu</td>
<td>1. boro</td>
<td>55.1</td>
<td></td>
<td>1. boro</td>
<td>61.6</td>
</tr>
<tr>
<td></td>
<td>2. boro-rabi</td>
<td>34.0</td>
<td></td>
<td>2. boro-rabi</td>
<td>24.8</td>
</tr>
<tr>
<td></td>
<td>3. aus-aman</td>
<td>2.5</td>
<td></td>
<td>3. aus</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Table 8.8  Ranking of cropping pattern by fertility in with- and without-project villages

<table>
<thead>
<tr>
<th>Village</th>
<th>Rotation ranking</th>
<th>Area(%)</th>
<th>Village</th>
<th>Rotation ranking</th>
<th>Area(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertile</td>
<td>1. boro-rabi</td>
<td>60.3</td>
<td></td>
<td>1. boro-rabi</td>
<td>46.7</td>
</tr>
<tr>
<td></td>
<td>2. boro</td>
<td>25.9</td>
<td></td>
<td>2. boro</td>
<td>40.2</td>
</tr>
<tr>
<td></td>
<td>3. aus-rabi</td>
<td>6.3</td>
<td></td>
<td>3. aus-rabi</td>
<td>10.6</td>
</tr>
<tr>
<td>Medium-</td>
<td>1. boro-rabi</td>
<td>39.7</td>
<td></td>
<td>1. boro</td>
<td>37.5</td>
</tr>
<tr>
<td>fertile</td>
<td>2. boro</td>
<td>31.7</td>
<td></td>
<td>2. boro-rabi</td>
<td>29.7</td>
</tr>
<tr>
<td></td>
<td>3. aus-rabi</td>
<td>6.9</td>
<td></td>
<td>3. aus-rabi</td>
<td>22.0</td>
</tr>
<tr>
<td>Infertile</td>
<td>1. boro</td>
<td>68.5</td>
<td></td>
<td>1. aus-rabi</td>
<td>57.4</td>
</tr>
<tr>
<td></td>
<td>2. boro-rabi</td>
<td>9.0</td>
<td></td>
<td>2. aus-aman-rabi</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>3. aus</td>
<td>8.5</td>
<td></td>
<td>3. boro-rabi</td>
<td>7.6</td>
</tr>
</tbody>
</table>
Table 8.9  Ranking of cropping pattern by fertility and elevation in with- and without-project villages

<table>
<thead>
<tr>
<th></th>
<th>Uchu</th>
<th>Medium</th>
<th>Nichu</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Geraki</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertile</td>
<td>1. boro-rabi</td>
<td>1. boro-rabi</td>
<td>1. boro</td>
</tr>
<tr>
<td></td>
<td>2. aus-rabi</td>
<td>2. boro</td>
<td>2. boro-rabi</td>
</tr>
<tr>
<td>Medium</td>
<td>1. boro-rabi</td>
<td>1. boro-rabi</td>
<td>1. boro</td>
</tr>
<tr>
<td></td>
<td>2. aus-rabi</td>
<td>2. boro</td>
<td>2. boro-rabi</td>
</tr>
<tr>
<td>Infertile</td>
<td>1. boro</td>
<td>1. boro</td>
<td>1. boro</td>
</tr>
<tr>
<td></td>
<td>2. aus-aman-rabi</td>
<td>2. boro-rabi</td>
<td>2. boro-rabi</td>
</tr>
<tr>
<td>b) Sutanari</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertile</td>
<td>1. boro-rabi</td>
<td>1. boro-rabi</td>
<td>1. boro</td>
</tr>
<tr>
<td></td>
<td>2. boro</td>
<td>2. aus-rabi</td>
<td>2. boro-rabi</td>
</tr>
<tr>
<td>Medium</td>
<td>1. boro-rabi</td>
<td>1. boro</td>
<td>1. aus-rabi</td>
</tr>
<tr>
<td></td>
<td>2. aus-rabi</td>
<td>2. boro-rabi</td>
<td>2. boro-rabi</td>
</tr>
<tr>
<td>Infertile</td>
<td>1. aus-rabi</td>
<td>1. aus-rabi</td>
<td>1. aus-rabi</td>
</tr>
<tr>
<td></td>
<td>2. aus-aman-rabi</td>
<td>2. boro-rabi</td>
<td>2. boro</td>
</tr>
</tbody>
</table>
between crop selection and land quality, and the specific changes wrought by the embankment on land quality (and hence on crop selection) in Geraki. The categories used were the same ones employed by the farmers in their descriptions of the physical characteristics of their fields: uchu, moddhom and nichu (high, medium and low) are the assigned elevation categories, and 'fertile', 'medium-fertile' and 'infertile' are the fertility classes. The terms 'uchi' and 'nichu' are retained in this discussion as a reminder of the different scale of height here under consideration: a matter of a few metres rather than the hundreds or even thousands of metres implicit in the English terms 'highland' and 'lowland'. Even within Bangladesh, the terms 'uchi' and 'nichu' are location-specific: what might be uchu land to a farmer here in the Jamuna floodplain might be nichu land to a farmer in Rajshahi; what might be nichu land here might be uchu land to a farmer in the Sylhet Depression. No land category in either of the two villages under study was exempt from annual inundation of considerable depth, so there is no connotation of 'flood-free' in the term 'uchi'.

Sutanari displays a pronounced sequence of crop rotation with elevation. On uchu land, an aus - rabi rotation dominates; on middling land, a boro - rabi rotation prevails; and on nichu land, the most common 'rotation' is a single boro crop. In Geraki, boro - rabi is the dominant rotation on both uchu and medium land, while on nichu land the single boro cropping is again predominant. The aus - rabi rotation which is so pronounced on Sutanari's uchu land comes a distant second in the Geraki ranking. The most plausible explanation
for the similarity in cropping pattern between uchu and medium land in Geraki is that this in fact represents a reclassification of land in the minds of the local farmers, with land that is actually of medium elevation being described as uchu because of its altered flood regime. Comparison with pre-project data certainly suggested this to be so, as there had been an expansion in the area of land classified as uchu. The result is that the significance of field elevation as a determining factor in crop rotation options has been reduced in Geraki, while in Sutanari field height remains a major control on the cropping pattern.

The relationship between cropping pattern and soil fertility also reveals telling differences between the two villages (see ranking in table 8.8). In Geraki, the three main crop rotations on land classed as fertile are identical to those on land classed as being of only medium fertility: first boro - rabi, second boro, then aus - rabi. Only on Sutanari's fertile land does this ranking obtain. Medium-fertile land in Sutanari displays an ordering of crop rotations more akin to that on Geraki's least fertile land, with a single boro cropping assuming dominance. On Sutanari's infertile land, a traditional aus - rabi rotation is that most commonly adopted, with there being barely any HYV boro cultivation in this land category at all. Altogether, the pattern in Geraki is one of greater uniformity between fertility classes, as was the case for land height. In addition, more land in Geraki was classed as fertile by the respondents, but again this is more likely to reflect changed perceptions of fertility as natural limitations have become less
severely constraining, rather than any miraculous improvement in soil fertility (although the embankment's prevention of the sand deposition which continues to plague the surrounding area could be a factor here). The implication of the cropping and fertility data is that farmers in Geraki are more prepared than their counterparts in Sutanari to take positive steps to overcome environmental limitations by adopting input-intensive modern farming methods, even on the most naturally disadvantaged land. The response to fertility limitations in Sutanari is simply to adopt one of the low-input (and low-output) traditional crop rotations, and hence the dominance in this land category of the aus - rabi rotation.

The situation becomes clearer when fertility and elevation are considered in combination (table 8.9). Combining the three height categories with the three classes of fertility gives nine combined fertility and height categories. In the optimal land categories, Geraki and Sutanari differ little in their cropping patterns. The distinction between the two begins to emerge on medium-fertile land. Whereas in Geraki the pattern on medium-fertile land is no different from that on its fertile land, the pattern which emerges in this fertility category in Sutanari is quite distinct from that on either its own fertile land or Geraki's medium-fertile land.

The patterns in Geraki show a considerable degree of uniformity across categories. In all nine land quality classes, the top spot is occupied by either a boro - rabi or a boro rotation, the single-crop rotation prevailing at all heights on infertile land and at the
lowest elevations on fertile and medium-fertile land (i.e. where flood risk and/or poor fertility restrict agricultural potential). In Sutanari, the top spot is occupied by a rotation that includes HYV boro only on land where the chances of the crop's success are at their greatest: in the upper two height categories on medium-fertile land and on all height categories of fertile land. In all other land categories in Sutanari, where flood risk is greater or fertility less, an aus - rabi rotation dominates.

This analysis of the combined effect of fertility and elevation in determining a farmer's selection of crop rotation reinforces the conclusions drawn from the separate, individual analyses of fertility and elevation, and sheds more light on the changes noted in the 'before - after' comparison. In Geraki, HYV boro has assumed the place of aus in the cropping calendar, with a number of related changes ensuing: a reduction in aman, which was previously grown in a mixed cropping with the aus; an increase in the popularity of mustard as a rabi crop; and a general standardisation of cropping patterns across land types. While Sutanari's cropping pattern is not simply that of pre-embankment Geraki, it seems to have been arrested at a transitional stage in the process of agricultural transformation, with traditional and modern crop rotations co-existing. In Geraki, only vestiges of the traditional elevation- and fertility-determined cropping pattern remain intact, being for the most part superseded by irrigated, fertilised, dry season cultivation. This has radically altered traditional agricultural seasonality, with the once-lean boro season now the season of maximum agricultural activity and
productivity, and the once-ubiquitous *aus* and *aman* cultivation reduced almost to obsolescence. In Sutanari, modern crops and farming methods have essentially been accommodated within the traditional structure; in Geraki, they have imposed an altogether new structure of their own.

Cropping practices in the two villages differ not only in terms of their spatial pattern but also in the timing of field preparation, sowing, transplantation and harvest for particular crops (see fig. 8). This information was gleaned from the month-by-month activity calendars compiled for each respondent. In this respect, Sutanari closely resembles pre-embankment Geraki, with a shorter flood-free season limiting flexibility in the agricultural calendar. Earlier flooding means the earlier harvesting of *boro* rice, so that farmers are obliged to grow quicker-maturing varieties, including some *deshi boro*. Even then, they have to ensure that fields are prepared in good time for the timely planting of *boro* in January. This, in turn, imposes an urgency on the harvest of the *rabi* crops which occupy the land to be planted to *boro*. If there has been any delay in the recession of flooding, and hence late planting of *rabi* crops, a farmer may be forced to remove these crops from his fields before they have reached full maturity, sacrificing *rabi* production in order to give the *boro* crop a better chance of success. Too much of a delay in the flood's recession might mean that a farmer chooses not to plant a *rabi* crop at all. The *aus - rabi* rotation suffers similar constraints. The *aus* crop, be it rice or jute, must be harvested by mid-July if it is not to be put at great risk of flood damage, so
planting in March is essential. Those rabi crops (e.g. wheat, potatoes) which accompany the aus in rotation must therefore be harvested in time to make way for the aus sowing, often at the expense of rabi productivity.

Geraki's farmers appear to have greater leeway in the timing of agricultural activities. The boro harvest continues for up to a month after it has been brought to an end in Sutanari. This means not only that later-maturing varieties can be grown, but also that there is less urgency about the boro field preparation and planting, which can be carried over into February without placing the crop at undue risk. This makes the timing of the rabi harvest less crucial. The same latitude extends to aus cultivation - sowing can be done as late as April, and July rather than June is the peak aus harvest, so rabi crops are more easily accommodated. The embankment has thus served to loosen the limits of agricultural seasons, blurring the divisions between them, while in Sutanari the agricultural seasons remain rigidly defined by environmental conditions.

As has been emphasised from the outset, a difference between the two villages in terms of their spatial and temporal cropping patterns does not in itself reveal the full impact of the embankment on the agricultural system. Indeed, the cropping patterns represent only the starting point in an analysis of the local agricultural economy. Two primary issues are here of relevance. The first, in view of the main objective of the larger national development strategy, is the effect of the project on agricultural productivity, and particularly
foodgrain productivity. The second, in view of the project funding agency's egalitarian planning philosophy, is the equity in distribution of the benefits which have accrued from project-induced agricultural change.

Of these, productivity is the more readily evaluated. Commonly cited as an index of productivity is the cropping intensity i.e. the area of cropped land relative to the total cultivable area. With widespread double and triple cropping, both villages have figures for cropping intensity of over 100%: Geraki's is 163; Sutanari's 155. The greater prevalence of the double boro - rabi cropping in Geraki, and of the single boro cropping in Sutanari, is borne out in these figures. If one assumes Geraki's pre-embankment cropping intensity of 164 to have been representative of the wider local area at that time, then Sutanari can be taken to have experienced an actual decline in cropping intensity over the four-year period, while in Geraki it has remained effectively constant. Again, this is attributable to the different manner in which HYV boro cultivation has replaced the traditional aus and aman crops in the cropping system of each village: usually in a two-crop boro - rabi rotation in Geraki, thus having no effect on cropping intensity, but in Sutanari more commonly as a single crop, giving a lower intensity of cropping. However, the wide disparity in yield between the modern HYVs and the traditional paddy crops means that cropping intensity is fundamentally flawed as an index of agricultural productivity. To obtain a true assessment of the impact of the embankment on agricultural productivity, crop yields must be taken into account as
well as cropping pattern and intensity.

Table 8.10 shows the average yields of each of the major crops in the two villages, along with the acreage under each crop. With these data on cropping pattern and crop yields, it is possible to calculate the average annual output of each crop, and thus to calculate the total agricultural production of each village. The pattern in Geraki is clearly more heavily biased towards the cultivation of foodgrains, both in terms of areal coverage and of yield. The dominance of HYV boro in Geraki's agriculture is evidenced by the fact that for almost all other crops, yields are here lower than in Sutanari. Their concentration of labour and capital on boro cultivation rewards Geraki's farmers with an average yield of 54 maunds per acre to Sutanari's 51 maunds. Sutanari's farmers obtain higher yields from the aus jute and rabi wheat which there continue to make an important contribution to the local agricultural economy. Farmers in Geraki would have a rotation of aus jute and rabi wheat only on their poorer fields, and would expend less labour and capital on these than on their major crop rotation of boro rice and rabi mustard.

In combination, the different crop yields and the distinctive cropping patterns in each village produce a quite different situation with respect to agricultural output. Sutanari's output exceeds that of Geraki only for jute and wheat. In terms of total output, Geraki is some 30% better off than Sutanari. In terms of paddy output, Geraki's superiority rises to close on 50%. The improvement in Geraki's agricultural productivity noted in the 'before - after'
Table 8.10 Production from major crops in with- and without-project villages

<table>
<thead>
<tr>
<th>Crop</th>
<th>Yield (maunds/acre)</th>
<th>Area (acres)</th>
<th>Production (maunds)</th>
<th>Yield (maunds/acre)</th>
<th>Area (acres)</th>
<th>Production (maunds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>aus</td>
<td>8.5</td>
<td>8.9</td>
<td>76</td>
<td>10.7</td>
<td>5.4</td>
<td>58</td>
</tr>
<tr>
<td>aman</td>
<td>18.5</td>
<td>18.7</td>
<td>346</td>
<td>12.9</td>
<td>5.4</td>
<td>70</td>
</tr>
<tr>
<td>HYV boro</td>
<td>53.6</td>
<td>165.5</td>
<td>8,871</td>
<td>51.2</td>
<td>115.9</td>
<td>5,934</td>
</tr>
<tr>
<td>local boro</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
<td>28.5</td>
<td>8.9</td>
<td>254</td>
</tr>
<tr>
<td>wheat</td>
<td>19.4</td>
<td>12.4</td>
<td>241</td>
<td>22.5</td>
<td>27.8</td>
<td>626</td>
</tr>
<tr>
<td>mustard</td>
<td>9.9</td>
<td>105.8</td>
<td>1,047</td>
<td>9.7</td>
<td>74.0</td>
<td>718</td>
</tr>
<tr>
<td>jute</td>
<td>12.8</td>
<td>15.6</td>
<td>200</td>
<td>15.1</td>
<td>49.7</td>
<td>750</td>
</tr>
</tbody>
</table>

Total paddy production: 9,293 6,316
Total foodgrain production: 9,534 6,942
Total production: 10,781 8,410
comparison is thus proved as having been achieved largely through the impact of the embankment on the agricultural system, particularly through its influence on the cropping pattern, as Geraki and Sutanari have been subjected to similar forces for change in all but this one respect.

Given the project funding agency's particular concern for the poorest groups, it is important to look at the differential impact of the project through the socio-economic hierarchy. An overall improvement in agriculture, particularly when measured in terms of production, can often mean a widening gap between rich and poor. Much has been written in a general re-evaluation of the 'green revolution' in this light. It was quite feasible that the lion's share of the benefits from this flood control project would accrue to the better-off peasants, who with their greater access to the resources of land and capital would be better disposed to take advantage of the opportunity to enhance their agricultural production, leaving the poorer peasants in their all-too-familiar poverty trap. Suggestions from the 'before - after' comparison were that this had not been the case, the distribution of benefits in fact having been fairly equitable, and the 'with - without' comparison serves to verify this conclusion.

The primary evidence for this assertion is based on a comparison of the cropping patterns within the various landholding classes in each of the two villages. The situation in Sutanari differs only slightly from that in pre-embankment Geraki: 14% of the marginal farmers and 6% of the small farmers continue to practise an agriculture comprised
entirely of traditional crops and crop rotations, and only among the medium and large landholders is there 100% adoption of HYVs. The similarity extends to other aspects of the cropping system, too. It was noted of Geraki in the pre-project survey that agricultural diversification was greatest among medium and large farmers, who combined traditional and modern (i.e. HYV-inclusive) rotations in their cropping systems while many small and marginal farmers did not. This phenomenon is still characteristic of Sutanari, where all the medium and large farmers devote some land to traditional and some to modern rotations, but many small and marginal farmers have all their land exclusively under one or the other. In Geraki, the conversion to HYVs has been virtually across the board, there remaining but a single farmer who practises a purely traditional cropping system: a marginal farmer who grows aus and rabi in order to free himself to earn money as an agricultural labourer in the boro season. Here, too, diversification is the hallmark of the larger landowner, but unlike their counterparts in Sutanari, the smaller landholders do not regard traditional crop rotations as a viable option, choosing instead to concentrate their energies and resources on growing HYVs under irrigation in the dry season. The primary agricultural change effected by the embankment, the expansion in boro cultivation, has thus been universal rather than class-distinctive in its impact, while Sutanari retains an element of class-determinism in its agricultural system, with the productivity benefits of modern agricultural technology being out of reach to certain among the poorer farmers.
It might be supposed that an analysis solely in terms of cropping pattern would be inadequate, and that an analysis of crop yields by landholding class might reveal inequalities not immediately evident. Study of the data, however, reveals no suggestion of any variation in the yields obtained by farmers of differing economic status in either Geraki or Sutanari. Other studies, both in Bangladesh and elsewhere, have suggested variously that poor farmers, with their very survival in the balance, obtain higher yields than do rich farmers, or that poor farmers, unable to afford the full input package for HYV cultivation, obtain lower yields from these crops than do rich farmers. Neither case is true in either of the study villages, as the average yields of both traditional crops and HYVs show no variation between landholding classes. If crop yields could have been actually measured rather than the average yields reported by the farmers themselves merely being recorded, a degree of variation might have emerged. Even so, the fundamental distinction between landholding classes in the without-project situation would remain in their cropping patterns, and it is in the removal of this distinction that the embankment has had its most significant impact.

