Understanding Indigenous Knowledge: Its Role and Potential in Water Resource Management in Bangladesh

M. Chadwick[1], J. Soussan[1], D. Mallick[2] and S. Alam[2]

[1] ENVIRONMENT CENTRE, UNIVERSITY OF LEEDS

[2] BANGLADESH CENTRE FOR ADVANCED S'T'UDIES

CONTENTS

ABBREVIATIONS AND ACRONYMS

ASFA	**Aquatic Sciences and Fisheries Abstracts**
BARC	**Bangladesh Agricultural Research Council**
BBS	**Bangladesh Bureau of Statistics**
BCAS	**Bangladesh Centre for Advanced Studies**
BIDS'	**Bath Information and Data Services**
BIDS[2]	**Bangladesh Institute of Development Studies**
BRAC	**Bangladesh Rural Advancement Committee**
BWDB	**Bangladesh Water Development Board**
CABI	**Commonwealth Agricultural Bureau International**
CC	**Chowk Committees**
CPP	**Compartmentalisation Pilot Project**
CWMC	**Compartment Water Management Committees**
DFID	**Department For International Development**
EGISII	**Environment and GIS Support Project**
FAP	**Flood Action Plan**
FCDI	**Flood Control, Drainage and Irrigation**
FPCO	**Flood Plan Coordination Organisation**
FUG	**Forest User Group**
GOB	**Government of Bangladesh**
GPP	**Guidelines on People's Participation**
IK	**Indigenous Knowledge**
IPM	**Integrated Pest Management**
ISPAN	**Irrigation Support Project for Asia and the Near**
ITK	**Indigenous Technical Knowledge**
KS	**Knowledge Systems**
MPO	**Master Plan Organisation**
MWR	**Ministry of Water Resources**
NGO	**Non-Government Organisation**
O&M	**Operation and Maintenance**
PRA	**Participatory Rural Appraisal**
RNRRS	**Renewable Natural Resources Strategy**
RPK	**Rural People's Knowledge**
SCWMC	**Sub-Compartment Water Management**
SPARRSO	**Space Research and Remote Sensing Organisation**
SRP	**Systems Rehabilitation Project**
SWC	**Soil and Water Conservation**

SWC	**Soil and Water Conservation**
UNCED	**United Nations Conference on Environment and Development**
UNDP	**United Nations Development Programme**
WUG	**Water User Group**
WRI	**World Resources Institute**

ACKNOWLEDGEMENTS

The authors would like to give special thanks to the:

• Bath Information and Data Services (BIDS) for use of their ISI database;

• Commonwealth Agricultural Bureau International (CABI) for use of their CABI database;

• Royal Tropical Institute for the use of their TROPAG/RURAL database; and •

Cambridge Scientific Abstracts for the use of their ASFA database.

EXECUTIVE SUMMARY

1. This review forms part of the Department For International Development's (DFID) Renewable Natural Resources Research Strategy (RNRRS) research project, "Sustainable Local Water Management Strategies in Bangladesh - Meeting Needs and Resolving Conflicts" (ZE0034), fiulded as part of the High Potential Systems programme. It forms one of three components of the project development work, providing a synthesis of previous work in relation to the socio-economic trends and the growth of participation in the water sector in Bangladesh.

2. The review attempts to focus on indigenous knowledge used in natural resources, particularly water resources management, within the wider context of livelihood systems. Water resources management uses and functions are many, and include fisheries, navigation, domestic water uses (health, hygiene and sanitation) as well as those for agriculture (principally irrigation and soil and water conservation).

3. Through the review it is hoped to:

• outline and place indigenous knowledge within the wider context of livelihood systems;

identify locally developed and adapted technologies (indigenous technical knowledge) for potential implementation in the field; and

• by comparative analysis, identify the institutional and policy settings best suited to implementation of an integrated, and sustainable, water resources management strategy which makes best use of the indigenous knowledge at its disposal.

4. In the quest for better living conditions and greater economic gains for some countries or simply in an attempt to meet the increasing demands for food and industrial production of a rapidly expanding population for others, consumption of natural resources has increased markedly in the last 25 years. In agriculture, through the use of Green Revolution technologies such as agrochemicals, hybrid varieties, irrigation and on-farm mechanisation we have expanded our food production many times over and, at a global level, consistently managed to increase food production at a faster rate than population growth. However, the costs of such unfettered growth are now becoming increasingly clear and many now question such approaches to resource management. The reality of such technological innovations has given rise to disturbing issues of sustainability, and the negative social and environmental impacts of high external input agriculture and state of the art fishing and forestry are now apparent.

5. Many including policy makers, development planners and the public at large have become increasingly aware of the important role that traditional knowledge of the indigenous people's can play in the promotion of sustainable development (Davies and Ebbe, 1993). They feel we have much to learn from those who have managed to survive and adapt to local ecological conditions and see this knowledge as the

basis for identifying ecologically sustainable, and more equitable options of resource use (Richards, 1985; Johnson, 1992, Chambers et al, 1989, Scoones and Thompson, 1994).

6. Knowledge systems (KS) are "a set of actors, networks or organisations which are expected to work synergically to support knowledge processes that improve the correspondence between knowledge and environment, and/or the control, provided through technology use, in a given domain of human activity"

7. There are a great many definitions of knowledge and indigenous knowledge, all of which are invariably characterised by the discipline of the author. Common, and fundamental, to all of these definitions is the fact that the knowledge an individual acquires is based on how they perceive and interpret reality in response to a given situation at a specific point in time. However, this fact and that relating to the simplifications inherent in the labeling of rural people's knowledge presents problems. Which individuals knowledge should be put first? Should farmers' knowledge come before that of fisherfolk? Are male or female knowledge of most value? Is the knowledge of the rich more valuable than that of the poor? Should greater credence be given to the knowledge of the old than that of the young? Since knowledge is socially and politically constructed, it requires a socially differentiated, politically astute analysis to comprehend (Scoones and Thompson, 1994).

8. The original focus of ITK research was on local people's knowledge and abilities in agricultural production (Richards 1985). In recent years, this perspective has been expanded to consider indigenous knowledge as *cultural* knowledge producing and reproducing mutual understanding and identity among the members of the farming community, where local technical knowledge, skills and capacities are inextricably linked to non-technical ones (i.e. cultural, ecological and sociological factors (Moock and Rhoades, 1992). As a consequence `ITK' has become part of "rural peoples' knowledge" (RPK). This shift has involved the development and/or modification of methodologies for examining and supporting local knowledge, with parallel changes occurring in professional attitudes and behaviour towards local people's capacities, practices and values (Scoones and Thompson, 1994). The resultant stream of research has led to the development of a multitude of terms such as local knowledge, traditional knowledge, indigenous knowledge, community knowledge, resource users' knowledge, rural people's knowledge and farmers' knowledge which are frequently used interchangeably. Common to all terms is that they denote knowledge developed and held at grass roots level or by rural people.

9. With the exception of soil and water conservation, the water management sector, and these `other uses' in particular, have attracted far less attention in relation to ITK than the forestry and agriculture sectors; perhaps a reflection of the far greater attention paid to these sectors in local-level development initiatives and approaches to participatory development.

10. Chowdhury's research (1996) represents one of the most extensive pieces of work on ITK in Bangladesh, and covers the fields of general agricultural production, irrigation, livestock, soil and moisture conservation, wild catch fishing and fish farming.

11. IK is structured by the systems of classification and management that govern resource use, and fuelled by observation, experimentation and innovation of these community members (Fernandez, 1994). Moreover, it is accessible to, and developed within the framework of, those members of society who are responsible for that aspect of resource management and production, and as such, IK is by its very nature gender sensitive (Warren, 1989). In Bangladesh as is the case elsewhere women are traditionally the "water providers" and domestic water managers. As such they have developed a wide range of indigenous strategies to obtain, purify and preserve water, and to use it frugally. This water is used for a wide range of homestead activities including drinking water for the family and for livestock, water for cooking and cleaning, water for homestead vegetable plots and water for sanitation.

12. In the management of any resource, there is a high degree of interaction between the nature and structure of local institutions and the workable technical management of the resource. Development of strategies for optimum technical management, therefore, are not only dependent on the physical potential and limitations of the resource, but on the existence, form and strength of social organisation controlling access. As a consequence, analyses of the functions, relationships and influence of national and local institutions on the form of resource management are crucial if we are to develop equitable and sustainable strategies of integrated water resources management.

13. Any form of rural research involves encounters between individuals and groups representing different interests and supported by different resources. Typically, these interacting parties will be differentiated in terms of relations of power. Analysis of social interfaces needs to reveal the dynamic and emergent nature of the interactions taking place and to show how the objectives, perceptions and priorities and relationships of the various actors and their networks are influenced and reshaped as a result of the encounter. Analysis also needs to explore how these interactions affect and are affected by individual perceptions, institutional alliances, local and external market conditions, national and international policies and other forces which lie beyond the interface situation itself (Soussan, 1998). Past attempts at the participatory development process have tended lack the analytical depth required of them. Moreover, they have invariably tried to impose externally defined models of organisation with little thought to existing social structures and institutions.

14. Looking at the approaches to the incorporation of IK and peoples' participation in general of large-sale water sector projects reveals a number of important lessons in terms of appropriate means of institutionalising IK and, the importance of such a process in the development of integrated water resource management strategies.

15. In Bangladesh such processes in the past have generally failed because they have failed to adequately account for the fact that rural Bangladesh is characterised by civil institutions which do not adequately represent all stakeholders. They have lso tended to be far to simplistic viewing agriculture as the only use of water and therefore farmers as the only water users

16. A further key failing is the fact that so many projects fail to ensure an effective process of participation in the initial stages of sub-project design and planning, the point where participation is at its most crucial. However, one must question whether, with all the will in the world these institutional arrangements are capable of adequately addressing the complexity of the multiple demands the diverse range of stakeholders place on the system. Inevitably there is going to be conflict over decisions, there will always be some winner and some losers. Such systems of local participation and management need to develop means to resolve such conflicts. The participation process needs to be integrated, some would argue grounded in, the wider framework of local agencies and civil society. Already existing institutions, both formal and informal, exist and have been resolving such roblems for many years. Would they be better placed to resolve these? Do they do so in an equitable manner or do they, as some claim is the case of the Project's participatory institutions, invariably benefit the rich? Furthermore, does the system have any mechanism where it can identify and build in indigenous knowledge of water management which could be properly assessed and avoid immediately looking to a western engineering `solution'?

17. The shortcomings in projects do not reflect an unwillingness or inability of their local populations to be involved in the management of water resources and structures to control them. Project evaluation surveys show a high level of desire to be consulted in the management of BWDB structures (Soussan and Datta, 1998). They also show a long and well-developed tradition of water resources management in rural areas of Bangladesh; a tradition which involves both sophisticated systems of collective action, locally developed technical knowledge and systems of payment.

18. Existing government organisations appear limited in their ability to conduct systems-based participatory development. At an institutional level, inflexible management can often generate misleading favourable feedback based on centrally determined criteria. Government field agencies with deadlines on financial years, often concentrate on physical construction to meet targets. Their hierarchical character and the elitist attitudes of many officials make them remote and inaccessible to most sections of the population, and in particular to the poor, who are also socially and politically marginal.

19. Experience has shown us that for organisations and projects to facilitate participation requires that their own procedures, style and culture be participatory. The changes required in organisations are reversals, from top-down and imposed system with their associated targets and supervision to bottom up articulation of needs, and local operation and management. This, we would argue is vital: IK and the processes that operate upon it are not static. Such characteristics are crucial in a sector where the dynamics of water management are changing at a frenetic pace. For many farmers today, the main issue is not excess surface water

in the wet season; it is increasingly the sustainability of access to surface and groundwater supplies in the dry. These dynamics of changing human-water resources issues are locally specific and need to be reflected in the development of policies and interventions in water resources management. We would argue that the only effective way to achieve this is to utilise the knowledge and flexibility of local institutions. If this can be achieved, then there is indeed an opportunity to channel the directions of change into ones which are both developmental and sustainable.

CHAPTER 1: INTRODUCTION

1.1 Background

This review forms part of the Department For International Development's (DFID) Renewable Natural Resources Research Strategy (RNRRS) research project, "Sustainable Local Water Management Strategies in Bangladesh - Meeting Needs and Resolving Conflicts" (ZE0034), funded as part of the High Potential Systems programme. It forms one of three components of the project development work, providing a synthesis of previous work in the field of indigenous technical knowledge with specific attention paid to indigenous water resource management.

A considerable body of work and associated literature relating to indigenous technical knowledge already exists. The literature covers a broad range of resources, including forest management (Messerschmidt, 1986; 1987; Appleton and Hill, 1994;), agronomy and agricultural research (Chambers *et al,* 1989, Richards 1985, Scoones and Thompson, 1994) soils (Dvorak, 1988; Tabor, 1993; Chadwick and Seeley, 1996), and soil and water conservation (Kerr and Sanghi, 1992; Critchley *et al,* 1994; Reij *et al,* 1996). The literature also covers indigenous institutions and organisations (Messerschmidt, 1984; Price, 1995), indigenous knowledge and gender (Fernandez, 1994; Shah and Shah, 1994) and indigenous experimentation (Abedin and Haque, 1989), as well reviews of indigenous knowledge systems as a whole (Brokensha *et al* 1980, Hausler *et al* 1995; Warren *et* al, 1995).

This review attempts to focus on indigenous knowledge used in natural resources, particularly water resources management, within the wider context of livelihood systems. Water resources management uses and functions are many, and include fisheries, navigation, domestic water uses (health, hygiene and sanitation) as well as those for agriculture (principally irrigation and soil and water conservation). With the exception of soil and water conservation, the water management sector, and these `other uses' in particular, have attracted far less attention in relation to ITK than the forestry and agriculture sectors; perhaps a reflection of the far greater attention paid to these sectors in local-level development initiatives and approaches to participatory development.

This paper primarily, but not exclusively, focuses on literature relating to developing countries in Asia, with particular attention paid to practices in Bangladesh.

Through the review it is hoped to:

- outline and place indigenous knowledge within the wider context of livelihood systems;

- identify locally developed and adapted technologies (indigenous technical knowledge) for potential implementation in the field; and

- by comparative analysis, identify the institutional and policy settings best suited to implementation of an integrated, and sustainable, water resources management strategy which makes best use of the indigenous knowledge at its disposal.

CHAPTER 2: KNOWLEDGE, ENVIRONMENT AND HUMAN BEHAVIOUR

2.1. Introduction

In the quest for better living conditions and greater economic gains for some countries or simply in an attempt to meet the increasing demands for food and industrial production of a rapidly expanding population for others, consumption of natural resources has increased markedly in the last 25 years. In the face of these economic and demographic conditions we have developed technologies that enable us to intensify production and expand our resource base into new areas. In agriculture, through the use of Green Revolution technologies such as agrochemicals, hybrid varieties, irrigation and on-farm mechanisation we have expanded our food production many times over and, at a global level, consistently managed to increase food production at a faster rate than population growth. In the fisheries sector, through the application of sonar we are now able to pinpoint fish resources whilst developments in refrigeration mean we are now able to fish further afield for longer. In forestry, mechanisation has resulted in us harvesting vast areas in relatively little time and plantation technologies have produced increases in the rates of biomass production. However, the costs of such unfettered growth are now becoming increasingly clear and many now question such approaches to resource management. The reality of such technological innovations has given rise to disturbing issues of sustainability, and the negative social and environmental impacts of high external input agriculture and state of the art fishing and forestry are now apparent.

Equally clear is the fact that such developments have failed to focus the benefits in the hands of those most at need. Capital intensive approaches to production have tended to marginalise the resource poor, and sustainable agriculture, fishing and forestry have become the focus for current investigation. As part of achieving this, many feel we have much to learn from those who have managed to survive and adapt to local ecological conditions and see this knowledge as the basis for identifying ecologically sustainable, and more equitable options of resource use (Richards, 1985; Johnson, 1992, Chambers et al, 1989, Scoones and Thompson, 1994). To others they represent a relatively cheap source of ideas and knowledge which have considerable scope for commercial exploitation, whilst for the more altruistic of use, there is the belief that only through gaining a proper understanding of the technical, social and environmental aspects of indigenous knowledge can the form, degree and direction of planned change most appropriate for the client be assessed. Over the last decade, policy makers, development planners and the public at large have become increasingly aware of the important role that traditional knowledge of the indigenous people's can play in the promotion of sustainable development (Davies and Ebbe, 1993).

The significance of such a pool of knowledge for sustainable development was recognised as far back as 1987 in the Brundtland Commission Report, *Our Common Future* (1987). The role of indigenous knowledge was similarly acknowledged at the Earth Summit in Rio de Janeiro in 1992, and is incorporated in the Agenda 21

documents of the United Nations and the International Convention on Biodiversity. Both reports emphasised the need to use directly the environmental expertise of local people in managing natural resources. They stressed the sustainable management of natural resources could only be achieved by developing a science based on the priorities of local people and creating a technological base that blends both traditional and modern approaches to solving problems (Johnson, 1992).

The World Bank was the first multilateral development agency to establish a special policy for indigenous peoples in internationally funded development projects, a policy that dates back to the early 1980s (Davis and Ebbe, 1993). The emergence of international and national indigenous resource centres such as CIRAN, CIKARD, REPPIKA, PHIRCSDIK, LEAD, CTK, ARCIK, KENRIK and VERSIK is also an expression of the importance placed on indigenous knowledge in development. Yet despite such interest and debate over the relative importance and role indigenous knowledge, the term is still contested and proves somewhat difficult to define.

2.2 Knowledge Systems, Indigenous Knowledge and Indigenous Technical Knowledge

Roling and Seegers (1991), describe knowledge systems (KS) are "a set of actors, networks or organisations which are expected to work synergically to support knowledge processes that improve the correspondence between knowledge and environment, and/or the control, provided through technology use, in a given domain of human activity". Several features distinguish indigenous systems from western scientific knowledge systems. Warren *et al* (1995) see indigenous knowledge as local knowledge that is unique to a given culture or society and contrasts with the western scientific knowledge, or as they prefer to call it the "international knowledge system" *which is* generated through a global network of universities and research institutes. For others (Guba, 1990, Scoones and Thompson, 1994), it is the systems epistemology: its own basis of validity, methods and its scope, that is all important. As a consequence, there have been numerous critiques (Guba, 1990; Sayer, 1992; Scoones and Thompson, 1994) highlighting the failings of western scientific epistemologies. Scoones and Thompson (1994) strove to undermine what they term the positivist view of investigation that sees knowledge as a tangible stock or store to be tapped, extracted and documented (an argument that seems somewhat ironic given the fact they go on to document varies RPK case studies).

There are a great many definitions of knowledge and indigenous knowledge, all of which are invariably characterised by the discipline of the author. Box (1993) suggests knowledge refers to the categorisations that individuals make to understand the reality and meanings attached to their experiences. These categorisations are usually shared, or socially available, but it is ultimately at the level of the individual that knowledge occurs. Similarly Brouwers (1993) defines knowledge as an interaction between the subject and the way reality is perceived or reconstructed. He views it as the result of active reconstruction of reality through `sense making' activities. These are activities whereby people identify shared objectives, develop theories and learn.

Van der Bleik and van Veldhuizen (1993) give perhaps the most comprehensive definition with IK referring to: "ideas, experiences, practices and information that has been generated locally, or is generated elsewhere but has been transformed by local people and incorporated into the local way of life. Indigenous knowledge incorporates local technologies but also cultural, social and economic aspects." However, this is not a view held by all. Kapiyo (1991) argued IK refers to the knowledge, skills and techniques that belong naturally to particular people and have evolved through their efforts i.e. those practices conceived and generated by original inhabitants of the place for the purpose of solving real-life problems. Awori (1991) goes even further and argues for differentiation between indigenous and traditional knowledge, where indigenous knowledge is an original form of knowledge which cultures have evolved out of the sheer need to survive. However, how "original" is to be defined is uncertain and highlights the difficulty in answering questions relating to whether external knowledge can become indigenous and, if so, when?

Knowledge, Indigenous Knowledge and Knowledge System Definitions

Knowledge refers to thee categorisations that individuals make to understand the reality and meanings attached to their experiences (Box; I 9 9 3)

K n o w l e d g e is the interaction between the subject, and the way reality i s perceived or reconstructed. (Brouwersy 1993)

Indigenous knowledge is local knowledge - knowledge that is unique to a given culture and society. (Warren,et. al, 1995)

Indigenous knowledge is a dynamic and ever-changing accumulation of the collective experience of generations. (Reijntes et al , 1992)

Indigenous knowledge is the:complex, traditional beliefs and practices generated by indigenous people in relatian to natural resource management, agriculture and human; and animal health care. Chowdhury, 1996)

Indigenous knowledge represents .accumulated experiences and in of the past (Wang, 1988)

Indigenous knowledge refers to the knowledge, skills and techniques that belong naturally t o particular people and have evolved through their efforts (Kaptya, 1991)

Indigenous knowledge is.an original form of knowledge which cultures have evolved out of the sheer need to survive (Awori, 1991)

Knowledge systems are sets of actors, networks or organisations which. are expected to work synergically to support knowledge processes that improve the correspondence between knowledge and environment, and/or the control; provided through technology use, in a given domain of human activity. (Roling and Seegers, 1991) .

Berkes (1992) raises exactly this question by pointing out that the use of the term traditional is ambiguous and goes on to raise questions regarding the cultural dynamics of such knowledge systems. In the dictionary `traditional' usually refers to cultural continuity transmitted in the form of social attitudes, beliefs, principles and conventions of behaviour and practice derived from historical experience. However, societies change through time, constantly adapting new practices and technologies, making it difficult to define just how much and what kind of change would affect the labeling of a practice as `traditional'. For this reason many prefer the term IK. Yet, similar problems are apparent in relation to the term IK in that similar knowledge is found among non-indigenous groups. These groups have also acquired their knowledge and skills through hands-on experience living in close contact with their environment.

One problem is that many studies have concentrated on the knowledge systems of isolated, often minority, communities who have retained the essence of knowledge systems, and the cosmologies associated with them, which have been little influenced by external contacts (Johnson, 1992). Whilst interesting and valid in their own right, the vast majority of people in the Developing World, and certainly everyone living in rural Bangladesh, live in societies which have a long history of external contacts and which have and are ever-changing. In such societies, knowledge never is and should not be approached as unchanging: it is difficult, and probably counter-productive, to try to separate the "traditional" or the "indigenous" from the outside. Knowledge systems, and the language and other media through which they are expressed, are dynamic and evolutionary entities which will be negated if they are somehow fossilised at any given time.

The original focus attention for many was on indigenous *technical* knowledge (ITK), an emphasis many (Thrupp, 1987; Scoones and Thompson, 1994; Morin-Labatut and Akhtar, 1994) saw as indicative of a rather narrow interpretation of local people's knowledge and abilities. This is undoubtedly true, indigenous knowledge is far more that merely what **is** reflected in technical methods, and entails many insights, perceptions and intuitions relating to the environment. Many of these are frequently founded on interpretations of lunar or solar cycles, astrology, and meteorology. However, this must not detract from the fact that such material is, and has been shown to be, of great value.

Common, and. fundamental, to all of these definitions is the fact that the knowledge an individual acquires is based on how they perceive and interpret reality in response to a given situation at a specific point in time. However, this fact and that relating to the simplifications inherent in the labeling of rural people's knowledge presents problems. Which individuals knowledge should be put first? Should farmers' knowledge come before that of fisherfolk? Are male or female knowledge of most value? Is the knowledge of the rich more valuable than that of the poor? Should greater credence be given to the knowledge of the old than that of the young? Since knowledge is socially and politically constructed, it requires a socially differentiated, politically astute analysis to comprehend (Scoones and Thompson, 1994).