It would thus appear that among cultivators at least the project has not led to any widening of the gap between rich and poor. Geraki's small and marginal landholders have not been excluded from the development process; indeed it seems that the embankment has served actively to bring them into certain processes of change from which they were previously excluded. All landholding classes have been involved in the expansion of HYV boro cultivation; all have benefited
from the increased agricultural productivity this has brought about. Obviously those with the most land benefit most from the increased production, but the smaller farmers have enjoyed at least a proportional share of the benefits. In Sutanari, where farmers have not been released from the constraints imposed by the flood hazard, agricultural change has been less evenly distributed, favouring the larger landholders, and excluding certain among the poorer farmers altogether. By reducing the risk of flooding, the embankment has played a dual role: it has expanded the area physically suited to HYV boro cultivation, and it has expanded the number of farmers economically able to undertake HYV cultivation.

It is important to consider also those among the villages' inhabitants who are not cultivators, especially the agricultural labourers. The 'before - after' comparison suggested that the embankment, through its effect on the agricultural system, had been beneficial to labourers as well as to cultivators. The 'with - without' comparison has confirmed the relative importance of the embankment (vis-a-vis other factors such as the general trend towards HYV cultivation) in Geraki's agricultural transformation; it thus confirms also that higher agricultural labour demand in Geraki is attributable to the embankment's influence. Using the post-project cropping data and assuming the labour input required for each crop to have remained constant at pre-embankment levels, it is possible to quantify the level of labour demand in the with- and without-project villages, and thereby to evaluate the role of the embankment in creating agricultural employment.
The figures obtained for total labour use per crop in the two study villages are shown in table 8.11. Occupying the bulk of the land in Geraki, and thus absorbing the greatest amount of labour, are HYV boro rice and rabi mustard. A third crop, jute, is a significant labour user in Sutanari in addition to these two. HYV boro is the most labour-demanding of all the crops cultivated, and it is the larger area under boro which is the most significant factor in giving Geraki the higher overall labour demand: 19,699 mandays to Sutanari's 17,132. Geraki's slightly larger land area contributes to the greater labour input required, but its cropping pattern demands a higher labour input on a 'per acre' basis as well: 95 mandays to Sutanari's 90. That this is so confirms the role of the embankment in creating the increased demand for labour noted in the 'before - after' comparison.

Greater labour demand in Geraki must mean that those who earn all or part of their livelihood through agricultural labour are better off in the flood-protected village than in the unprotected village. The number of days in the year on which a casual labourer can expect to find gainful employment is greater, and heightened labour demand means higher wages. The situation is complicated by the question of seasonality in agricultural employment; a question pursued in more detail in the next section. Such is the nature of HYV boro cultivation, however, that it requires a high labour input at all stages of its cultivation, from field preparation to harvesting, and so the dominance of this single crop does not have the marked effect
### Table 8.11 Labour demand in with- and without-project villages

<table>
<thead>
<tr>
<th>Crop</th>
<th>Labour use per crop (mandays/acre)</th>
<th>Area under crop (acres)</th>
<th>Total mandays required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geraki</td>
<td>Sutanari</td>
<td>Geraki</td>
</tr>
<tr>
<td>aus</td>
<td>32</td>
<td>8.9</td>
<td>5.4</td>
</tr>
<tr>
<td>aman</td>
<td>32</td>
<td>18.7</td>
<td>5.4</td>
</tr>
<tr>
<td>HYV boro</td>
<td>83</td>
<td>165.5</td>
<td>115.9</td>
</tr>
<tr>
<td>local boro</td>
<td>41 (E)</td>
<td>0.0</td>
<td>8.9</td>
</tr>
<tr>
<td>mustard</td>
<td>34</td>
<td>105.8</td>
<td>74.0</td>
</tr>
<tr>
<td>jute</td>
<td>62</td>
<td>15.6</td>
<td>49.7</td>
</tr>
<tr>
<td>pulses</td>
<td>13</td>
<td>0.6</td>
<td>4.9</td>
</tr>
<tr>
<td>wheat</td>
<td>41 (E)</td>
<td>12.4</td>
<td>27.8</td>
</tr>
<tr>
<td><strong>Total labour requirement:</strong></td>
<td>19,699</td>
<td>17,132</td>
<td></td>
</tr>
</tbody>
</table>

E: estimated from post-project data
(other values are the pre-project figures from Miah, 1983)
on labour demand seasonality that might be anticipated. This would not necessarily be the case in a different physical environment, where a shift to HYV cultivation might be accompanied by a shift towards agricultural mechanisation and hence to a reduction in labour demand. In rural Bangladesh, a number of factors combine to ensure that the potential for mechanisation is severely limited, and that agriculture will always remain a highly labour-intensive enterprise: the high degree of land fragmentation; the absence of roads; the fact that the land is submerged for a large part of the year; and the semi-aquatic nature of paddy cultivation. Labourers have therefore shared in the benefits brought by the flood control project, where in a different environment the embankment might have served to facilitate mechanisation, thereby reducing the demand for agricultural labour.

The 'with - without' comparison has served to confirm the tentative conclusions drawn from the 'before - after' comparison, and has shown up just how significant the embankment has been in effecting agricultural change. By taking Sutanari as representative of the way Geraki might have developed had there not been any embankment, it has been possible to separate out the changes induced by flood control from those emanating from the wider processes of development affecting Bangladesh as a whole. As borne out by the situation in Sutanari, changes would have occurred had there been no flood control project, with the advent of hybrid seeds and irrigation, but the impact of the embankment has been to hasten and facilitate those changes, extending them not only over a wider physical area but
across a wider spectrum of rural society. Flood control has acted as a catalyst for, rather than a direct agent of, change.

The most important alteration in the physical environment has been a delay in the onset of flooding, and thus the extension of the flood-free period at a critical stage in the agricultural calendar. The effect of this has been to bring the environmental risk factor below the critical level at which farmers - even poor farmers - are prepared to make the substantial investment in inputs required for HYV cultivation. Perhaps the most striking feature of the 'new' agriculture inside the project area is its uniformity: HYV boro rice dominates the crop rotations on uchu and nichu land, on fertile and infertile land, on land belonging to rich landowners and on land belonging to the poorest peasant cultivators. Without flood control, land which is of inferior quality or which belongs to the poorest farmers is still, as a rule, planted to low-input, low-risk and low-yielding traditional crop rotations. High flood risk constrains farmers' options in selecting crop rotations, and they have constantly to play off a crop's flood resistance against its productivity. The very hazard of flooding thus limits agricultural productivity by restricting farmers to less productive crop rotations. The embankment was intended to remove this limitation as much as to reduce actual flood damage to crops, and in this it has been a complete success. It has been a success, too, in terms of equity, bringing benefits to large and small landholders alike, and not just to cultivators but to labourers as well.
8.4 The seasonality of economic activity

With agriculture being the primary activity of the bulk of the respondents in both Geraki and Sutanari, agricultural seasonality very much determines the pattern of their existence. Changed agricultural seasonality has profoundly altered seasonal rhythms of activity and inactivity, and thus of labour demand and wage rates. These changes have led in turn to altered seasonal patterns in the economy beyond the agricultural sector, reflecting the need of many to seek employment in the non-farm sector during slack periods in the agricultural calendar. Little attention was paid to the seasonality of agricultural labour demand in the pre-project survey, with the total labour demand per crop being the primary consideration. In the post-project survey, too, data collection in this regard was only rudimentary, with respondents being asked to give their primary and secondary activity on a month-by-month basis. Much can be inferred from these data, however, especially when they are considered in the light of the prevailing cropping patterns and in connection with the data on cropping pattern and seasonal labour use presented in studies such as those by Chaudhury (1981) and Clay (1981).

Both Chaudhury and Clay provide a description of the seasonal labour requirements in the traditional agricultural system where aman rice is the main crop. This rotation creates a bimodal pattern of labour demand with peaks in the periods March - May and October - December, the first being the season of field preparation and planting and the
second that of the main harvest. Minor peaks are introduced depending on the secondary crops grown. Aus cultivation further heightens labour demand in March and April, and then creates a further demand peak at the time of its harvest in June - July. Rabi crops introduce further variation, each having its own pattern of labour demand.

Such would have been the pattern in pre-embankment Geraki, with mixed aus and aman and broadcast aman dominating the agricultural system. The likely distribution of labour demand for mixed aus and aman cultivation is shown in fig. 9, which uses the values obtained in the pre-project survey for the total labour demand per crop and imposes on these the seasonal distribution of labour demand labour presented in Clay (1981). In the post-embankment situation, seasonal labour demand has been transformed along with the cropping pattern. The replacement of aus and aman by HYV boro moves the seasons of peak labour demand to December - January (seedbed and field preparation followed by transplantation) and May - June (harvesting), as well as increasing the overall demand for labour. The distribution of labour demand for HYV boro is depicted in fig. 10, again based on the pre-project data and Clay's pattern of labour distribution. The implications for seasonal labour demand of the conversion from aus and aman to HYV boro are clear; and that the conversion to HYV boro has been more pronounced in Geraki, while Sutanari has retained a significant proportion of aus cultivation, means that the corresponding alteration in the pattern of labour demand has been more pronounced in Geraki.
Fig. 9 Seasonal labour demand for mixed aus and aman

Fig. 10 Seasonal labour demand for boro
In the post-project survey, only aggregate monthly data on respondents' activities were obtained, making it impossible to compile a precise picture of seasonal labour demand. Respondents were asked only what activities they were engaged in each month, but not the number of days in the month that they were engaged in those activities. It was still possible to compile month-by-month 'activity calendars', however, and even these reveal important contrasts between the two villages, as well as many broad similarities (figs. 11 to 14). The practice of multiple occupations, with respondents seeking employment outside the agricultural sector during slack periods in the agricultural calendar, is clearly depicted, as is the strong seasonality inherent in the agricultural system.

January is a month of intense agricultural activity in both Geraki and Sutanari, this month seeing the end of the mustard harvest and the preparation for and transplanting of boro. Labour demand in this month is particularly high in Geraki, which has significantly more of its land under a boro rice - rabi mustard rotation than does Sutanari. All other activities take second place to the task of ensuring the successful establishment of the year's main food crop.

This boro sowing is completed first in Sutanari, where the threat of early flooding interrupting the harvest necessitates the earliest establishment of the boro crop. In Geraki, several farmers and labourers are still engaged in transplanting boro during the first weeks of February. In both villages, the most frequently cited
Fig. 11 Seasonal pattern of agricultural activity

Fig. 12 Seasonal pattern of non-agricultural activity
Fig. 13 Seasonal pattern of fishing activity

Fig. 14 Seasonal pattern of economic inactivity
activity for this month was the tending of the boro crop, particularly weeding and irrigating it. The numbers engaged in non-agricultural activities pick up slightly as people look for alternative employment. Labour demand is elevated somewhat in Sutanari in this month by the harvest of late rabi crops such as wheat and potatoes. In this it bears more resemblance to the pattern of labour demand in pre-embankment Geraki, where pulses and mustard were harvested in February.

Agricultural employment picks up in March in Sutanari, which has a significant acreage under the aus crops that are now sown. Tending the boro crop remains the most common agricultural activity in Geraki in this month. A few labourers in Geraki find employment in April bringing in the late rabi crops of wheat and potatoes, and preparing for and planting aus crops. Meanwhile, the earliest of the deshi boro is ready for harvest in Sutanari, deshi varieties being selected by some Sutanari farmers in preference to the later-maturing and therefore more flood-vulnerable HYVs. Not until May does labour demand begin to pick up significantly in Geraki. The larger area and higher yields of HYV boro in Geraki do not have quite the effect that might be expected in elevating labour demand, owing to the spread of the harvest over a longer period of time (while in Sutanari the threat of early flooding necessitates the completion of the boro harvest before the end of May, harvest activity continues in Geraki well into June).

Geraki has significantly less aus cultivation than Sutanari, so once
the boro harvest is complete there is a marked falling-off of labour demand. The cutting and stripping of the **aus** jute crop continues to create a demand for agricultural labour in Sutanari in June and even into July, until finally the floodwaters become too deep even for this activity.

Once inundation has brought agricultural activity to an end, there is no longer any demand for agricultural labour in either village, and those without the resources of stored food or saved capital to survive a period without earning any income are obliged to seek employment either outside the agricultural sector or outside the local area altogether. The number of people engaged in fishing and in the marketing of fish rises sharply, and this absorbs some of the excess labour (fig. 13). Others become engaged in activities such as carpentry or thatching, as the villagers utilise this slack agricultural season to repair and improve their dwellings. Boat owners earn money transporting goods and passengers. The proximity of the Madhupur hill tracts is fortuitous, as its distinctive agricultural system continues to demand a labour input throughout the monsoon season. The hill tracts are also the location of wooded areas which are exploited for their timber, and the felling and transportation of this timber provides employment for some.

Agricultural activity resumes in Geraki and Sutanari as soon as the floods begin to recede in October. Preparation and planting for the rabi season demands a considerable amount of labour in both villages, each having a similar proportion of its area under rabi crops. In
Geraki, with the dominance of mustard among its rabi crops, usually in a rotation with HYV boro, the resumption of agricultural activity is more marked than in Sutanari, where instead the sowing of a wide variety of different rabi crops continues over a number of months. Boro seedbed preparation in November and the harvest of rabi crops (particularly mustard) in December sustains the demand for agricultural labour right up to the recommencement of the annual cycle with the preparations for the boro crop.

Geraki's more uniform cropping pattern, where the boro rice - rabi mustard rotation dominates, gives a labour demand pattern of marked seasonality. In Sutanari's cropping system, the inclusion of a significant proportion of aus cultivation, the smaller area under boro and the wider variety of rabi crops create a situation of more sustained, albeit lower, labour demand.

To obtain a meaningful quantitative assessment of the seasonal variation in labour demand would have required a systematic day-by-day investigation over a full agricultural year, a task beyond the scope of this study. Yet the differences observable between the two villages from the monthly data provide some indication of the influence the embankment has had in the labour sphere, echoing the changes in cropping. As in crop choice, the differences between the two villages in terms of labour demand are differences of degree rather than fundamental characteristics. Wider agricultural change has been a more important influence than the embankment alone, and labour demand seasonality in Geraki bears more resemblance to that in
Sutanari than to that of its own pre-embankment state. Sutanari is again seen to occupy a transitional state, incorporating in its labour demand pattern elements of both the traditional and the modern pattern, and the role of the embankment is once more seen to have been that of catalyst rather than direct agent of change.

Comparing the situation in Geraki with that prevailing before the embankment, there can be no doubt that the traditional labour demand seasonality has been dramatically transformed through the expansion of HYV boro at the expense of aus and aman, an expansion much facilitated by the provision of flood protection. While the embankment has thus played its part in altering the timing of labour demand seasonality, it cannot be said however that it has much altered the degree of that seasonality. The peaks in labour demand have been shifted from March - April (aus and aman planting) and October - November (aman harvest) to December - January (boro planting) and May - June (boro harvest), but they remain distinct peaks nonetheless. It could even be argued that the embankment has increased seasonality by so encouraging the two-crop rotation of boro rice and rabi mustard. Low labour demand in the flood season persists, and has even been exacerbated by the near-disappearance of aus and aman from the agricultural calendar. This means that unemployment adds to the vulnerability of the poorest section of the population, that dependent on employment as agricultural labour, at the very time when flood disasters are likely to strike. Yet although the embankment has failed to reduce the inherent seasonality of agriculture, it has increased both agricultural labour demand and
agricultural productivity in aggregate terms.

Occupations outside the agricultural sector have their own seasonality, but even people who are not farmers themselves are strongly affected by the agricultural seasons. Food prices, for example, rise and fall according to the supply of foodgrains on the market. Fishing is subject to a distinct seasonality of its own which, being directly complementary to the main (boro) agricultural season, allows many to combine the occupations of farmer or agricultural labourer with that of fisherman. This was less true before the embankment, when farmers and fishermen often had conflicting interests over land use in the monsoon season when standing aman crops could be damaged by fishing boats. The embankment's influence on agricultural seasonality has thus had ramifications throughout the local economy, and while it is difficult to say whether these ramifications have been positive or negative, that they have profoundly changed the pattern of people's lives is certain.

The embankment's most important influence on agriculture remains its encouragement, through containment of flooding in the early part of the season, of the expansion of irrigated HYV boro cultivation, and the increase in both food production and labour demand that this has brought about. The previously noted improvements in Geraki's economy - the lower incidence of multiple occupations; the higher degree of food self-sufficiency; the stable pattern of landholding - are thus explained. As anticipated, it was changes in agriculture that held
the key to understanding the nature of the embankment's influence both in physically modifying the flood regime and in fostering economic improvement.
LOCAL REACTION TO FLOODS AND FLOOD CONTROL

While the socio-economic and agricultural comparison between protected and unprotected villages provides the primary evidence for the assessment of the embankment's impact, including by inference its effect on the local flood regime, it would have been inappropriate to restrict this investigation to questions of society and economy alone without any direct reference to the floods which are, after all, the central object of the whole enquiry. Apart from any other consideration, the respondents would likely have been thoroughly bemused had they not been asked about their experiences of flooding, the issue of floods and their control having been given as the pretext for the very presence of the research team in the villages.

From a methodological standpoint, enquiring into individuals' perceptions of and responses to floods and their control provided insight into the mechanisms by which the provision of flood control had worked to alter the local socio-economic system, and indeed how in turn economic change had influenced perceptions of the flood hazard. No such investigation was incorporated in the pre-project survey, so a 'with - without' comparison has to form the basis of analysis.
9.1 The physical characteristics of flooding

The starting point of any conventional analysis of flood regime is a quantitative examination of the depth, duration and frequency of flooding. In this unique physical environment, however, such an analysis is not easily performed, as none of the conventional parameters of flood definition and description is directly applicable. With processes of accretion and erosion continually altering the land's surface, it is difficult at the local scale even to define a datum line from which flood depths can be measured. This, along with the sheer lack of hydrological data to provide a suitable frame of reference, meant that a strictly quantitative evaluation of the embankment's physical impact on flooding was not possible. It was also considered that hydrological parameters as perceived through the eyes of the local inhabitants were every bit as important as the absolute measure of those parameters, as it is these perceived parameters which determine conscious changes in economic behaviour.

The pre-project survey included no data either quantitative or qualitative on floods per se, and so the only basis for an evaluation of the embankment's role in physically altering the local flood regime was a comparison of flood depth, duration and frequency as reported by respondents in the with- and without-project villages. The questions posed on the nature, severity and frequency of flood occurrence had another purpose, too, being set so as to allow the local definitions of normal and abnormal flooding to be ascertained.
Was it the depth, duration or timing of flooding which formed the basis for distinction, and at what critical limits of these parameters was a flood no longer considered 'normal'? Clarifying these points of definition was an essential prerequisite to the correct expression of the questions - and comprehension of the responses - which made up the rest of the questionnaire.

All respondents in both villages affirmed the annual inundation of the entire local area to considerable depth, with all but homestead land (and latterly the embankment) being submerged even in years of below normal flood levels. This normal annual flooding was universally referred to as borsha. Interestingly, despite the embankment having been designed and built to allow the inflow of water into the embanked area, and there being no significant difference in elevation between the two villages, the average reported depth of normal flooding was greater in Sutanari than in Geraki. This suggests one of two things: either the embankment was not fulfilling its design criteria and was restricting the entry of water, thus preventing flooding inside the embanked area from attaining the same height as that outside; or the difference in flood depth was perceived rather than real, with respondents in the unprotected village tending to overstate flood depth and/or respondents in the protected village tending to understate it. With no physical evidence of the embankment inlet pipes failing to perform their design function, the latter case is the more likely. The range of normal flood depth reported in Geraki was 6-14ft (1.8-4.3m), with a mean of 9ft (2.7m); in Sutanari the range was 3-16ft (1.0-4.9m),
with a mean of 12ft (3.7m). The wide range in reported depths is due to the absence of a fixed datum level, with respondents reporting the flood depths experienced on their own land. The absence of any locally defined datum meant that this data shortcoming was unavoidable, as any arbitrarily defined datum would probably have led to respondents estimating flood depths with even less accuracy. While obviously flawed as even an approximation of actual flood depth, the figures are nonetheless sufficiently valid to form the basis of an inter-village comparison and, whether real or perceived, the greater flood depth reported in Sutanari is surely significant.

Methodological problems are compounded when one comes to consider abnormal flooding (bonna). In recalling severe floods, respondents in Geraki were obviously drawing on their pre- as well as post-embankment experience, so that their responses could not be considered to represent just the post-embankment situation. Again this shortcoming was unavoidable. There had at least been an abnormal flood event between the time of the embankment's completion and the time of questioning, that of 1984 having been the worst since the notorious 1974 flood. Any difference between the two villages in the reporting of bonna characteristics was therefore likely to reflect embankment-induced change at least to a degree.

As with normal flood depth, the reported depths for abnormal flooding were significantly higher in the unprotected village - a mean of 19ft (5.8m) in Sutanari compared with 16ft (4.9m) in Geraki. The range of values was again wider in Sutanari, where the lowest estimated depth
of bona was 13ft (4.0m) to Geraki's 10ft (3.1m), and the highest value 25ft (7.6m) to Geraki's 20ft (6.1m). There is some physical basis for lower flood depth inside the embanked area, but only in the case of abnormal flooding of a particular type. A rapidly rising flood level outside the embankment might grossly exceed the capacity of the inlet pipes, giving a slower rate of rise inside the embankment. If the water level outside the embankment were then to recede fairly rapidly, the water level inside the embankment would never reach the maximum level attained outside. It is, however, possible that here too it is simply the perceived lesser flood hazard which leads to a tendency to understatement in the protected village. That the difference between the average reported depths of normal and abnormal flooding stood at exactly 7ft (2.1m) in both villages is an indication that the estimates of flood depth are rather more accurate than one might suppose, but a true assessment of their accuracy would demand a comprehensive hydrological survey of the area. Without any hard data, any speculations on the role of the embankment in altering flood depth must remain just that.

Likely to be more reliable than the data on flood depth were the data on flood duration which, being measured in the fixed units of local calendar months, was easier to recall and evaluate with greater accuracy. (Flood depth was reported in the various units of feet, 'man-heights', or with reference to fixed objects such as house walls.) What emerged immediately when looking at the reported duration of flooding was that bona was generally defined not in terms of overall duration (i.e. the beginning to the end of the
flooded period), but rather in terms of the length of time during the flood season that the water level remained above the level normal for that particular time of the season. In both villages, the overall flood duration stated for abnormal flooding was almost invariably identical to that given for normal flooding. The average estimated duration of both bona and borsha was four and a half months in Geraki and five months in Sutanari. This indicates that the embankment has shortened the flood season by delaying the onset of flooding, and would seem to dispel the theory that the embankment would act to extend the flood season by delaying the water's recession at the season's end. Where the embankment does appear to have had a lengthening effect on flood duration is in retaining the water at greater than normal depth for longer during periods of abnormal flooding. The average reported time in weeks that water remained above the critical level that distinguishes bona from borsha was 4.8 in Geraki; 3.5 in Sutanari.

It was clear from the wide range in reported flood depth and duration that there was no fixed definition of abnormal flooding in these terms. In neither village was there a universally agreed critical limit of depth and/or duration which, when exceeded, would mean that a flood had ceased to be just borsha and had become bona. This is not to say that flood depth and duration are not the critical factors in the distinction between borsha and bona, but rather that this distinction varies both temporally within the flood season and between people in different occupations or between farmers practising different systems of agriculture. A flood two metres in depth
lasting two weeks in late June would hydrologically constitute a condition of abnormal flooding, but the water level would be expected to remain at a depth well above two metres for the whole of August and September, otherwise being considered abnormally low. This same June flood might pass almost unnoticed by a farmer who had completed his boro harvest, but might mean ruin for a farmer whose fields were planted to aus paddy. A Bangla version of the saying: 'One man's meat is another man's poison' might well run: 'One man's borsha is another man's bona'.

The complexities involved in the definition of normal and abnormal flooding in terms of depth and duration made it difficult to determine the precise role of the embankment in influencing these definitions. Its main effect seems to have been in narrowing the limits of normal flooding as perceived by those in the embanked area, where flooding has come to be expected to arrive some two weeks later than in the area outside the embankment. This on its own provides sufficient grounds for the observed changes in local agriculture. The situation regarding abnormal flooding is less straightforward. That elevated water levels were reported to persist for longer in Geraki could be due at least in part to the embankment, but the single occurrence of abnormal flooding in the time between the completion of the embankment and the conducting of the questionnaire survey meant that there was no conclusive evidence. As regards flood depth, that lower flood levels were reported in Geraki for both borsha and bona could be due merely to perceptual error inherent in the subjective nature of the data.
9.2 Flood events: recall, perception and prediction

Varying definitions of what constitutes an abnormal flood meant that the recall of flood events was also a highly subjective exercise. Faulty memory, especially among the older respondents, no doubt also played a part in the wide disparities in reported flood frequency. Notwithstanding these limitations, an analysis of flood event recall by age revealed important distinctions between the two villages. In reply to the question: 'How often do abnormal floods affect the village?' (which was generally answered in terms of the number of flood events experienced by the respondent), the most common response among all age groups in the unprotected village was a simple 'many'. In the protected village, there was a correlation between the number of flood events recalled and the age of the respondent: those under thirty most commonly recalled just one or two; those between thirty and forty, two or three; and those above forty, three or more. The distinction between Geraki and Sutanari in the manner in which this question was answered suggests that the embankment has been effective in shielding the embanked area from the worst effects of recent abnormal flooding. That the responses of many Geraki respondents included a qualifying statement that abnormal flooding had not occurred since the construction of the embankment reinforces this conclusion.

As a further means of identifying the definitive characteristics of
abnormal flooding, respondents were asked how many times they had experienced flooding of the bari. In almost all cases in both villages, the reported frequency of bari flooding was less than or equal to the reported frequency of bona occurrence. This confirmed a presupposition that bari flooding always implied bona but not vice versa. The early flooding known to have been characteristic of the now-protected area before the embankment and which still bedevils the unprotected area is here borne out as, in the early part of the flood season, flooding of well below the level of the bari can still constitute an abnormal flood in terms of agriculture.

More telling than the reported frequencies of abnormal flooding were the actual dates of flood events recalled (table 9.1). Asked to give the year of the worst flooding they had ever experienced, most respondents in both Geraki and Sutanari cited 1974, which was indeed the year of the most catastrophic flooding the country had experienced in recent times—until, of course, 1988. In Geraki, the year which ranks second to 1974 in the number of citations is 1962, despite this being before the possible recall or even the birth of many of the younger respondents. The year 1962 ranks a lowly fourth among Sutanari respondents, with 1984 and then 1969 being more frequently mentioned. In Geraki, 1984 was mentioned by only 7% of respondents as being among the most severe floods of their experience, being exceeded even by the distant 1942.

What is most interesting about these figures is that one can practically date the construction of the embankment from them.
Table 9.1 Recall of worst flood experienced

<table>
<thead>
<tr>
<th>Year</th>
<th>Geraki</th>
<th>Sutanari</th>
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</thead>
<tbody>
<tr>
<td>1921</td>
<td>&lt;1</td>
<td>0</td>
</tr>
<tr>
<td>1931</td>
<td>2</td>
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<td>1942</td>
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<tr>
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</tr>
<tr>
<td>1980</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1984</td>
<td>7</td>
<td>25</td>
</tr>
</tbody>
</table>

(Values do not add up to 100% because some respondents gave more than one year and some respondents did not give any year.)
Before 1984, the years of significant flooding as indicated by their frequency of citation as the 'worst ever' flood were the same in Geraki as in Sutanari: 1942, 1962, 1969 and 1974. That the floods of 1984 were cited with far greater frequency in Sutanari than in Geraki suggests strongly that Sutanari suffered the effects of the 1984 flood more acutely and thus that the embankment, completed in the dry season of 1982-3, had been successful in providing protection from flood damage. This it could have achieved either (or both) through physical flood control or (or and) through strengthening the resilience of the local economy.

A breakdown of flood event recall by age lends further weight to these conclusions. Geraki displayed a close correlation of event recall with age: people over sixty most commonly recalled the floods of 1942-3 as the worst they had ever lived through; for people between the ages of forty and sixty it was 1962; and for those under forty, 1974. While it would be incorrect to assume this to imply that the floods of 1942 and 1962 were in reality worse than those of 1974 or 1984, the contrast between this and the situation in Sutanari is striking. In Sutanari there was found no such correlation of event recall with age, the pattern instead being seemingly random, although 1974 and 1984 occurred with some frequency in all age groups. With reference to the 1984 floods, no-one in Geraki's younger age bracket (under forty) cited this year, but in the equivalent age bracket in Sutanari 17% of respondents gave this as the most severe flood. While this does not provide sufficient basis for claiming that the embankment has radically modified the hydrological regime, it does
suggest that people living in the embanked area have perceived a lessening of the flood hazard in recent times while those living outside the embankment have not.

A breakdown of event recall by occupation was attempted, but this did not yield any significant insights, largely because with so many people in both villages practising multiple occupations it was impossible to separate out the perceptions of farmers or fishermen alone. In any event, even those not directly involved with agriculture remain so dependent on the agricultural economy that the major flood events are essentially universal in their impact.

Of little direct relevance to the immediate purpose of assessing the impact of the embankment, yet an interesting adjunct to the investigation into flood event recall, was to obtain an indication of how historical flood events have become embedded in the collective consciousness. This was done by asking respondents whether they were aware of past floods more severe than those in their own experience. Approximately half of the Geraki respondents and one third of Sutanari respondents said that they were aware of such events, and of these most could name the year(s) in which the events occurred. The years 1931 and 1942 were mentioned repeatedly in both Geraki and Sutanari as having been marked by particularly severe flooding. One surprising omission from the oral record was the year 1955, perhaps revealing how this extreme hydrological flood had been rather less severe in agricultural, and therefore economic, terms - at least in this particular locality. The significance of the 1942-3 flood in
the collective psyche is clearly evident, running contrary to the assertion by Sen (1982) that the 1943 famine was not caused by flooding. A refutation of Sen's argument is not implied here as, with fallible hindsight and even less reliable hearsay being the respondents' sources of information, it could be that the severe famine of 1943 has in retrospect been attributed to a much-exaggerated flood event. Scale is also significant, as what may well have been a local flood disaster could have been dwarfed by processes operating at the larger regional, national and international levels. The importance of 1931 in the oral record is also interesting. That these earlier floods are generally considered to have exceeded in severity the more recent events of 1974 and 1984 calls into question the recently much-mooted hypothesis that floods in the region have shown a steady worsening in this century, with each flood being worse than its predecessor. The reality is clearly far more complex. It is perhaps true that the return period of severe floods is shortening, but that does not mean that each successive major flood event is unprecedented.

An interesting sequel to this research would be to assess the relative severity of the 1988 flood as perceived by this same group of respondents, and thus to judge whether it deserved its media tag of the 'worst ever to have hit the country'. My own feeling is that the 1988 flood, while certainly severe, was much on a par with earlier flood events; certainly the descriptions provided by villagers who had experienced previous major flood events indicate that these were every bit as severe:
In the flood of 1338 (1930-1), water flooded our baris and houses. Every side of the village was affected. After the flood a serious famine started - we took only one small meal in a day.

Once the flood was so bad that we had no food. There was no green to be seen anywhere, just mile after mile of water. We clustered together on the rooftops for survival.

In addition to their recollections of past flood events, respondents were asked about flood forecasting - whether they received flood warnings from any external source, or whether they themselves were able to make predictions of abnormal flooding. Flood warning is a vital part of an effective flood protection strategy. If a flood-vulnerable population can be provided with adequate advance warning of an extreme flood event, it can bolster its defences accordingly and thus reduce the potential flood damage. Official policy in Bangladesh has, rightly, concentrated on cyclone warnings, as an impending cyclone is potentially far more damaging and requires far more drastic evasive action than an 'ordinary' inland flood. In the study area, warning of severe flooding might not be of any use in averting damage to crops, but it would allow people to reinforce homestead structures, elevate personal possessions on machans, store emergency food reserves or even, if necessary, evacuate themselves and their livestock from the area. Only one respondent in Geraki and two in Sutanari reported that they received any flood warning, giving the source of the warning as radio broadcasts. There clearly exists the need for the development of effective flood forecasting in the country, including appropriate measures for the dissemination of flood warnings.
In the absence of flood warnings from external sources, and given the enduring nature of the flood problem in Bangladesh, it would be expected that there might have evolved indigenous strategies for flood prediction. In order to investigate this, respondents were asked whether they were themselves able to predict bonne by any means. Six respondents in Geraki and eleven in Sutanari replied that they could make accurate flood predictions. That the unprotected village had more amateur flood forecasters suggests that the embankment may have caused a decline in local forecasting, perhaps by modifying the physical characteristics of flooding and thus interfering with indigenous forecasting methods based on the study of flood behaviour. Alternatively, or in addition, it might be that the embankment has so reduced the impact of what would previously have been damaging flood events that the retention and passing on of indigenous technical knowledge about flood prediction has come to be regarded as less important.

Not only was there a lesser number of people in Geraki claiming to be able to predict flooding, but they employed fewer methods in making their predictions: four respondents used observations of weather patterns and flood behaviour and two (both Hindu) used astrology. To these methods were added in Sutanari the observation of the size and species composition of the fishing catch; the detection of a regular flood cycle; and reference to climatic folklore based on the weather in the lunar asterisms which make up the Bengali calendar (the equivalent of our 'If rain falls on St Swithin's day...' etc.).
This strengthens the argument that the embankment has so altered historical patterns of environmental behaviour as to render traditional associations invalid - Geraki's fishing catch, for example, may no longer reflect wider hydrological processes as it still does in the view of some Sutanari respondents.

The small numbers in the two study villages claiming to be able to predict flooding contrasts with the findings of Paul (1984) who, in his study of flood perception in the Jamuna floodplain, noted that most of the respondents in his study area (some distance to the north of that of this study) claimed to be able to predict both the timing of the normal flood and the severity of the flood in a given year. Observation of cloud patterns, rainfall and river behaviour are given by Paul as the most common means by which floods could be predicted. His published findings were based on fieldwork conducted in 1978, and if the apparent demise of indigenous technical knowledge about flood forecasting over just an eight-year period is true, the implications are serious indeed. While the reliability of traditional flood forecasting methods cannot be affirmed here, and while certain of the forecasting methods are obviously fundamentally unsound, it would be a tragedy if the effect of the embankment were to accelerate the total loss of appropriate indigenous technical knowledge rather than to encourage its adaptation to a changed hydrological regime.

The final question put to respondents in the section on flood perception asked them to rank the three natural hazards which most affect them (flood, drought and pest) in order of severity. Analysis
Table 9.2 Hazard ranking

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Number of respondents citing given ranking (%)</th>
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of their replies shows that the embankment has profoundly altered their relative hazard perception (table 9.2). Whereas 72% of the Sutanari respondents placed flooding above both drought and pest in their ranking, this assessment of relative hazard was shared by only 54% of respondents in Geraki. As a corollary, more Geraki respondents rated either pest or drought as a more serious hazard than flooding (21% in Geraki as against 12% in Sutanari). A significant number in both villages, although rather more in Geraki than Sutanari, judged all three hazards to pose an equal threat. The two villages are too geographically close and physically similar for there to be a significant difference in their relative exposure to drought or pest attack. The difference in their perceptions of the relative seriousness of different natural hazards probably reflects differences in cropping: the protected area, with its greater emphasis on dry season cultivation of high-yielding varieties of rice, would be more vulnerable to drought and pest; the unprotected area, with a considerable area under aus, would be more vulnerable to flood. Yet it has already been demonstrated that the difference in cropping pattern itself reflects the reduced flood hazard in the embanked area.

It is apparent from the foregoing discussion that the embankment has wrought significant hydrological change, and that those affected are aware of that change. The observed differences between Geraki and Sutanari in the perception of flooding are sufficient to account for the previously noted agricultural differences, and thus for Geraki's economic superiority. Together, the hydrological, agricultural and
economic changes induced by the embankment have quite altered the impact of flooding in the protected area.

9.3 Flood damage

A central test of the embankment's physical and economic impact was to compare reported flood damage in protected and unprotected villages. For the purposes of this comparison, damage was broken down into the categories of the bari and its contents; crops; economic activity; agricultural inputs; and agricultural land; and each of these categories further subdivided into damage from borsha and damage from bona.

The bari suffers damage not just from particularly severe flooding, but also from the normal annual flood. In a normal flood season, homestead mounds and plinths are eroded; thatch roofs and jute walls become sodden and decayed; bedding and clothing become damp and mould-ridden; and if stored food and fuel cannot be kept dry, they too can become rotten and infected by fungi. These forms of damage were reported by respondents in both Geraki and Sutanari, but by a far greater proportion of the Sutanari respondents - 56% as against 27% in Geraki. Particularly spectacular was the difference in the numbers reporting homestead mound erosion. This suggests that the lower level of damage in Geraki is indeed attributable to the embankment, as the delayed and controlled entry of floodwater into the embanked area will have reduced its erosivity. It is likely that
the embankment operates indirectly, too, through the improved economic status of its beneficiaries, enabling them better to maintain and reinforce their homestead structures.

It was beyond the embankment's designed capability, however, to provide physical protection from the damaging effects of abnormal flooding. Despite this, the reported incidence of **bonna** damage to the homestead was significantly higher in Sutanari than in Geraki. All but one of the Sutanari respondents reported severe **bari** damage, whereas twenty Geraki respondents reported no or only slight damage to their homesteads. The single exception in Sutanari was a rich farmer with a large landholding and a sturdily-built, well-elevated house of wood and tin, well capable of withstanding flood damage. Those in Geraki suffering little or no damage covered the full range of economic status and occupation, from landless fishermen and labourers to wealthy landowning farmers, suggesting that some agent other than mere economic status is at work - that agent quite probably being the embankment. With the embankment lacking the capacity to physically modify flooding to the degree required to wholly account for the reported discrepancy between the two villages in terms of **bari** damage, one must look for ways in which the embankment may have exerted an influence in an indirect manner. Perhaps the mere physical presence of the embankment has encouraged an optimistic sense of invulnerability in the protected village, leading to an under-reporting of damage there; or perhaps the economic improvement effected by the embankment has encouraged a general improvement in homestead maintenance and thus in resistance.
to damage from bonna as well as borsha. Before too readily attributing any damage reduction to the embankment, however, one must remember the recurrent methodological dilemma in that Geraki respondents were probably drawing on pre- as well as post-embankment experience in recalling damage from abnormal flooding, thus making it impossible to isolate the impact of the embankment.