2. 3. The Nature of Indigenous Knowledge - The Consensus and Debate

Despite the aforementioned problems, the consensus and debate in relation to IK has moved on greatly during the past two decades. Since Paul Richards first groundbreaking works, the interactions of actors and the institutional setting within which such information is placed has been analysed, scrutinised and debated from every possible angle. For reasons outlined above, the original focus of the populists was on ITK, with attention concentrating on local people's knowledge and abilities in agricultural production (Richards 1985). In recent years, this perspective has been expanded to consider indigenous knowledge as *cultural* knowledge producing and reproducing mutual understanding and identity among the members of the farming community, where local technical knowledge, skills and capacities are inextricably linked to non-technical ones (i.e. cultural, ecological and sociological factors (Moock and Rhoades, 1992). As a consequence `ITK' has become part of "rural peoples' knowledge" (RPK). This shift has involved the development and/or modification of methodologies for examining and supporting local knowledge, with parallel changes occurring in professional attitudes and behaviour towards local people's capacities, practices and values (Scoones and Thompson, 1994). The resultant stream of research has led to the development of a multitude of terms such as local knowledge, traditional knowledge, indigenous knowledge, community knowledge, resource users' knowledge, rural people's knowledge and farmers' knowledge which are frequently used interchangeably.

The "correctness" of such interchange is beyond the scope of this report and one which many view as unnecessary. Common to all terms is that they denote knowledge developed and held at grass roots level or by rural people. The days when the debate whether IK is misguided, unscientific and wrong are gone: rather the discourse and over the last half a decade or so the debate has centred on the ability and means by which information from different epistemologies can contribute together to produce sustainable management strategies. Chambers (1992) stated that there was much overlap between `popular' and scientific knowledge. Fairhead (1993) also felt that "farmers' knowledge is more empirical and dynamic than he imagined". Others however, (Scoones and Thompson, 1994) are less convinced by the similarities. In what represents an excellent critique of the debate surrounding IK, they point out that attempts to bend or integrate local knowledge into existing scientific behaviour incorrectly assumes that IK represents an easily definable stock of knowledge which can be easily extracted and incorporated into proposed management plans and procedures. Attempts to remove IK from the web of meaning and influence in which it arose and attempt to fit it into the constrictive framework of western scientific rationality are likely to lead to significant errors in interpretation, assimilation and application. They go on to make the point that IK, like scientific knowledge, is always manifold, discontinuous and dispersed, not singular, cohesive and systemised. It is never fully unified or integrated in terms of a logical system of classification or categorisation. Whilst there are plenty of examples which suggest the later half of the statement is something of a generalisation, what is clear is that the interplay between the knowledge of different individuals and institutions means a multidimensional analysis of rural livelihoods is essential if we are to maximise livelihood resource strategies.

2.4. Knowledge Development and Livelihood Systems

Like IK, Livelihood Systems, Secure Livelihoods, and Sustainable Livelihoods are jargon phrases in vogue in development. "Livelihoods" are used as an integrating concept but ones that are rarely defined. However, general definitions are important, so for the purposes of this study the term livelihood system is used to describe: how people attempt to secure adequate stocks and flows of assets or goods (food, products and capital) given the existing environmental conditions, to meet their basic needs

This they try to achieve through secure ownership of, or securing access to, resources (material such as private land and other property and common property resources, and social such social and political contacts) and income earning activities, including reserves and assets *(Figure 2.4a)*. Food security, that is access to enough food at all times for an active healthy life[2] (World Bank, 1996) is but one component in determining how and why people take decisions, spread risk and allocate resources in order to subsist both in the long and short-term. Contrary to the often-cited `hierarchy of basic needs' (Handy, 1.985) in which food needs must be satisfied in preference to all others, food-insecure households in fact juggle between a range of requirements, including immediate consumption and future capacity to produce. The achievement of food security is but one sub-set of objectives and the need for food one of a range of variables which determine why the poor take decisions and spread risk, and how they balance competing interests in order to subsist both in the short and longer term (Davies, 1996). As Frankenberger and Goldstein (1990) state, "the dilemma facing small-farm households... involves a trade-off between immediate subsistence and long-term sustainability". A livelihood system is said to be "sustainable" when it can cope with, and recover from, stresses and shocks, enhance or at least maintain its capabilities and assets and provide net benefits now and in the future, whilst not undermining the resource (human, natural and social) base.

It is within the context of this people-environment interaction that IK is shaped. The environment consists of complex conditions shaped by factors such as the physical and biological environment (altitude, temperature, soil, soil fertility and soil erosion, slope, season, flooding, drought etc), economic conditions such as market prices, operating costs, cost of production inputs, and socio-cultural conditions such as wishes and demands of formal and informal institutions, and cultural norms. In response to these conditions the stakeholder undertakes actions. These actions in the case of farmers include decisions relating to cropping patterns, allocation of labour resources, cultivation practices, seed purchase and product use or sale. In the case of fisherfolk it relates to decisions such as where to fish and when, equipment purchases, and marketing strategies. In the process of interaction between stakeholder and the environment the stakeholder develops a cognitive view of their environment. During

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1 This definition is an adaptation of the definition of a livelihood provided by the Advisory Panel on Food Security, Agriculture, Forestry and the Environment (Food 1000, 1987).

2 This definition has frequently been modified to emphasize different aspects of having enough to eat. Maxwell and Smith (19921 cited in Davies (1996) identified 32 such variations.

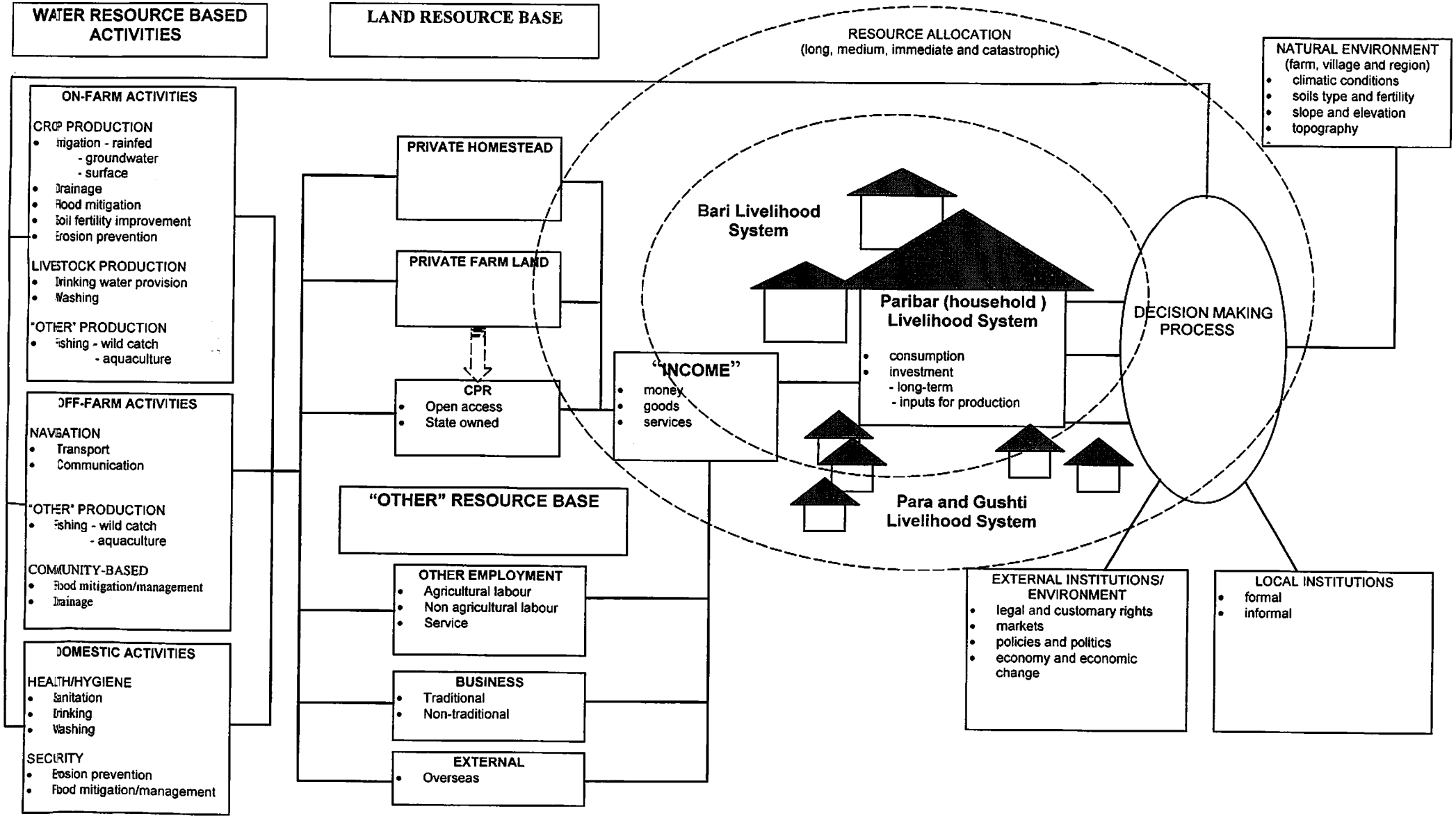

Figure 1: Model of Rural People's Livelihood System for Bangladesh

this process of cognition, they undertake complex and interlinked stages of sensing, perceiving, remembering, supposition, questioning, imagining, and judging, culminating in processes of testing and evaluation (*Figure 2.4b*).

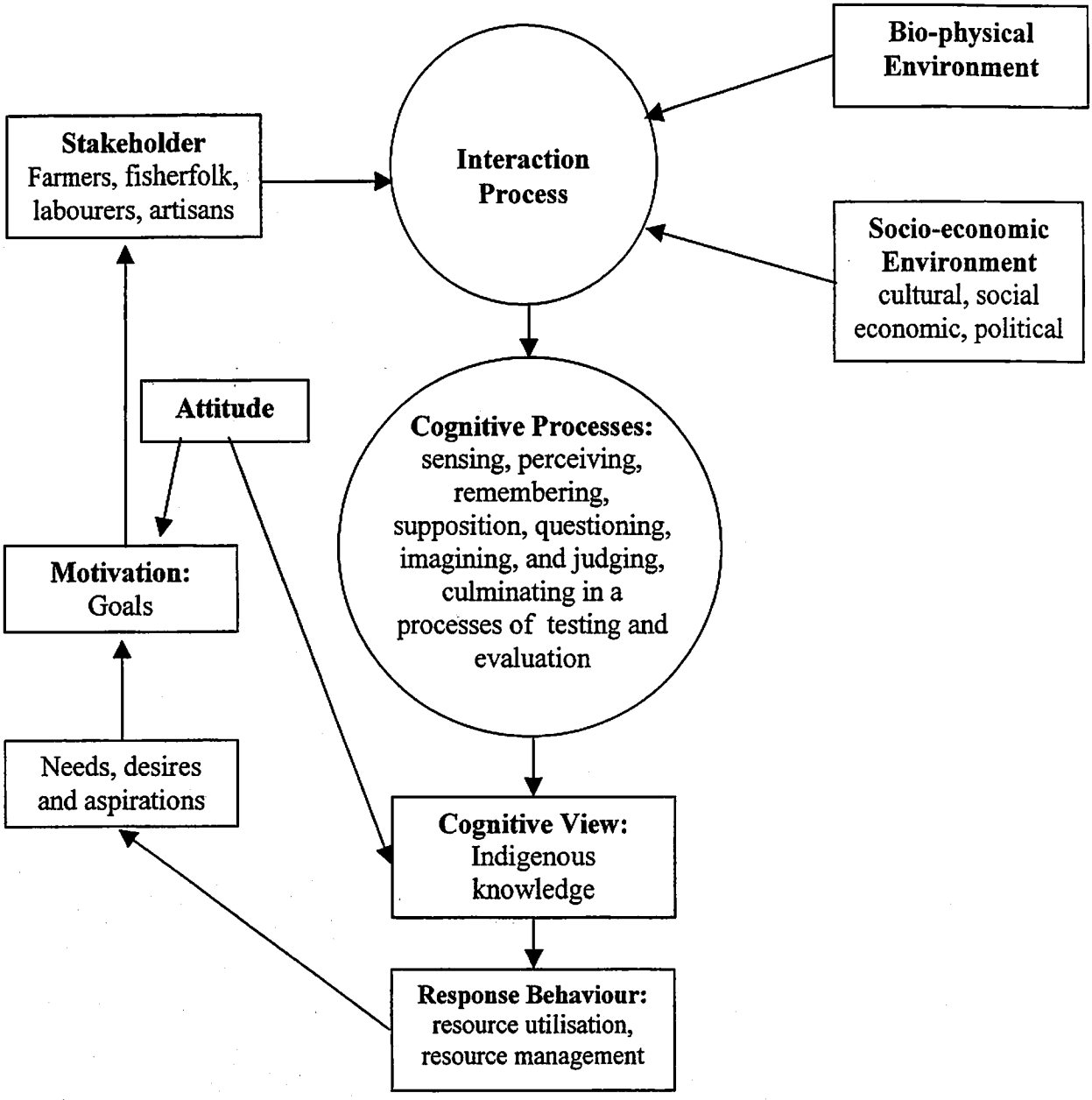

Figure 2.4b: Model of Knowledge Development (adapted from Lawas, 1997)

The stakeholder also has needs, wants and aspirations. Such motivations also influence their decision making processes and the resultant views and actions undertaken. This process is not static but dynamic, evolving and being modified as changes in the stakeholders' environment and cognitive process occur. Lawas (1997) refers to this a cyclical process, which may be an oversimplification, rather it is a process that is continuous, dynamic and multiple.

The response behaviour of the stakeholder is assumed to me induced by their motivation. Responses of the stakeholder depend in part in their cognitive view of their environment, that is, their behaviour is a consequence of the reflection of their view of the environment.

2.5. Gender and Generation Aspects to Indigenous Knowledge

IK is structured by the systems of classification and management that govern resource use, and are fuelled by observation, experimentation and innovation of these community members (Fernandez, 1994). Moreover, it is accessible to, and developed within the framework of, those members of society who are responsible for that aspect of resource management and production, and as such, IK is by its very nature gender sensitive (Warren, 1989). Gender differentiation comes about as a result of the specific experiences, knowledge and skills which women and men develop as they carry out the responsibilities assigned to them (Feldstein and Poats, 1988). In addition, the kinds of relationships which exists between these two sets of innovators affect hierarchies of access, use and control, resulting in different perceptions and priorities for the innovation and use of technology by women and men (Appleton, 1993). The degree of gender specificity attached to the IK depends not only on the way responsibilities are allocated but also on the degree of flexibility men and women (particularly women) have to carry out the work. Whilst such differences are clear, as Fairhead (1992) points out, it should not be assumed that knowledge is limited to areas within people have a role to play.

In many countries, particularly Muslim countries such as Bangladesh where *purdah is* prevalent the gender-based division of labour leads to the majority of women having a major role in attending to the daily needs of the household. Agenda 21 (1992), developed out of the United Nations Conference on Environment and Development (UNCED), discusses the concerns of women and their relationship to the environment in Chapter 24. However, it gives no clear recommendations concerning either indigenous women or women's indigenous or local knowledge systems. Whilst Chapter 26 recognises the role of indigenous communities in relation to the environment, there are few references to women and those that do exist are and even these are generally in the form of an addition to a more general recommendation. One article proposes that international development agencies, financial bodies, the UN system, and national governments incorporate indigenous peoples' values, views and knowledge (including women's unique contributions) into programmes and policies which affect them (Section 26.5). Despite such criticisms, Chapter 26 does acknowledge indigenous peoples' long tradition of holistic scientific knowledge of the environment and natural resources, and suggests that this may serve as a basis for action, although provides no concrete recommendations as to how these bodies might proceed. As a consequence of the gender analysis in relation to IK the role of age in relation IK or more usually erosion and loss of indigenous knowledge has begun to attract increased attention. IK about the management and potential use of resources is in danger of being lost when it is no longer seen as useful and when large scale out migration leaves fewer members of the younger generation in rural areas. As knowledge is generally passed on orally from one generation to the next, information can easily be lost from within a community within two or three generations.

CHAPTER 3: INDIGENOUS KNOWLEDGE OF WATER RESOURCES MANAGEMENT

3.1. Indigenous Knowledge of Resources within the Context of the Farming Systems

This Chapter comprises three sections. The first reviews IK literature in relation to the farming system. The Chapter then goes on to review the literature relating to the freshwater ecosystem and is dominated by the livelihood activity of fish production. Finally, the section concerns IK linked to domestic life. Within the context of rural life in Bangladesh this tends be refer to IK of women.

3.1.1. General Agricultural Production

Some of the earliest work undertaken on IK in Bangladesh was that produced by the Bangladesh Agricultural Research Council BARC (1982) published the first and only extensive review of the various agricultural tools and appliances that are now used in different parts of the country. The work provides a detailed descriptions of each implement and includes details including its local name, size, mode of operation, usage weight and dimensions, and material of construction. The work was the result of the recognition of the rapid nature of change within the agricultural sector, and as such represents an important source of information on tools whose day to day use is under decline.

Hossain et al (1987), showed that farmers in Bangladesh, as is the case elsewhere, are constantly experimenting with new cropping patterns. Their research, based over a six year period showed that the area of land allocated to local and modern paddy varieties in the three rice growing seasons varied greatly from year to year in the light of farmers experiences of yields, quality and resistance to pests and as they adjust to variable weather conditions during the year. The work concluded that there was a consensus amongst farmers at the time, that on irrigated two crops as opposed to the potential three crops was more desirable.

In Asia, the majority of IK identified unsurprisingly relates to the growth of paddy. Prashna (1996) In India cactus powder is frequently used to cure drying disease in paddy. The seeds and pieces of dried cactus are ground into a fine powder which is then put on hot coals and the smoke passed over the paddy field.

Hossain and Alam (1993), reported that farmers in Kasirshimla, Mymensingh district, Bangladesh have developed several indigenous methods of pest control. The powdered seeds of petard (Amoora rohutika) are reported to be an effective insecticide.

Chowdhury (1996) represents one of the most extensive pieces of work on ITK in Bangladesh. on a nation-wide study he reported a vast array of indigenous pest control methods. In several areas farmers are known to insert bamboo sticks or branches in rice fields to attract birds and thus reduce the number of insects. In Raj shahi tobacco leaf and neem extract and smoking hookah's water are spread on the

rice fields as an insect repellent. A similar practice was recorded in use in Lahnonirhat, north-west Bangladesh, where powdered tobacco leaf is spread early in the morning, so as to utilise the benefits of the morning dew over the moist leaves of the rice. Farmers from Sunamganj, north-east Bangladesh use a different practice. Rope made from paddy straw is soaked in kerosene and dragged over the paddy several times. The odour of kerosene is said to repel insects.

Other practices include the application of liquid cowdung to the stem of seedlings and saplings of different fruit trees has been recorded in Nepal, Bangladesh and India (Lohar,1952; Peties,1986; Chowdhury,1996).

Many different innovative methods have developed as attempts to increase levels of seed germination. One of the most common is the soaking of the seed in water for 24 hours and then keeping them inside straw bails, or alternatively cowdung manure pits, in bags (AIS, 1994a). Hot water is then poured over the gunny bags. A practice cited by Islam (1996) as being used to test germination rates of seeds is to split the outer layer of banana plants (longitudinally) and then to place the seeds of cereals and pulses inside. The seeds should germinate within 24 hours.

A number of practices exist to improve the physico-chemical composition of the soil In Rajasthan, India, many of the tanks used for irrigation become dry. Large quantities of silt and organic matter collected during the water's journey are deposited in and accumulate in these tanks. Farmers collect this enriched soil and broadcast it on their fields to improve soil structure and organic content, improve soil fertility and to reduce salinity. Kashem *et* al (1996) noted a similar practice in Bangladesh when they observed farmers extracting mud from the bottom of ponds to enrich the fertility and water retaining capabilities of the soil.

One of the most bizarre pieces of indigenous knowledge is the application of the water used when cleaning fish to beans and cucurbit plant bases, which apparently increases yields (Islam, 1996).

Indigenous mechanical practices are also reported. Additional laddering of local aus and also wheat is done when the seedlings are between two to three week old, just after the top dressing. Farmers' say this leads to profuse tillering and results in yield increases (Chowdhury *et al,* 1996).

3.1.2. Irrigated Agricultural Production

Irrigation has been practiced in some parts of the world for several thousands of years. Rice has been grown in India and the Far East for nearly 5000 years (Stem, 1979). Basin agriculture in the form of paddies dominates agriculture in Bangladesh, both in the wet and the dry seasons. Today the lifting of water from surface water bodies using traditional methods serves arV ever declining area of land and tends to be an activity used by the poorest in society. Such methods also tend to be man-powered systems. There are three main indigenous instruments for raising water. The *Seuni* or. Basket, it is a scoop operated by two to four persons who swing it on ¯ropes j~ *t i i t s* four corners. Water can be raised approximately five metres by this means About nine litres is raised each time, equivalent to approximately eight cubic metres an hour. The *L a t a* or *Dhenkli* are used to raise water from shallow wells. They

operate via a bamboo pole operating on a fulcrum at the end of which another smaller bamboo is tied, which has a can to the lower end. The bigger bamboo has a weighted lower end, so that when it is raised and left free the can is dipped in the water and raised. The technology displays marked similarities to that of the *Shadouf* found throughout the Middle East. In the drier areas of Northern Region, *Dhenklis* may be made to raise water as much as five metres.

Stern (1979) provides details of the Archimedian Screw, a device still common use in India and Egypt for low lifts of up to approximately 1.3 metres. Limited to areas that have fairly consistent water levels, the system has been shown to be one of the more efficient water lifting devices in terms of output for energy input. Stem provides one of the most detailed works on small-scale irrigation and, whilst written from a n j engineering perspective, still provides a wealth of information on indigenous practices.

3.1.3. Soil and Moisture Conservation

Indigenous soil and conservation practices (SWC) have, relative to other forms of IK, gained considerable attention (Chambers *et al,* 1983; Critchley *et al,* 1994; Ayers, 1995; Reij *et al,* 1996). This is in part due to the failure of many modern SWC facilities, either as a result of poor design, poor construction or poor operation and maintenance (or some combination of all three). The majority of this work has been undertaken on Sub Saharan Africa. Reij *et al* (1996) provides arguably the most detailed investigation of the various biological and mechanical methods, providing detailed outlines of a wide range of locally developed or adapted technologies. However, many of the techniques described have their Asian and Latin American equivalents (Kerr and Singh, 1992; Sanghi et al, 1994; Ferroukhi and Chokkakula, 1997). Kerr and Singh (1992) provide a review of indigenous SWC in India's semi-and tropics. The research, which was based on a field survey of indigenous soil and water conservation programmes in the four 4 states of India's semi and tropics, has several implications for SWC programme officials, policy makers and research workers. They point out that SWC programmes should minimise expenditures that farmers would be willing to make on their own, and provide a means to increase SWC investment in a cost effective manner. Profitability is highlighted as the major constraint to adoption, and advocate the development of cheaper technologies

Ferroukhi and Chokkakula (1997), explored IK of water harvesting and artificial recharge in northern India. Here, the most important strategy by with the Maldharis, the local people have traditionally managed to safeguard their livelihood has been through rainwater harvesting. The techniques they have developed, which harvest the sporadic floodwater, ensure that their drinking needs are fulfilled even during water scarce years when no rain at all falls. Their extensive knowledge of water harvesting as well as of the local ecosystem and of the complex water harvesting system they subsequently developed, is based on hundreds of years of experience and is deeply embedded in their culture. Though the area is flat, some depressions, known locally as tanks or jells, of various sizes exist and act as storage areas for flood water. The water lasts several months before drying up. The local nomads discovered that after infiltration the freshwater is trapped in the ground and stored at shallow depths in a layer `floating' above denser salty groundwater. In these zones they have for centuries dug shallow wells called *`virda'* reaching down as far as the freshwater. Each virda is used until the water begins to get salty at which point the *virda* is filled

with grasses and silt from the next virda and left to replenish. Other methods include the development of a series of tanks sunk parallel with the slope. These progressively fill during the rainy season with each feeding to one larger deeper tank.