Although there was a marked difference in the number of respondents reporting bonna damage in and to the bari, the nature of the damage reported in the two villages was essentially similar: homestead mounds severely eroded; dwelling structures severely damaged or even washed away altogether; stored food and fuel destroyed or washed away; trees uprooted; livestock drowned; clothes and bedding lost or damaged. In recalling flood damage, however, Sutanari respondents tended to be far more specific, citing particular items which had been damaged and giving precise accounts of damage to the homestead mound and individual dwelling structures, whereas in Geraki respondents more often gave a vague: 'Everything was damaged'. This may carry no particular significance, but if one adheres to one of the accepted premises of hazards research as expounded by White et al., a superior ability to remember and describe past flood damage means a greater perceived vulnerability to the flood hazard.

The next category of damage to be considered was damage to crops. Again, damage caused by normal flooding was distinguished from damage arising from abnormal flooding. That some crop damage from the annual borsha is considered normal, and does not automatically imply
that the flood constitutes a situation of *bonna*, is an important finding in understanding the local distinction between the two, and is consistent with the findings of Paul (1984) in his investigation into the perception of flooding in this area. As in the case of *bari* damage, crop damage from normal flooding was reported by a greater proportion of respondents in Sutanari than in Geraki - 28% and 13% respectively. Not only that, but the reported extent of damage was significantly higher in the unprotected village. Those Geraki farmers reporting crop damage from *borsha* generally estimated it at between 5% and 15% of potential yield, whether for *aus*, *aman* or *boro*. In Sutanari, on the other hand, damage was more commonly estimated at 20% - 30% for *aus* and *aman* crops, and at anything up to 100% for *boro*. This latter finding is significant, especially considering the greater area under *boro* in Geraki, as it indicates the success of the embankment in fulfilling its intended function of protecting the *boro* crop from early flooding. It also indicates how *boro* does not fit into the traditionally defined normal pattern of the seasons, as even a flood which completely destroys the *boro* crop is still not considered by Sutanari respondents to have exceeded the normal limits of flood depth and timing. The embankment can thus be seen to have led to a complete redefinition of the normal flood in the protected area.

The contrast between the two villages essentially parallels that for *bari* damage, although in the case of crops the role played by the embankment is far more direct: it physically contains flooding in the early part of the season, protecting *aus*, *aman* and *boro* from damage.
Thus while it was impossible to state with absolute certainty that the difference between the two villages in the level of bari damage was in fact attributable to the embankment, the difference in the nature and extent of damage to crops does allow such an assertion.

The situation regarding crop damage becomes somewhat more complicated when one comes to consider damage from abnormal flooding. All those respondents in either village who make all or part of their living from agriculture reported crop damage from bonna, and only when the extent of damage is considered does any contrast between the protected and unprotected situations emerge. While damage to aus and aman crops was almost invariably given as 100% in Sutanari, a significant number in Geraki gave lower estimates of damage, some even as low as 20%. A similar situation prevailed for damage to the boro crop, with most Sutanari respondents reporting 100% crop loss and none lower than 50%, while damage estimates in Geraki covered the full range from 20% to 100%. Thus for each crop mentioned - aus rice, jute, aman rice and boro rice - the number of respondents reporting total crop destruction was higher in Sutanari than in Geraki. This refutes the possibility that the differences in reported crop damage might be attributable to cropping pattern alone. Had that been the case, one would have expected there to be a higher reported incidence and severity of boro damage in Geraki, whereas in reality the number of respondents in Sutanari reporting 100% damage to their boro was more than double that in Geraki. The number of reported cases of damage for other crops did tend to reflect the influence of cropping pattern more closely - the higher incidence of aus rice and jute in
Sutanari was reflected in the higher reported incidence of damage to those crops, for example.

As was the case for bari damage, Sutanari respondents tended to be far more specific than those in Geraki when describing damage to their crops, suggesting once more that they possess a greater sense of vulnerability, perhaps due to their having been more recently affected by abnormal flooding (which in itself indicates the protective effect of the embankment). There was some evidence too that Geraki farmers were answering the questions on crop damage from a hypothetical standpoint, recalling past (i.e. pre-embankment) experience and describing damage that might occur in a cropping system other than that which they currently practised. Several farmers, for example, described damage to aus crops even though they had completely replaced aus with boro on their own land. This makes it impossible to ascertain the true extent of crop damage in the protected village, but the mere fact that Sutanari farmers reported damage in more real and precise terms is again an indication of the sense of relative invulnerability acquired by Geraki's inhabitants since the construction of the embankment.

That sense of invulnerability does seem to be rooted in reality rather than in a misguided optimism as, even given the data shortcomings, the evidence suggests that the embankment has indeed been effective in providing protection against crop damage from bona as well as from borsha. It has achieved this by direct as well as indirect means. The lower bottom limit of the estimates by farmers
in Geraki of damage to particular crops shows that the embankment does provide some direct physical protection from the worst effects of abnormal flooding, certainly in floods of moderate rather than extreme severity, and especially in cases where early flooding is the problem. More significant, however, is the indirect impact of the embankment in encouraging the establishment of a cropping system in which the less damage-prone boro - rabi rotation prevails. Rabi crops are effectively exempt from damage, their planting being deliberately delayed until after the flood's recession and their harvest taking place well before the onset of the next flood season. Boro crops are vulnerable to damage from early flooding, but even then it is often possible to salvage at least some of the harvest. Aus crops, of which there is a significantly larger area in Sutanari than in Geraki, are more susceptible to damage from abnormal flooding simply by virtue of their growing season coinciding with the flood season for a longer period. At times of the most extreme flooding, any standing crops are completely destroyed, so by accelerating the move away from monsoon season cultivation altogether, the embankment has effectively reduced the risk of damage to crops. The embankment's influence on the normal borsha thus in effect reduces the potential damage from bonne.

One category of damage which is easy to overlook, largely because it is so difficult to gauge or even to define, is that of disruption to normal economic activity. It is in this way that abnormal flooding most makes itself felt in the economy outside the agricultural sector, preventing fishermen from fishing, disrupting transport and
communications and thereby the functioning of markets, and inhibiting even the most basic domestic tasks. Disruption to agricultural activity takes many forms, only some of which have been accounted for in the category of actual damage to crops. The premature curtailment of harvesting and delays in seedbed establishment, field preparation and planting all have direct consequences in terms of measurable crop damage, but far more serious than any of these is the disruption of agricultural activity to the extent that the planting of crops is altogether prevented. The forced suspension of much economic activity in even a normal flood season is in itself a major constraint to the mobilisation of human and physical resources for development, and when abnormal flooding exacerbates the situation, dire economic crisis can ensue. In order to examine the nature and extent of this type of flood 'damage', respondents were asked to describe the manner in which their activities were interrupted both in normal and in abnormal flooding, as for the other categories of damage. Their responses provided further evidence of the embankment's effectiveness, particularly in its modification of the normal flood regime to one more conducive to improved agriculture and a more secure local economy.

The reported disruption to economic activity during borsha followed the same pattern as damage from normal flooding in the damage categories already discussed: the type of damage suffered was much the same in both Geraki and Sutanari, but damage was more widespread in the unprotected village. The difference was less marked for this relative to the other damage categories, however, with 66% of Geraki
respondents maintaining that they suffered disruptions compared to 78% in Sutanari. (For bari and crop damage, the number of respondents reporting damage from borsha was roughly double in Sutanari what it was in Geraki.) Clearly, all households are affected to some extent by the constraints imposed on human activity by the annual flood, but it was only those households for whom these constraints represented particular hardship or frustration who were likely to consider them an impediment rather than merely part of the normal cycle of the seasons.

To households without boats, the most vexing constraint was the restriction on personal mobility during the flood season. This was the most commonly cited complaint in either village, yet occurring more frequently in Sutanari owing to the lower level of boat ownership. The difference between the two villages in terms of boat ownership reflects in turn the superior economic status of the protected area, demonstrating once again how the embankment has worked to reduce vulnerability by helping people to acquire the means to overcome environmental limitations. Restriction on mobility curtails not only social activity but economic activity as well, as moving fish and agricultural produce to and from markets becomes a difficult and costly task for those lacking the private means of transport that a boat provides. The secondary function of the embankment as a year-round road has much facilitated monsoon season mobility, as just a short boat trip will bring a Geraki respondent from his bari to the embankment, whereafter the rest of the journey to the markets at Patharghata and Mirzapur can be made on foot.
Another frequent complaint was the disruption to domestic activity, particularly cooking, with the difficulties of keeping food stores from spoiling and of finding dry fuel. This has as much to do with the heavy rainfall of the monsoon season as with flooding per se, and affects both villages equally. One or two respondents in either village bemoaned the complete lack of demand for agricultural labour in the flood season - a normal and accepted aspect of the seasonal cycle to most respondents, but a cause of real hardship to those few households without any alternative source of income. In neither the domestic nor the labour sphere was there any difference in the level of reported disruption in the two villages to indicate that the embankment might in some way have relieved the restrictions imposed by the normal annual flood.

Apart from respondents' comments on agricultural labour demand, only one form of disruption from borsha to the agricultural calendar was reported. A number of respondents in Sutanari, but none in Geraki, said that their boro harvest was curtailed or even prevented by normal flooding. This confirms all that has already been said about the impact of the embankment on agricultural seasonality: that it has so altered the normal flood regime in the protected area that the very definition of what constitutes a 'normal' flood has been modified accordingly. Were a flood to disrupt the boro harvest in Geraki, it would automatically be considered bona; certainly no single Geraki respondent gave the boro harvest as one of the activities that might be disrupted by normal flooding, and this
despite the far greater area planted to boro in Geraki. No respondent in either village mentioned any possibility of the aus harvest or the sowing of aman being disrupted by normal flooding, showing how the traditional agriculture has evolved around the seasonal cycle to the extent that disruption to that agriculture can be considered definitive in distinguishing bona from borsha.

The overall effect of the embankment with respect to disruption caused by normal flooding has been a slight lessening of the constraints on human activity. The embankment has again operated both directly and indirectly to achieve this amelioration of the situation: directly by containing flooding in the early part of the season, so allowing agricultural activity to continue unhindered for longer; and indirectly by strengthening the local economy, allowing improved access to boat transport and thus overcoming the flood-imposed restrictions on mobility. The picture becomes quite different when one comes to consider abnormal flooding. Cessation of economic activity then becomes universal, affecting all occupations and classes in both villages alike. In times of the most severe flooding, not only is the containment capacity of the embankment far exceeded, but the embankment itself is likely to be submerged and at risk of damage to its structure by erosion. All respondents in both Geraki and Sutanari described the total disruption of their normal lives that accompanies such extreme bona.

As was the case for normal flooding, the most common form of disruption from bona was that to transport and communication,
although this is obviously to a much more extreme degree than the mild inconvenience experienced in a normal flood season. Even boat travel becomes hazardous and, with roads submerged and bridges washed away, the economy of the entire country can be disrupted. Reaching markets is impossible, so unless a household has been able to store a reserve of food, it is forced to go hungry. Even those households who have stored a food reserve often see it damaged or washed away by the flood. The same can happen to stored fuel, which means that the preparation of meals becomes impossible even if food is available. When flooding becomes so severe that the bari courtyard and even houses are submerged to some depth, then families have to take refuge on machans, boats or makeshift rafts, and cooking must be attempted on these. Sometimes a household might have just harvested a paddy crop, but the flood might prevent them from carrying out the post-harvest husking and drying operation necessary to convert the paddy into rice which can be cooked and eaten. Other domestic tasks are also rendered difficult or even impossible, especially when the submergence of wells and handpumps removes the supply of clean, potable water.

The economic activities in which people usually engage in the flood season to supplement their income during this slack period in the agricultural calendar are similarly disrupted. Fishing can be prevented altogether if boat travel becomes too hazardous and nets are washed away. If a fisherman somehow succeeds in bringing in a catch, he may then find that he is unable either to get it to market for sale or even to cook it for his household's consumption.
Carpenters are unable to practise their craft; hawkers are unable to get about to sell their wares; and even those in permanent employment as e.g. teachers, night watchmen or transport workers are unable to get to their places of work. Life comes to a standstill until the floodwaters again subside to their normal level.

Such total disruption ensues only when the most extreme flooding occurs, and there are several intermediate stages of disruption between the minor constraints of a normal flood season and the complete stasis described above, the degree of disruption corresponding to the severity of flooding. A flood is described as bona long before it reaches the proportions just described, and agricultural activity in particular can be disrupted by a seemingly minor flood which allows other forms of economic activity to continue uninterrupted. Damage caused by disruption to agricultural activity has already been accounted for to some extent under the category of crop damage - the curtailment or prevention of harvesting, for example, leads to an immediate and quantifiable loss. Other forms of disruption cause no direct damage, but are just as significant in terms of the loss of potential crop yield - the delay of rabi sowing, for example, may force the exclusion of a rabi crop from a farmer's rotation altogether. The importance of assessing this latter, rather more intangible form of damage, as well as the opportunity provided for cross-checking the reported crop damage in the two villages, made an analysis of disruptions to agriculture not just worthwhile but essential if the impact of the embankment was to be properly appraised.
As the information on crop damage indicated, the periods in the agricultural calendar most vulnerable to disruption from flooding are at the beginning and end of the flood season: the maturation and harvest of boro and aus crops and the establishment of aman in June - July; and then the aman harvest and establishment of rabi crops in October - November. Both the protected and the unprotected village reported this list of agricultural activities as being prone to disruption from bona, but the frequency with which particular activities were mentioned differs. To a certain extent, this mirrored differences already noted under crop damage, with the same implications for understanding the role of the embankment. The greater move away from aus and towards boro cultivation in the embanked area meant that disruption to aus rice and jute cultivation was reported by fewer respondents in Geraki than in Sutanari. Despite the greater area under boro in Geraki, however, reports of disruption to boro cultivation were no more frequent there than in Sutanari, pointing once again to the embankment's capacity to hold even abnormal flooding in check in the early part of the flood season.

One form of damage which did not show up in the category of crop damage, but which can be just as significant a cause of loss in terms of potential crop yield as can actual physical crop damage, was the delay in the planting of rabi crops which results if abnormal flooding towards the end of the flood season leads to the late recession of floodwaters. This was the one disruption to agricultural activity most frequently cited in both Geraki and
Sutanari. If the flood's recession is too long delayed, farmers can be forced to forgo the *rabi* crop altogether, which is in effect a 100% crop loss even though there is no actual crop damage. The preparation of *boro* seedling nurseries can also be delayed, initiating a knock-on effect throughout the *boro* season, culminating in a late harvest which places the crop at greater risk from early flooding in the successive flood season. As well as being the most common form of flood-related disruption to agriculture in both Geraki and Sutanari, these delays to activity at the beginning of the *rabi* season were reported by the same proportion of respondents in either village. That Geraki experiences no greater occurrence of this phenomenon than does Sutanari indicates that the potential of the embankment to so restrict drainage as to hinder *rabi* cultivation has not been realised.

The importance of considering disruptions to economic activity (both agricultural and non-agricultural) as a type of flood damage is clear. Most importantly, it shows how floods of varying severity and occurring at different times of the year impinge in very different ways on different sectors of the local economy. A flood with devastating consequences for agriculture may cause no hindrance to domestic or other non-agricultural activity, and *vice versa*. It demonstrates also how what happens in one flood season can have damaging ramifications for some time afterwards, and the folly therefore of considering damage merely in terms of the immediately evident destruction following a major flood. Damage is neither always immediately evident nor indeed dependent on a major flood, as
seemingly moderate flooding can, if it occurs at crucial times of the year, be just as economically disruptive. Comparison between Geraki and Sutanari suggests that the role of the embankment has been to reduce the amount of damage in this category, both by modifying the physical character of flooding and by encouraging a shift to a pattern of economic (particularly agricultural) activity less vulnerable to disruption by flooding.

A further attempt to coax more information out of respondents on the perhaps less obvious agricultural damage caused by flooding was to ask them about damage to agricultural inputs - flooding might for example leave a crop relatively unscathed but leach out and wash away fertiliser, thus wasting a farmer's investment. Whether owing to the original phrasing or translation of the question, or whether to the question simply being inappropriate, the answers that were supplied were unclear and mutually inconsistent. Some possibly significant trends nevertheless emerged. Only a very small number of respondents reported any damage to inputs from normal flooding, although as in the other categories of damage a greater number reported damage in Sutanari than in Geraki. That the level of damage was so low suggests that the application of inputs is deliberately adjusted around the normal annual flood, as indeed is every aspect of the local agriculture. In abnormal flooding, however, the situation was reversed, with a higher incidence of damage reported and more farmers reporting loss of inputs in Geraki. This could reflect the greater proportion of Geraki farmers who have the economic means to apply yield-enhancing inputs on their fields, or it could be a reflection
of the cropping pattern, as the application of inputs was concentrated on HYV boro of which there was a larger area in the protected village. It could be that farmers in Geraki suffer only this relatively minor form of damage when their Sutanari counterparts suffer actual crop losses. Overall, the enquiry into flood-related input loss yielded insufficient evidence to indicate that the embankment has had any effect in either mitigating or aggravating damage in this category.

The final category of damage to be investigated was physical damage to agricultural land, again a category of damage easy to overlook yet having consequences potentially far more destructive than damage to crops or household effects. As in the other categories of damage, the effects of normal and abnormal flooding were considered separately.

In the case of bari and crop damage, the nature of the damage caused by the normal annual flood was essentially the same in with- and without-project villages, but the reported extent of damage was greater in the unprotected situation. In the case of physical damage to agricultural land, however, the reported damage was not only more extensive in the unprotected situation but also of an altogether more severe nature. Only ten respondents in Geraki reported that borsha caused any damage to their fields, but well over half the cultivators in Sutanari reported such damage - as many as in Geraki for abnormal flooding. The borsha damage reported in Geraki was generally rather trivial: field edge demarcation ridges (bunds) eroded; infestation by
water hyacinth; or at worst slight deposition of sand. Sutanari suffered all these and, except for water hyacinth, to a worse degree, as well as another form of damage far more devastating - and irreversible - than any of them: field erosion. This is not just erosion in terms of the stripping of a layer of topsoil, but riverbank erosion as the Langli annually eats away large chunks of land, even whole fields. Geraki's situation on the outside of a tight bend in the Bangshi river means that it too would be prone to such erosion were the embankment not there to arrest the process. The process of sand deposition has also been arrested by the embankment - just two Geraki farmers reported deposition of sand in times of normal flooding, while almost half the Sutanari respondents reported that their fields were covered by a layer of infertile sand after every flood season. This effect of the embankment is perhaps the single greatest benefit derived from it, as Geraki farmers can at least rely on a physically stable land resource while in Sutanari land erosion and sand deposition further undermine the already precarious land tenure situation. Verbal and physical evidence from Geraki confirmed that sand deposition had been as significant a problem in pre-embankment Geraki as it remained in Sutanari, corroborating the embankment's role in halting the process.

In the case of abnormal flooding, too, reported damage to fields was far more extensive in the unprotected situation, again unlike the other categories of damage where abnormal flooding tended to act as something of a leveller. Only around half of Geraki's landholding respondents reported damage to their fields from bona, but amongst
Sutanari's cultivators damage was essentially universal. Not only was there a greater number of respondents in Sutanari reporting any damage, but the numbers reporting that all their fields underwent damage was considerably higher. In either village, the damage from bona was of the same nature as that from borsha, but of far greater severity and extent. Damage in Geraki was more extensive than that in Sutanari only for the more trivial types of damage such as hyacinth infestation and bund erosion; the more serious field erosion and sand deposition were far more widely reported in Sutanari.

The embankment has clearly been effective in guarding against some of the worst deprivations of bona, reducing the sediment load and erosivity of the floodwaters and thus restricting flood damage to the altogether less drastic damage by submergence rather than damage by erosion or sediment deposition. Since the construction of the embankment, a Geraki farmer can at least hope to recover from bona by getting in a crop as soon as the flood recedes; a Sutanari farmer might wait for the flood to recede only to find his land washed away altogether or buried under a layer of quite infertile sand. The only negative impact of the embankment in this regard, and a minor one at that, is that it seems to have encouraged the growth and spread of water hyacinth in the embanked area, but the extra work involved in clearing hyacinth from the land or ploughing it into the soil at the end of the flood season is a small price to pay for the protection afforded by the embankment against erosion and sand deposition.

In terms of overall flood damage, then, the embankment has clearly
had a mitigating effect. The embankment has been particularly beneficial in reducing damage from normal flooding, the unspectacular yet cumulatively serious annual losses and disruptions which make life during the flood season so fraught, especially for the economically weaker members of the society. In all categories of damage studied - to bari, to crops, to economic activity, to agricultural inputs and to agricultural land - damage caused by borsha in Sutanari exceeded that in Geraki in terms of both numbers affected and the severity of damage suffered. The embankment's ability to prevent damage from abnormal flooding is in fact rather limited, and what bonna-mitigating effect it has been able to provide can in most instances be traced back to its influence on the normal annual flood, and particularly to the prevention of damage to crops. By keeping out flooding in the early part of a normal flood season, the embankment has encouraged a shift to dry season boro cultivation and away from the monsoon season crops of aus and aman. This ensures that there is little land under cultivation in the protected area should bonna strike later in the flood season. The incidence of bonna damage to crops is thus lower in Geraki than in Sutanari even though the physical flood event in each may have been similar. Lowered crop damage from both bonna and borsha, combined with the inherently higher productivity of HYV boro cultivation, has meant the strengthening of the local economy in the protected area, which in turn has allowed households to adopt measures to bolster their resilience to other forms of flood damage - improved dwellings mean lower bari damage; a higher level of boat ownership means greater...
mobility in a normal flood season and a better chance of survival in extreme flood events.

That much of the embankment's influence has been wrought by such indirect means does not in any way detract from the significance of that influence; rather, it proves just how profound and all-pervasive that influence has been. Where the embankment has had a direct influence in mitigating flood damage is in the prevention of erosion and sand deposition, and this alone provides sufficient grounds for deeming the embankment a success. The overall role of the embankment in the prevention of flood damage is akin to its role as a catalyst for agricultural change: it fosters reduced vulnerability not by drastic modification of the physical flood event, but by inducing a number of positive feedback cycles within the local socio-economic system, thus contributing to the strengthening of that system and to a greater inherent resilience to flood damage.

9.4 Protection and response

In the light of the impact of the embankment in reducing flood damage, it was interesting to observe how this had led in turn to alterations in local flood protection and response measures. The likely effect of the embankment in the sphere of flood protection was difficult to predict - had there arisen a sense of complacency, with the embankment being perceived as having removed from the individual household some of the responsibility for protecting itself against
flood damage; or had the economic uplift effected by the embankment led to the wider adoption of household-based hazard response strategies? The absence of data on the pre-project situation meant that the comparison of with- and without-project villages had to provide the primary basis for analysis, but something of a 'before - after' comparison was made possible by asking respondents in both villages whether the flood protection measures they currently adopted were in any way different from those they had adopted in the past. Asking respondents to compare past and present strategies in this way had another advantage too: by inviting respondents to consider changes in their behaviour, it encouraged them to comment on aspects of behaviour so much part of everyday life that they were deemed hardly worthy of note.

Very few respondents (5% in Geraki; 7% in Sutanari) claimed to take any active measures to guard against flood damage from either borsha or bona, although direct field observation showed that all households took such measures. Indeed it could be said that there was no single aspect of the local socio-economic system that was not designed so as to minimise disruption from bona (flood as hazard) while maximising gains from borsha (flood as resource). Asked whether their current damage prevention strategy differed from that they had adopted in the past, however, respondents proved rather more forthcoming, recalling measures that had been discontinued, whether by design or simply by neglect. This was particularly true of Geraki, where the coming of the embankment had led to a conscious change in hazard perception and response, thus providing both a
definite date and a clear motive to which changes in response strategy could be traced. In Geraki, 19% of respondents reported that they had stopped practising certain damage prevention measures, compared with only 3% of respondents in Sutanari. Among the measures that had been dropped by certain households in Geraki since the construction of the embankment were: the seasonal movement of livestock and sometimes even household members to higher ground in the neighbouring hill tracts; the protection of the bari mound with bamboo matting during the flood season; and the carrying out of regular maintenance work on bari mounds and dwelling plinths. Although reported by only a limited number of households in Sutanari, field observation revealed these measures as continuing to form an important component of household flood protection in the area outside the embankment. All indications were that the embankment had led to a perceived lessening of the flood hazard, with households coming to rely on the embankment to protect them against flood damage rather than taking active protection measures themselves.

The difficulties encountered in obtaining information on damage prevention were somewhat reduced when it came to considering damage response, which is an altogether more real and tangible concept. Even here, however, the most common reply to the question on household response to flood damage was, in either village, a resigned 'What can we do?', indicative of a prevailing sense of fatalism and helplessness. The very survival of households gives the lie to the idea that this fatalism leads to apathy and inaction in the face of disaster as, fatalistic though they might claim to be, the villagers
must have responded to past floods with effective response strategies simply in order to have continued their existence in Geraki or Sutanari. As with flood protection, response to flooding is so automatic, so ingrained in the local way of life, that it is considered hardly noteworthy.

Significant contrasts in the response strategies adopted in the two villages emerged despite this under-reporting. Even the number of households reporting active responses to flood damage differed - 28% of the respondents in Geraki reported that they would take measures to recover from flood damage as against only 22% in Sutanari. The question on flood response was deliberately phrased hypothetically ('What measures would you take...' rather than 'What measures have you taken in the past...') in order that the replies might provide a more accurate reflection of the post-embankment situation. Given that the reported level of flood damage was higher in Sutanari, it would have been reasonable to assume that the number of households reporting damage response measures would be higher in the unprotected village. That this was not the case, and that the opposite was instead true, suggests perhaps that the embankment has contributed to a less fatalistic attitude in Geraki, with more households considering recovery from flood damage to be within their capability.

The specific recovery measures cited also show significant differences when the two villages are compared. In Geraki, people expected to have to take only interim emergency measures, borrowing
money and food to tide them over the immediate post-disaster period and to enable them to repair or rebuild damaged houses and re-establish crops. At worst, household heads anticipated that they might have to take up additional employment, perhaps as agricultural labour, in order to generate some income to assist the household's recovery. Several Sutanari respondents anticipated having to take altogether more drastic (and often irreversible) measures to enable their households to recover from flood damage: mortgaging or even selling land; selling livestock and household effects; migrating in search of employment.

These measures can form the first steps in a downward spiral of impoverishment leading ultimately to landlessness and chronic indebtedness, as households fail to meet mortgage and loan repayments and fall victim to what Chambers (1981) terms the 'poverty ratchet'. This describes the process by which 'poor people are made permanently poorer (by the) loss of assets or rights which it is difficult to reverse' (Chambers, 1981, p. 115). Past instances in Sutanari were several. Mortgage repayments have not been met and land has had to be forfeited; the loss of land has meant that households could no longer subsist on their own production; and once self-sufficient households have been forced into the insecurity of the agricultural labour market in order to survive. Other households had held onto their land but instead sold draught animals or agricultural implements, then found that in order to hire these at the beginning of the next cropping season they were forced to incur further debts. At times of hardship such as immediately after a major flood, the
market for land and livestock is heavily in favour of the buyer, who can force the desperate seller into accepting too low a price. The creditor, too, can take advantage of the misfortune of his borrowers by setting extortionate rates of interest on loans. The better-off households are thus able to exploit the economically weaker households and, perversely, to turn others' misfortune to their own advantage.

In stark contrast to the situation just described in Sutanari, not one Geraki household anticipated any likelihood of having to sell or mortgage land or to sell livestock or other productive assets in order to recover from a damaging flood event, suggesting that few households had had to adopt these measures in the recent past. This observed contrast between the two villages must be attributable to the embankment; to its strengthening of the local economy and thus the improvement in the capacity of its beneficiaries to recover from flood damage without having to resort to desperate measures.

Damaging floods provide the opportunity not just for extortion and exploitation but also for benevolence and co-operation, with villagers providing each other with mutual support and assistance in the recovery phase after a major flood event. Not every lender of money or food has personal profit as his motive, and respondents in both villages reported the giving and receiving of genuine charity in the wake of flood disasters. The number of respondents reporting that they would give help to neighbours who had suffered flood damage was considerably higher in Geraki than in Sutanari, as was the number
of respondents reporting the receipt of assistance from their village neighbours. This in itself tells us little, not least because of the difficulty of distinguishing genuine charity from exploitation - a person lending money might purport that he does so out of charity when in reality he stands to gain through attaching a high rate of interest to the loan. More revealing is the fact that in Geraki the households giving assistance were often the same households that received assistance, whereas in Sutanari the 'giving' and 'receiving' households tended to form two distinct groups. This suggests a greater degree of mutual assistance in Geraki; of households co-operating in their efforts towards rehabilitation. In Sutanari, the flow of 'charity' tended to be far more unidirectional, from the richer to the poorer households, with all the associated implications of potential exploitation.

The difference between the two villages becomes even more apparent when one comes to consider the type of assistance offered in either village. In Geraki, while there were many instances of loans of cash or food, there were also many reported cases of assistance of a less material nature - people physically helping their neighbours to retrieve possessions and repair damaged homes; those owning boats rescuing their neighbours and carrying them to safety; people providing shelter to those whose houses have been washed away. Emotional support was even mentioned by one respondent as one of the means by which he was able to aid his neighbours' recovery from flood damage. Such charitable acts were reported with far lower frequency in Sutanari, where instead the loan of money was the dominant type of
assistance within the village. Quite what the difference between Geraki and Sutanari in their communal reaction to flood damage tells of the impact of the embankment is far from obvious, but that the differences are so pronounced does suggest that the embankment has played some role in fostering a stronger spirit of community in Geraki.

Another important aspect of recovery from flooding is the provision of relief from external sources. Relief is distributed to the villagers by local government officials, but most has its origin in the aid provided to Bangladesh by the international community. Several questions were put to respondents on the nature, amount and adequacy of this outside assistance. Owing perhaps to the unprotected village having been more severely affected by recent flood damage, the proportion of respondents reporting the receipt of some form of flood relief was far higher in Sutanari (40%) than in Geraki (17%). The system by which relief is distributed is notoriously inadequate and prone to abuse, however, so that the difference in the level of relief in the two villages is as likely to be due to the malfunctioning of the relief system as to any genuine assessment of their relative need. For this reason, the lower level of relief supplied to Geraki cannot necessarily be attributed to a lesser need for relief, although the lower level of flood damage reported in Geraki, along with a stronger village economy and a greater degree of co-operation between households, makes it likely that households in Geraki are indeed better able to survive flood damage without having to rely on external assistance.
In each village, the nature of the flood relief that was reported as being supplied was much the same: handouts of food or clothing; sales of subsidised food; cash grants or loans; and food-for-work projects, usually involving construction work to improve the rural infrastructure. While relief was welcomed by those who had received it, most respondents expressed dissatisfaction at the failure of past relief efforts to meet their real needs. Not one respondent considered the supply of relief to be adequate, and there was much bitterness expressed at the corruption and graft among the local officials responsible for relief distribution. As one Geraki man had it:

Government relief? You must be joking! Last time there was a flood, all the government did was to send a man who made a list of our names. When he had done this, he went away, and we did not see him again - nor did we ever see any relief.

and from a respondent in Sutanari:

Government assistance? Yes, I've heard of it - they send money, wheat and clothes. But I've never actually seen any such relief, nor received any myself.

The enquiry into flood response measures (internal and external) was concluded with an examination of responses to hypothetical 'worst case' flood scenarios: the recurrence of the worst flood an individual had ever experienced, and the occurrence of a flood so devastating as to force an individual to seek his living in a different occupation and/or in a different location. This line of questioning was more effective than the earlier, more straightforward questioning on response to flood damage, encouraging a greater number
of respondents to consider their likely responses to severe flooding. While the number of respondents describing their responses to flood damage was greater, however, the nature of their responses served merely to reinforce the conclusions drawn earlier. In Sutanari, drastic and irreversible response measures were foreseen by many, while in Geraki people expected to have to adopt only temporary contingency measures. More people in Sutanari anticipated having to sell or mortgage land; to sell livestock or food stores; to take on an extra occupation; to rely on external assistance; or to migrate out of the local area. In Geraki, almost all respondents expected to be able to restore themselves to the 'status quo ante diluvium' by rebuilding their houses and replanting their crops after flood damage, taking out loans, drawing on personal savings, or using earnings from a usually secondary occupation such as fishing in order to finance their re-establishment. Interestingly, only very few households in either village could envisage the occurrence of 'a flood so bad that it would force you to leave the village and/or change your occupation', as it was stated in the questionnaire. This suggests that a certain sense of optimism, or at least of survival, is embedded within the resigned fatalism which respondents all too readily claim.

It would be interesting to learn just how the inhabitants of Geraki and Sutanari were affected by the 1988 flood, which at least equalled if not exceeded in severity the worst flood hitherto experienced by anyone in either village. From their own predictions, and judging by the relative weakness of their village economy, the households of
Sutanari will have proved the more vulnerable and the social and economic disruption caused by the flooding will have been greater in the unprotected area than in that protected by the embankment. Evidence to prove this supposition could have been obtained only by another visit to the field, but a letter written in January 1989 by a young man from Geraki, Abul Hassan, shows how the embankment served, if nothing else, to aid sheer physical survival:

Really a devastating flood occurred in our country and...we were the victim of that flood. Our houses were under water and we the villagers took shelter on our embankment. Without it, it would have been troublesome to survive.

Abul Hassan goes on to describe the inadequacy of the relief effort:

It is true that the government helped the flood victim people, but that relief did not reach to everybody. In our locality no relief reached to the people.

The whole tone of Hassan's letter underlines the positive feelings of the local people towards 'their' embankment, feelings which were already in evidence at the time of the survey, before the embankment had been subjected to so rigorous a test as the 1988 flood. Local attitudes to the embankment formed the subject of the final section of the questionnaires.

9.5 Reaction to the embankment

In this section of the questionnaire, respondents in Geraki were asked about their perceptions of the embankment while respondents in Sutanari were asked about their reactions to the prospect of an
embankment. Each and every respondent in Geraki was aware of not just the existence but also the significance of the embankment, even those respondents in non-agricultural occupations. Most could recall with accuracy the number of years since the embankment's construction, some four years prior to the time of questioning, indicating just how significant an event this had been in village life. Several people could even provide the date of construction of the earlier closure dam on Pathakhali khal.

The high level of awareness about the embankment reflects not only the consciousness of the agricultural and therefore economic transformation it has wrought, but also the memory of the high activity and disruption of village routine that accompanied the planning and implementation of the embankment project. A village deputation visited officials at Afgana Union headquarters; Union officials met BWDB officials; BWDB officials visited the intended project area; aid workers from EIP visited the area; BWDB engineers surveyed the land to plan the precise location and design of the embankment; Dr. M. Maniruzzaman Miah and his field workers visited the area to do their pre-project socio-economic survey; BWDB negotiated the requisition of land for the project and the recruitment of labour from the local area - and only then could the actual construction work commence.

It was the express wish of the funding agency that the local people should be consulted and kept informed during the planning phase of the project, and by the accounts of the respondents this consultation
process does appear to have been implemented - although it seems to have involved only the top rank of the village socio-economic hierarchy. The village was visited by BWDB officials and by foreign aid workers from EIP, and formal and informal village meetings saw to it that information was disseminated throughout the local area. Only 18% of household heads, and most of these engaged primarily in non-agricultural occupations, reported that they had not been informed of the nature and purpose of the embankment prior to its construction.

The fact that the construction of the embankment required the requisition by the BWDB authorities of a substantial amount of productive agricultural land is another factor in the upheaval which the embankment's construction entailed. Fully a quarter of Geraki households reported the loss of land to the embankment, and with land so scarce and so vital a resource to a rural Bangladeshi household, to lose land for any reason is a serious occurrence. Most of the respondents reporting land ceded to the embankment did not declare the area of land they had been forced to give up, nor the amount of money they had been paid in compensation, but all but one declared the amount of money they had received to have been 'inadequate'. While these complaints about compensation payments are unsurprising, and would likely be encountered anywhere in the world that landowners were forced to give up land to public works, the lingering discontent evident in Geraki suggests that the problem is deeper-seated. Problems with land acquisition for projects are indeed acknowledged by EIP, notably in the report by Akbar (1981), who looked at ten
different EIP projects including the initial phase of the project under consideration here. Acquisition of land for EIP projects is the responsibility of the project executing agency, BWDB, working through the local (Union) authority. Akbar comments on the unsatisfactory nature of this arrangement, which is rather loose and open to abuse and malpractice on the part of local BWDB and Union officials. Proshika (1986) echo Akbar's opinions, reporting instances of graft and corruption during the process of land acquisition for the embankment. A particular problem is the landlessness resulting when marginal farmers are forced to give up the small fields which constitute their entire holdings, a fate that befell two households in Geraki and almost certainly a higher proportion of households in the villages of Trimohan and Seoratal, whose lands abut the embankment to a greater extent.

With the sacrifice made in terms of land, the embankment had to yield perceptible benefits in order to convince its intended beneficiaries of its worth. The primary test is, of course, whether the villagers consider it adequate protection against flooding. In the questionnaire survey, 94% reported that they considered the embankment to provide adequate flood protection, a quite conclusive vote of confidence. This generally positive response was qualified by only a limited number of complaints about negative side-effects of the embankment. Just two Geraki farmers reported negative side-effects in agriculture, both complaining of a slight delay to rabi sowing by retarded drainage. Other complaints were of water stagnation and associated skin problems; decreased catches of fish in
the immediate village surrounds; and, with the embankment forming a barrier to boat transport, the necessity of mooring fishing boats away from the bari. Each of these complaints was mentioned by only one or two respondents, and then usually as a qualifier to a statement of general approval. There was found no landholding status, occupational or religious basis for respondents' opinions on the embankment.