A number of interesting SWC techniques emerged from the research undertaken in Bangladesh by Chowdhury *et al* (1996) and Islam (1996). For example, during prolonged drought farmers in Raj shahi, Bangladesh, have been observed pulling a rope across the rice field early in the morning as a means of capturing the dew that accumulates on the leaves during the night. A similar practice that can be observed is the brushing of wheat fields, before head emergence early in the morning. This returns the morning dew to the soil. The cultivation of drought resistant varieties such *as Kata begun,* a local variety of brinjal with numerous spines on its leaves, stem and fruit is often grown in drought prone areas as a reserve food source. The species is also said to be highly pest resistant.

The making of a thin slurry from cowdung that is then sprinkled over drought affected paddy so as to increase the water retention properties of the soil is also common practice. In the field of local Aus rice, at an early stage, the use of a hand hoe followed by laddering is undertaken. This process thins out unwanted seedlings and weeds, and aids mulching.

The Bangladesh Agricultural Information Service produces a quarterly journal (Agriculture Information) which frequently has articles regarding indigenous knowledge. For example, the journal reported methods for planting seeds during dry periods (AIS, 1994a). After seeding in the normal way the method prescribes ploughing the land lightly and then laddering the upper portion. This process is said to put seeds in contact with free soil with high moisture levels than that they have already extracted moisture from. Another article (AIS, 1994b) provided information on an adapted transplanting process to be used during dry periods. Five days before the plantation of plants the seedlings should be lifted and placed in bundles. The roots should then be trimmed back slightly and the bundles placed in ponds, out of direct sunlight but exposed to the air. Water should be sprayed over the bundles if the weather is very hot and sunny. Four to five days later the growth of new roots should be visible and the plants should be sown in the field. Fertiliser should be added approximately two weeks later.

The AIS publications also attempt to provide information on local methodologies associated with crops grown on homestead vegetable plots. *Chichinga,* a green vegetable rather like spinach is often attacked by greenfly. Whilst pesticide is frequently used, their use means that the leaf should not be picked for two weeks after spraying. An alternative approach is to hang the peduncle of a ripe jackfruit (ripe and soft) from the protective shade latticework.

3.1.4. Livestock

A further area of keen research interest relates to the IK of livestock production, the majority of which realities to animal health (Chambers *et al,* 1983; Vivekanadan, 1996; Chowdhury *et al,* 1996). Vivekanadan (1996) reported a range of local practices for curing foot and mouth. Banana fruits soaked in castor oil overnight and then fed to the animal is a commonly reported practice. Water that has had dried fish soaking in it is poured over the hooves of infected animals.

During the puddling of fields draught animals are occasionally injured. A number of different techniques are reported from India including the practice of feeding field crabs with grass. In Bangladesh ointment made from *motihari* tobacco and *pathar chun* is applied to the wound and bandaged (Chowdhury *et al,* 1996; Islam, 1996).

3.2. Indigenous Knowledge within the Context of Freshwater Ecosystems

3.2.1. Wild Catch Fishing

Bangladesh has traditionally been rich in fish stocks. The Padma, Brahmaputra and Jamuna and their numerous tributaries have provided a plentiful supply of freshwater fish, supplemented by fish collected from other inland water bodies such as oxbow lakes and lowland areas, known as *heels,* flooded during the monsoon. The inland fisheries system is estimated to contribute almost 73 percent of total production and supplies 80 percent of the country's animal protein requirements (Rahman, 1989). Fisheries is predominantly small-scale in character, and whilst little recent data are available, it is estimated that in 1975 a total of 95 percent of production came from small-scale producers using simple technologies employed by fisherfolk and producers from rural communities (Platteau, 1989).

The modernisation of agriculture using the `green revolution' technologies (improved seeds, fertiliser and mechanised irrigation) has not generally been beneficial to local fish production. The irrigation-based growth of food-grain production has led to the reclaiming of floodplains, while rapid increase in the use of chemical fertilisers and pesticides for the control of weeds, crop pests and diseases poses a serious threat to the availability of wild fish. There has also been overexploitation of the country's fisheries resources. Environmental degradation has been hastened by deepening rural poverty, which has increased the pressure on the aquatic ecosystem. Overfishing has depleted the natural fish resources in the rivers, lakes and ponds. The use of small mesh nylon fishing nets reduces the numbers of small and immature fish left in the water (Lewis *et al,* 1996). Natural fish stocks have reportedly also decreased due to increasing river siltation. Population pressure has reduced the quantities of land left for village ponds. Increased population pressure has also reduced the number of fish available. However, increased exploitation of aquatic resources is also the result of poor management practices by the states in the region. The construction and continued debacle over water dammed by the Farraka barrage has interfered with migrating fish. The system of leasing fishing rights to beels has been reduced in Bangladesh from five to one year, leading to overfishing and the neglect of the long-term viability of such waterbodies, which represent essential common resources for rural communities. Matters have been made worse in recent years by the appearance of ulcerative fish disease (Paul, 1991). It is particularly worrying that the ulcerative disease primarily threatens the wild fish species, such as *Shoal* and *Gojar, (as* opposed to the cultured carps) upon which the rural poor depend heavily for protein.

Lightfoot *et al* (1992) provide an overall perspective of rice-fish research and development in Asia is given through a country analysis and highlights of research. Existing and potential rice-fish areas, and rice-fish system characteristics and their performance in several Asian countries including Bangladesh. The research findings give detailed information on production systems, indigenous knowledge, effects on

rice yield and pesticide management. Country analysis shows that rice-fish systems presently occupy only a very small percentage of the potential area. The wide array of systems that exist can be broadly characterised by field design, growing period and fish species. Three types of field design are common: trench within the ricefield, pond or sump within or adjacent to the ricefield, and deepwater ricefield. Research on productions systems reveals that while most systems are for growout operations, ricefields are also suitable for nursery operations. Research has also found that modest increases of 10 to 20 percent are to be expected in rice yields when fish are cultured in ricefields. While overuse of pesticides has limited fish culture in ricefields, research findings indicate that proper application, selection of chemicals and integrated pest management (IPM) strategies can overcome this constraint.

As part of their work, Tsai and Ali (1997) provided a valuable overview of the indigenous fishing technologies utilised in Bangladesh. People use every conceivable type of fishing gear including hands, spears, traps and nets. Many of these are technologies originally provided by one of the many fisheries projects that were initiated in the 1980s and have since been adapted by the local population. The work also provides an insight into some of the management strategies associated with the various water bodies used by the rural population. The study found a total of 51 types of fishing gear in operation over the survey period. The type of fishing gear changes with the seasons, according to flood conditions, target species and size of fish. This includes 11 types of trap which display a bewildering variety of shapes, sizes and modes of operation. The *polo* for example is a bell shaped trap with an open bottom and a small opening at the top. This type of trap is used throughout Bangladesh during the dry season from December through to May. The trap is pressed into the mud in shallow water. The *charai* by comparison is a rectangular box like trap. The trap has a door extending from the base of the front to the apex at the back. At the top there is an opening for the removal of fish. The trap is set at the surface under floating vegetation. Often snail meat is placed inside as bait. A fishermen may operate about 100 traps which are set in the evening and checked in the morning.

Islam (1996), reports the use of tubes made from bamboo, date palm, palmyra palm or betel nut trunk which are placed in ponds, canals and rivers. After a few days, the ends are covered and the logs raised and fish inside removed. Hossain and Alain (1993) found that the aquatic weed get is tied in a bunch and then hung from a rope into water as a means of catching freshwater shrimp in Naogaon, Bangladesh.

Harvesting crabs from the bunds of rice fields is one of several food production systems practiced by resource-poor people in rice-based farming systems in south India. Rajasekaran and Whiteford (1993) conclude that the local population possess an in-depth knowledge of the crabs and their ecology, and that there are socio-cultural factors that influence the catching and consumption of crabs. They also highlight the important contribution crabs make to the protein intake of resource-poor households.

Jansen *et al* (1989) provide an in depth analysis of the country boat sector, including descriptions of the myriad of boats types that exist in Bangladesh. Much of the variation in boat type is dictated by operational purpose and logistical needs. The work also provides a brief insight in the methods, and techniques of country boat

construction. However, unfortwiately the work does not provide details of the small crafts used and all kinds of fishing vessel.

3.2.2. AquacuIture

Various efforts are needed to check further declines in the productivity of inland fisheries, stemming from over fishing, environmental pollution, and poorly designed flood control, irrigation and drainage and infrastructure development projects. Unstable development of shrimp production can be increased for the development of smal0cale aquaculture among rural communities and at the household level (WRI, 1999 .

Aquaculture is the controlled production, propagation and rearing of aquatic organisms of economic importance in a controlled environment such as ponds, channels and enclosures, using a higher density of cultured aquatic organisms than is normally found in nature (Ameen, 1987). Aquaculture is not a practice new to rural Bangladesh. Village ponds have been used for rearing fish for generations, although production has/and remains extensive rather than intensive.

IK extends into many spheres of aquaculture. T l e may be placed in two broad categories: production and trade. Production knowledge relates to the best locations, times and means of wild hatchling collection or to techniques of hatchling production such as correct temperature and most suitable feed. Trade tends to refer to the movement and sales of eggs, fry and fingerlings via a network (formal and informal) of fish traders and merchants.

A random sample survey of ponds was carried out in the months of February and March 1982 in rural areas of all the districts (except Chittagong Hill Tracts) excluding reserved forest and tea gardens by the Bangladesh Bureau of Statistics (1984). The total number of ponds was estimated to be 1.86 million of three 18.4 percent were derelict, i.e., completely out of use. The number of non-derelict ponds was estimated to be 1.54 million, with a standard error of 2.2 percent. The average area of a derelict pond was 0.17 acres. The ponds accounted for nearly 40 percent of the total inland fish catch. Major carp accounted for about 60 percent of the total catch and live fish (Koi, Singi, Magur etc.) for about 25 erce (the non-n__ erennig ponds wer"sed mainly for fishing and nearly 70 percent f e owners of ponds not being used for st` / fishing reportedly lack of finance as thcs~son for non-use. Only about 2 percent the non-perennial ponds were cultivated during the dry months. Practically all the ponds were owned privately either singly (47 percent) or jointly (BBS, 1994).

Islam's work (1996 which involved extensive research into farmer' ITK in Dinajpur district also inclu e,2omment on a number of fishing practices. Many farmers were found to add *kura,* the red powdery coating of rice under the husk to their ponds.Others food sources include cowdung, poultry waste, *chokar* (the remains of wheat grains obtained after the extraction of *aata* and oil cake. The addition of banana leaves to ponds stocked with grasscarp was also recorded. Chowdhury *et al* (1996) observed that farmers in Lalmonirhat, north-west Bangladesh, frequently grind up the intestines of livestock and feed it to fish. In Joydebpur, termites are a frequently cited problem by farmers. Women and children collect up the mounds which are then thrown into fish ponds. Carp, particularly Ruhi, Katla and Thai saputi appear particularly fond of termite eggs.

The application of lime to ponds and pagars to clear unclean water is also common A large proportion of farmers were also found to add fragments of banana plants (pseudostems) into the pond to clear algal growth on the water surface.

In many areas fish are dried, salted or fermented as a means of preservation (Hossairt:: and Alam, 1993).

Lewis *et al* (1996) provides possibly the most extensive research to date on the state of aquaculture in Bangladesh. They conclude that not all III **is** useful any more than all outsider knowledge could be said to be harmful. There are gaps in all knowledge systems and local sets of practices. Access to reliable sources of pond management knowledge **is** proving to be a problem for many farmers, who may rely on questionable folklore beliefs about aquaculture and upon information from self interested sources such as fry traders,:

Whilst aquaculture is still generally an extensive practice undertaken by farmers as an additional means of livelihood security, the incorporation of markets into wider patterns of supply and demand are now generating, in relatively small numbers at present, a new type of commercial fish producer interested in the economic possibilities of intensive pond fish production, The producers are also challenging existing cultural norms of labour task specificity, and many are seeking to harvest their ponds themselves. Such approaches pose a threat in terms of the potential loss of the local system of fish culture, with practices and technologies that have evolved over many generations. These types of skills, informed by local knowledge, and based upon sets of local beliefs and practices, are somewhat undervalued and often dismissed by outsiders (Hobart, 1993).

Cage culture is a relatively modern development in aquaculture, and one that has changed the long established, fish farming structures and, pushed forward fisheries development in China. Cage culture is typically characterised by intensive farming, running-water culture, high yield and great efficiency. It is generally accepted that cage culture will actively play an increasingly important role in international aquaculture (Hu, 1994).

3.3. Indigenous Knowledge within the Context of the Household

As water providers and domestic water managers, women have traditionally developed a wide range of strategies to obtain, purify and preserve water, and to use it frugally. This water is used for a wide range of homestead activities including drinking water for the family and for livestock, water for cooking and cleaning, water for homestead vegetable plots and water for sanitation.

3.3.1. Domestic tasks

In India, village irrigation tanks are intended primarily to provide water for paddy cultivation, but are also used as a major source of water for drinking, bathing, washing clothes and other sanitary and hygienic purposes. There is also evidence of spatial separation of collection points based on use. In Sri Lanka, Ullawishewa (1994) also reported such practices with decision-making on collection points based on: the depth of water (deeper parts of the tank tending to be calmer and clear), access

to sunshine (to kill germs and "purify the water", the distance to the other site points (as far away as possible), the existence of aquatic plants around the points (a thick cover of plants on the open water makes the water calm and also prevents the restricts the influx of sediment from other points, and, the presence of *Terminalia arjuna (Kumbuk)* trees near the water (the tree is believed to have de-salinising properties). Furthermore, in order to filter and purify the water entering the well from the springs, wood from the same tree was burnt and deposited between the walls and the logs, so that the springs feeding the well have to pass through the charcoal burnt wood. Often burnt wood and burnt coconut shells were added to the bottom of the well; the former to reduce salinity, while the latter apparently cleared the water. In Bangladesh, during heavy flooding when people are forced to drink unclean water the population use alum *(Fitkiri),* a coagulant to clear the water (ISPAN, 1995). Ullawishewa also reports that wastewater generated by the washing and bathing, which takes place around the well, was diverted, and therefore recycled to the vegetable gardens, which the women maintained. Other forms of water recycling are also documented. During the rainy season water from the tin roofs, often containing extracts after coming in contact with leaves, makes the courtyard slippery. To prevent this, women tie half longitudinal sections of *Borack* bamboo along the margin of the roof and a cement jar used to collect the runoff water, which is then used for washing purposes (Chowdhury, 1996).

3.3.2. **Homestead agriculture**

Another homestead practice observed being used by women as a means of pest control in vegetables is the mixing of ash with kerosene that is then spread over vegetables infected with aphids. on homestead plots women also often hang banana leaf threads over brinjal to prevent bird attack. A common practice in many countries is to use local chickens to hatch the eggs of improved exotic varieties. (Chowdhury *et al,* 1996) reported that snails are collected from fields, the shells are cracked and the met fed to young ducklings, with the meat acts as a protein concentrate.

Women were also aware that water taken from the tanks and wells was often contaminated with bacteria, silt and floating solid particles. As a result they practiced a number of traditional methods to purify water. For example, they filtered it at the water point with a filtering cloth. Often the inside of the pots were rubbed with the seeds *Stryclinos potatorum (ingini),* which helped to clear the water, and had no poisonous or toxic effect. Boiling destroyed any microorganisms in the water, and boiled water was given to the children, the old and the sick (Ullawishewa, 1994).

The German aid agency, GTS, sponsored research into traditional methods of water purification early in the 1980s. The work highlighted the array of different indigenous methodologies that develop in different environments. For example, various plant powders, seeds, algae and even fish scales are used in various parts of the world as coagulants to remove suspended material from drinking water.

Gabunada *et al* (1992) reported detailed indigenous health practices in the Philippines, detailing the methods of preparation and administration. Internal parasites were expelled using *ampalaya* leaf extract mixed with coconut milk. Raw sugar mixed with water was also used for this purpose. Infestation by external parasites such as screw worms are prevented through the use of a applying a petroleum-based mixture

that includes either scorched deer horn, burned tobacco or *Callicarpa candidans* leaves.

In Bangladesh, Chowdhury *et al* reported a number of local medicinal practices. The use of lime ($CaC0_3$) soaked in water overnight and one teaspoon of the clear water is fed to children to deworm them. The liquid extract from the lower white portion of the tender leaves of the pineapple and the juice of young shoots *of Chlorodendrum viscosum* (Vat pata), mixed with turmeric juice are also common deworming medicines. In the rainy season there are frequently foot and hand problems (scabs and fungal infections) associated with being in water for long periods of time. Scabs frequently form between the toes and fingers. To cure this local cultivars of Amra *(Spondias pinnata)* are cooked in the oven until the pulp is soft. This is used as an ointment and is applied for three to five days.

On the homestead plots a number of horticultural practices are common. Ash is a frequently used by-product of daily life. Many women use it as a source of fertiliser in their vegetable plots, and as already mentioned as a constituent of indigenous pesticides.

The cutting of narrow incisions in the stem of papaya *(Carica papaya)* and also betel nut *(Areca catechu)* plants is said to result in better fruiting. The incisions are made at a height a few feet from the plant base. The practice is said to prevent fruit dropping.

3.3.3. Flood and soil erosion awareness, preparedness and adjustment

The unpredictability of river encroachment is devastating for households settled in vulnerable area (Hossain, 1993). Population displacement due to erosion is endemic throughout Bangladesh. It is estimated that about one million people are directly affected every year by riverbank erosion (Elahi, 1991). Population displacement due to erosion is endemic throughout Bangladesh.

Perception and awareness of bank erosion play a profound role in the preparedness and adjustment behaviour of people living in high risk areas. In the absence of government interventions, the inhabitants of erosion-prone areas have continued to adapt their own indigenous strategies to cope with bank erosion. However, the major finding of the work was that many, frustrated by continuous land loss, and their helplessness in preventing it, has led them to diversify into income generating activities than are not land intensive.

Haque (1991) also investigated indigenous adjustment strategies to riverbank erosion hazard in Bangladesh. The study concluded that inhabitants of the floodplains were reluctant to take measures to control or intervene directly. Instead their responses tended to be characterised by loss reduction strategies through investment in movable assets and loss share through the maintenance of social ties and group coherence. Haque (1991) argued that Bangladesh and the water sector would better serve the population by directing resources towards the reinforcement of prevailing readjustment strategies.

A BRAC report, prepared in 1989 went some way to highlighting the flood awareness and local coping strategies developed by the rural population. Many people are

known to prepare clay stoves *(chula)* in the month of Chaitra to be used during the flood. The raising of the floors of animals' stalls is also common practice. House construction is also influenced by the susceptibility to flood.
Much effort has gone into research into the lives of char dwellers, farmers who inherited their land from their ancestors. Chars are islands made up of sediment deposit often over a kilometre in length. The may remain in the river channel less than a year or may last several decades. Char-dwellers know the recurrent events of flood and erosion better than most. As a result they have built up a stock of local knowledge that they use to adapt to events and mitigate against their negative effects. Schmuck-Widmann (1996) studied the char dwellers in Tangail district. Her research revealed a number of phenomena that are used to aid them in flood forecasting. Clouds drifting south - north with accompanying strong during the period mid July to mid September then water levels are said to rise greatly in a short time. This rudimentary flood warning phenomena is also described in the BRAC report on the 1988 flood (BRAC, 1989). Talawar and Singh (1992) observed a whole range of indigenous meteorological practices being used in Karnataka, India. Further signs cited are strong heat and "thunderstorms in the Bay of Bengal", body pains and joint aches, strong temperatures and fever. Others reported changes in the colour of the river, whilst cold air and thunder to the East are signs of the flood retreating. Such comments generally expected in the middle of June.

Mamun (1996) evaluated the awareness and preparedness of households vulnerable to the effects of river-bank erosion. Most of the area, Hisla thana in Barisal district, is covered in the west by the Meghna-Ganges floodplain. The research suggests that two predominant views regarding the causes of river bank erosion exist: the first group perceives erosion as being caused by currents in the river; others consider erosion and removal of their farm land as an act of God. The views of the first group equate with their generally higher level of education, which allows them to look more rationally at their environment when compared with the fatalistic approach of the second group. The study, suggests that the perception of erosion, and adjustment measures aimed at coping with the threat of riverbank erosion, appear to be related not only with the householders personal experience, and environmental setting, but also to a great extent on aspects of resource control (land ownership) or social entitlement (occupation) to resources.

CHAPTER 4: POLICIES, INSTITUTIONS AND WATER MANAGEMENT

4.1. Introduction

In Bangladesh, the dynamics of change in water resources management in rural areas are many and varied. There are huge differences in the patterns of use of these resources in different parts of the country, with regional differences such as those between the *haor* areas in the north-east, the patterns along the main Jamuna-Ganges floodplain, those of coastal areas and so on meaning that the basic needs and resource opportunities of these regions are fundamentally different. Similarly, at the local scale, there can be great variation within each of these regions and even, at the village level, between different groups within the same community. This diversity is a determining feature of life, with both the problems people face and potential answers to these problems reflecting a complex pattern of people-resource inter-relationships.

In the management of any resource, there is a high degree of interaction between the nature and structure of local institutions and the workable technical management of the resource. Development of strategies for optimum technical management, therefore, are not only dependent on the physical potential and limitations of the resource, but on the existence, form and strength of social organisation controlling access. This Chapter analyses the functions, relationships and influence of national and local institutions on the form of resource management.

Institutional analysis of participatory approaches requires a detailed analysis of the roles of different actors and the linkages and divisions between them (Scoones and Thompson, 1994). The superficial notion of "participation" espoused by many does not reveal the socio-political complexity of settings where farmers interact with fisherfolk, business entrepreneurs and the like. These social interfaces, according to Long (1992), are critical points of interaction between different social and knowledge systems, where competition over resources and conflicts over social and political agendas are most likely to be found.

Any form of rural research involves encounters between individuals and groups representing different interests and supported by different resources. Typically, these interacting parties will be differentiated in terms of relations of power. Analysis of social interfaces needs to reveal the dynamic and emergent nature of the interactions taking place and to show how the objectives, perceptions and priorities and relationships of the various actors and their networks are influenced and reshaped as a result of the encounter. Analysis also needs to explore how these interactions affect and are affected by individual perceptions, institutional alliances, local and external market conditions, national and international policies and other forces which lie beyond the interface situation itself (Soussan, 1998). This is not a rebuttal of the participatory development process, but in the past such processes have frequently lacked the analytical depth required of them. In particular, many have tried to impose externally defined models of organisation with little thought to existing social structures and institutions.

This Chapter looks at the approaches to the incorporation of IK and peoples' participation in general of large-sale water sector projects. It then attempts to outline the lessons learnt in terms of appropriate means of institutionalising IK and at the importance of such a process in the development of integrated water resource management strategies.

4.2. Indigenous Knowledge and Local Participation in Large-scale Water Management Projects.

4.2.1. Systems Rehabilitation Project, Bangladesh

The Systems Rehabilitation Project (SRP) came about as a result of an assessment of Water Development Board (BWDB) schemes by the United Nations Development Programme (UNDP). The assessment showed that approximately 200 of the existing flood control schemes were in need of rehabilitation. The assessment was wholly on physical rehabilitation but the subsequent development of the project proposals led to the addition of separate project components to improve operation and maintenance (0&M). Another theme that developed was to improve the procedures and practices of the BWDB and, as a result of the increasing criticism of infrastructural projects by the voluntary sector, the need for increased farmer participation through on-farm development works. These latter activities were marginal at first, but by the time the project was in its later stages the development of a process of participation in the operation and maintenance of the rehabilitated water control structures has become one of its central objectives. As time went on it became increasingly clear to project designers and managers that they need to better address the question of sustainability of the improvements being made.

SRP, followed the earlier examples set by other BWDB projects, particularly irrigation schemes and established Water User Groups (WUGs), which comprised farmers only organised around hydrological units. In doing so it also cast itself from the same mould as other sector projects and FAP studies of the time.

At the time the programme began, the GOB'S draft Guidelines on People's Participation (GPP) were in the final stages of preparation and these were taken as a reference point. This was both natural and sensible, the sector has spent some time in consultation with the government in the process of GPP development and it would have made little sense or been practical to develop a independent approach. However, as several reviews have now established (Soussan, 1996; BCAS, 1997; Soussan and Datta, 1998, MWR, 1998) there were a number of inherent flaws in the GPPs. The GPP prescribe an organisational structure based on those of *the* BWDB, which works on the assumption that water use and management are discrete units separated from other aspects of rural peoples livelihood systems. The approach sees the appropriate spatial structure for organising community participation solely as a hydrological one rather than a also needs to contain a social reference.

A further failing is the fact that rural Bangladesh is characterised by civil institutions which fail to adequately represent all stakeholders. As Soussan and Datta state, there is no long tradition of accountable state organisations which have a clear mandate understood by the rural population. Moreover, two key concepts of GPP, that is

water users (exclusively farmers) and integrated water management (surface water for crop production) are simplistic and inadequate, and do not reflect the realities of rural life. They exclude key groups of stakeholders (such as fishermen, landless and boatmen) and key aspects of water resource management (such as groundwater utilisation, domestic water supply, fishing resources and navigation).

These_ failings, plus those relating to lack of clear delineation of the BWDB tasks, no clear mandate of authority or legal status made the GPPs a poor model to follow. The process became a target-driven, paper exercise which had few redeemable features, a fact brought into focus by the project's recent review (Soussan and Datta, 1998). Their livelihood survey contained questions about the respondents' knowledge of the WUGs and other organisations developed by SRP in their area, about the extent to which they had been consulted in any way on operation and maintenance of the water control infrastructure and about whether they would like to be consulted. The results show an almost total ignorance of these issues, with few respondents having any knowledge of the WUOs and even less believing themselves to be involved. Only 16 percent of all respondents had heard of the WUG/Os and only 4 percent thought that they were members. The review also found no examples within SRP of fully functioning, effective WUOs which have taken over responsibility for the functioning of the systems.

SRP like so many projects following BWDB approach failed to ensure an effective process of participation in the initial stages of sub-project design and planning, the point where participation is at its most crucial. The participation process needs to be integrated, some would argue grounded in, the wider framework of local agencies and civil society. SRP is far from unique in this, in fact it appears to be a characteristic common to the majority of water sector projects.

4.2.2. Compartmentalisation Pilot Project (CPP), Bangladesh

Immediately after the 1988 flood, several studies were carried out by the international community to, as it was put at the time, "find a lasting solution to the flood problem". In June 1989, the World Bank agreed with the GoB to coordinate the various flood control measures, and related activities. The Compartmentalisation Pilot Project (CPP), was one of them, and was formally commissioned in 1991. The concept behind the project was to enclose an area behind the right bank of the Jamuna River and divide this up into compartments. Embankments surround a compartment with gated openings mainly at the upstream side through which the inflow and outflow of the flood water can be controlled. Inside the compartment a system of channels and khals have the function of transporting the water. Natural ridges, roads and paths subdivide the compartment into hydrological units known as sub-compartments. Regulators and minor structures in these roads and paths control the distribution over these sub-compartments. The aim was to develop, in consultation with the local population and institutions, an integrated management system accommodating the water requirements of various sectors such as agriculture, fisheries and human habitation. In an attempt to `gain people's participation, CPP identified four different

[3] The CPP project has, as part of an interim review, recently undertaken an assessment of its entire community participation programme. This has resulted in a number of changes in the structure and mode of operation of its participatory programme. This paper reviews their programme PRIOR to those changes.

interest groups in the rural area; farmers, fishermen, landless and women. To identify people's needs and opinions a needs assessment survey using a multidisciplinary team of professionals including an engineer, agriculturist, environmentalist, sociologist and fisheries specialist was undertaken. However, a review of project in 1992 highlighted a number of limitations in the needs assessment process. This included time limitations of key staff, insufficient time for the multidisciplinary team to undertake the work and questions relating to the suitability of RRA methodologies for data collection.

Despite such limitations it is generally felt that the outputs from the needs assessment exercise, in the form of a number of interventions (needs assessment intervention or NAI matrix) for developing the water management system of the compartment.

During the next stage a number of consultation process meetings of the different interest groups were organised to discuss the findings of the NAI matrix. This second phase is of crucial importance. A review of people's perceptions and people's participation unfortunately suggests that despite several views being voiced at such meetings the items added to the NAI matrix tended to serve the interests of certain groups (namely the rich and power-holders). The review also argues that whilst ordinary villagers were present during the early stages of consultation this declined at the latter stages, and at the combined final stage local influential participants were found to have dominated the consultation meeting and their perceptions tended to be reflected in the outcome. The review also complains that at the consultation meetings the CPP officials did not present their technical plans of proposed interventions in an unbiased way or outline the potential impacts that may result (SGK and Unnayan Shamannay, 1997). Finally, the report draws attention to the fact that participants asked for certain actions to be undertaken such as the movement of the main regulator further north but the request was ignored. There may be practical reasons that make such action impossible and it should be acknowledges that such comments are the result of a rapid appraisal rather than full evaluation as was the case with SRP, they are of concern and can, in part, be substantiated by other sources. The Re-formulation survey (1995) points out that people do not distinguish between different aspects of water resource management and do not regard flooding impacts as the only or even the main water resource problem they face. Water shortages in the dry season and low rainfall monsoons, water quality and availability or non-farming uses, ground water utilisation, drainage and other issues have all been identified in the needs assessment and other project studies as equal to or more important than flood control. This is particularly true for socially and marginal groups such as landless, women and fishermen. The results of this did not appear to play any role in directing the implementation of the project. What this does show is the importance and necessity for full and equal participation during the design stage.

The institutionalisation of the project is based on a three-tier organisation for representation and management of water in the compartment.. This comprises: Water User Groups (WUGs), or *Chowk* Committees (CCs), made up by a functionally and socially-economically defined category of people (farmers, fishermen, women and landless), Sub-Compartmental Water Management Committees (SCWMCs), made up of representatives of the WUGs selected government and non-government agencies and Union Parishad members, and Compartmental Water Management Committee (CWMC), comprising of representatives from SCWMCs, technical departments,

NGOs and government. According to SGK and Unnayan Shamannay (1997) the CCs exist for facilitating the participation of farmers only. CCs are the lowest tier of community water management. Their report was critical of both the composition and operation of the CCs. The groups tend to be dominated by rich farmers rather than expressing a balance of the socio-economic range of households in the area. Only 33 percent of villagers knew who their committee members were and more than half did not know how these people had been selected as their representatives.

Many of the problems identified in CPP parallel those in the SRP. Many have questioned the will or desires of the structures initiated by projects to undertake water management at a local level in an equitable appropriate manner. Certainly it appears to fail to take proper account of the wishes of stakeholders, particularly those in marginal groups. As Soussan (1998) points out in the evaluation of SRP, rarely is the diversity reflected in external interventions. As part of the evaluation of the SRP, Soussan states that the project like many other large development projects apply uniform systems of intervention design, implementation and management to regardless of local conditions. The predominant model, on which SRP, and most other water sector projects, were based was one which recognised only one dimension of water usage (water management for paddy rice production) and was predominantly concerned with one `problem': the risk of too much surface water during the summer monsoon.

This is, of course, not an unimportant issue, but to simplify the complex dynamics of water resources management to this single point misses so much and diminishes the effectiveness and relevance of such interventions. Water resources are managed for many purposes. Agriculture is, clearly, the dominant component of rural economies, but there are many crops other than aman rice, groundwater is increasingly widely used (the irrigated boro rice crop is equaling or overtaking the aman crop in importance in many parts of the country) and water scarcity is at least as important an issue as too much water, as the CPP's own reports show.

All households need access to adequate and safe domestic water, most rural families fish for, at least, subsistence purposes, waterways are the basis of transport for many, water is used extensively in many types of handicraft and industrial production and, last but not least, water is a vital component to ecosystems around the country.

The patterns of interaction between these different types of water use are changing rapidly. This is most vividly illustrated by the rapid growth of groundwater use for both domestic purposes and irrigation. Fishing, so important to the rural diet and the basis of the livelihoods of traditional fishing communities, is increasingly changing in terms of both where people fish and who does the fishing (the decline of open water catches, the growth of aquaculture, the leasing of beels and khals, etc). Similarly, navigation has been transformed by the arrival of diesel engines but is increasingly giving way to road transport in many areas.

To fully understand, or even describe, these changes would require a report in itself. The crucial point is that the impact of and people's response to interventions such as those implemented by large-scale projects like SRP need to be considered within this wider context of complex and dynamic patterns of water resources management. It is not surprising that SRP or CPP took the forms they did: indeed, it would have been

extraordinary if it had been anything other than a construction-oriented project whose main purpose was to restore and maintain structures designed to limit the impact of flooding upon people and crops.

However, one must question whether, with all the will in the world these institutional arrangements are capable of adequately addressing the complexity of the multiple demands the diverse range of stakeholders place on the system. Inevitably there is going to be conflict over decisions, there will always be some winner and some losers. Such systems of local participation and management need to develop means to resolve such conflicts. Already existing institutions, both formal and informal, exist and have been doing so for many years, would they be better placed to resolve these? Do they do so in an equitable manner or do they, as some claim is the case of the Project's participatory institutions, invariably benefit the rich? Furthermore, does the system have any mechanism where it can identify and build in indigenous knowledge of water management which could be properly assessed and avoid immediately looking to a western engineering `solution'? Naqvi (1996) investigating potential indigenous solutions to environmental problems in Pakistan highlighted the lack of, and need for an institutional framework at the grass roots if indigenous knowledge is to be fully utilised. He concluded that any such institution needs to be participatory, legal and accountable, continuous and self-correcting. These are undoubtedly reasons why in Nepal the Forestry User Groups (FUGs) have been successful (Soussan, 1995, Hobley, 1996). Navvi also goes on to state that this should occur within the local government system, a view many may not share in both Pakistan, or elsewhere, but it does beg the question as to whether the development of new bureaucracies are likely to do the work any better.

There has, in recent years, in turn given way to an emerging new consensus on the need for, firstly, an integrated water resources management approach which considers all aspects of water resources and uses, and, secondly, on the need for approaches which are built around the social, and not the technical, dimensions of water resources management. This consensus is reflected in both the new policy framework of the Bangladesh Government (reflected in key policy changes such as the 1995 Strategy Paper on Water and Flood Management) and the types of issues the donor community is emphasising in their support to the sector.

The most recent phase of this process is the consideration being given to profound changes to the institutional arrangements of water resources management within GoB and the search for strategies through which local people can become central actors in water resources management policies and programmes. These developments are reflected in the First Draft National Water Policy, which was published in the autumn of 1997. Although only in a draft, discussion form at the time of writing, this new policy clearly sets out a significantly new direction for water resources management in Bangladesh. It is based on an integrated water resources management approach, clearly recognised the multiple nature of both water resources uses and water resources problems and recognises the need to build policies in this field on an appropriate policy, legal and institutional framework.

4.3. Indigenous Knowledge: Local Initiatives in Water Resources Management

The shortcomings in projects such as SRP and CPP do not reflect an unwillingness or inability of their local populations to be involved in the management of water resources and structures to control them. In fact the SRP evaluation field surveys showed a high level of desire to be consulted in the management of BWDB structures (Soussan, 1998). In fact, they show a long and well-developed tradition of water resources management in rural areas of Bangladesh; a tradition which involves both sophisticated systems of collective action, locally developed technical knowledge and systems of payment. The SRP evaluation undertook field studies to explore such systems in four sub-projects. These studies set out to assess whether there are spontaneous individual or collective actions to enhance the benefits or reduce the negative impacts of public water management infrastructures: in other words, whether local people in practice organise to operate or adapt BWDB or other structures. All sorts of actions were found in the field research. Many were small and localised, but they included some large, sophisticated and regular modifications of the characteristics of structures to reflect local needs. The size and social organisation of some of the initiatives was impressive. This was particularly true of the large number of interventions people made to somehow modify the functioning of embankments. Examples of embankment cuts, closing breaches and raising roads and embankments were found in all areas, and were particularly characteristic of localities such as *haors* and coastal areas where the embankments are vital to agricultural production.

Collective action to raise embankments and roads to protect homesteads and crops from flooding were also found to be common. Such initiatives typically occurred in response to immediate crises, where the threat of flooding is real and there is no time to apply to external agencies for assistance. At such times, all act for the collective good, providing labour (and/or cash) regardless of the proportional benefits they receive. There is a strong social cohesion in this, with different stakeholder groups joining together to meet a common threat. This can be truly impressive in scale when the need arises. For example, in at Chaptir Haor, southern Bangladesh, in 1996 thousands worked together for days and nights to seal and raise two roads-cumembankments against a flood that threatened to destroy the crops and flood the homes of the entire area. This rapid public response saved all but a small proportion of the crop (Soussan, 1998). This is a recurrent theme of the analysis of local water resources management: both the problems faced and the strategies adopted are highly localised. Many are regular annual processes, whilst others are one-offs in response to particular circumstances. Any attempt to build upon such initiatives needs to be similarly flexible and locality-specific; something which is extremely difficulty within the context of a project like SRP (or organisation like the BWDB) whose whole management system is premised upon conformity to regular procedures and centralised flows of information and decision-making.

Such initiatives can also be regular and long-term. The local population no doubt feel themselves to be better judges of what should be rehabilitated, and when, than the officials which effectively abandoned them to their fate. It is true that the BWDB does not have the capacity to re-section an embankment every year. This does not mean that it is neither possible nor desirable to do so.

The "public cuts" of embankments are a well-known phenomenon, and indeed are demonised in the eyes of most BWDB officials, who regard them as a violation of their structures. Similarly, to the anti-FAP activists, such cuts were the ultimate proof of the iniquity of embankments and are represented as a popular rejection of their construction. Both positions reflect a profound misunderstanding of the nature and organisation of such cuts. Far from being either a violation or rejection of the embankments, locally organised initiatives to breach (and then close) embankments are a sophisticated, flexible and cost-effective water management strategy (Soussan, 1997).

Embankments are generally cut in a well-planned and systematic way and, unless people have the certainty that someone else (such as the BWDB or the Union Parishad) will close them again, are closed in a similarly well planned and systematic manner. They are made to allow the right balance between drainage, land preparation for boro cultivation, fish migration and navigation; thus serving a multiplicity of stakeholders.

The timing and responsibilities for making and closing the cuts are well-established and formalised amongst local communities, with the specific timing each year decided by discussions in response to local conditions. The precise locations are similarly flexible, to reflect existing hydrological conditions and the changes to what are very dynamic drainage systems. The costs are low and are socially accepted and the process is efficient, flexible to local conditions and, above all, socially legitimate, with the needs and interests of all stakeholder groups represented in the process.

As such, the process of embankment cuts and contains all of the characteristics of good participatory management. All interests are represented and all groups accept the legitimacy of the process, the management decisions are flexible and reflect local needs and priorities and the systems is efficient and cost-effective. This is in sharp contrast to the attempts at participatory development made by SRP and CPP, which possess none of these virtues.

The field studies showed that the people of rural Bangladesh are not passive recipients or victims of water development projects but rather they actively manage and adapt them to meet their own needs, and are able to organise to achieve these ends. The studies also identified a number of other features of local initiatives that are worthy of note. The first is that the level of organisation was often not just local. A number of initiatives which involved external agencies were found with, the Union Parishads the dominant one identified. They appear to have a unique capacity to mobilise both internal and external resources for a particular purpose and have a high level of legitimacy at all levels.

Many of the initiatives identified were both more appropriate and cheaper than external interventions. This is particularly true of actions such as public cuts, the engineering alternative to which is a regulator. The cuts can be adjusted in size and site according to local conditions and require no maintenance. The regulators are fixed and soon cease to function effectively if not maintained. The cost of making and closing cuts is only a fraction of the maintenance costs of regulators and they, of course, do not need any initial investments.

Although BWDB officials are typically openly skeptical about people's participation in the design, in particular, of water control structures, the studies showed that in many areas local people are well able to articulate their needs and have a capacity to design and construct relatively complex water management structures. Good examples of this are the gravity flow irrigation canals in Beet Singri and the salt inlets, which hardly differ in design or construction quality from similar BWDB structures.

Much the same is true of local people's ability to look after the structures they build. Many of the initiatives found involved the rehabilitation and periodic maintenance of dilapidated structures, including long stretches of embankments in several locations. The findings challenge the conventional wisdom that rural people do not have a `maintenance culture'; where this appears to be lacking is in government agencies, not amongst local communities.

The social base of the organisation found is important for both understanding their dynamics and identifying the process through which they can be built upon in the future. Many were led by traditional rural elites, the *mathahars* who dominate much of rural life. In contrast, women were almost completely absent from their organisation and the work undertaken. This high level of inequality is, however, not as it first appears. Although elite men dominated, they were seen as the legitimate representatives of local interests. Local people regarded them as the individuals best placed to both understand and take account of the needs of all local stakeholders and, crucially, to interact with external agencies such as local government officials and the BWDB. Their management capacities and wealth were also valued. As such, the development of local participatory processes for water resources management needs to be built on local social realities, not externally `engineered' based on imposed ideologies and with tokenism in the representation of different stakeholder groups.

To conclude, the studies undertaken of local-level water management processes found that people were active managers of water resources in general and water control structures in particular. These local initiatives were sophisticated, efficient and tuned to local needs and realities. They tended to be representative of all local stakeholders (though there were exceptions to this), but less effective where their actions would affect others downstream. Many were well integrated into the wider fabric of local institutions, including those of local government such as the Union Parishads. The potential of such processes is enormous and as yet untapped. There can be little doubt that the majority of the objectives which a project such as SRP is established to achieve can best be solved by devolving control and, where appropriate, resources to the local level.

4.4. Institutionalising Indigenous Knowledge and Local Participation

Government organisations appear limited in their ability to conduct systems-based participatory development. At an institutional level, inflexible management can generate misleading favourable feedback based on centrally determined criteria as some claim has happened with the CPP. Government field agencies with deadlines on financial years, often concentrate on physical construction to meet targets, or was the case with SRP, with targets for the establishment of community groups but neglecting

the role those groups were to play. Their hierarchical character and the elitist attitudes of many officials make them remote and inaccessible to most sections of the population, and in particular to the poor, who are also socially and politically marginal.

The water sector may benefit from the fields of agricultural research and extension, and forestry. Agricultural research was the first to investigate the importance, role and extent of indigenous knowledge (Brokensha *et al,* 1980; Chambers, 1983; Chambers *et al,* 1989; Okali *et al,* 1994), and to examine and develop means by which it can be institutionalised (Scoones and Thompson, 1994, Warren *et al* 1995). Here, the `transfer of technology' approach for agricultural research and extension has long been recognised to be inappropriate for many of the conditions of complex, diverse and risk-prone agriculture, and the idea of indigenous management seen as a possible way forward in the task of strengthening and sustaining local institutions and capacities (Marsden, 1994).

Over the last decade or so worldwide there has been a reassessment of the roles and responsibilities of the state. Efforts have directed at increasing efficiency, economy, and effectiveness and providing opportunities for the encouragement of private entrepreneurial activity. Policies for privatisation have aimed at sectors that have traditionally been defined as part of the public domain. These changes in approach have run parallel in the developing world, where the failure of many top-down, externally conceived, development projects and programmes has led to major changes in the dominant approach, with an adjustment to more locally-based, indigenous strategies and attempts to adopt more flexible management approaches. As efforts are made to get government off the backs of people, more attention is paid to the development of local institutions that are small enough to command authority yet are able to promote participation. As part of this adjustment, in more recent times there is a recognition that there is more to development than just economic productivity which has led people to focus on processes as well as outputs. What can be learnt from these experiences? In particular, are there mechanisms through which IK can be integrated into effective institutional structures which bring these knowledge systems in an equal partnership with that of the outside institutions with which they interact? These questions reflect the most significant challenge facing the field of IK: to move from interesting analysis and earnest intent to a position where the potentials of this knowledge is built upon through its integration into the institutions through which local-level development is channeled. They are questions with no easy answer, but it is hoped that the current research can provide insights into how this could be achieved in the context of water resources management in Bangladesh.

A starting point for this analysis is to understand the nature of knowledge. Marsden (1994) argues that we need to recast the distinction between IK and exogenous knowledge and think more in terms of specialists and generalists. Those employed in development projects bring specialist knowledge to the task as opposed to the local population who brings practical knowledge of everyday existence. As a result of the failings of the past, there is a realisation that the effective management of resources in a sustainable manner requires both specialist knowledge and generalists. Indigenous knowledge and decision-making shares many of the attributes that modem management theory is trying to promote: flexibility, fluidity and responsiveness; features that are vital in the highly dynamic system of water resources Bangladesh.

Referring to changes in industrial enterprises, Reed (1989) stated that "that managers' interest in participation strategies springs directly from the problem of consent and co-ordination that is at the heart of the management job". The same should be, but rarely is, said of development projects and the relationship between external agencies and local institutions.

However, others offer a word of caution, drawing our attention to the shortcomings of many local groups. Some community-level institutions establish and legitimise unequal access to resources as Mosse (1992) noted was the case with water in Tamil Nadu during times of scarcity. External interventions create problems in that they are liable to weaken and erode local institutions, and suffocate local initiative and responsibility. Local politicians and the local elite often seek to take over successes and use them to their own means. The complexity of such problems is cannot be over-emphasised. Scoones and Thompson (1994) refer to the threat of a single institution in terms of its ability to restrict access and membership. However, later in the same article, they refer to the problems associated with having a diversity of local institutions which can lead to factionalism and conflict unless attention is paid to articulation between groups and federation to higher level bodies. What is clear is that there is a need to understand and integrate local institutions into the process of local-level development, whatever the approach taken.