Further evidence of the Geraki villagers' generally positive attitude towards the embankment is provided by their responses to the final, open question which asked for their general remarks on the embankment's impact and effectiveness. Comments ranged from the pragmatic to the poetic, but virtually all respondents expressed their categorical approval. The most common reply was a straightforward 'khub bhalo' ('very good'), but several respondents were either more euphoric in their praise of the embankment or more explicit in describing the improvements it has brought about.

Typical of the responses were these:

The embankment is the highest blessing for the villagers. I am very happy with its positive influence in our economic life.

The embankment has much influenced the daily economic life of the village farmers. If there were no embankment, many villagers might have been put in a miserable condition. I am very grateful to those who performed the noble deed of giving us an embankment.

The embankment has brought prosperity and happiness to my household. Here there is no famine, no bona now.

The embankment has brought certainty and permanence to our continued existence in the village. It is as important to us fishermen as it is to the farmers.
Others likened themselves in their new-found security to 'children in the womb' or 'chicks under their mother's wing'. Particular benefits mentioned with some regularity were: the protection of crops and resultant improvements in cropping; protection of the homestead; improved communication through the road facility formed by the embankment; the prevention of sand deposition; the facilitation of irrigation; and even, contradicting other reports, improvements in fishing.

Several respondents used the opportunity for general remarks to express their concerns about the maintenance of the embankment, anxious that its benefits should be enjoyed by succeeding generations. Around 30% of the respondents had already indicated that they were aware of damage to the embankment, those having their baris or fields closest to the embankment being most conscious of its wear. Field observation did indeed show that, after almost four years' existence, the embankment was beginning to show signs of damage by erosion by both rain and river, its top and sides being in some places deeply gullied. Heavy pedestrian traffic, especially at the site of the weekly hat, keeps the top of the embankment almost bare of vegetation, thus rendering it more vulnerable to erosion than it would be with some vegetative cover. Respondents had various suggestions as to the means by which the embankment might best be kept in a good state of repair and who should assume responsibility for embankment maintenance as, while willing to perform the required physical labour themselves, respondents were aware of their need for technical advice and financial assistance to ensure that the job be
done properly. Their awareness of the necessity for regular repair work on the embankment to ensure its upkeep suggests that the people of Geraki would respond well to the Rehabilitation, Operation and Maintenance (ROM) phase to the project which has been initiated since the field survey was carried out.

Of particular importance to embankment maintenance is the carrying out of major repairs following serious damage to the embankment, such as that caused by the 1988 flood. My only source of information on the effects of the 1988 flood is again the letters sent from Geraki by Abul Hassan, who reported that the embankment had been breached in more than one place, but that it had been repaired by June 1989, the repair having been planned and overseen by officials of BWDB (the original project executing agency), but carried out by local labour. The letter suggests that damage was fairly extensive; that its repair was so rapid, being completed before the succeeding flood season, testifies to the success of maintenance procedures.

An unfortunate truism is that the occasions when the embankment requires urgent and large-scale repair come at times when the local people are least equipped to carry out the repair work, being economically, psychologically and physically weakened by the effects of flood damage. At the same time, national resources of money and manpower are being deployed on the more pressing task of flood relief distribution and the rehabilitation of flood victims, so that project maintenance work is delayed or in some cases even neglected altogether. Ensuring the proper repair and maintenance of project
structures and equipment remains one of the fundamental stumbling blocks of attempts at development assistance, whether for flood control, irrigation, or items of infrastructure such as roads or power transmission facilities. The most well-intentioned and well-planned development interventions can soon flounder if a maintenance component is not incorporated in project planning. The future of this project depends entirely on whether the ROM strategy continues to prove effective in channelling the high level of local awareness and motivation into practical action to maintain the embankment.

With the overwhelming enthusiasm of the Geraki villagers towards the embankment in mind, it was interesting to test the reaction of respondents in Sutanari to the hypothetical proposal of an embankment being constructed to protect their village from flooding. It emerged during the survey that there had been recurrent rumours circulating in the village concerning the construction of an embankment, but whether these rumours were based on any genuine proposal or were merely the product of local gossip was impossible to ascertain. It is probable that the building of the nearby Pathakhali-Konai embankment had raised hopes of flood control being implemented over a wider area. People in Sutanari had clearly given the idea of an embankment some thought, as they were strongly aware of the effects an embankment might have, both positive and negative, and had strong opinions either for or against the proposal. Probably as the result of witnessing the generally favourable impact of the embankment on the livelihoods of their neighbours across the Bangshi river, most
respondents in Sutanari (85%) were in favour of an embankment. Only 3% were strongly against the proposal, and the remaining 12% were either indifferent, feeling that their personal circumstances would be little altered, or had mixed feelings, being unsure whether the advantages of having an embankment would outweigh the possible negative side-effects. Certainly the responses of people in Sutanari indicated astute perception and voiced some legitimate and well-founded concerns. Among the views expressed were these:

An embankment on the west bank of the Bangshi would protect all the lands of the village from the flood hazard. We will then be able to transplant aman paddy easily after harvesting the boro crop. Our homesteads will not be eroded by strong currents, and there will be no sand deposition in our fields. (small farmer)

An embankment would protect us from sand deposition and river erosion. It will also give us easier road transportation. (small farmer)

If there is an embankment, I will not need to have three occupations (farmer, fisherman and labourer). There will be greater security of cropping and my bari will be safe. (marginal farmer)

Bonna is a problem for the landowner. We (the landless) work in their fields, so it is a problem for us also, because damage to crops means we are unemployed. So an embankment would benefit us too. (landless labourer)

An embankment will benefit only the rich villagers. The only advantage to the poor will be employment in its construction. (marginal farmer)

An embankment might improve fishing to some extent by ensuring that there is water in the khals through the winter months. Apart from this possible benefit, fishermen will profit little. (landless fisherman)

I am not sure of the exact impact of an embankment. But every year my economic condition is deteriorating - if an embankment could change this, I'll be most grateful. (medium farmer)

I am worried that I might lose my land if an embankment
were to be constructed here. (small farmer)

The diversity and divergence of opinion in Sutanari is clearly related to the economic status and occupation of the respondents. The relationships at household level between economic status and vulnerability to the flood hazard, and between economic status and the nature and extent of benefit from the embankment, have so far received only cursory consideration; attention has instead been paid to the differences at village level which indicate the overall impact of the embankment. The generally favourable impact of the embankment has been proved beyond doubt - the comparative analysis of the two village economies; the conversion to a more productive agriculture in the protected village; the contrast between the two villages in their perceptions of and reactions to the hazard and the occurrence of flooding; and the expressed opinions of project beneficiaries all attest to the success of the project in general terms. But has it succeeded on the stated terms of the project funding agency, i.e. the provision of benefit to the most vulnerable groups? Who, in fact, are the people most vulnerable to the flood hazard? Such considerations form the subject of the final, concluding chapter, in which the economic parameters from the first section of the questionnaire are linked with the parameters of flood perception and response from the second part of the questionnaire, thus examining the impact of the embankment at all levels in the socio-economic hierarchy.
10.1 Relative vulnerability and project targeting

Inasmuch as there was ever a single hypothesis that this work set out to test, beyond a simple project evaluation, it was that of the greater vulnerability of the poor to natural hazards and the failure of hazard-reducing interventions to improve the circumstances of those most vulnerable. Considering the socio-economic parameters of the first section of the questionnaire alongside the flood damage and hazard perception parameters of the second allows this hypothesis to be tested. Comparative socio-economic analysis has proved that embankment-related economic improvement, being based in improvements in agriculture, is distributed in absolute terms in proportion to household landholding; yet, in relative terms, the most significant impact has been on the households in the smaller landholding categories, and the embankment has even included the landless among its beneficiaries. This distribution of project benefits is a necessary but not sufficient condition for deeming the project a success in reaching the most vulnerable, as it fails to define just which socio-economic group is in reality the most vulnerable to economic decline consequent upon flood damage. Was the planning agency correct in defining the target group as landless labourers and marginal farmers, or are other groups equally or perhaps even more vulnerable to the flood hazard? It is essential to identify the most
vulnerable group (or groups), and to evaluate the impact of the embankment on the vulnerable households thus defined, in order to pronounce final judgment on the embankment's success as hazard reducer and development aid.

One means of assessing the relative vulnerability of different socio-economic groups is to consider vulnerability in the sense of absolute material loss from flooding and to see whether the degree of flood damage reported by each household bears any relation to its economic status. Much of the data on flood damage was expressed in too crude a form for there to be established any form of quantitative correlation between the degree of damage suffered by a household and its economic status - respondents described damage to the bari only as 'slight', 'severe' or 'total'; crop damage was reported in percentage values of doubtful accuracy. Nevertheless, the picture that has emerged from comparative socio-economic analysis of the two villages, along with the broad picture of the nature and extent of flood damage in each village, allows certain deductions to be made.

In assessing the relative vulnerability of households of differing economic status, it is appropriate to look at the unprotected situation, where there has been no intervention designed to alter the pattern of vulnerability inherent in the village economy. There was found no evidence in the unprotected situation of the greater vulnerability of the poorer households to the purely material effects of abnormal flooding (bonna). Landless and marginal-landholding households were no more likely to describe damage as 'severe' or
'total' than were small, medium or large landholders. It could even be argued that the poorer households are the least vulnerable to material damage, having the least to lose, thus constituting what is in effect a 'sub-vulnerable' class. This is particularly true in terms of the material household, as the possessions of the poorest households are so few, often comprising just personal clothing and a few kitchen utensils, that they are easily carried to safety in times of severe flooding. At the opposite end of the socio-economic scale can be said to exist a 'supra-vulnerable' class, whose sturdier and often more elevated homes can better withstand flooding and protect their contents from damage, even if this means storing household effects on the rooftops. It is reasonable to conclude that the most vulnerable households are those in the intermediate category, who have possessions enough so that they literally have 'something to lose', yet without the superior dwelling structures to provide their possessions with adequate protection.

The same categories of vulnerability hold for agricultural damage. Here, too, marginal landholders were no more likely to put damage at 100% than were respondents from higher landholding categories. It would thus appear that the extreme depth of abnormal flooding in this area is sufficient to negate any advantage or disadvantage in the different elevation distribution in the holdings of the different landholding categories. The difference in relative vulnerability here lies in the different damage response measures available to the different classes. The larger landholders may suffer more damage simply by virtue of owning more land, but they are able to recover
more quickly from agricultural damage by getting in a replacement crop as soon as the floods have receded, using savings to purchase the necessary inputs. Those marginal and small farmers with an established additional occupation outside agriculture, such as fishing, have a source of interim income which can tide them over until such time as they are able to re-establish their agricultural practices. It is only farmers in the small and marginal landholding categories and without any established alternative occupation for whom 100% crop loss means 100% loss of their livelihood, as all their capital, and perhaps even borrowed capital, is invested in their standing crops.

Landless households are by definition exempt from agricultural damage, although they are affected by the effect of flood damage on labour demand, as indeed are those marginal farmers who depend on employment as agricultural labour for a significant portion of their income. The effect of bonne on labour demand is far from straightforward as, depending on the flood's timing in the agricultural calendar and the length of flood warning received, a flood can either increase or decrease labour demand. If bonne threatens early in the season, adding urgency to the boro and aus harvests, the demand for labour (and therefore the wages paid) can multiply many times over. Likewise, if early flooding recedes quickly, allowing a planting of a monsoon season aman crop, the sowing of that crop becomes an urgent priority, again placing demand on agricultural labour. If, however, an early flood completely destroys boro and aus crops, so that there can be no harvest of
these, and then remains at too great a depth for the establishment of an aman crop, the demand for agricultural labour will be virtually nil for the greater part of the agricultural year. Even then, the urgent sowing of rabi crops at the end of the flood season, probably over an expanded area, will place significant demand on agricultural labour, so that the livelihood of labourers' households is restored. It remains the small landholder, with no established secondary occupation and no savings with which to re-establish his crops, who is effectively the most vulnerable to agricultural damage.

Disruption caused by bonna to other economic activity is rather more egalitarian in its impact, affecting rich and poor alike. Again, any real difference in vulnerability arises in the strategies that a household is able to adopt to recover from the economic loss caused by the disruption, and in the degree to which a household was dependent on the particular activities curtailed or prevented. As with the effect on agricultural labour, the timing of the flood event is crucial in determining the type of disruption caused and thus the households most vulnerable, and no simple class-vulnerability relationship exists. One part of the agricultural calendar particularly prone to flooding, however, is the post-harvest period, be it for boro or for aus crops, when the work of the agricultural labourers is essentially complete and only the task of the post-harvest preparation of crops for sale or storage - tasks performed by household, usually female, labour - remains. If flooding occurs at this time, then agricultural labourers suffer little disruption, their wages already having been paid, but
disruption to the activity of a farming household can see the entire crop irremediably spoiled. Again, the effect of such damage is felt most strongly by the smaller landholders, who have few or no resources to fall back on, and who may have gone into debt in order to meet the costs of cultivation.

The vulnerability profile of the protected village, Geraki, was much the same in its basic characteristics as that just described for Sutanari, the difference between the two villages being that damage from bonna was expressed at a lower level in all landholding categories in the protected village. The embankment does not appear to have been class-selective in its damage mitigation, but has instead facilitated access to 'supra-vulnerability' for households at all levels of the socio-economic hierarchy, through such improvements as household reinforcement, increased boat ownership, and a modified cropping pattern. A note of caution is due here, however. There had occurred but a single abnormal flood event between the construction of the embankment and the time of questioning, and that event one not particularly severe. It could well be that the more catastrophic flood event of 1988 revealed a different profile of vulnerability in Geraki. The embankment may even have served to create greater vulnerability to extreme flood events, through improvements in the material household which have seen households increasing their possessions, thus making damage greater in an absolute if not in a relative sense. It might be that there exists a distinctive vulnerability profile for each distinctive flood hydrograph profile - logic would suggest that the more extreme the flood event, the more

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universal would be its damaging impact. The simple two-way distinction used in this study between bona and borsha does not allow any conclusive statement on this, but it does reveal that the vulnerability profile for the annually recurrent, usually minor damage caused by normal flooding is quite distinct from that just described for bona.

The relationship in Sutanari between economic status and vulnerability to borsha damage resembles more closely the original hypothesis of the greater vulnerability of the poor. There is again found a 'supra-vulnerable' category comprising the wealthier households, but below this there is a steady increase in vulnerability as one moves down the economic ladder. This is true whether one considers bari damage, crop damage or disruption to economic activity. The dwellings of poorer households are constructed of inferior materials; their bari mounds and the plinths on which their huts are constructed are of less substantial proportions and inferior maintenance; and the whole is altogether more susceptible to damage from erosion and even from the heavy rainfall of the monsoon season. In terms of agriculture, it is not necessarily real flood damage but the very threat of damage which makes poorer farmers more reluctant to invest in the inputs for HYV boro cultivation, restricting them wholly or partially to the less productive traditional crop rotations. As this constraint on the poorer farmers represents an effective economic loss, it too can be considered a type of 'damage' caused by the normal flood. The relationship between economic status and borsha vulnerability is
perhaps most evident in the disruption caused to economic activity in the flood season - boat ownership is essential to overcome the restrictions imposed on personal mobility and thus to continue any form of social or economic life; and boat ownership has already been shown to correspond closely with economic status.

There was a greater difference between Geraki and Sutanari in the pattern of vulnerability to normal flooding than had been found for abnormal flooding. For bonna, the basic relationship between economic status and vulnerability was much the same in the two villages, the difference arising in the lower level of damage in all landholding categories in Geraki. For damage from normal flooding, however, the strong relationship observable in Sutanari between economic status and vulnerability was barely in evidence in Geraki. Damage to the bari was reported at a negligible level by all categories of landholder; even marginal landholders considered flood risk to have been lowered to a level where they felt able to bear the risks inherent in high-input boro cultivation; and the personal mobility of all households had been facilitated through both expanded boat ownership and the raised path formed by the embankment itself.

From this inter-village comparison, it would appear that not only has the embankment avoided inequity in the distribution of its damage-reducing impact, it has also had its maximum impact precisely on those households who outside the embankment are most vulnerable to damage. Even without an embankment, large landholders can afford to reinforce their dwelling structures; to practise input-intensive
agriculture; and to maintain their personal mobility during the flood season. With the coming of the embankment to Geraki, more poorer households have found themselves in a position where they can adopt these practices. That the inter-village differences are more significant for the normal flood than for the extreme flood events provides a vital clue to understanding the means by which the embankment has exerted its influence: not by the prevention or reduction of abnormal flooding, but by modification of the normal flood, setting in progress a chain of agricultural change, economic improvement and enhanced resilience to extreme flood events.

Another way of looking at relative vulnerability through the socio-economic hierarchy is to consider not just material damage and the immediate response of households to that damage, but to consider a number of different scenarios of the damage response measures adopted by households of differing economic status, along with the longer-term consequences of those damage response strategies. This provides a far superior indication of vulnerability, which is surely best measured in terms of the overall change in a household's functioning and status following flood damage, rather than in the simple amount of damage suffered. Response strategies have already been considered in some detail in the preceding chapter and so it is to the implications of those strategies, rather than to the strategies per se, that attention will be paid here.

The different response strategies available to households of differing economic status mean that two households may suffer the
same absolute damage - crop destruction and damage to the homestead, perhaps - yet suffer very different consequences from that damage. A large landholder might need simply to draw on his savings, earned from the sale of earlier surplus agricultural production, in order to rebuild his home and establish another crop on his fields as soon as conditions allow. His household would experience little qualitative change either in the means of earning their livelihood or in their relative economic status, suffering perhaps only a short-term restriction on their expenditure, and perhaps even benefiting from being able to purchase land and other assets at deflated prices. A household less well-off in terms of land assets, likely to lack any significant savings or even to be in some debt, would be more likely to have to adopt a package of response measures to re-establish itself: sending some household members out to work as agricultural or other labour; going further into debt; selling any domestic possessions that may have been salvaged. Such a household will have undergone change both in its standard of living and in the very means by which it earns its livelihood, but may retain some prospect of restoring itself to its former position in the medium term.

Such might be the fate of a medium-landholding household or one in the upper ranks of the small landholding category. At the lower end of that category and among marginal landholders, the response to the same flood damage is likely to be altogether more drastic. Such a household is likely to have been depending entirely on the coming harvest in the immediate term, and may already have been in a state of some deprivation whilst waiting for that harvest, perhaps even
entering into forward sales agreements. Destruction of the crop by flooding would put such a household into dire economic straits, causing it to adopt desperate and drastic response measures: all household members might be forced into the labour market, even if working for no payment other than their food; productive assets such as livestock and agricultural implements might have to be sold; and, as a final resort, land might need to be mortgaged or sold. Such measures are likely to involve a substantial and irreversible decline in the household's economic fortunes, such that the household suffers a permanent change both in economic status and in the means by which it earns its livelihood.

For a household already landless and dependent on agricultural labour for its livelihood, destruction of crops and damage to the homestead will mean immediate and intense hardship. However, as this class of household depends for employment largely on the medium- and large-landholding households, they may, after a period of destitution, begin to restore their livelihood as soon as those larger landowners recommence their agricultural activity. That livelihood is thus interrupted rather than altogether destroyed, and the means by which a labouring household earns its living undergoes no permanent change - landless labourers they were before the flood, and landless labourers they remain. For a landless household that earns all or part of its income from fishing, the interruption to their livelihood may be more brief yet. It remains the small and marginal landholders, therefore, who are the most vulnerable in a real sense.
This interpretation of relative vulnerability does not deny the hardship suffered by landless households, but rather suggests that these households for the most part occupy such a lowly position in the economic hierarchy, with extreme poverty for them already an everyday reality, that the qualitative and material change affecting their lives as a result of flood damage is relatively small. For a marginal- or small-landholding household, a damaging flood may be the very event which forces them into landlessness and extreme poverty, so that they too come to occupy this class of 'sub-vulnerability', where they have lost so much that they literally no longer have anything to lose.