It is suggested that these problems can be overcome by external organisations using the following strategies:

- Where there has been little spontaneous local organisation, external agents can play a positive role in change, often by concentrating on rural context rather than content. They may mobilise resources and act as a broker between interest groups, as in a Tamil Nadu case or they can create demand for local institutions by beginning awareness and articulation of local needs and interests;
- Ensuring the existence of responsible leadership where groups select their own leaders and make their own rules;

- Training where it is involved is to help people gain new problem-solving skills; and

- Perhaps the most important strategy is to find ways to allow local institutions to federate, with small groups at the base represented by wider and stronger institutions at higher levels.

These issues provide a point of departure for the analysis of these issues in the fieldwork that this project will undertake in the communities in Tangail where the project is based. Further insights will be gained through more rapid comparative analyses in other regions of Bangladesh and, where available through the literature, further afield. This issue, the institutionalisation of IK, is one of the key development challenges of the current era if we are to move beyond rhetorical pleas for the virtues of such knowledge and see its potential become a development reality.

CHAPTER 5: CONCLUSIONS

Today the majority of people working in development, be it in agriculture, aquaculture, or other forms of natural resources management, recognise the benefits and necessity of working alongside the local population. Such a realisation is hardly surprising. Water, is a dominant feature of life in rural Bangladesh. It takes many forms, is managed using a vast array of techniques and methods, and is regulated by many institutions, including customary rights, traditions and social norms as well as more formal types of organisation.

Every farmer and every fisherman manages water resources, both individually and co-operatively. In addition, there are specialised groups whose whole livelihood depends on their ability to manage these resources including professional fishing communities, boatmen, net makers and irrigation pump owners. All these people have built up an intimate knowledge of how their environment operates around them and have developed appropriate, often complex, systems of management. This knowledge is not universal, but is rather localised, differing by locality, group and individual. Furthermore, such knowledge is of great importance: it is often sophisticated and efficient and always relevant to local needs and realities. As such, they represent a wealth of untapped knowledge and processes. This is not a rejection of modern scientific knowledge. Such information has its own validity and value. Nor is it a carte blanche for IK, for it, like that generated in any knowledge system, may be based on spurious information and/or may be incorrectly interpreted. However, it does generally represent knowledge articulated with the realities of everyday life in a setting where it may mean the difference between survival and destitution.

1K is frequently well integrated into the wider fabric of local institutions, including those of local government. Many therefore advocate that control, and where appropriate resources, should be devolved to the local level: indeed, this has become the new development orthodoxy of the late 20" Century. What has often been neglected, however, is the nature of the relationship between local knowledge (and the institutions through which it is channeled) and outside knowledge and institutions.

Experience has shown us that for organisations and projects to facilitate participation requires that their own procedures, style and culture be participatory. The changes required in organisations are reversals, from top-down and imposed system with their associated targets and supervision to bottom up articulation of needs, and local operation and management. This, we would argue is vital: IK and the processes that operate upon it are not static. Such characteristics are crucial in a sector where the dynamics of water management are changing at a frenetic pace. For many farmers today, the main issue is not excess surface water in the wet season; it is increasingly the sustainability of access to surface and groundwater supplies in the dry. These dynamics of changing human-water resources issues are locally specific and need to be reflected in the development of policies and interventions in water resources management. We would argue that the only effective way to achieve this is to utilise the knowledge and flexibility of local institutions. If this can be achieved, then there is indeed an opportunity to channel the directions of change into ones which are both developmental and sustainable.

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ANNOTATED BIBLIOGRAPHY

5.1. Introduction

This annotated bibliography has been produced to support the review of indigenous knowledge and water resource. It forms part of the Department For International Development's (DFID) Renewable Natural Resources Research Strategy (RNRRS) research project, "Sustainable Local Water Management Strategies in Bangladesh - Meeting Needs and Resolving Conflicts" (SE0034), funded as part of the High Potential Systems programme. The bibliography is designed to be a resource, providing information from a number of literatures that are generally not published together and not readily available to researchers in the field.

This review attempts to focus on indigenous knowledge used in natural resources, particularly water resources management, within the wider context of livelihood systems. Water resources management uses and functions are many, and include fisheries, navigation, domestic water uses (health, hygiene and sanitation) as well as those for agriculture (principally irrigation and soil and water conservation). With the exception of soil and water conservation, the water management sector, and these `other uses' in particular, have attracted far less attention in relation to ITK than the forestry and agriculture sectors; perhaps a reflection of the far greater attention paid to these sectors in local-level development initiatives and approaches to participatory development. This bibliography hopes to go some way in capturing much of the material in these other fields.

The review also attempts to capture material relating to the institutional and policy settings best suited to implementation of an integrated, and sustainable, water resources management strategy which makes best use of the indigenous knowledge at its disposal**.**

5.2. Scope of Study

Relevant literature contained within CABI, TROPAG/RURAL, ISI, ASFA databases as well as the University of Leeds library system are included. Some abstracts have been taken from the abstracting journals. Where this has occurred, the source is referred to in the database field. All other abstracts have been written by the authors and are referred to as LEEDSBCAS in the database field

5.3. Analysis

5.3.1. General information

The bibliography has been prepared to help inform researchers in their development of strategies where IK may be of use or where such information is already known to be available and is being used but is not built into the projects framework.

The review provides a general analysis of the literature cited. All material referred to in the review is given in full in the bibliography. Within this references are divided into sections, and keyworded to give an overview of the spread and depth of coverage on specific areas.

5.3.2. Sectional analysis

Each of the references has been placed in one of three sections that are considered to be main topic areas that influence management, policy and planning of water resources. These are:

• Knowledge Systems, Indigenous Knowledge and Indigenous Technical Knowledge

• Indigenous Knowledge of Water Resources Management

• Policies, Institutions and Water Management

5.4. Collection of material

Leeds University Library provides access to major literature databases held on CD-ROM. These are: CABI, BIDS (ISSI and ISI) TROPAGlRURAL. These were searched using keywords. The university libraries database was also searched. A number of libraries in Bangladesh were also searched for relevant material.

Each reference has been assigned to a single section as described above and a set of keywords added to aid identification of the reference.

Section A: Knowledge Systems, Indigenous Knowledge and Indigenous Technical Knowledge

Author: Alcorn, J.B. and Warren, D.M.
Date: 1995
Title: Ethnobotanical Knowledge Systems - A Resource for Meeting Rural Development Goals. In Warren, D.M., Slikkerveer, L.J.and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: farming systems, indigenous knowledge, ethnobotany, sustainability, rural development, plant genetic resources
Abstract: The paper summarises some of the contributions that ethnobotanical knowledge can make to development. It focuses on ethnobotanical knowledge as a system of knowledge in use in real situations. Ethnobotanical knowledge can be acquired by studying agricultural landscapes and agricultural systems, as well as by talking with individual rural residents. The paper discusses seven kinds of resources that can be obtained from ethnobotanical knowledge: principles, facts, technologies, crops, farming systems, strategies, and information about local constraints and opportunities. Resources derived from ethnobotanical knowledge can contribute to the attainment of rural development goals, including: improved rural livelihoods, sustainable use of the natural resource base, improved well-being, health, and nutrition, strengthened institutional capacity to meet the needs of rural people, generation of capital surplus for financing industrialisation. Contributions are especially valuable in regions of marginal farmland or pasture where high-input, capital intensive systems are unprofitable or unsustainable.
Database:CABI

Author: Bernstein, H., Crow, B. and Johnson, H. (eds.)
Date: 1992
Title: Rural livelihoods: crises and responses
Source: Institute for Development Policy and Management, University of Manchester, Manchester, UK
Keywords: poverty, households, employment, environment, health, survival, rural development
Abstract: The book discusses and debates the activities engaged in by rural people to secure their livelihoods. It investigates the factors which affect their access to resources and employment; how rural life is organised and how it has changed; how rural people respond to crisis, and how they are helped or hindered by others. The first of four parts questions concepts, measures and meanings of rural poverty and provides an historical framework for analysing agrarian structures and change in Latin America, India and sub-Saharan Africa. In particular it focuses on changing patterns of land distribution and the growth of commercialisation, and how they have affected rural livelihoods. The second part explores the internal dynamics of rural households and the varied ways in which production, co-residence and consumption are organised. The reproduction and differentiation of households over time are also examined. The third part comprises four case studies: the first two take a sub-continental view

(India and sub-Saharan Africa) and focus respectively on employment and environmental issues; the other two are based on village studies in Uganda, analysing patterns of class differentiation, and exploring concepts of health and healing practices. The fourth part concludes the book by considering action on rural poverty and crises in rural livelihoods by the state, non-governmental organisations, and individuals and groups of the rural poor. The book uses key questions, diagrams, tables, photographs and summaries to illustrate and clarify the text. It is designed to be of use to students of development studies and development practitioners.

Database: CABI

Author: Chadwick, M.T. and Seeley, J.
Date: 1994
Title: Indigenous Soil Classification - An Investigation Into Vernacular Soil Typology in Nepal
Source: FORESC Occasional Paper, Forestry Research and Survey Centre, Kathmandu
Keywords: soil classification, forestry, participatory sketch maps, wealth ranking
Abstract: The report attempts to identify and record intra- and inter-regional variations in the types of soils recognised by Nepali farmers, the means by which they differentiate between them, and if, and if so how, these diagnostic properties can be quantified. The feasibility of identifying the nearest USDA soil classification for each soil type was also investigated. The relative values place on soils by farmers in relation to labour requirements, potential productivity, fertiliser requirement and erosion risk were explored. Finally, the extent of farmers' knowledge of indigenous soil management practice in forest areas is discussed.

Database: Leeds/BCAS

Author: Chambers, R.
Date: 1995
Title: Poverty and Livelihoods - Whose Reality Counts?
Source: Environment and Urbanisation 7 **1**
Keywords: poverty, strategies, wealth, livelihoods
Abstract: This paper explores how professionals' universal, reductionist and standardised views of poverty differ from those of the poor themselves. Poverty line thinking concerned with income-poverty and employment thinking concerned with jobs, project Northern concerns on the South, where the realities of the poor are local, diverse, often complex and dynamic.

Examples illustrate how poor people's criteria differ from those assumed for them by professionals. The paper also discusses neglected dimensions of deprivation including vulnerability, seasonality, powerlessness and humilation. In the new understandings of poverty,

wealth as an objective is replaced by wellbeing and “employment” in jobs by livelihood.

The final sections argue for altruism and reversals to enable poor people to analyse and articulate their own needs, and they conclude with the implications for policy and practice of putting first the priorities of the poor.

Database: LeedsBCAS

Author: Davies, S.
Date: 1996
Title: Adaptable Livelihoods: Coping with Food Insecurity in the Malian Sahel
Source: Science, Technology and Development 14 1
Keywords: food supply, NGOs, case studies, rural development
Abstract: A case study of the Inner Niger Delta, Mali is presented to demonstrate how famine Early Warning Systems (EWS) are seriously flawed. An experimental local food monitoring system established by save the Children Fund (UK) is examined which uses a framework within which vulnerability to food insecurity, including coping strategies are monitored. Indicators used by the monitoring systems address three issues: whether primary and secondary activities could guarantee food security; if not, how people would cope with food insecurity; and how and whether people would recover from episodes of food insecurity or adapt to more permanent changes. Results from the monitoring system show firstly, that cultivating, fishing and herding can no longer guarantee annual food needs in most years. Also all livelihood systems are much more market dependent than in the past. The use of coping strategies as predictive indicators of stress is discussed. The implications of the study's findings for rethinking traditional EWS are examined.

Database: CABI

Author: Dewalt, B.R.
Date: 1994
Title: Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management
Source: Human Organisation 53 2
Keywords: farming systems, millets, tillage, agricultural research, diffusion of research, indigenous knowledge, traditional society, diffusion of information, resource management, tropical forests, forest man
Abstract: The paper argues that there is a need to search for more effective and creative interactions between indigenous knowledge and scientific knowledge systems. It discusses the strengths and the weaknesses of both scientific and indigenous knowledge systems, and then uses three examples to illustrate the strengths and limitations of indigenous knowledge systems. The paper then draws on these examples to indicate the situations in which guidance and ideas from indigenousknowledge

systems should be sought. The paper closes with a discussion of how scientists, social scientists and people with local knowledge can better work together to improve agricultural and natural resource management systems. The case studies are drawn from the Langosta in Honduras, where the International Sorghum/Millet Project has been working since 1981, tropical forest management in the Ecuadorian Amazon, and no-tillage farming in Kentucky, USA. The paper concludes that the cases show that advantage should be taken of both indigenous knowledge systems and scientific knowledge systems, as complementary sources of wisdom.

Database: CABI

Author: Faiez, S.
Date: 1996
Title: Indigenous Water Knowledge Drains Away
Source: International Agricultural Development 16 1
Keywords: farming systems, land use, water resources, dams, rural development
Abstract: It is argued that modern water resource management in sub-Saharan Africa has replaced and undermined indigenous practices. Some examples are discussed of the impacts of dam building, for example the Lagdo Dam along the river Benue which flows from Cameroon into Nigeria.. Problems occur because planners often do not take into consideration the needs of small farmers downstream from schemes who rely on long periods of flooding for their crops, farmers have to change from vegetable crops or rice to less productive millet or sorghum, or leave farming altogether, entering a period of dry season labour migration. The situation is further complicated by pastoralists who usually graze their animals on land that was cropped whilst under flood, but had drained and been harvested by the time they arrived, but is now under crops for much longer, because of the shortage of flood water. A table at the end of the article discusses some of the indigenous systems that have been used, and the ways in which these were in harmony with the cycle of flooding and drought.

Database: CABI

Author: Fairhead J. and Pottier, J.
Date: 1993
Title: Representing Knowledge, The New Farmer' in Research Fashions.
Source: Routledge, London, UK
Keywords: agricultural development, indigenous knowledge, technology, research, methodology, plant protection, farming systems research, communication, anthropology, rural development
Abstract: This chapter explores indigenous technical knowledge in local agriculture, and its representation and use by agricultural research organisations. It is written from the perspective of a professional working in the area of crop health in Ritshuru zone, Kivu, Zaire, charged with reducing the 'social distance' between the farmer and the research organisation. The chapter looks at crop failure in the area, the

problems of representing ITK (Indigenous Technical Knowledge), the perceived 'uncreative farmer', the 'a political' and 'a social' farmer, and farmers' knowledge in the eye of the beholder. It also considers the images of farmers and self images of research institutes, the reproduction of social distance, 'myths' of difference, and the status of ITK in the context of these issues. Finally, the chapter maintains that in the act of reducing social distance between the research institution and the farmer, paradoxically, the distance has been recreated and reproduced.

Database: LeedsBCAS

Author: Fernandez, M.E.
Date: 1994
Title: Gender and Indigenous Knowledge
Source: Indigenous Knowledge and Development Monitor 2 3
Keywords: women, men, local population, indigenous knowledge, gender relations, social impact, rural development
Abstract: Indigenous knowledge systems have long been undervalued. The article notes that fortunately an increasing amount of research on indigenous knowledge systems is now coming to the fore; however, in these studies, the role of gender is often neglected. The article argues that indigenous knowledge and gender are inextricably bound up with each other. It is also maintained that if indigenous knowledge systems are capable of forming a basis for sustainable development, their capacity to innovate on the basis of gendered-knowledge-generating processes must be recognised and respected.

Database: CABI

Author: Gupta, A.K.
Date: 1995
Title: Survival Under Stress: Socioecological Perspectives On Farmers Innovations and Risk Adjustments. In: Warren, D.M., Slikkerveer, L.J., and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: farming systems, indigenous knowledge, households , risk, rural development
Abstract: Linking the context in which farmers' work, and the context in which scientists work, at station or at farmers' fields, requires precise understanding of the risk adjustment (RA) mechanisms evolved by different classes of rural producers. The paper presents the socioecological paradigm in which household adjustment with risks can be studied in a multi-enterprise, multi-market context. Part two discusses the institutional aspect of research on farmers' RA mechanisms. Part three presents a framework in which local/indigenous technical knowledge, and the experimental process of generating this knowledge, can be linked with formal research processes. Empirical examples drawn from historical studies in India,

China and other parts of the world dating back to the second century BC are presented. Finally, a case is made for natural scientists to consider research on indigenous knowledge systems as a necessary complement of formal laboratory research. It is hoped that plant physiologists might find the innovations evolved by the farmers with regard to survival of crops/trees in high risk conditions worthy of formal testing before rejecting or accepting any innovation.

Database: CABI

Author: Gupta, A.K., Warren, D.M., Slikkerveer, L.J. and Brokensha, D.
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Database: LeedsBCAS

Author: Hausler, S. and Inatoy, E.
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Title: Listening to the people: the use of indigenous knowledge to curb environmental degradation. In: Warren, D.M., Rajasekaran, B. and Stiles, D. Social Aspects of Sustainable Dryland Management
Source: John Wiley & Sons, Chichester, UK
Keywords: soil conservation, land management, forests, traditional society, erosion control, sustainability, protection, rural development
Abstract: The paper discusses the ` colonial approach to soil erosion and conservation and contrasts it with indigenous techniques.

Database: LeedsBCAS

Author: Herbon, D. (ed.), Kahrs, F., Muller, H, Plesch, R., Rader, C.
Date: 1992
Title: Agrarian Reproduction in Bangladesh - Studies of Attempts to Ensure a Livelihood in a Rural Region
Source: Alano Verlag, Aachon
Keywords:
Abstract: The book attempts to describe and understand, how the rural population of Bangladesh, especially in the poorer groups succeed, or as the case may be, do not, in finding a means of a livelihood. The book outlines the main geographical, demographic and socioeconomic features of the survey region in the district of bogra. The varies strategies of the population, agriculture, crafts, trade and services are then explored. The patterns of labour use within the framework of a households livelihood are explored as is the interdependence of the activities in the home, field and market. The importance and complex nature of the social and institutional aspects within the framework of people's strategies is also highlighted.
Database: LeedsBCAS

Author: Joekes, S. AND Leach, M.
Date: 1995
Title: Gender and Livelihoods in Northern Pakistan
Source: IDS Bulletin 26 1
Keywords: income population change, deforestation, living standards, roads, gender relations, women, environmental management, resource utilisation, projects, rural development
Abstract: The agro-pastoral system in the mountains of Hunza and Nagar in Northern Pakistan is under severe pressure. Basic conditions are difficult (cultivation is on steep slopes formed of friable rock and scree, and rainfall, at around 150 mm pa is inadequate), population growth is rapid and communal forest has been heavily depleted. Even so, incomes have increased substantially over the past twenty years. This is due to the construction of a metalled all weather road in the late 1970s and to investments made by the local NGO, the Aga Khan Rural Support Programme (AKRSP). This article examines different arguments about the nature of the relationship between women and environmental resources in the context of rapid socioeconomic changes in this area. It argues that there is no special spiritual affinity between women and the environment, that women's livelihood is not closely linked with common property resources, that the welfare impact of environmental change on women is not obviously more marked than on men in terms of labour demands, though certainly they have risen, especially for older women, and, finally, that while women's bargaining power has not increased during the period of upheaval in the livelihood system, it is not negligible and has been significantly supported by the projects for women undertaken largely on women's initiative - by the AKRSP.
Database: LeedsBCAS

Author: Lane, C, Yaber, R.A., Diegues, A.C.S., Ghai, D., Ghai, D. and Vivian, J.M.

Date: 1995

Title: Traditional Systems of Resource Management. In: Grassroots Environmental Action: People's Participation in Sustainable Development.

Source: Routledge, London, UK

Keywords: indigenous knowledge, irrigation systems, agricultural development, environmental management, resource utilisation, sustainability, traditional technology, pastoralism, irrigation

Abstract: Case studies from Tanzania, the Philippines and Brazil document the mechanisms and structures of traditional resource management systems, as well as people's reactions to pressures put on them, in three very different ecosystems. The Barabaig pastoralists of Tanzania: sustainable land use in jeopardy (Lane, pp.81-105) documents the ecological knowledge of the pastoralists of the Hanang plains of north-eastern Tanzania, and provides evidence of the efficiency of pastoralism in the area. The Sanjeras and the Ilocos Norte irrigation project: lessons of environmental sustainability from Philippine traditional resource management systems (Yabes, pp. 106-140) looks at one example of the traditional irrigation societies which have supplied water for much of Asian agriculture for centuries, and are based on communal, participatory management systems. It demonstrates the environmental and productive damage which results when such traditional management arrangements are supplanted by modern irrigation infrastructure. Sustainable development and people's participation in wetland ecosystem conservation in Brazil: two comparative studies (Diegues, pp.141-158) documents the traditional resource management practices of two Brazilian wetlands communities, and explores the ecological and social impacts of the disruption of these practices by state-supported schemes for increased levels of resource exploitation. It shows the environmental impacts of large-scale agricultural schemes for the wetlands ecosystem of the Marituba floodplain, and the resulting adverse effects of the projects on local livelihoods, a similar pattern is shown by events in the Guapore valley.

Database: LeedsBCAS

Author: Lawas, M.C.M.
Date: 1997
Title: The Resource User's Knowledge, The Neglected Input in Land Resource Management
Source: International Institute for Aorespace Survey and Earth Sciences (ITC), Enschede, The Netherlands
Keywords: user's knowledge, gis, farmer's knowledge, polygon, raster, environmental knowledge
Abstract: The book explores the concept of farmers' knowledge in an attempt to better understand it better and to explore the possibility of analysing it using modern information systems. It solicits answers to why and how farmers' knowledge can be studied and better understood. The study concludes that such information is invaluable in relation to land resource management. The study explores ways to apply geographic information systems , in combination with other tools, to formalise farmers' knowledge.
Database: LeedsBCAS

Author: Mabry, J.B. and Cleveland, D.A.
Date: 1996
Title: Relevance of Indigenous Irrigation: A Comparative Analysis of Sustainability. In: Mabry, J.B., Canals and Communities: Small Scale Irrigation Systems
Source: University of Arizona Press, Tucson, Arizona, USA
Keywords: irrigation systems, indigenous knowledge, sustainability, rural development
Abstract: It is hypothesised that indigenous systems of irrigated agriculture are more ecologically and socially sustainable over the long term than 'industrial' irrigation systems. Three general hypotheses are discussed which suggest that indigenous systems: are more efficient in their use of energy, capital and natural resources, provide more stable yields over the long term, and are more equitable in terms of opportunities, benefits, and risks. These are tested through a review of comparative data on relative efficiency, stability and equity. It is concluded that the data reviewed support the acceptance of a number of hypothetical comparisons between indigenous and industrial irrigation based on the theory that indigenous modes of irrigated agriculture tend to be more sustainable.
Database: CABI

Author: Morin-Labatut, G. and Akhtar, S.
Date: 1993
Title: Traditional Environmental Knowledge: A Resource to Manage and Share
Source: International Development Research Centre (IDRC), Ottawa
Keywords: knowledge, environment, indigenous population, information exchange
Abstract: Traditional environmental knowledge refers to the knowledge base acquired by indigenous and local peoples over the generations through

direct contact with their environment. There is a growing recognition that indigenous knowledge is more sophisticated than previously assumed and that it can offer new models for development that are both ecologically and socially sound.

Having explored how traditional and Western environmental knowledge may complement each other and jointly contribute to sustainable development, a number of national and international initiatives in the field of collecting and disseminating information on indigenous knowledge are described.

Database: Leeds/BCAS

Author: Piercer-Colfer, C.J. and Al-Mamry, J.

Date: 1989

Title: An Introductory Method for Gaining Access to the Indigenous Knowledge of Fishermen

Source: Report of the 3rd Southeast Asian Tuna Conference, Bali, Indonesia, 22-24 August, 1989.

Keywords: marine fisheries, artisanal fishing, fishermen, sociological aspects, fishery management, Oman

Abstract: This paper describes a method which can be used by non-specialists to begin studying fishermen's knowledge. The method-an open-ended interviewing technique is described, with examples using our experience among Omani fishermen from the Sur area. The specific topic we were investigating was fishermen's knowledge and beliefs about kingfish *(Scomberomorus commerson),* one of Oman's most valuable fisheries resources.

Database: CABI

Author: Ranasinghe, T.T.

Date: 1995

Title: Sustainable Homesteads

Source: International Agricultural Development 15 1

Keywords: technology transfer, soil conservation, environmental management, home gardens, sustainability, extension, rural development

Abstract: The paper examines farmer participation in a sustainable development effort in Sri Lanka. in the process of extension, the conventional theme of short term home gardening or kitchen gardening has been converted into a long term concept of sustainable homestead development. This change takes place against a background of emerging problems such as environmental degradation and poverty, particularly deforestation. An extension package, introduced in 1986 and in 1990 to the Moneragala district of Sri Lanka (in dry conditions) and to the Gampaha district (in wet conditions) was designed to address such issues. The package covered integrated crop livestock management, soil and water conservation, waste management, family nutrition, kitchen improvement, and income generating projects. The integration of both farmers' indigenous knowledge and their needs into research recommendations was encouraged in order to widen the coverage of full time farmers in the hinterland as well as part time farmers in the

heartland. Priority was given to sustainable soil management techniques within a farming systems approach in order to build economically viable and environmentally sound homesteads in the long run.

Database: LeedsBCAS

Author: Scoones, I. and Thompson, J.
Date: 1994
Title: Beyond Farmer First - Rural People's Knowledge, Agricultural Research and Extension Practice
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: farmer first, ITK, indigenous knowledge, rural people's knowledge, traditional science, agricultural extension, agricultural research, agricultural innovations, farmers, agricultural development
Abstract: Since 1989, when the Farmer First book was published, growing numbers of professionals have been advocating and adopting'a farmer first approach to technology development. However, the changes advocated are not being realised on a sufficient scale or with the required commitment. In 1991, the Sustainable Agriculture Programme of the International Institute for Environment and Development launched a three-year programme of research support and institutional collaboration entitled ‘Beyond Farmer First: Rural People's Knowledge Agricultural Research and Extension Practice'. Collaborators from a number of countries prepared detailed case studies on the interplay between formal and informal knowledge systems and assessed the wider implications for agricultural research and extension practice. The cases were presented and reviewed, along with a variety of discussion papers on key theoretical, methodological and institutional issues surrounding knowledge, power and agricultural science, at the Institute of Development Studies, University of Sussex, UK, in 1992. Together, they provide the basis for this book. Case study material. is presented from Africa, Asia, Australia, Central and South America and Europe. The book is divided into three sections: theoretical considerations, methodological challenges, and institutional innovations. The book seeks to illustrate knowledge as a social process which is manifold, discontinuous and dispersed. From this viewpoint, knowledge emerges as a product of the interaction and dialogue between actors (e.g. 'insiders' (farmers) and 'outsiders' (development agents, extensionists, researchers)) and networks of actors (e.g. resource poor/resource rich, men/women, old/young etc.) often with competing interests, conflicting allegiances and incomplete knowledge
Database: CABI

Author: Shah, M.K. and Shah, P.
Date: 1994
Title: Gender, Environment and Livelihood Security: An Alternative Viewpoint from India
Source: IDS Bulletin 26 1
Keywords: ecofeminist, women, institutions, natural resources
Abstract: Using a case study from India, this article examines the limitations of populist ecofeminist thought. The case study shows that both men and women assume interchangable roles as destroyers and conservers of the environment, depending on both the material relationship they have with their natural resources and the social context within which they operate. Secure livelihood opportunities and usufruct rights, and the existence of enabling institutional mechanisms are of considerable importance for people to have a stake in conserving their natural resources. The article fiuther shows that if environment, focused development programmes are to be sustainable, it is necessary to develop a consultative process with both men and women, so that the concerns and needs of all social groups within a community are addressed. in the case of common property resources, the role of inter, village dialogues, which take into account the complex gender and social relations within and among the village communities, are of critical importance.
Database: Leeds/BCAS

Author: Tabor, J.A. and Hutchinson, C.F.
Date: 1994
Title: Using Indigenous Knowledge, Remote Sensing and GIS for Sustainable Development
Source: Indigenous Knowledge and Development Monitor
Keywords: natural resources, surveying, remote sensing, traditional technology, information systems
Abstract: Information describing the natural resources of any region (e.g. soil, water and vegetation) forms the base upon which sustainable development is highly dependent. The twin challenges of providing information that can lead to sustainable development are to keep acquisition costs low and utility high. An alternative approach based on several techniques of data acquisition, interpretation, and management is presented. These techniques are indigenous knowledge and classification systems, remote sensing and satellite navigation, and geographic information systems. This approach is intended to enhance the utility and lower the cost of surveys by complementing, not replacing, conventional survey techniques. Authors' summary
Database: LeedsBCAS

Author: Titilola, S.O. and Marsden, D.
Date: 1995
Title: Indigenous knowledge as reflected in agriculture and rural development In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D.
Source: Intermediate Technology Publications Ltd (ITP), London, UK
Keywords: indigenous knowledge, agricultural development, rural development, participation, decision making, rural development
Abstract: The paper notes that although the links between agriculture, rural development and indigenous knowledge are not new, the evolving relationship between anthropology and other disciplines concerned with development has a more recent history. A number of themes have become dominant in development discourse and underpin thinking across a broad spectrum of interests. All focus on a clearer understanding and intensified utilisation of indigenous knowledge systems. These include: participation and decentralisation of decision-making; encouragement of the private and the voluntary sectors associated with the retreat of the state; a focus on the poor and on disadvantaged minorities; and an increased concern with gender issues. The paper presents a brief review of the literature that has focused on indigenous knowledge and agriculture and rural development.
Database: CABI

Author: Warren, D.M., and Rajasekaran, B.
Date: 1993
Title: Putting Local Knowledge to Good Use
Source: International Agricultural Development, UK.
Keywords: farming systems, research institutions, diffusion of information, traditional technology
Abstract: A growing number of case studies conducted in recent years have shown that indigenous knowledge (IK) systems can play an important facilitating role in establishing a dialogue between rural populations and development workers. It is imperative that these systems should form the foundations for agricultural and food policy initiatives and technological interventions. Policy actions in the years to come should give priorities for recording, documenting, and incorporating these threatened knowledge systems. Regional and national IK resource centres have embarked on systematic recording of IK systems for use in development. The functions of national IK centres are described. The incorporation of IK systems into agricultural development consists of 3 essential components: conducting participatory on station research, conducting on farm farmer orientated research, and validating farmer experiments. These components are described in detail. It is concluded that the establishment of national IK systems resource centres is important for strengthening the capacities of agricultural research and extension systems.
Database: LeedsBCAS

Author: Warren, D.M., Slikkerveer, L.J. and Brokensha, D.
Date: 1995
Title: The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: development policy, indigenous knowledge, development theory, cultural integration, sustainability, rural development
Abstract: As a result of the increasing awareness of the international community and the reorientation in scientific thinking, UNESCO proclaimed in the mid-1980s the World Decade for Cultural Development, parallel to the Third World Development Decade of the United Nations. The cultural dimension of development has now become a key concept for the international development strategy for the concluding part of the twentieth century. New ways are being sought to incorporate cultural components effectively into development plans and programmes. in this context, the current efforts to record, document, and make accessible the contextual information on indigenous knowledge systems, as presented in this book, seek to shape further the cultural dimension of development from the points of view of different disciplines. Indigenous knowledge systems are visualised in the book as a more dynamic conception of culture and as the ultimate foundation upon which decision making takes place. Part I consists of chapters with a focus on indigenous knowledge. Part II is devoted to studies showing how the knowledge is used in decision making. Part III goes a step further, with contributions focused on the role that indigenous organisations play in the decision-making process. These studies demonstrate that by working with and through existing organisations, the development process can be greatly facilitated. Part IV is on indigenous experimentation and innovations. Contributions in Part V describe how different development institutes are using indigenous knowledge to facilitate the development process. Part VI consists of bibliographical essays, which explore the attention provided to indigenous knowledge in the literature in past decade in the areas of agriculture, rural development and natural resource management.
Database: CABI

Section B: Indigenous Knowledge of Water Resources Management

Author: Ayers, A.
Date: 1995
Title: Indigenous Soil and Water Conservation in Djenne, Mali In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: contour ridging, rotations, fallow, bunds, mixed cropping, agroforestry, tie-ridging, fertilisers, sociology, soil conservation, water conservation, traditional technology
Abstract: The main indigenous techniques of Soil and Water Conservation (SWC) such as contour tillage, farming on the grade, rotations, fallowing, mounds, mixed cropping, mulching, fertilisation and agroforestry are described. Mechanical SWC structures such as contour/stop wash line, tied ridging, contour bunds and says/pitting practiced by 1-12% of the farmers in Djenne are discussed. Data on correlations between SWC practices and ethnic origin or sociopolitical status is provided.
Database: CABI

Author: BARC
Date: 1982
Title: Indigenous Agricultural Tools and Equipment of Bangladesh
Source: City Press, Dhaka, Bangladesh
Keywords: agriculture, tools, appliances
Abstract: The book forms an extensive review of the various agricultural tools and appliances that are now used in different parts of the country. Pictorial views are given. Given the rapid nature of change within the agricultural sector, this acts as an important source of information on tools whose day to day use is under decline.
Database: LeedsBCAS

Author: BBS
Date: 1984
Title: The Survey of Ponds - 1982
Source: Bangladesh Bureau of Statistics, Dhaka, Bangladesh
Keywords: ponds, fish, fishing, live fish
Abstract: A random sample survey of ponds was carried out in the months of February and March 1982 in rural areas of all the districts (except Chittagong Hill Tracts) excluding reserved forest and tea gardens. The total number of ponds was estimated to be 1.86 million of three 18.4 percent were derelict, i.e. completely out of use. The number of non-derelict ponds was estimated to be 1.54 million, with a standard error of 2.2 percent. The average area of a derelict pond was 0.17 acres. The ponds accounted for nearly 40% of the total inland fish catch. Major carp accounted for about 60% of the total catch and live fish (Koi, Singi, Magur etc.) for about 25% of the non-perennial ponds were used mainly for fishing and nearly 70% of the owners of ponds not being used for fishing reportedly lack of finance as the season for non-use.

Only about 2% the non-perennial ponds were cultivated during the dry months. Practically all the ponds were owned privately either singly (47%) or jointly (52[1]/6). In 41 % of ponds no spawn/fry was released. About 53% of the operators did not sell fish at all, 13% sold a quarter of the catch, 16% sold half and 13% sold three-quarters of the catch.

Database: LeedsBCAS

Author: Bhattacharyya, S.K.
Date: 1976
Title: Farmers Rituals and Modernisation - A Sociological Study
Source: Minerva Associates Publications, India
Keywords: rituals, farmers,
Abstract: This book is unique in its combination of a treatment of rituals with farming practices and modernisation. Rituals are organic to life and reflect the general culture-consciousness of a society in all its aspects, including the technical. Thus Indian feudal farm practices are enshrined, along with the rituals. Both practices and rituals are changing as a result of the modernising efforts of government and private agencies. The author explains how this is taking place, on the basis of certain extensive field studies.
Database: LeedsBCAS

Author: Chambers, R., Saxena, N.C. and Shah, T.
Date: 1989
Title: To The Hands of the Poor
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords:
Abstract:
Database: LeedsBCAS

Author: El Sammani M.O. and Dabloub, S.M.A.
Date: 1996
Title: Making the Most of Local Knowledge: Water Harvesting in the Red Sea Hills of Northern Sudan. In: Riej C., Scoones 1. and Toulmin, C. Sustaining the Soil: Indigenous Soil and Water Conservation in Africa
Source: Earthscan Publications Ltd, London, UK
Keywords: hill land, water harvesting, indigenous knowledge, soil conservation, water conservation, agricultural society, farm families, agricultural development, development projects, projects, rural development.
Abstract: In the title area, agriculture is practiced with households operating from fixed settlements along wadi courses. Permanent settlements along wadi courses are characterised by the presence of hand dug wells. The Beja grow sorghum and millet on small plots of flat land along wadi beds. Water harnessing is based on the construction of earth embankments built across wadi beds. The embankments are built to fit in with the shape of the gully and the intensity of water running through it. There is no overall conflict between labour requirements for farming and livestock management. The farming communities are small and based on tribal groups and farming is a community activity.

The Soil Conservation, Land Use and Water Programming Administration, initiated in 1986, has increased the acreage reclaimed for agricultural purposes, increased the number of farming families covered, increased the provision of machinery and supplies, and has drawn women into farming and development plans.

Database: LeedsBCAS

Author: Everett, Y. and Warren, D.M.
Date: 1995
Title: Forest Gardens of Highland Sri Lanka:An Indigenous System for Reclaiming Forest Land. In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural. Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: highlands, botanical composition, management, farmers' attitudes, agro-silvicultural systems, agroforestry systems, farming systems, stand structure, canopy gaps, indigenous knowledge, research
Abstract: This paper describes initial efforts made to understand farmers' ecological theory and management of forest garden systems located immediately around owner's homes, in a village in highland Sri Lanka. These were studied by the author for 13 months in 198586, during which time the structure and composition of the gardens were documented. The gardens are part of a larger farming system which may also include rice paddies, vegetable fields and/or plantation crops (such as tea). The research undertaken was multidisciplinary, and employed a combination of methods from landscape and vegetation ecology and ethnoscience. Different sections of the paper discuss the relevance of forest garden research, the process of understanding the principles of garden management, and ethnoscientific exploration of the farmers' approach. The results show that the farmers' classification of compatible and incompatible species in the gardens was commensurate with the pattern predicted by forest successional theory, and that the patchy structure of the gardens could be interpreted as a successional pattern, like gap phase succession, but understood and managed by the farmers, in part, on the basis of compatibility. An appendix lists the perennial species found in the gardens: on average the gardens contained 250 individual woody perennials of 29 species.

Database CABI

Author: Gowing, J., Hatibu, N., Wyseure, G.C.L. and Young, D.
Date: 1994
Title: Local Solutions to Irrigation Needs in Semi Arid Africa
Source: Agricultural Engineer 49 4
Keywords: water harvesting, micro-catchments, contour ridges, furrow dyking
Abstract: A collaborative programme between the University of Newcastle upon Tyne and Soloine University, Tanzania to evaluate and promote rain harvesting in semiarid areas of Africa is described. The programme involved investigation of indigenous soil/water management practices in Tanzania, demonstration of alternative techniques on three experimental sites and in on farm trials, and development of a simulation model (THIRST). Water harvesting methods could be classified into two main types: within field methods (micro-catchments, contour ridges, furrow dyking, contour benches and strip planning) and external catchment methods (terraced wall systems, hillside conduit systems, and dams for recession planting).
Database: LeedsBCAS

Author: Hu, B.
Date: 1994
Title: Cage Culture Development and its Role in Aquaculture in China
Source: Aquaculture Fish Management 25 3
Keywords: cage culture, aquaculture techniques, aquaculture equipment, fish culture, pisces, china
Abstract: This paper is divided into four parts. First, history: cage culture has long been practiced. The origin of cage culture world-wide should be regarded as the middle reaches of the Yangtse River, China, in the Sung Dynasty. Second, characteristics of cage culture in China. Third, influence: development of open-water fisheries is actively promoted in lakes, reservoirs and rivers. More kinds of water bodies have been employed for this purpose. Marine cages have also rapidly developed. Finally, discussion and conclusions. Cage culture is a modern development of aquaculture which has changed the long-established, fish-farming structures and, to a great extent, pushed forward fisheries development in China. Cage culture is typically characterised by intensive farming, running-water culture, high yield and great efficiency. It is generally accepted that cage culture will actively play an increasingly important role in international aquaculture.
Database: ASFA

Author: Hussain, M.D. and Ziauddin, A.T.M.
Date: 1992
Title: Rainwater Harvesting and Storage Techniques from Bangladesh
Source: Waterlines 10 3
Keywords: rainwater, harvesting, surface water, dry season
Abstract:
Database: LeedsBCAS

Author: Hviding, E., and Baines, G.B.K.
Date: 1994
Title: Community-based Fisheries Management: Tradition and the Challenges of Development in Marovo, Solomon Islands
Source: Development and Change 25 1
Keywords:
Abstract: This study examines traditional fisheries-related resource management through a case in which local communities, from a basis of customary, 'common property' control over the sea and its resources, handle a multitude of development issues. Presenting first some important issues relating to people's role in fisheries management and to the 'common property` debate, the article then describes a traditional system for management of land and sea resources in a Pacific Islands society, that of Marovo Lagoon, Solomon Islands. Emphasis is given to fisheries resources, with a view to explaining in practical terms how a system of customary marine tenure operates under the wider social, political, economic and ecological circumstances of change arising from development pressures. Against this background, assessments are made of the viability of this traditional fisheries management system under present conditions of state control and of both external and internal pressures for large-scale resource development enterprises.
Database: ASFA

Author: Ireson, W.R.
Date: 1995
Title: Village Irrigation in Laos - Traditional Patterns of Common Property Resource Management
Source: Society & Natural Resources 8 6
Keywords: collective *action,* assurance, state common property, commons, cooperation, irrigation, Laos, mutual assistance, natural resource, resource management, village
Abstract: Many lowland Lao villages manage traditional paddy rice irrigation systems constructed of local materials. The process of securing agreement to construct such a system, as well as the patterns of mobilising farmers for operations and maintenance, illustrate the relevance of the Assurance Problem model for understanding collective behavior in managing common property resources. Household cooperation and compliance with irrigation system rules is not isolated behavior, but must be understood *in* the context of village norms of mutual assistance, social support, and decision-making

by consensus. Comparing Lao patterns of regulating access to other natural resources with successful and unsuccessful irrigation systems suggests the limits of successful common property management, and the situations in which it is likely to occur.

Database: LeedsBCAS

Author: Jansen, E.G., Doman, A.T., Jerve, A.M. and Rahman, N.
Date: 1989
Title: The Country Boats of Bangladesh - Social and Economic Development and Decision-Making in Inland Water Transport
Source: The University Press Ltd., Dhaka, Bangladesh
Keywords: country boats, transport sector, craftsmen, boatmen, river system
Abstract: The book examines the history, development and operation of the country boats of Bangladesh, the traditional crafts that have plied inland and coastal waters for hundreds of years. The work, which forms the first in-depth analysis of the country boat sector, discusses the decision-making environment of inland water transport. This includes a review of the operational environment which focuses on the boats, their owners and operators, and the main actors in the transport sector.

Database: LeedsBCAS

Author: Kerr J. and Sanghi, N.K.
Date: 1992
Title: Indigenous Soil and Water Conservation in India's Semi Arid Tropics.
Source: Gatekeeper Series, International Institute for Environment and Development (IIED), London, UK
Keywords: soil conservation, indigenous knowledge, semiarid zones, water conservation
Abstract: A field survey of indigenous soil and water conservation programmes was made in the 4 states of India's semi and tropics. This research has several implications for its primary clients, SWC programme officials, policy makers and research workers. in general, the main lessons from farmers' indigenous practices are as follows: (1) Farmers' objectives should be clearly understood so that SWC programmes can be designed that they will accept rather than reject, (2) SWC programmes should minimise expenditures that farmers would be willing to make on their own. They should provide enabling conditions to increase SWC investment in a cost effective manner, and (3) profitability is a major constraint to adoption, so cheaper technologies need to be developed. Divergence between private and social benefits of SWC should be identified to guide policies and indicate circumstances in which subsidies are justified.

Database: LeedsBCAS

Author: Khan, A.H., Majid, A., Hussein, M.H. and Vander-Velde, E.J.
Date: 1994
Title: Farmer-Managed Irrigation Systems in Chitral
Source: International Irrigation Management Institute,
Keywords: water scarcity, irrigation system, irrigation history
Abstract: A knowledge base that would provide reliable information on both physical and institutional features of indigenous irrigation systems and their management in Chitral, Pakistan was developed. The irrigation systems in Chitral are described. Three irrigation systems were studied, representing conditions of relative water scarcity, adequacy, and abundance. These were the Deh Joi, Pahlawanandeh Joi and Moldeh Joi irrigation systems. The area, irrigation history, irrigation system, institutions and social environment, agricultural system and support services, key strengths and potential weaknesses are described for each system.
Database: LeedsBCAS

Author: Lansing, J.S. and Kremer,J.N.
Date: 1995
Title: A Sociological Analysis of Balinese Water Temples.In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: traditional technology, irrigation systems, indigenous knowledge, cultural environment, rural development
Abstract: The paper notes that Balinese farmers complained that new development plans were ignoring the temple system, and creating unprecedented problems in water scheduling and pest control. Development agencies, however, were inclined to dismiss the water temples as a purely religious system, with no practical significance. The paper examines whether the water temples had a role as irrigation managers, as the farmers claimed. a computer simulation model is presented of the role of water temples along two adjacent Balinese rivers, the Oos and the Petanu. The model permits an investigation of the relationships between physical, biological and social systems at the level of catchment areas, thus allowing the discovery of structures and relationships which would remain hidden from a purely sociological study of Balinese irrigation. The paper explains the logic of the approach, and the results of attempts to persuade development experts to explore new ways to think about water temples and ecological management. Since the approach is based on an ecological perspective, it begins with a brief introduction to the ecology of wet-rice terraces.
Database: CABI

Author: Lewis, D.J., Gregory, R. and Wood, G.D.
Date: 1993
Title: Indigenising Extension: Farmers, Fish-Seed Traders and Poverty-Focused Aquaculture in Bangladesh
Source: Development Policy Review 11
Keywords: small-scale aquaculture, aquaculture development, technology transfer,
Abstract: A discussion is presented on the development and application of an innovative extension approach which addresses policy questions as to whether aquaculture intensification is compatible with the aim poverty alleviation in Bangladesh using fish seed traders as indigenous extension agents. Although aquaculture may offer significant opportunities for improving living standards in rural Bangladesh, interventions in the systems of production and trading need to be made with great care. The approach described provides a set of simple by potentially effective extension messages, without losing sight of poverty-focused project objectives. By "indigenising" extension in this "way it is possible to build upon local knowledge systems and transactions, utilise existing regular fact-to-face contact with the client group in remote locations, keep down costs and follow the existing patterns of information demand.
Database: ASFA

Author: Lewis, D.J., Wood, G.D. and Gregory, R.
Date: 1995
Title: Trading The Silver Seed
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: fingerlings, hatchlings, fish trading, aquaculture, ponds, aquaculture, marketing, distribution, entrepreneurship, markets, poverty, income
Abstract: The book examines the fish culture system in north west Bangladesh in its entirety from hatching to the marketing of food fish. The classes of people involved in the different stages of fish growth are identified along with the accompanying entrepreneurial opportunities for income and employment generation among the poor. The book is divided into three parts. Part 1 (ponds, protein and the poor) contains two chapter examining general aquaculture in Bangladesh and the markets and entrepreneurs related to it. Part 2 (the fish trading networks-trains, buses and rickshaws) is made up of four chapters which discuss the collection and production of fingerlings, station markets, transportation techniques, management of fish ponds, the decline of traditional fisherfolk and fish markets and traders. The final part (poverty, markets and projects) contains three chapters: risky transactions; social preconditions of markets-the test case of cultured fish; and, improving opportunities for the poor.
Database: LeedsBCAS