An appropriate analogy is perhaps with a stock market crash, the stock exchange representing the agricultural economy; the investors, the farming households; the number of shares held, the area of land owned; and the market crash, the flood disaster. The biggest investors may lose the greatest amount in absolute terms, but they are likely to have savings and investments elsewhere on which they can draw, so that they can retain their shareholdings until the market recovers and they can begin to reinvest. They may even be able to take advantage of the situation to purchase shares at deflated prices, just as occurs in the land market after a flood in Bangladesh. Those owning no shares themselves, but employed in the financial sector, will suffer no direct personal loss, yet may lose their jobs and have difficulty in finding alternative employment until the market recovers. The small investor whose shareholdings
represent the entirety of his personal investments, who depends on the earnings from those shares for the greater part of his income, and who may have entered into other financial agreements expecting to make a profit on share dealings, is the one who suffers the most in a real sense, and whose life is most fundamentally and permanently altered by the event. He may be forced to sell shares at a loss in order to meet financial obligations, or even to sell any other assets he might own, such as his house. The large landholder is like the big investor; the landless labourer like the financial sector employee; and the small or marginal farmer like the small investor. The difference in the real situation in Bangladesh is that there is no alternative to investment in agriculture, and no insurance against the high risks involved in that investment.

I would contest, therefore, the project funding agency's identification of the target groups as marginal landholders and the landless, and suggest instead that it is the marginal and small landholders who are most vulnerable to flood damage. That the embankment has benefited the landless only indirectly, through increased labour demand, and relatively less than it has the landholding classes, represents not a failure of the project but proof of its success in reaching a more appropriate target group. That said, the embankment has in a sense increased vulnerability to flood damage by assisting to maintain in the category of small and marginal landholders households who would otherwise have been forced into landlessness and therefore 'sub-vulnerability'. This makes it even more important that any project follow-up activities should
focus on small and especially on marginal landholders, rather than on the already landless as at present. The improvement of the lot of the landless, although a worthy and urgent task, is essentially tangential to what should be the primary aim of flood control: to encourage agricultural development both by relieving the constraints imposed on the agricultural economy by normal flooding, and by mitigating the damage caused to the agricultural economy by abnormal flooding.

Such a reappraisal of vulnerability appears to fly in the face of conventional wisdom, which has come to hold that the poorest are the most vulnerable to natural hazards, and indeed of the findings of Sen (1982) and Alamgir (1980). Each of these authors has undertaken an analysis of the 1974 famine in Bangladesh in an attempt to identify the most vulnerable socio-economic groups. While disagreeing about the role of the flood of 1974 in causing the famine, both agree in their assessment of relative vulnerability, noting the prevalence of agricultural labourers among the destitutes seeking food relief, with farmers being relatively less hard-hit. Unfortunately, neither author incorporates information on multiple occupations, making it impossible to extract the extent of destitution among marginal farmers, who also work as agricultural labourers, from that among landless labourers. The former category might well have proved the more severely affected, but any such difference is obscured in the simplistic two-way categorisation of farmers and labourers.

The subdivision of famine victims by landholding category rather than
occupation is more revealing, yet omissions in the data still make it impossible to assess the relative vulnerability of marginal landholders. Using the same set of data, both Sen and Alamgir present the following statistic: of the inmates of the famine relief centres, 31.6% owned no land at all; 49.5% owned some land, but less than half an acre. Neither, however, goes on to give a comparable all-Bangladesh figure of households owning less than half an acre. Sen lumps the marginal farmers together with the landless households to give a figure of 32.69% in this category for the country as a whole in 1974; Alamgir refers to Jannuzi and Peach (1977) in citing a figure of 47% for households in the 'less-than-one-acre' category. Another problem with the findings of Alamgir and Sen is that they do not distinguish among the landless households between those landless before the flood and famine of 1974 and those who had only recently sold their land as a distress response. Who, therefore, was the most vulnerable: households previously landless or households only recently become landless? Indeed, had some of their respondents been classified as agricultural labourers only because they had sold their land and could therefore no longer be classified as farmers, even though until the events of 1974 farming had been their primary occupation?

Sen and Alamgir certainly noted an inverse relationship between the proportion of owned land sold in 1974, irrespective of the stated purpose of the sale, and the size of the selling household's pre-sale landholding. Sen observes 'a clear bias towards land alienation on the part of the smaller landholders', a development which 'generally
impoverished the group of small peasants' (p. 151). Alamgir states bluntly: 'After land transactions in 1974, the less than one acre group became either landless or near landless' (p. 162). Thus both authors, while purporting that it is 'the landless end of the village spectrum' that is the most vulnerable (Sen, p. 145), fail to give full import to the vulnerability of small and marginal farmers, even though close perusal of the data they present suggests that this might well be the group that suffered the greatest relative destitution.

Further evidence for the greater vulnerability of small and marginal landholders, relative either to landless or to larger-landholding households, is to be found in Alamgir's comparison of 'famine' and 'non-famine' districts. For example, in terms of mortality, while the highest mortality figures were recorded among landless households in both famine and non-famine districts, the relative difference in mortality between famine and non-famine districts was greatest among small and marginal farmers. Child mortality in the famine districts was virtually identical in Alamgir's lowest category of landholders to that among landless households, even though in the non-famine districts it was substantially less. Again, here is evidence of the everyday condition of landless households being so desperate that they constitute a class of 'sub-vulnerability', while small and marginal landholders occupy a tenuous position of relative prosperity, easily lost when disaster strikes.

Consideration of the data from my own 1986 survey suggests that it is
the small and marginal farmers, and not the landless, who suffer most from flood damage in terms of both material loss and loss of livelihood. It should be pointed out, however, that Sen and Alamgir were dealing not with flood damage alone, but with the complete famine syndrome, in which both agree that flood damage plays only a part (although disagreeing on the size of that part). Flood damage, they hold, may trigger or contribute to a famine, but there are several other contributory factors. The vulnerability profile for flood damage per se may differ from that for a full-blown famine such as occurred in 1974, so that the comparison between their data and mine may not be entirely appropriate. This study, formulated to assess the impact of flood control, deals only with direct and discernible flood damage. In so doing, it has not considered aspects of the local economy which are all-important in an understanding of famine, yet cannot be described as the direct result of flood damage (such as changes in rice prices and in what Sen terms 'exchange entitlements').

It was perhaps in equating flood vulnerability with famine vulnerability that the misdefinition of the project's target group arose. I would certainly hold that the project funding agency has erred in too readily assuming as its target group the landless and marginal farmers. In its own terms, the project agency would consider that the project has missed its target group, as it has failed to benefit the landless to any great degree. This overlooks the fact that the embankment has had an important influence in preventing the number of landless households from expanding.
Although the benefits of the Pathakhali-Konai embankment have fallen largely on the landholding classes, having only indirect benefits for the landless, the very flood damage which the embankment sets out to prevent itself impinges most on the landholding classes, and affects the landholding classes only indirectly. That the impact of the embankment has been felt most by the small- and marginal-landholding households, some of whom have certainly been kept from the fate of landlessness only by the embankment's influence, represents not a failure of the project but perhaps its greatest success.

10.2 Summary of the primary effects of the embankment

The embankment's success in reaching the most vulnerable group having been asserted, it is appropriate now to summarise the changes the embankment has wrought in the local economy and to consider how these have affected the target group as here re-defined i.e. the small and marginal landholders.

Perhaps the most important consequence of the economic improvement induced by the embankment has been the stabilisation of the land tenure situation. Land sales, mortgaging and leasing were found to be far less in the village with flood protection than in that without, with sales and notably mortgaging of land being especially rife in the latter. As the implications of land loss are far more devastating for the smaller landholders, the embankment can be regarded as having brought particular benefit to households in this
category.

There were many other indications of the economic superiority of the protected village to attest to the favourable impact of the embankment. There was, in the protected village, both a lower incidence of multiple occupations and a greater number of households who could depend primarily on their agricultural operations for a living. There were not higher incomes, but there was a higher incidence of food self-sufficiency in the protected village, rendering households less vulnerable to perturbations in the wider economy. In terms of the standard of their dwelling structures and the range of their material possessions, households in the protected village were noticeably better off than households in the unprotected village. Households in the protected village were also significantly better off in terms of access to the productive assets of draught animals and agricultural implements. In almost all cases, the inter-village differences were most marked in the category of small and marginal landholders, indicating not that project benefits had been denied to the other landholding categories but that the positive impact of the embankment had been felt most strongly by households among the lower landholding classes.

A 'with - without' comparison alone cannot reveal the true nature of the embankment's influence, but must be considered alongside a 'before - after' comparison. Relative to the situation before the embankment, there had been no radical improvement in the economic fortunes of households in the protected village. The effect of the
embankment instead appears to have been to have arrested the economic
decline. Such decline persists in the unprotected situation, so
creating a substantial and increasing divergence between the with-
and without-project villages in virtually every aspect of their
economic status, structure and functioning. This shows the inherent
danger in using either a 'with - without' or a 'before-after'
comparison on its own as a basis for assessing the impact of any
project - in this case, a 'with - without' comparison alone would
have exaggerated the influence of the project, while a 'before-after'
comparison would have suggested that the embankment had had little
influence at all.

The economic benefits of the project have arisen from the impact of
the embankment on agriculture, both 'with - without' and 'before -
after' comparisons attesting to the agricultural transformation
wrought. The protected village has a higher intensity of cropping
than the unprotected village, not through cropping intensity having
increased but by its remaining at its pre-embankment level while that
outside the project area has declined. In response to lowered flood
risk in the early part of the flood season, farmers in the protected
situation have proved more willing to move to the high-input,
high-yielding cultivation of hybrid rice under irrigation in the dry
season, replacing the traditional monsoon crops of rice and jute.
Commonly, farmers have replaced an aus/aman-rabi with a boro-rabi
rotation. Farmers in the unprotected situation have shown less
enthusiasm in adopting HYV boro cultivation, many retaining some
fields under the traditional rotations as a form of insurance against
flood damage, and often having *boro* in a single cropping rather than in a double cropping with a *rabi* crop. This has been at the expense both of cropping intensity and of productivity—both overall and, more importantly, food productivity are higher in the protected situation.

Flood control has served to amplify the beneficial effects of irrigation—both villages have access to irrigation facilities, but the protected village, with more land under HYV *boro* cultivation, has, relative to the unprotected village, not just more land under irrigation but more of its farming households using the irrigation facilities. Again, the inter-village difference is most marked in the smaller landholding categories, with households in this group in the unprotected village being reluctant to make investments in irrigated HYV cultivation while the *boro* crop remains vulnerable to flood damage. The reduction of the flood hazard, particularly in the early part of the flood season when *boro* is being harvested, has encouraged households in the protected village to make the necessary investment in inputs and to take advantage of the availability of irrigation. Even the landless have benefited from agricultural change, as labour demand has been increased by the expansion of HYV *boro*.

The detail of the changes in agriculture provides the key to understanding how the embankment has modified flooding in a physical sense. The embankment was discovered to have had a more significant effect on the normal annual *borshā*, itself a severe economic
constraint, than in controlling the extreme flood events. It is modification of borsha, and particularly the delay in the onset of flooding, which has encouraged the observed agricultural improvements. These have led in turn to economic improvements at not just village but at household level; these economic improvements have in turn allowed households to resist the damaging effects of abnormal flooding more easily. Evidence of the influence of the embankment in reducing the risk of flood damage was both implicit, in the observed changes in the local economy, and explicit, in the statements of the respondents themselves. Flood damage, both that from borsha and that from bonne, was reported at lower levels and by fewer households in the protected village, whether damage to the homestead, to agriculture or to general economic activity; and respondents were in no doubt as to the contribution of the embankment to damage reduction. Damage reduction was observable in all socio-economic categories, and was not restricted to one landholding class or occupational group, a sure indication of just how far-reaching the influence of the embankment has been.

The benefits accruing from the flood control project are indeed many and various, and by all evidence and accounts have been distributed equitably through the socio-economic hierarchy - or at least have filtered through that hierarchy, even to landless households. Households in all socio-economic categories in the protected village expressed enthusiastic praise for the embankment and the improvement it had brought to their lives; objective assessment indicates their enthusiasm to be well-founded. Where the unprotected village has
seen landholding polarisation and economic decline, the protected village has experienced stability; wherever the unprotected village has seen any economic improvement, that same improvement is evident to an even greater extent in the protected village. Household heads in the unprotected village were found to be continually juggling their (limited) economic options - engaging in multiple occupations; letting out or renting in land; combining modern and traditional crop rotations - a form of risk management strategy in a hazardous environment. In removing some of the risk, the embankment has made household livelihood less of a gamble, thus lending economic stability and security to households in the villages it protects.

10.3 Final observations and recommendations for future policy

The embankment has been judged to have been a success in terms both of agricultural productivity and of equity in the distribution of wider project benefits. That this is so, both from an objective assessment and in the express opinion of the project's intended beneficiaries, represents something of a triumph for the project planners, and has important implications for future water sector policy in Bangladesh. It is useful to consider what sets this project apart from many other projects in the country (and indeed elsewhere in the developing world) in order to see what lessons might be learned from its success.

A key feature of the project is its very scale. The small size of
the project area has three key advantages: the project has realistic physical objectives, being aimed at local modification rather than large-scale prevention of flooding; it is at an appropriate scale relative to local social organisation, thus being suited to its human environment; and it has been designed to deal specifically with local agro-hydrological conditions, thus being sensitive to the subtleties of variation in Bangladesh's natural environment.

In its physical aims, the embankment seeks not to prevent the inflow of water altogether over a wide area (as does e.g. the Chandpur Irrigation Project), so reducing the depth of the normal annual flood and preventing flooding from ever attaining abnormal depth, but rather simply to modify the timing of the annual flood to a regime more conducive to improved agriculture. Flood prevention is an unrealistic objective for flood control projects in Bangladesh, not least because of the greater likelihood from such projects of negative side-effects outside the project area - water kept out of one area must, after all, increase the depth of flooding outside that area. In addition, flood prevention leads to agricultural modifications and changes in traditional flood protection strategies, making the population inside the project area far more vulnerable to the extreme flooding which occurs when project structures fail. For example, in areas of the Chandpur project, there has been a switch to the cultivation of transplanted rather than broadcast varieties of aman (personal communication with Paul Thompson). While more productive, the transplanted varieties are also less flood-resistant, lacking the growth potential of the long-stemmed varieties. A breach
in the embankment during the monsoon season can therefore have catastrophic consequences. In the project studied here, modification rather than prevention of flooding has seen farmers forgo monsoon cultivation altogether in order to concentrate their energy and investment on irrigated dry season cultivation, so that even if project structures fail during the peak flood season, there are few if any standing crops there to be damaged.

In terms of social organisation, the size of the embankment means that it is seen as 'belonging' to a loosely-defined local community comprising a small number of neighbouring villages. Project beneficiaries perceive the embankment as having been provided to assist themselves and not some nebulous larger population; as being for their specific benefit rather than the general good. They know where the embankment begins and where it ends, and they understand its purpose and functioning. They are therefore more willing to contribute to its upkeep than perhaps would be the inhabitants of a village who know only a short stretch of a much larger embankment structure, which benefits not just them but a vast number of villages with whom they have no social ties. In addition, the planning philosophy of the funding agency, involving the intended beneficiaries in the project planning phase rather than implementing a project without warning of its coming or explaining its purpose, could not have been carried out effectively on a much larger scale.

The third main advantage of operating on a small scale is that the project can be designed to suit precisely the local conditions. The
particular problem which this project set out to address was one of early flooding which damaged the *aus* crop and made input-intensive *boro* cultivation a risky venture. Adaptation to the deep flooding characteristic of the local area was already inherent in local cropping practices which, before the advent of irrigation and HYV *boro* cultivation, concentrated on early-maturing *aus* varieties and broadcast deepwater *aman*. Any modification of flood depth would have had to be fairly drastic if it was to be sufficient to effect a significant agricultural transformation, yet only a minor adjustment in flood timing was enough to induce major changes in local cropping practices. Though Bangladesh to the outsider seems a homogeneous plain, there actually exists almost infinite variety in flood regime and associated cropping pattern, each agro-hydrological micro-environment requiring a slightly different type of modification in order to be made more productive. Far better, therefore, to plan modifications on the local scale.

Apart from contributing to the very success of the project, working on the minor scale has advantages to the funding and implementing agencies, as it makes projects easier to plan and design, quicker to implement, and easier to supervise and maintain. Small projects can better be tied to existing structures of local administration, again making the organisation and conduct of project maintenance an easier task.

Credit for the project's success does not lie entirely with successful planning, but also has much to do with the coming of
irrigation facilities to the local area under an entirely independent development scheme. While the flood control project, which incorporates a drainage component, would doubtless have brought significant change on its own, its impact has been magnified by the availability of irrigation from deep tubewells. Yet this could equally be stated the other way round, and the success of irrigation in improving agriculture owes much to the presence of the embankment. The case must be made strongly for multi-purpose schemes of flood control, drainage and irrigation, as integration of these various components of water management is essential if the resource potential of water is to be fully utilised and its hazard potential reduced. Single-purpose irrigation schemes are probably of more value to agriculture than single-purpose flood control schemes, as irrigation by its very role in expanding dry season cultivation serves to reduce dependence on the monsoon season crops, and thus to reduce effective vulnerability to flooding. It cannot be said that flood control does anything to alleviate the effects of drought.

Integration there must be too in the spatial sense, and arguing for locally-targeted and small-scale schemes does not imply an argument against tackling the problem of flooding at regional level. Projects must be planned which deal with local conditions yet fit into a broad overall strategy for water management (such as has indeed been formulated by the Master Plan Organisation). The effects of flooding are felt in different ways and to different degrees in different local areas, but the origins of flooding (i.e. of both bona and borsha) lie in processes operating well beyond the local or even the
national scale. It is sobering to read words penned by Mukerjee in 1938, when modern Bangladesh was eastern Bengal, a province of a united India:

The control of the Ganges and the Brahmaputra and of their tributaries is a vast and intricate undertaking which requires the co-ordination of divergent interests of different provinces and regions. No province must be permitted any longer to pursue its own regional policy as regards waters, and forests, which affect the fortunes of so many millions outside its boundaries. A co-ordinated policy of forest, soil and water management, based on the recognition of the river and drainage systems as an integral whole, must now be deemed essential in order that the prosperity of this vast valley...may be more evenly distributed in the future and be not jeopardised by recurrent famine, flood and malaria. The postponement of a co-ordinated programme would not only imply greater recurrent national losses...but may also range the provinces and regions in conflicting camps to make a comprehensive and integrated stream control impossible in the future. (p. 288)

Such a call might well be made today, when political developments have indeed 'range[d] the provinces and regions in conflicting camps' and the 'many millions' have multiplied, making co-operation and integration in water management more difficult and yet more urgent than ever.

A more integrated approach is now becoming evident both in national planning and in international efforts such as the United Nations' £400,000 million programme for flood control in Bangladesh (BBC World Service news, 7 June 1989). The programme aims to consider flood control within the broader context of economic development, and not merely as an engineering challenge; it will incorporate drainage and irrigation as integral components; and it hopes to encourage negotiations and to foster co-operation between the various countries.
involved. The very nature of the flood problem in Bangladesh makes such an integrated approach essential. It must be hoped, however, that emphasis on the regional scale will not spawn misguided, over-ambitious, large-scale projects. The sheer magnitude of the problem makes it easy, in a reversal of the popular expression, to not see the trees for the wood - in concern for the general, planners risk losing sight of the specific and of the contribution that minor projects can play in the overall water management strategy. It is also easy, given the complex nature of the region's hydrology, for planners to latch onto 'panacea' solutions, seeking to find the 'quick fix' rather than to confront the uncomfortable reality that the problem of flooding will not be solved by any single-factor intervention. After the 1988 floods, the deforestation theory rose to prominence in both popular and scientific perception, and the reforestation of Nepal was seen as the answer to Bangladesh's flood problem. In searching for a panacea, planners ignore the more urgent task of developing a viable, permanent flood management strategy, fully integrated into a comprehensive plan for national development. Only by such an approach will Bangladesh be able to gain maximum advantage from her water resources while controlling the damage from the inevitable flood disasters.

At the local level, the experts at flood management are the inhabitants of rural Bangladesh themselves. They live in one of the world's most hazardous and yet most fertile environments, and they have evolved a lifestyle and an agriculture remarkably attuned to that environment. Their environmental awareness, their adaptability,
and their proven resilience in the face of disaster must all be tapped if the country is to deal effectively with its flood problem. Perhaps nowhere more than here can be seen the importance of considering natural hazards as an integral part of the normal functioning of the society and economy, as many of the distinctive characteristics of that society and economy arise out of the country's very proneness to disaster. The economic significance of abnormal flooding lies not merely in the periodic flood disasters which disrupt the country's economy, but in the constraints imposed on the development of the country's economy by the omnipresent threat of abnormal flooding. Indeed in many parts of the country even the normal flood is a severe constraint to agricultural improvement, making effective water management crucial to future agricultural development.

The success of the flood control project evaluated in this study - a project local in scale and which involved the intended beneficiaries in its planning, implementation and maintenance - makes it an appropriate model which can be replicated, with appropriate local modifications, across the country. Bangladesh will forever be afflicted by recurrent extreme flooding; to aim at total flood prevention is simply unrealistic. What can be done, and what has been done at Pathakhali-Konai, is to aid agricultural development through better management of the normal flood, and through this development to strengthen resistance to the worst degradations of the inevitable extreme flood events.
Plate I  The embankment towards the end of the flood season (protected area to the right)

Plate II  A boat travels over the flooded landscape at the height of the flood season
Plate III  Aman rice with an 'island' of houses in the background

Plate IV  Harvesting aman after the flood's recession
Plate V  A woman prepares fish for cooking

Plate VI  Market day, the embankment providing a flood-free site
Plate VII  Erosion of the embankment at the market site

Plate VIII  Cattle being used to thresh grain in the courtyard of a large landowner
Plate IX  The author with the head of her Geraki host family (the labourers to the right have just delivered the pile of harvested aman rice in the background)

Plate X  The author and an interpreter conduct an interview
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QUESTIONNAIRE A

ASPECTS OF THE LOCAL ECONOMY

Village name: Genalli (South and 100 yds. distance from the embankment)

1. People (respondent and household members)

1.1 Name of respondent

Jahan Charan Das Jagnyoti

1.2 Age

35

1.3 Religion

Hindu

1.4 Caste (if Hindu)

Raymond

1.5 Occupation (or title)

Fishing

1.6 Secondary occupation

Krishi

1.7 Education

Illiterate

Household members

1.8 Sex 1.9 Age 1.10 Relation to head 1.11 Education

F 35 Wife Illiterate

M 25 Son Illiterate

F 25 Daughter in Law Illiterate

I 7 Grand Daughter Not yet in school

F 35 " " " " 

M 25 Son Illiterate

F 12 Daughter Illiterate

M 10 Son " "" 

Code no. 001

H.R. Khan

19.11.86
2. Land tenure

(Display these data on the attached table)

2.1 Do you have rights in any land?
   (if yes, go to 2.2; if no, go to 2.9)

2.2 What rights? (ownership/leasehold; type of tenancy)

2.3 To which land?
   (identify and name fields on map)

2.4 Do you lease out some of these fields?

2.5 Which fields, and to whom?

2.6 Have you recently (i.e. in the last 5 years) bought or sold any land?

2.7 Which land, and to/from whom?

2.8 Which of the fields that you own or rent do you actively cultivate?

2.9 Have you ever held rights in land, and if yes, why did you have to sell?

2.10 Have you ever had to mortgage any land, and if yes, why?
<table>
<thead>
<tr>
<th>Field name</th>
<th>Size (bighas)</th>
<th>Owned</th>
<th>Rented in</th>
<th>From</th>
<th>Rented out</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homestead</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palon</td>
<td>0.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pub check</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of lease bought (including amount paid/sharecrop ratio)</td>
<td>Recently bought</td>
<td>From</td>
<td>Recently sold</td>
<td>To Cultivated by respondent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>-----------------</td>
<td>------</td>
<td>---------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public sharecropper (0.14)</td>
<td></td>
<td></td>
<td></td>
<td>Neighbour</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Land quality (landholders only)

(Display on the following table)

2.11 Which of the fields that you own/rent are protected by a river embankment?

all the fields

2.12 Can you give an indication of the quality of your fields?
(fertile - Shurash and Maddym - med, fertile)

2.13 Can you give me any more detailed descriptions of the characteristics of your fields?
(high/medium/low land; 1/2/3-time land; fertility; drainage; moisture retention capacity - include Bangla terms)

<table>
<thead>
<tr>
<th>Field name</th>
<th>Embankment protected</th>
<th>General description</th>
<th>Detailed characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palam Khel</td>
<td>✓</td>
<td>Nichu (Low)</td>
<td>1/ IRRI Nit aso</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fertile, D.T.W</td>
</tr>
<tr>
<td>Pub Chek</td>
<td>✓</td>
<td>Uchu (High)</td>
<td>2/ Mustard &amp; IRRI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fertile, D.T.W</td>
</tr>
</tbody>
</table>
3. Cultivation

(Display on the following table)

3.1 List, by season of cultivation, the crop varieties that are grown in each of your fields.

3.2 What is the yield of each of these crops (average)?

3.3 Do you apply artificial fertilisers to your fields?

3.4 Which fertilisers, on which crop/field/season combinations?

3.5 Do you apply organic fertilisers (dung, compost) to your fields?

3.6 Which, and on which crop/field/season combinations?

3.7 Have you ever had to use pesticides?

3.8 Which type, and to eliminate which pests?

3.9 On which crop/field/season combinations?

3.10 Have you ever had to use herbicides?

3.11 Which type, and to eliminate which weeds?

3.12 On which crop/field/season combinations?

3.13 Do you apply irrigation to your fields, and if so, by what means?

3.14 Which crop/field/season combinations do you irrigate?
<table>
<thead>
<tr>
<th>Season</th>
<th>Field</th>
<th>Crop type</th>
<th>Variety</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabi</td>
<td>Pub chak</td>
<td>Mustard</td>
<td>Deshi</td>
<td>8-9 mds/acre oil</td>
</tr>
<tr>
<td>RRS</td>
<td>Pub chak</td>
<td>IRR5</td>
<td>Bideshi</td>
<td>50 mds/acre</td>
</tr>
<tr>
<td></td>
<td>Palan Khel</td>
<td>IRR5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table continued

<table>
<thead>
<tr>
<th>Chemical fertiliser (and type)</th>
<th>Organic fertiliser (and type)</th>
<th>Pesticide (and type)</th>
<th>Herbicide (and type)</th>
<th>Irrigation (and means)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabi</td>
<td>T.S.P</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Potash</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE</td>
<td>T.S. P</td>
<td>somewhat</td>
<td>Babendin</td>
<td>×</td>
</tr>
<tr>
<td>Potash</td>
<td></td>
<td>Babendin</td>
<td>Babendin</td>
<td>×</td>
</tr>
<tr>
<td>Urea</td>
<td></td>
<td>Babendin</td>
<td>Babendin</td>
<td>×</td>
</tr>
</tbody>
</table>
4. Work and employment

4.1 Can you describe the schedule of your activities through the year, in your occupation(s) and in your household routine (ploughing, sowing, transplanting etc.)

<table>
<thead>
<tr>
<th>Fields</th>
<th>Homestead</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>January</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magh</td>
<td>Sowing Paddy Seeds</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Weeding</td>
<td></td>
</tr>
<tr>
<td>Falguni</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>March</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaitra</td>
<td>Weeding</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baishakh</td>
<td>Netting</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jai Chaitra</td>
<td>Reaping Rice</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>Paddy Plant</td>
<td></td>
</tr>
<tr>
<td>Askar</td>
<td>Teasing</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Srabani</td>
<td>Fishing &amp;</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>Netting</td>
<td></td>
</tr>
<tr>
<td>Shravana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kartik</td>
<td></td>
<td></td>
</tr>
<tr>
<td>November</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agralayam</td>
<td>Fishing</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Marketing</td>
<td></td>
</tr>
<tr>
<td>Poush</td>
<td>Sowing Mustard Seeds</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Repairing house, selling fish.
4.2 Answer 4.1 for other members of your household.
(Include on table above.)

4.3 Are you or any of your household members employed by someone else?

4.4 to 4.9 for employers only

4.4 Do any labourers (apart from your own household members) assist you in your farming operations?

4.5 How many labourers do you employ on a permanent basis?

4.6 How many extra temporary labourers do you hire for:
   - ploughing \(X\) 2 person (daily)
   - puddling \(X\)
   - sowing \(\times\)
   - transplanting \(\times\)
   - weeding \(\times\)
   - fertilising \(\times\)
   - harvesting
   - any other tasks?

4.7 Is it always possible to meet your labour requirements?
   Yes
   If not, when do you have difficulty?

4.8 How are the labourers paid for their work?
   - Cash payment/payment in kind?
   - How much (Taka/kilograms of food)?
   - Tk. 25 (including meals)

4.9 Do you provide your labourers with meals while they are working on your fields?
   Yes
   How many meals per day?
   Twice in a day.
4.10 to 4.16 for labourers only (including those who are both cultivators and labourers)

4.10 You have indicated that you work as an agricultural labourer. For whom?

4.11 On what basis? (temporary/permanent)

4.12 Do you need to work all year round?

4.13 Can you find work all year round? If no, when do you have difficulty finding employment?

4.14 How, and how much, are you paid? Cash/kind? Amount (Taka/kilograms of food):

4.15 Are you provided with meals by your employer while you are working? How many per day?

4.16 Answer 4.10-4.15 for other members of your household.

<table>
<thead>
<tr>
<th>Employer</th>
<th>Nature of contract</th>
<th>When unemployed</th>
<th>Payment</th>
<th>Amount</th>
</tr>
</thead>
</table>

- 11 -
5. Production, consumption and sales

5.1 How do you meet your household's food requirements?
Own production? Payment in kind? Cash purchases?
Exchange?

5.2 What food and fodder do you buy? (type and amount)

5.3 Where?

5.4 What is the cost of these purchases?
Per month/year:

5.5 What agricultural produce do you sell?

5.6 Where?

5.7 How much do you earn from these sales?
Per month/year:

5.8 What other commodities/services do you sell?

5.9 Where?

5.10 How much do you earn from these sales?
Per month/year:

5.11 What, and how much, agricultural produce do you use to meet rent payments? (sharecroppers)

5.12 What, and how much, agricultural produce do you use in paying your labourers? (employers)

5.13 In times of food deficit due to e.g. flood or drought, do you get assistance from any source?

5.14 Where from (government, employer...)?

5.15 What sort of assistance (food donations, loans, subsidies)?
6. Detailed inventory of possessions

6.1 Do you own the following:

House 2 (1 for living 1 for kitchen)
Cattle byre X
Threshing yard Not measurable
Boat (small)
Plough X
Bullock cart X
Bullocks X
Cattle X
Sheep X
Goats X
Poultry ducks
Buffaloes X
Pump set X
Stored fertiliser X
Stored seed X
Stored herbicide X
Stored pesticide X
Tractor X
Scooter X
Bicycle X
Radio X
Kerosene stove
Stored fuel
Stored food
Storage jars Not measurable
Storage baskets big
Threshing baskets X
Cooking pots
Beds
Chairs
Tables X
Bedding
Lamps
Clothes
Special sarees X
Jewellery X

6.2 How many rooms does your house have?

No room accommodation.
6.3 Of what material is your house constructed?

Bamboo, dirt, wood, Tin,

6.4 If you own no plough or draught animals, do you hire these in order to plough your fields?

16-200ft season for 1 plough.
QUESTIONNAIRE B
FLOODS AND FLOOD DAMAGE

1. Flood occurrence

1.1 Is this area annually inundated by floodwaters?
   Yes every year

1.2 How often do abnormal floods affect the village?
   Twice before liberation

1.3 Has your homestead ever been flooded?
   Yes

1.4 How often?
   Twice before liberation

1.5 In a normal flood, which of your fields is flooded?
   All the fields

1.6 In an abnormal flood, which of your fields is flooded?
   All the fields

1.7 In a normal flood, how high do the floodwaters rise?
   4-8 ft

1.8 In an abnormal flood, how high do the floodwaters rise?
   10-12 ft

1.9 In a normal flood, how long do the floodwaters remain on the land?
   5-6 months

1.10 In an abnormal flood, how long do the floodwaters remain on the land?
   2-3 weeks (then return to normal)

1.11 Is the abnormal flood duration long enough to kill crops?

1.12 When was the most severe flood of your experience?
   1942

1.13 Have you been told of worse floods by those who have lived here longer than yourself?
   No

1.14 Are you ever warned in any way of an imminent abnormal flood?
   No

1.15 Are you yourself able to predict an abnormal flood?
   Some

1.16 How would you rank flood relative to other hazards e.g. drought, pest...
   Flood is the most terrible then
2. Damage

2.1 In a normal flood, do you suffer damage to items in your homestead? And in an abnormal flood? List the item and severity of damage on the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Damage description</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal:</td>
<td>Bedding and clothes slightly damaged</td>
<td></td>
</tr>
<tr>
<td>Abnormal:</td>
<td>Homestead destroyed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All possessions lost</td>
<td></td>
</tr>
</tbody>
</table>

In normal flood  
- Veg, Plnt. damages
- Nothing

In abnormal flood  
- All household goods lost
- Lead us and fro
2.2 In a normal flood, which crops in which fields suffer damage? And in an abnormal flood? (Cultivators only)

<table>
<thead>
<tr>
<th>Crop and field</th>
<th>Damage description</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal:</td>
<td>Au in field A 5-10% yield lost</td>
<td></td>
</tr>
<tr>
<td>Abnormal:</td>
<td>Aman in fields A,B,C,Completely destroyed</td>
<td></td>
</tr>
</tbody>
</table>

In normal flood: Nothing

In abnormal flood: Completely destroyed.
2.3 In a normal flood, which work activities are curtailed, delayed or altogether prevented? And in an abnormal flood?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Normal:</th>
<th>Abnormal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road transport</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Aus harvest</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Aman transplant</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Boro/rabi sowing</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

In normal flood, communication problem needed to be solved. In abnormal flood, somewhat prevented from lending money to the villagers.
2.4 In a normal flood, are any of the inputs on your fields affected? And in an abnormal flood?  
(Cultivators only)

<table>
<thead>
<tr>
<th>Input and field</th>
<th>Damage description</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal: Fertiliser on field A</td>
<td>Slight loss</td>
<td>(See 3.3)</td>
</tr>
<tr>
<td>Abnormal flood: Fertiliser on fields A, B, C</td>
<td>Complete loss</td>
<td></td>
</tr>
</tbody>
</table>

In normal flood: Yes slight loss of labour cost.

In abnormal flood: Almost everything lost. Need to tend money and food.
2.5 In a normal flood, are any of your fields physically damaged? And in an abnormal flood?
(Landholders only)

<table>
<thead>
<tr>
<th>Field</th>
<th>Damage description</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal:</td>
<td>Slight sand deposition</td>
<td></td>
</tr>
<tr>
<td>Field A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal:</td>
<td>Severe erosion</td>
<td></td>
</tr>
<tr>
<td>Field B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In normal flood: Nothing

In abnormal flood: Severe sand deposition before the embankment
3. Flood response

3.1 Do you take any protective measures against the type of damage you have just described? What measures? No at all

3.2 Did you take any such measures in the past? What measures? Only to protect the homestead area. Respondent muddied his land with soil.

3.3 What measures would you take in response to the type of damage you have just described? No need. After the embankment.

List on the damage tables just compiled.

3.4 Do your responses in any way differ from those you previously adopted? How? Not do much.

3.5 What do you do to assist other villagers who have suffered flood damage? Not at all.

3.6 Have you ever had to seek assistance from other villagers after a flood? What type of assistance? Yes before the liberation. Lend money, food to some extent for shelter.

3.7 Does the government or any other outside body assist flood victims? In what way? No.

3.8 Do you welcome such assistance? Yes in the flood situation.

3.9 Does this assistance always meet your needs? No at all.

3.10 Has outside assistance increased over the years? No.
3.11 If you have another flood such as the worst you have ever experienced, will you be able to go on living in this village in your present occupation? **NO**

If yes, can you describe the measures you would take to re-establish yourself in the village?

If no, can you describe what measures you might take to establish yourself elsewhere?

In that case the respondent has to depend totally on fishing and Beck to live otherwise.

3.12 Do you see the likelihood of there ever being a flood so bad that it would force you to leave the village and/or change your occupation? **NO**

Can you describe the nature of such a flood?
4. Flood prevention/protection

4.1 Is this village protected by an embankment?
   (if yes, go to 4.2; if no, go to 4.9)
   
   Yes

4.2 How long has the embankment been there?
   7-8 years ago

4.3 Do you consider the embankment adequate protection against flooding?
   Yes cent percent

4.4 Has the embankment ever been breached?
   Some what it has been breached
   When? This year and last year
   With what result? Not yet

4.5 Did anyone explain to the villagers the nature and purpose of the embankment before its construction, and ask their opinion as to whether it should be constructed?
   No one, respondent can't remember exactly

4.6 Did you lose any land for the construction of the embankment?
   No
   If yes, were you adequately reimbursed?
   X

4.7 Has the embankment decreased your yields by e.g preventing silt deposition, interfering with irrigation and drainage?
   In what way? No

4.8 Has the embankment in any other way interfered with your livelihood?
   After the embankment water has become impure to some extent. It may contain dor bacteria and it 9 bites and creates some disease like diabetes
4.9 If there is no embankment, has anyone ever mentioned the possibility of an embankment being constructed to protect the village?

"Member chairman and neighbours mentioned its possibility."

4.10 Would you be in favour of such a proposal?

"Yes. Certainly."

Reasons: better fishing and better living.

4.11 Do you have any other remarks on an embankment's impact and effectiveness?

"The Embankment is the highest blessing for the villagers. Respondent is very happy with its positive role in the economic life."