Author: Lightfoot, C., Costa-Pierce, B.A., Bimbao, M.P. and Del-a-Cruz, C.R.
Date: 1992
Title: Introduction to Rice-Fish Research and Development in Asia
Source: International Centre for Living Aquatic Resources Management, Manila, Philippines
Keywords: fish culture, agropisciculture, rice-field-aquaculture, polyculture, plant culture, Asia
Abstract: An overall perspective of rice-fish research and development in Asia is given through a country analysis and highlights of research. Existingand potential rice-fish areas, and rice-fish system characteristics and their performance in Bangladesh, China, India, Indonesia, Korea, Malaysia, Philippines, Thailand and Vietnam are presented. Similarly, highlighted are research findings on production systems, indigenous knowledge, effects on rice yield and pesticide management. Country analysis shows that rice-fish systems presently occupy only a very small percentage of the potential area. The wide array of systems that exist can be broadly characterised by field design, growing period and fish species. Three types of field design are common: trench within the ricefield, pond or sump within or adjacent to the ricefield, and deepwater ricefield. Carp, tilapia, silver barb, snakeskin gourami and prawns are grown. Research on productions systems revealed that while most systems are for growout operations, ricefields are also suitable for nursery operations. Research has also found that modest increases of 10 to 20% are to be expected in rice yields when fish are cultured in ricefields. While overuse of pesticides has limited fish culture in ricefields, research findings indicate that proper application, selection of chemicals and integrated pest management (IPM) strategies can overcome this constraint.
Database:ASFA

Author: **Mia, M.**
Date: 1986
Title: Prospect of Fish-Culture in Rice-Fields in Bangladesh
Source: ADB News, Dhaka, Bangladesh
Keywords: fish culture, rice fields
Abstract: In this paper, the author dwells upon the problems and prospects of fish-culture in Bangladesh, more specially in the inundated rice-fields of the country for about eight percent of the country's total animal protein supply and nine percent of its GDP, the author emphasises the need to utilise effectively the fishery resources of the country and stresses the need for adequate knowledge of scientific cultural methods and proper management practices. Finally the author, describes the socio-economic and management constraints in the connection with rice/fish culture regarding there with a few possible measures.
Database: Leeds/BCAS

Author: Perry, E. and Dotson, B.
Date: 1996
Title: The Treadle Pump - An Irrigation Technology Adapted to the Needs of Small Farmers
Source: GRID, IPTRID Network Magazine
Keywords: small farms, equipment, pumps, irrigation systems, irrigation water
Abstract: Advantages of the treadle pump for irrigation of agricultural land <1 ha in Developing Countries are discussed and the efforts of the Appropriate Technology International (ATI) in promoting, demonstrating and manufacturing of the pump are highlighted.
Database: CABI

Author: Phillips-Howard, K.
Date: 1996
Title: The Rapid Evolution of Small-Basin Irrigation on the Jos Plateau, Nigeria. In: Riej, C., Scoones, I. and Toulmin, C. (eds.) Sustaining the Soil: Indigenous Soil and Water Conservation in Africa
Source: Earthscan Publications Ltd, London
Keywords: irrigation systems, basin irrigation, plateaux, soil conservation, water conservation, indigenous knowledge
Abstract: The rapid evolution of small-basin irrigation on the Jos Plateau, Nigeria, since 1960 is described. The basins are typically square or rectangular measuring 8-12 m2 in area. Basin depth is 20-40 cm. Basins are individually flooded using a hoe to direct water from wide channels fed by gravity with water pumped to a high point on the farm from streams, lakes, or mine-ponds. The technique is suitable for the production of a range of vegetable crops and sugarcane, wheat, maize, and barley. The main disadvantage is that it is highly labour intensive.
Database: Leeds/BCAS

Author: Rajasekaran, B.
Date: 1995
Title: Indigenous Taxonomies and Decision-making Systems of Rice Farmers in South India. In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: extension, rice, indigenous knowledge, diffusion of information
Abstract: The paper explicates the relationship between indigenous rice taxonomies and farmers' rice production decision-making systems in south Indian agriculture. Specific objectives of the study are: to identify the local taxonomies of rice varieties in Tamil Nadu, India, to analyse the decision-making process of farmers in selecting rice varieties, to explain the implications of local taxonomies of rice varieties to rice production, to suggest suitable policy options regarding the use of local taxonomies in the formulation of recommendations by research and extension personnel, and to develop strategies to train village extension workers in identifying and using

local taxonomies of rice varieties. The indigenous categories of rice varieties used by farmers in Chengalpattu District of Tamil Nadu were recorded during 1980-86. These records were used to identify the decision-making criteria of the farmers in selecting a rice variety from its alternatives.

Database: CABI

Author: Rajasekaran, B. and Warren, D.M.
Date: 1995
Title: Role of Indigenous Soil Health Care Practices in Improving Soil Fertility: Evidence from South India
Source: Journal of Soil and Water Conservation 50 2
Keywords: manures, soil fertility, extension, land improvement, soil management, indigenous knowledge
Abstract: The role of indigenous soil management practices in improving soil fertility was studied in three villages in Pondicherry, India. The following recommendations are made: (1) systematic recording of indigenous soil management practices, (2) research into evaluation of manure applications, (3) determining costs and benefits of sheep penning, (4) local project establishment for distribution of cattle to landless labourers on credit through existing milk cooperative societies, with arrangements for collecting and marketing the manure to farmers, (5) extension programmes on selected soil management practices, and (6) encouragement of groups to market sheep raised by women in marginal farm holdings.

Database: LeedsBCAS

Author: Rajasekaran, B. and Whiteford, M.B.
Date: 1993
Title: Rice-Crab Production in South India: The Role of Indigenous Knowledge in Designing Food Security Policies
Source: Food Policy
Keywords: rice-field-aquaculture, crab culture, aquaculture, aquaculture systems, aquaculture economics, sociological aspects, India
Abstract: Harvesting crabs from the bunds of rice fields is one of several food production systems practiced by resource-poor people in rice-based farming systems in south India. Local people possess an in-depth knowledge of the crabs and their ecology. Crabs, in turn, contribute significantly to the protein intake of resource-poor households. This article discusses the impact of crab consumption on food expenditure, as well as analysing certain socio-cultural factors which influence the catching and consumption of crabs. Factors threatening the existence of the rice-crab production system are also enumerated. Finally, policy guidelines to conserve the autochthonous rice-crab production system are suggested.

Database: ASFA

Author: Rashid, H.E.
Date: 1991
Title: Geography of Bangladesh
Source: University Press Limited (UPL), Dhaka, Bangladesh
Keywords: geography, agricultural products, soils, vegetation, hydrography, fisheries, settlements, minerals
Abstract: The book covers all the major facets of geography in Bangladesh. It provides details on the physiography, hydrography, climate, soil conditions and land utilisations, agriculture, irrigation practices (including ITK) natural resources, industry and trade and commerce. The book also provides a history of the economic development of Bangladesh.
Database: LeedsBCAS

Author: Reij, C.
Date: 1993
Title: Improving Indigenous Soil and Water Conservation Techniques: Does It Work?
Source: Indigenous Knowledge and Development Monitor 1 1
Keywords: soil conservation, technology transfer, water conservation, projects
Abstract: The failure of most soil and water conservation projects in Africa is attributed to complex techniques introduced by outsiders and requiring heavy machinery often with costly maintenance. New approaches are required, based on simple, low cost and efficient traditional techniques. This is illustrated by a case study in Niger, where a project by the International Fund for Agricultural Development (IFAD) has been helping farmers to improve the traditional digging pits (tassa).
Database: LeedsBCAS

Author: Reij, C., W. Critchley, W., Pereira, L.S., Feddes, R.A., Gilley, J.R. and Lesaffre, B. (eds.)
Date: 1994
Title: Sustainability of Soil and Water Conservation in Sub-Saharan Africa
Source: Kluwer Academic Publishers, Dordrecht, Netherlands
Keywords: economics, sociology, soil, conservation, water, conservation, projects sustainability, agroforestry, development, projects, rural, development
Abstract: The results of many soil and water conservation (SWC) projects in sub, Saharan Africa have been disappointing due to lack of maintenance, deliberate destruction, and limited replicability. The major reasons for lack of replicability and sustainability in SWC in sub, Saharan Africa are outlined: a top, down approach, inappropriate techniques, high costs per hectare, low or uncertain benefits, insufficient attention to fertility maintenance and improvement, neglect of indigenous environmental knowledge, indiscriminate use of incentives, coercion, use of heavy machinery, lack of farmer training, scale of intervention, and income earning opportunities outside the agricultural sector. An analysis of successful projects showed that they normally have the following characteristics in common: simple and low, cost techniques, low maintenance requirements, immediate yield increases, training of land users, provision of equipment for land users, promotion

of techniques preferred by the land users, reliance on voluntary participation by land users. Examples of projects promoting SWC techniques showing high replicability and high sustainability are presented: (1) Oxfam, funded agroforestry project in Burkina Faso, (2) the IFAD, funded SWC programme in Illela District, Niger. Examples of projects promoting SWC techniques showing low replicability and low sustainability are presented: (1) the Keita Integrated Rural Development Project, (2) the Turkana Rehabilitation Programme in northern Kenya. New research priorities in SWC are identified.

Database: LeedsBCAS

Author: Richards, P.
Date: 1995
Title: The Versatility of the Poor: Indigenous Wetland Management Systems in Sierra Leone
Source: Gecjoumal 35 2
Keywords:cropping systems, high yielding varieties, farming systems, mechanisation, wetlands, rice, traditional farming, innovation, adoption
Abstract: This paper describes wetland management systems, rice cultivation, and technological change that have been developed in two areas of Sierra Leone, emphasising the dislocations and innovations which these innovations are intended to address. It concentrates on this process of indigenous innovation in Kamajei Chiefdom and Krim, comparing a case where the locus of change is largely internal with one in which local initiative has had to be exercised within a framework largely determined by outside agencies. Management involves knowledge, intensive or capital, intensive manipulation of water and soil. Irrigation is as much brain work as it is groundwork. Sensitive observation and use is made of variable soil conditions up and down slopes. a suite of numerous rice varieties and supplementary crops is maintained and used as appropriate under different physical conditions. The paper also explores why certain technological changes, such as the introduction of tractors in one area and the introduction of specific rice cultivar in another, have succeeded, while other innovations have disappeared. Successful technologies were highly compatible with pre-existing patterns of thought, social relations and ecological practices.The cases that are illustrated in this work contradict the view that development must shape landscape with machines on a massive scale.

Database: LeedsBCAS

Author: Riej, C., Scoones, I. and Toulmin, C. (eds.)
Date: 1996
Title: Sustaining The Soil: Indigenous Soil and Water Conservation in Africa
Source: Earthscan Publications Ltd,'London, UK
Keywords: soil, management, water, harvesting, mulching, , shifting, cultivation, soil, conservation, water, conservation, indigenous, knowledge

Abstract: This book contains 28 papers relating to the importance of traditional soil and water conservation (SWC) practices in Africa. The papers address: water harvesting in Sudan, SWC practices in Morocco, Mali, Zimbabwe, Ethiopia, the Transkei, Cameroon, Malawi, and Nigeria, the zai in Burkina Faso, mulching in Burkina Faso, firki, masakwa cultivation in Nigeria, shifting agricultural practices in Zambia, the yaba, itgo system in Ghana, rice farming, wafipa mounds, vinyungu farming, and pit cultivation in Tanzania, and small basin irrigation in Nigeria.

Database: BIDS

Author: Sadeque, S.S.
Date: 1992
Title: Capture Fisheries and Other Common Property Resources in the Flood Plains of Bangladesh
Source: Journal of Social Studies 55(special issue)
Keywords: fishery, resources, resources, management, fishing, flood control
Abstract: The emphasis of this article is on the importance to the poor of the flood plains of Bangladesh as a common property resource and a source of much, needed protein in the form of fish and marine life. The employment opportunities and income afforded by capture fisheries in this area are of special benefit to women and children, but the industry is declining due to factors such as resource use conflicts, indiscriminate use of pesticides and overfishing. The major constraint is said to be dams, embankments and other flood control measures which restrict the spread of water and fish movement and also limit access to common property resources by the poor. The adverse effects are described and it is recommended that development strategy should concentrate on harnessing and managing existing resources rather than environmental manipulation.
Database: LeedsBCAS

Author: Sangavai, S.
Date: 1994
Title: People's Initiative to Solve Water Crisis in Saurashtra
Source: Economic and Political Weekly 29 34
Keywords: decentralisation, design, water supply, wells, water conservation, water management, indigenous knowledge, rural development
Abstract: The article examines initiatives taken by local people in Saurashtra, Gujarat, India, to provide a sustainable solution to the perennial water problem in the region. The new campaign focuses on the possibilities of well-recharging, which the article discusses in terms of possible speed of implementation. It concludes that what politicians could not achieve, local people have already managed to do quite successfully.
Database: CABI

Author: Sanghi, N.K., Kerr, J. and Shainiwas, S.
Date: 1994.
Title: Soil and Water Conservation: Working with and Learning from Farmers in Andhra Pradesh
Source: Indian Farming 44 9
Keywords: soil conservation, water conservation, indigenous knowledge
Abstract: Over generations farmers developed indigenous methods of soil and water conservation specific to a particular soil, rainfall conditions and socioeconomic situations. Suggestions are made for the use of this indigenous information to be considered by researchers, extension workers and policy makers. a list of farmers' methods is provided.
Database: CABI

Author: Schmuck-Widmann, H.
Date: 1996
Title: Living with the Floods - Survival Strategies of Char Dwellers in Bangladesh
Source: Hilbert and Posger, Berlin
Keywords: Jamuna, char, char-dwellers, floods, local knowledge, agriculture
Abstract: This is the output of research conducted by the author in six char villages of the Gabsara Union belonging to Bhuapur thana in the district of Tangail. The book deals with the knowledge and perception of the rural people in terms of survival strategies while living with the floods.

The publication reveals that the Flood Action Plan (FAP) undertaken to control the floods in Bangladesh, is an example of how engineering knowledge and local or indigenous knowledge can conflict with each other. The FAP planners have ignored the knowledge developed by the rural people over centuries of how to live with floods. The book contains the analysis of the statements and accounts of the char-dwellers, which gives the synthesis about their coping strategies.
Database: LeedsBCAS

Author: Shah, M.S. and Haque, A.
Date: 1980
Title: Quantitative and Qualitative Study of Sample of Fry and Fingerlings of Major Carps from the River Old Brahmaputra at Mymensingh
Source: Bangladesh Journal of Agricultural Science 7 2
Keywords: fry and fingerlings, major carp
Abstract: A qualitative and quantitative study of sample of fry and fingerlings of major carps collected from natural spawning grounds of the river old Brahmaputra at Mymensingh was made. Fry and fingerlings of 25 species fishes including three species of major carps *(Catla catla, Labeo rohita,* and *Cirrrhina mrigala)* have been two species of medium carps *(Labeo calbasu* and *Cirrhing reba)* have been obtained in the samples. The three major carps together constitutes 37%, the two medium carps, 45%, and out of remaining 20 species of predatory

and weed fishes, an unidentified species of the genus *puntius* alone constituted 48.54% of the total catch. The number of species represented in the catch as also the number of species have been found to have some relationship with the size of the carp fry as also with the occurrence of monsoon flood, both being greater in samples immediately following floods.

Database: LeedsBCAS

Author: Stem, P
Date: 1979
Title: Small-Scale Irrigation
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: irrigation, water, crops, moisture conservation, surface irrigation, overhead irrigation, drainage, channels, infiltration
Abstract: The book provides the basic information needed for developing irrigated agriculture on a small scale. It discusses the technological and social factors which need to be considered by the farmer planning to embark on irrigation, and describes the various irrigation systems and methods commonly in use, and some simple technology which is not widely known.

Database: LeedsBCAS

Author: Thakur, R., Singh, S.S., Singh, A.K. and Singh, R.S.
Date: 1994
Title: Some Innovative Approaches in Deepwater Rice Farming Systems based on Indigenous Knowledge
Source: Paper presented at Recherches, Systeme en Agriculture et Developpement Rural: Symposium International, Montpellier, France
Keywords: productivity, technical progress, extension, mixed farming, fish farming, farming systems research, rice, farming systems, agricultural development, indigenous knowledge
Abstract: Deepwater rice ecosystems, characterised by stagnation of water from 0.5 to 4 in for a long period, occupy more than 2.5 million ha in eastern India. Farmers have developed rice cultivars and cultural practices which minimise the risk of flood and drought. The productivity is poor however, and this disadvantaged ecology is generally managed by resource poor farmers. Existing farming systems in a cluster of four representative villages were studied. Workable methodologies were designed for intervention to develop new technologies in the system context where indigenous knowledge played a crucial role. Work over five years led to (i) identification of a rice variety Rajshree for shallow deepwater conditions which was adopted on a large scale, replacing the long duration local cultivar, (ii) mixed cropping rice with green gram was developed which has farmers' preference and yielded as high as 4042 kg/ha in terms of rice equivalent, and (iii) deepwater Chaurs were identified as suitable for rice and fish farming on a sustainable basis. The results indicate deepwater to be a useful resource for farm households. Despite the general view that a resource poor environment

has limited production potential, combinations of appropriate farming systems techniques can lead to success even under this difficult environment.

Database: LeedsBCAS

Author: Tsai, C. and Ali, M.Y.
Date: 1997
Title: Openwater Fisheries of Bangladesh
Source: University Press Limited (UPL), Dhaka, Bangladesh
Keywords: fish, fisheries, openwater, floodplain, fishing gear, nets, fish traps
Abstract: This book **is** a valuable compilation of fourteen chapters containing information on different aspects of openwater fish and fishers. The Chapters are: 1) Tropical Floodplain Fisheries, 2) Riparian Rights; The organisation of Work and Market Relations Among the Inland Fishers of Colonial Bengal, 3) Stock Improvement and Genetic Resource Conservation of the Floodplain Fishes, 4) Fish Health and Management in Bangladesh Floodplain, 5) Fish Biodiversity, Human Nutrition and Environmental Relation in Bangladesh, 6) Socio-economic and Policy Issues in the Floodplain Fisheries of Bangladesh, 7) Marketing of Fish from Selected Floodplains in Bangladesh, Limnology of some Floodplains of Bangladesh, 10) Floodplain Fishing Gears of Bangladesh, 11) Ecology of Floodplains in the Northeastern Region of Bangladesh, 12) Openwater Fisheries in the Northeastern Region Of Bangladesh, 13) Stock Enhancement in the Floodplain Fisheries of Northeastern Bangladesh, and 14) Impact of Flood Control and Drainage with or Without Irrigation Project, on Fish Resources and Fishing Community in Bangladesh. This book has possibly for the first time in Bangladesh, brought together different aspects of inland openwater capture fisheries and is expected to provide an impetus to further work by fisheries biologists, fisheries economists, fisheries technologists, fisheries planners . and others in developing sustainable use of fishery resources of the country.

Database:CABI

Author: Ulluwishewa, R.
Date: 1994
Title: Women's Indigenous Knowledge of Water Management in Sri Lanka
Source: Indigenous Knowledge and Development Monitor 2 3
Keywords: water resources, resource utilisation, women, water management,
Abstract: As water providers and water managers, women have traditionally developed a wide range of strategies to obtain, purify and preserve water. The article highlights the water management strategies practiced by women. The Dry Zone of Sri Lanka, covering two thirds of the island is characterised by harsh environmental conditions, including a long dry season and an uncertain rainfall pattern. In the traditional society of the Dry Zone, women were responsible for providing water

for drinking, cleaning, washing and all other domestic purposes. They derived water without interrupting the natural processes by which it is regenerated, improved the quality of the water by means of various non toxic botanicals, and used it frugally, thus managing their water resources in a sustainable manner.

Database: Leeds/BCAS

Author: Zumstein, S.
Date: 1997
Title: Bangladesh: Local Strategies to Cope with a Hazardous Environment
In: IAO Network International. Alternative Flood Protection
Source: IAO Network International, Berlin, Germany
Keywords: erosion, coping strategies, hazardous environment, floods, *chula*
Abstract: The paper looks at farmers local strategies and attitudes to flooding. The author also explores people's knowledge of the river characteristics and how this assists them in coping with flood and erosion risks.
Database: LeedsBCAS

Section C: Policies, Institutions and Water Management

Author: Agrawal, A.
Date: 1993
Title: Removing Ropes, Attaching Strings: Institutional Arrangements to Provide Water
Source: Indigenous Knowledge and Development Monitor 13
Keywords: projects, villages, drinking water, water supply, living standards, participation, rural development
Abstract: The case of Dodopani (the real name of the village has been disguised) in India illustrates that governments often attempt drastic technically oriented changes to improve standards of living without paying adequate attention to the political and institutional context that defines rural power dynamics, interactions and realities. The article argues that the manner in which the government chose to supplement the water supply in Dodopani discouraged villagers from acting together to create collective solutions, spurred the breakdown of indigenous participatory institutions and worsened the drinking water supply for many of the villagers. The main conclusion is that development projects cannot be successful unless they understand issues from the perspective of people influenced by the projects and pay attention to local institutional realities.
Database: Leeds/BCAS

Author: Bardhan, P.
Date: 1993
Title: Analytics of the Institutions of Informal Cooperation in Rural Development
Source: World Development, UK
Keywords: self-help, water-management, communities, development theory,
Abstract: Local community-level water management is crucial for rural development in South Asia and Sub-Saharan Africa. Local cooperative institutions have been successful in water management in some cases but there are numerous cases of failure. Relevant lessons from the theoretical literature on cooperation in game theory, both in economic and evolutionary biology, are considered. Evidence from field studies by anthropologists and others on the conditions for success or failure of local cooperation are discussed. Some additional insights are found which the theoretical models are, as yet, too constricted to incorporate.
Database: TROPAG/RURAL

Author: BCAS
Date: 1997
Title: Peoples' Participation in the Water Sector - Lessons Learned from Experience
Source: Bangladesh Centre for Advanced Studies
Keywords: people's participation, water sector, practitioners
Abstract: The work summaries the findings of a two day workshop run in Bangladesh in June 1997. The main objective of the workshop was to provide an opportunity for practitioners to share their experiences in relation to people's participation within the water sector and to try to agree a means by which true participation may be achieved in the future.
Database: Leeds/BCAS

Author: Blunt. P. and Warren, D.M.
Date: 1996
Title: Indigenous Organisations and Development
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: economic development, sustainability, indigenous knowledge, local population, rural development
Abstract: Two emerging subjects from development theory are brought together, those of indigenous knowledge systems, and local organisations. This leads to indigenous organisations and presents a consideration of what they can contribute to self-managed and, sustainable development in people's lives. The 20 chapters investigate local planning and management systems, local levels of technology and development, and community-based systems of evaluation and capacity building. Nine case studies are presented from Africa, four from South Asia, and seven from Asia-Pacific (Australia and New Zealand, Canada, China, Indonesia, and the Philippines).
Database: CABI

Author: Chambers, R.
Date: 1983
Title: Rural Development: Putting The Last First
Source: Longman Scientific and Technical, Harlow, UK
Keywords: rural poverty, indigenous, indigenous knowledge, research and development, aid, farmers, women
Abstract: It is argued that personal, profession and institutional change is essential if the realities of the poor are to receive greater recognition. It examines the experience of development practitioners in recent years focusing on the continuing methodological revolution of participatory rural appraisal.
Database: Leeds/BCAS

Author: Chambers, R.
Date: 1993
Title: Challenging The Professions: Frontiers for Rural Development
Source: Intermediate Technology Publications (ITP) Ltd, London
Keywords: rural development, cultural values, participation, development theory, value systems, projects, personnel
Abstract: This book questions the dominant approaches of the professions, disciplines and bureaucracies concerned with rural development, by examining and outlining a new paradigm: the professionalism of reversals. The challenge is to turn current thinking on its head. New frontiers can be opened up by breaking out of, and reversing many of the ideas, values, methods and behaviour normally dominant in disciplines and departments, by offsetting biases, decentralizing, encouraging diversity, and attempting to put people before things. These themes are explored through analysis of different topics: normal professionalism and new paradigms; modes of thought and procedures; poverty-focused projects and the project process; tropical seasonality; agricultural research and extension; NGOs' comparative competence with new participatory approaches and methods; and an ideology of reversals and practical pluralism, to dismantle the disabling state and empower the poor.
Database: CABI

Author: Chambers, R.
Date: 1994
Title: Participatory Rural Appraisal (PRA) - Challenges and Paradigm
Source: World Environment 22 10
Keywords: empowerment, PRA, monitoring, questionnaire surveys, farmers
Abstract: Much of the spread of participatory rural appraisal (PRA) as an emerging family of approaches and methods has been lateral, South-South, through experiential learning and changes in behavior, with different local applications. Rapid spread has made quality assurance a concern, with dangers from "instant fashion", rushing, formalism and ruts. Promising potentials include farmers' own farming systems research, alternatives to questionnaire surveys, monitoring, evaluation and lateral spread by local people, empowerment of the and weaker, and policy review. Changes in personal behavior attitudes, and in organisational cultures, are implied. PRA parallels and resonates with paradigm shifts in the social and natural sciences, business management, and development thinking, supporting decentralisation, local diversity, and personal responsibility.
Database: Leeds/BCAS

Author: Davis, A. and Bailey, C.
Date: 1996
Title: Common in Custom, Uncommon in Advantage - Common Property, Local Elates, and Alternative Approaches to Fisheries Management
Source: Society & Natural Resources 9 3
Keywords: fisheries, management, social justice, social organisation
Abstract: Fisheries social research has attracted increasing attention in recent debates concerning alternative approaches in the design of fisheries management systems. This essay examines case study and fisheries social research literature with a view to highlighting conceptual-analytical strengths, shortcomings, and lessons with respect to management concerns. II is argued that effective and sustainable management regimes require that central consideration be given the principles of social justice and distribution equity. Approaching these goals, in turn, requires that research and management design attend to issues such as local-level social structures, gender/ethnic relations, and the distribution of socioeconomic power and material benefits.
Database: LeedsBCAS

Author: Euroconsult, Lahmeyer International, and Bangladesh Engineering and Technological Services
Date: 1997
Title: People's Participation in Planning Exercise
Source: CPP Project, Dhaka, Bangladesh
Keywords: peoples' participation, Compartmentalisation pilot project, WUG
Abstract:
Database: LeedsBCAS

Author: Farrington, J., Bebbington, T., Withard, K. and Lewis, D.
Date: 1993
Title: Reluctant Partners? Non-governmental Organisations, the State and Sustainable Agricultural Development
Source: Routledge, London
Keywords: economic policy, economic recovery, structural change, appropriate technology, poverty, agricultural development, rural development
Abstract: This book combines comprehensive empirical insights into NGOs' work in agriculture with wider considerations of their relations with the state and their contribution to democratic pluralism. This is the overview volume for the series on NGOs, and contextualises and synthesises case study material in three volumes on Africa, Asia and Latin America, respectively, in which over 60 specially commissioned case studies of farmer participatory approaches to agricultural innovation are presented. The book addresses specific issues relating to NGOs' ability to promote technological innovation and constraints to change in peasant agriculture, the effectiveness of NGOs at strengthening grassroots and local organisations and how donor pressures can influence NGOs and their links to the state.
Database: CABI

Author: Fujisaka, S. and Warren, D.M.
Date: 1995
Title: Incorporating Farmers' Knowledge in International Rice Research. In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: international organisations, rice, agricultural research, indigenous knowledge
Abstract: Awareness of the need to incorporate farmers' perspectives in research at the International Rice Research Institute (IRRI) has increased as the institute's emphasis has shifted from the irrigated lowlands to rainfed lowland and upland rice ecosystems, and as the sustainability and stability of these systems have started to be addressed as research problems. in response to the needs of resource-poor marginal farmers who have to produce enough rice to feed themselves (50% of world rice production), interdisciplinary teams of agronomists, plant protection specialists, plant breeders, agricultural economists and agricultural anthropologists at IRRI are seeking to incorporate farmer perspectives into the development of appropriate rice technologies and rural country programmes. The paper discusses methods and describes an example of each of these research activities from the rainfed lowland and upland rice environments. Case studies come from Claveria, the Philippines, Kampuchea. It is concluded that the knowledge of farmers can be used first to identify and prioritise research issues. Such knowledge can then be applied via farmers' participation in the design, testing, and adaptation of appropriate technologies. Finally, such knowledge can be efficiently shared via farmer-to-farmer technology transfer.
Database:CABI

Author: Fujisaka, S., Moock, J.L. and Rhoades, R.E.
Date: 1992
Title: Farmer Knowledge and Sustainability in Rice Farming Systems: Blending Science and Indigenous Innovation
Source: Cornell University Press, Ithaca, New York, USA
Keywords: rice, farming systems, indigenous knowledge, technology transfer
Abstract: The post Green Revolution period in Asia has been characterised by a slowing down of the rate of growth of farm yields, high input use intensity, and an apparent decreasing efficiency of input use. More attention has been given to non irrigated rice environments, which have more adverse environments than irrigated areas, with low, unstable, or even declining yields of upland rice. Therefore, the sustainability of rice production systems has been called into question, and agricultural science is realising the need to incorporate the previously underutilised resources of farmer experimentation and indigenous technical knowledge in the development of technologies to enhance sustainability. This chapter presents cases that illustrate how farmer science and formal science can be complementary in the development of more sustainable rice systems.

The use of greenmanure, and the adaptation of traditional methods of land preparation and weeding, and soil erosion control in the Philippines are discussed and given as examples of farmer to farmer technology transfer.

Database: LeedsBCAS

Author: Gadgil-M; Berkes-F; Folke-C
Date: 1993
Title: Indigenous knowledge for Biodiversity Conservation
Source: Ambio 22 2
Keywords: genetic resources, ethnobotany, indigenous knowledge, conservation
Abstract: Indigenous peoples with a historical continuity of resource-use practices often possess a broad knowledge base of the behaviour of complex ecological systems in their own localities. This knowledge has accumulated through a long series of observations transmitted from generation to generation. Such diachronic observations can be of great value and complement the synchronic observations on which western science is based. Where indigenous peoples have depended, for long periods of time, on local environments for the provision of a variety of resources, they have developed a stake in conserving, and in some cases, enhancing, biodiversity. They are aware that biological diversity is a crucial factor in generating the ecological services and natural resources on which they depend. Some indigenous groups manipulate the local landscape to augment its heterogeneity, and some have been found to be motivated to restore biodiversity in degraded landscapes. Their practices for the conservation of biodiversity were grounded in a series of rules of thumb which are apparently arrived at through a trial and error process over a long historical time period. This implies that their knowledge base is indefinite and their implementation involves an intimate relationship with the belief system. Such knowledge is difficult for western science to understand. It is vital, however, that the value of the knowledge-practice-belief complex of indigenous peoples relating to conservation of biodiversity is fully recognised if ecosystems and biodiversity are to be managed sustainably. Conserving this knowledge would be most appropriately accomplished through promoting the community-based resource-management systems of indigenous peoples.

Database: LeedsBCAS

Author: Green, C. and Baden, S.
Date: 1995
Title: Integrated Water Resources Management: A Gender Perspective. In: Leach, M., Joekes, S. and Green, C. (eds.) Gender Relations and Environmental Change
Source: IDS Bulletin 26 1
Keywords: gender relations, conservation, environmental management, women, water resources, water management, resource utilisation, evaluation, rural development

Abstract: The concept of integrated water resources management (V I M is currently high on the international policy making agenda and has gained momentum as an approach important from both economic and environmental viewpoints. This article looks critically at the broad approach to women adopted in the WRM policy and then examines, using a gender perspective, two key areas of the policy agenda: pricing and environmental protection and conservation. Although the approach has potential for increased responsiveness of WRM to the interests of women, it is argued that to the extent that gender analysis is limited, this potential may be lost. Given the likely influence of the policy, it is crucial at this stage to ensure that a gender analysis of the conceptual, methodological and empirical dimensions of WRM informs the frameworks and practices currently being developed and authenticated under the 'new consensus'.

Database: CABI

Author: Haagsma, B.
Date: 1995
Title: Traditional Water Management and State Intervention: The Case of Santo Antao, Cape Verde
Source: Mountain Research and Development 15 1
Keywords: irrigation, sociology, traditional technology, administration, government, intervention
Abstract: Local farmers on Santo Antao, one of the Cape Verde islands, have developed a traditional irrigation system that is well-adapted to the difficult physical conditions of steep slopes and limited water flow. Since independence, the Republic of Cape Verde has attempted to upgrade the performance of irrigation systems by introducing large-scale employment schemes. The impact of this intervention on water management and farmer participation is reviewed. a field study was conducted in Biveira de Duque to examine the quality of traditional water management. This led to recommendations for a revised policy towards irrigation development. Major elements of this new policy were the use of the river basin as the appropriate planning and intervention unit, increased farmer participation, and a less direct, low-profile approach by the government towards irrigation development, allowing farmers to re-assume greater responsibility for local water management.
Database: CABI

Author: Jiggins J. and Baker, M.J.
Date: 1993
Title: From Technology Transfer to Resource Management
Source: Sir Publishing, Wellington, New Zealand
Keywords: farming systems research, `research, extension, resource management, technology transfer, models, technical progress, participation
Abstract: Six models of technological innovation are examined. These are: (i) Transfer of Technology (ToT), the dominant linear paradigm,

(ii)Farming Systems Research and Extension (FSR/E), an adaptation and extension of the ToT model, (iii) the Five Element model, drawn from community development and poverty alleviation programming, (iv) the Chain linked model, derived from industrial practice, (v) Participatory Technology Development (PTD), which combines the power of science and indigenous technical knowledge in order to strengthen community based experimental capacity and knowledge systems, and (vi) Natural Resource Management (NRM), a response to emerging environmental problems. The implications for the roles and functions of research and extension, and of agricultural education systems, are analysed. The models are assessed against issues of gender, natural resource management and poverty, with consideration of who pays, and who benefits. The conclusion is drawn that the Transfer of Technology model is not a generalisable model to all circumstances, clients and policy goals. Client driven systems and participatory approaches which build partnerships among researchers, extensionists, producers and other users of grassland landscapes, can be more effective and efficient.

Database: Leeds/BCAS

Author: Jinapala, K., Brewer, J.D. and Sakthivadivel, R.
Date: 1996
Title: Multi-level Participatory Planning for Water Resources Development in Sri Lanka
Source: International Institute for Environment and Development (IIED), London, UK
Source: Gatekeeper Series Sustainable Agriculture Programme 62
Keywords: indigenous knowledge, water resources, community involvement, participation, development planning, water allocation, planning, rural development
Abstract: The paper describes a multi-level approach to participatory water resources planning developed in Sri Lanka. This approach ensures that all local interests are reflected in the plans and was used in Sri Lanka to plan small tank (reservoir) rehabilitation activities. Preliminary studies found that farmers had little idea about the hydrology of parts of the watersheds outside their village areas. The multi-level approach gave farmers the knowledge to prepare workable proposals for improving water distribution within the sub-watershed. The sub-watershed level plans, however, included means for augmenting tank water supplies and thus increasing irrigated area. a key point was that the farmers shared their local knowledge with farmers from other villages to produce useful watershed level knowledge and plans and this was combined with scientist's knowledge of the watershed hydrology. The paper concludes by outlining the institutional and policy support needed to make this approach more widespread in natural resource planning and management.
Database: CABI

Author: Knudsen, A.J.
Date: 1995
Title: Living with The Commons: Local Institutions for Natural Resource Management
Source: Department of Social Science and Development, Michelsen Institute, Norway
Keywords: common-lands, resource-management, social-institutions, customary-law, tenure
Abstract: An overview of research on common property regimes and resource management is presented. It may also serve as an introduction to common property theory for non-specialists. Case studies are reviewed that deal with the following main themes: (1) coastal fisheries, (2) rangeland management, with an emphasis on East African pastoralism, and (3) forestry management. Most case studies are from Africa and Asia. The circumstances under which local institutions represent an alternative to state management of renewable natural resources are discussed. The report calls for an interdisciplinary approach to the study of common property regimes and advocates an analytical focus on local institutions.
Database: LeedsBCAS

Author: Moore, M.
Date: 1995
Title: Promoting Good Government by Supporting Institutional Development?
Source: IDS Bulletin 26 2
Keywords: development aid, development theory, institution building, government, democracy, development policy, rural development
Abstract: Positive support to better government requires aid agencies mainly to engage in 'institutional development', or 'institution building' activities. The paper discusses four sets of problems that arise for aid agencies: the fact that they are not very good at supporting institution building; the frailty of the technical assistance mechanisms available to support institution building; the threat that the newly-fashionable term 'capacity building' will confuse the debate and inhibit effective action; and the fact that successful promotion of institution building may require aid agency staff to intervene directly and effectively in the internal affairs of recipient nations.
Database: LeedsBCAS

Author: Naqvi, H.M.
Date: 1996
Title: Indigenous Nature of Environmental Problems of Pakistan and their Indigenous Solutions
Source: Journal of Rural Development and Administration 28 2
Keywords: air pollution, water pollution, poverty, health, migration, resource management, environmental management, environmental protection

Abstract: A geographical profile of Pakistan is presented followed by an assessment of the environmental challenges faced by the country. Three sources of environmental problems are identified: nature, focusing on topographic and climatic constraints, floods, desertification, deforestation, man nature interaction, dealing with population growth and resources, salinity and water logging, soil erosion and soil toxicity, and man, examining urban growth, air pollution, water pollution, solid wastes and noise pollution. Five major environmental impacts on the poor in developing countries are discussed: (a)pollution and health, (b) environmental degradation lowers the poor's productivity, (c) the impact of poverty on resource management, (d) population and the environment, and (e) migration. Indigenous solutions to environmental problems are assessed.

Database: BIDS

Author: Okali, C., Sumberg, J. and Farrington, J.
Date: 1994
Title: Farmer Participatory Research - Rhetoric and Reality
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: farmer participatory research, monitoring and evaluation, sustainable, social processes, agricultural research, field experimentation, participation, farmers

Abstract: This book reviews and evaluates recent developments, both in terms of concepts and implementation, in farmer participatory research. Rather than setting out to advocate expanded use of farmer participatory research, the purpose is to discover how the approach has been and is being applied, to identify its key distinguishing features, and to assess ways in which its potential value might be enhanced. Farmer participatory research has attempted to move beyond the formal interactions that characterised much farmer participation in the early years of farming systems research. An important difference between farming systems research and farmer participatory research is the latter's focus on the value of farmers' own research processes. However, few projects have yet developed a satisfactory approach to the interaction of formal and informal research activities. If farmer participatory research is to make a significant contribution to the establishment of a dynamic collegiate interface between formal and informal research, new conceptual frameworks and methods that permit the description and analysis of local experimentation and information exchange will be required. Some groundwork has already been laid, and it is suggested how this might be expanded.

Database: LeedsBCAS

Author: Pretty, J.N. and Chambers, R.
Date: 1994
Title: Towards a Learning Paradigm: New Professionalism and Institutions for Agriculture In: Scoones, I and Thompson, J. Beyond Farmer First Rural People's Knowledge Agricultural Research and Extension Practice
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: innovation adoption, technology transfer; government organisations, agricultural policy, agricultural research, participation, farmers, rural development
Abstract: The introduction of the Farmer First concept marked the growing strength of a new world view in agriculture. It put farmers' needs and views first and realised the potential for growth and regeneration in complex, diverse and risk prone areas to be far greater than previously supposed. However, to do this on a large scale would require great changes in professionals and the institutions in which they work. The last few years have witnessed change in government organisations, NGOs, the CGIAR, local organisations and agricultural universities. The characteristics of each type of institution are outlined and the advantages and disadvantages of each discussed. It is suggested that for change to be rapid and sustained requires the mutual reinforcement of participatory methods, new learning environments and institutional support. These conditions have been most favourable in a few NGOs which have also been centres of innovation, while a few government organisations, university groups and individuals in IARCs have also pioneered and adopted new approaches.
Database: LeedsBCAS

Author: Price, T.L.
Date: 1995
Title: Use of Local Knowledge in Managing The Niger River Fisheries Project. In: Warren, D.M., Slikkerveer, L.J. and Brokensha, D. The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: conservation, projects, fisheries, resource management, traditional technology, rural development
Abstract: The Niger River Fisheries Project evolved based on a premise different from most development projects financed by bilateral or multilateral donors and executed in conjunction with national services. The Nigerian Fisheries Direction initiated a new approach to Niger River fishermen from 1983. An FAO-staffed and UNDP-funded fisheries project for Niger completed basic research on the river environment, fish populations, captures, and fishermen society and economy between 1983 and 1987. Niger fishermen have a profound knowledge Of river ecology, that once served as the basis for their management of the fisheries. Project personnel solicited details of this knowledge and organisation from senior fishermen, complemented by information from biological, fish capture and socioeconomic surveys.They subsequently presented propositions for

future management based on the resulting synthesis of scientific and local knowledge. Fishermen and fisheries agents debated the justifications, means of application, and effects of each management approach in a series of public meetings. This procedure was a significant departure from the former practice of fisheries service. Fishermen responded quickly with interest in revitalising local practices based on a respect of their knowledge, in collaboration with government technical services. Project results suggest this approach is a genuine foundation for long-term development by and for local populations.

Database: CABI

Author: Rajasekaran, B., Martin. R.A. and Warren, D.M.
Date: 1993
Title: A Framework for Incorporating Indigenous Knowledge Systems intoAgricultural Extension
Source: Indigenous Knowledge and Development Monitor 13
Keywords: participation, indigenous knowledge, extension, sustainability, rural development
Abstract: A study in three villages of the Union Territory of Pondicherry, in India, revealed that indigenous knowledge systems can provide a frame of reference for strengthening agricultural extension programmes. The findings of the study have led researchers to develop a framework for incorporating indigenous knowledge systems into agricultural extension organisations. This article presents their methodological framework to incorporate indigenous knowledge systems into agricultural extension organisations for sustainable agricultural development in India. By incorporating indigenous knowledge systems into agricultural and extension education programmes leads to a bridging of the communications gap between outsiders and insiders, a recognition of the accomplishments of local farmers, a familiarisation of outsiders with local conditions and increased participation by farmers and their organisations in integrating, utilising and disseminating what already exists.

Database:CABI

Author: Scoones, I. and Thompson, J.
Date: 1994
Title: Beyond Farmer First - Rural People's Knowledge, Agricultural Research and Extension Practice
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: farmer first, ITK, indigenous knowledge, rural people's knowledge, traditional science, agricultural extension, agricultural research, agricultural innovations, farmers, agricultural development
Abstract: Since 1989, when the Farmer First book was published, growing numbers of professionals have been advocating and adopting a farmer-first approach to technology development. However, the changes advocated are not being realised on a sufficient scale or with the required commitment. In 1991, the Sustainable Agriculture Programme

of the International Institute for Environment and Development launched a three-year programme of research support and institutional collaboration entitled 'Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice'. Collaborators from a number of countries prepared detailed case studies on the interplay between formal and informal knowledge systems and assessed the wider implications for agricultural research and extension practice. The cases were presented and reviewed, along with a variety of discussion papers on key theoretical, methodological and institutional issues surrounding knowledge, power and agricultural science, at the Institute of Development Studies, University of Sussex, UK, in 1992. Together, they provide the basis for this book. Case study material is presented from Africa, Asia, Australia., Central and South *America* and Europe. The book is divided into three sections: theoretical considerations, methodological challenges, and institutional innovations. The book seeks to illustrate knowledge as a social process which is manifold, discontinuous and dispersed. From this viewpoint, knowledge emerges as a product of the interaction and dialogue between actors (e.g. 'insiders' (farmers) and 'outsiders' (development agents, extensionists, researchers)} and networks of actors (e.g. resource poor/resource rich, men/women, old/young etc.) often with competing interests, conflicting allegiances and incomplete knowledge.

Database: CABI

Author: SGK and Unnayan Shamannay
Date: 1997
Title: People's Perceptions, Participation and Payment of Compensation - An Assessment of the Compartmentalisation Pilot Project
Source: SGK and Unnayan Shamannay, Dhaka, Bangladesh
Keywords: perception, PRA, compensation, local management, infrastructure, regulators, canals, drainage, irrigation, fishing
Abstract:
Database: Leeds/BCAS

Author: Sharland, R.
Date: **1991**
Title: ITK and Extension: How can Extension to Low Resource, Subsistence Farmers Better Relate to Indigenous Knowledge?
Source: University of Reading Agricultural Extension and Rural Development Department
Keywords- indigenous knowledge, farming systems, extension, rural development
Abstract: in recent years the idea of taking indigenous knowledge into consideration in development projects has been gaining momentum. There has been a growing `realisation of the rationality of indigenous knowledge and the appropriateness of indigenous technology. However, application of indigenous knowledge in agricultural extension has been rare. The subsistence sector is one important

agricultural section where indigenous knowledge has continued to be the dominant resource. This paper reviews some of the key features of indigenous knowledge systems, drawing on a farming system in Southern Sudan to put forward a series of scenarios which show some of the ways in which indigenous knowledge may be blended with formal scientific knowledge for the benefit of traditional farming communities.

Database: CABI

Author: Warren, D.M., Slikkerveer, L.J. and Brokensha, D.
Date: 1995
Title: The Cultural Dimension of Development: Indigenous Knowledge Systems
Source: Intermediate Technology Publications Ltd (ITP), London
Keywords: development policy, indigenous knowledge, development theory, cultural integration, sustainability, rural development
Abstract: As a result of the increasing awareness of the international community and the reorientation in scientific thinking, UNESCO proclaimed in the mid-1980s the World Decade for Cultural Development, parallel to the Third World Development Decade of the United Nations. The cultural dimension of development has now become a key concept for the international development strategy for the concluding part of the twentieth century. New ways are being sought to incorporate cultural components effectively into development plans and programmes. In this context, the current efforts to record, document, and make accessible the contextual information on indigenous knowledge systems, as presented in this book, seek to shape further the cultural dimension of development from the points of view of different disciplines. Indigenous knowledge systems are visualised in the book as a more dynamic conception of culture and as the ultimate foundation upon which decision making takes place. Part I consists of chapters with a focus on indigenous knowledge. Part II is devoted to studies showing how the knowledge is used in decision making. Part III goes a step further, with contributions focused on the role that indigenous organisations play in the decision-making process. These studies demonstrate that by working with and through existing organisations, the development process can be greatly facilitated. Part IV is on indigenous experimentation and innovations. Contributions in Part V describe how different development institutes are using indigenous knowledge to facilitate the development process. Part VI consists of bibliographical essays, which explore the attention provided to indigenous knowledge in the literature in past decade in the areas of agriculture, rural development and natural resource management.
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