Developing a people-centred approach to the coastal management of Pulicat lake, a threatened coastal lagoon in South India

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DEVELOPING A PEOPLE-CENTRED APPROACH TO THE COASTAL MANAGEMENT OF PULICAT LAKE, A THREATENED COASTAL LAGOON IN SOUTH INDIA

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for the degree of Doctor of Philosophy

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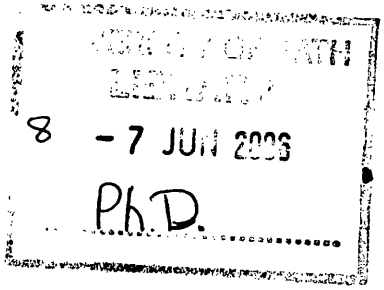

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ABSTRACT

Despite the vast debate, discourse and experience encompassed under the 'umbrella' of coastal management, the subject continues to neglect coastal people as an integral part of the management process. This thesis addresses the need to recentralise current coastal management ideology to better consider 'people' as an integral part of the coast: 'people' in terms of coastal communities, and 'people' as coastal policy makers, those in charge of managing an increasingly unstable coastal zone. The thesis develops a 'people-centred' coastal management process, which applies a cross disciplinary research methodology to the case study of Pulicat lake, a threatened coastal lagoon in South East India.

The research has at its core a participatory approach, which has integrated perceptions of scientists, policy makers and local communities on the coastal management needs at Pulicat lake. This identified that people's coastal management needs are largely based around a fear for the future of the fishing livelihood at Pulicat lake. However, the drivers of change and threats to the fishery are largely contested and unclear, argued differently by people both between and within stakeholder groups. This contestation is shown to present a barrier to coastal policy makers, who are unable to deal with the complexity of contestation, political drivers and the uncertainty of scientific evidence.

In accepting that contestation over management needs and priorities exist, the thesis then introduces an alternative approach to management. Drawing on theories of community 'Adaptive capacity' and 'Resilience' (Berkes et al 2003), the thesis argues that coastal managers can find a direction through consideration of how coastal communities are responding to, and coping with, coastal change.

The thesis concludes that at Pulicat lake, a traditional fisheries management institution known as the *Padu system* is instrumental in shaping adaptive capacity, and that better recognition of such institutions within the coastal management process is necessary. The people-centred approach built in this thesis is then applied to suggest management options for Pulicat lake, which are more in tune with social and cultural sensitivities, and which can generate better informed advice to policy makers.

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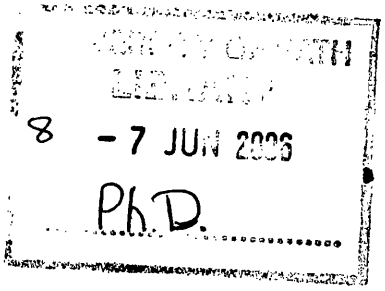

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CHAPTER ONE

THE NEED FOR A PEOPLE CENTRED APPROACH TO COASTAL MANAGEMENT

1. The Problem

The question must be asked to what extent current management of our natural resources is actually working and if it can be effective in the longer term under increasing pressure from population rise and resource demand. Within the realm of coastal resources, 75% per cent of global marine fisheries have been fished to capacity and demands are expected to rise by 40% over the next decade (WWF 2000). It is also widely agreed that most of the world's small scale fisheries are continuingly over fished and progressively more unsustainable (Pauly et al 2002, Berkes 2003). One third of the world's coastal regions have been classified as 'high risk of degradation' (UNEP 1997), half of the world's coastal mangrove systems have been lost (Annan 2002) and over two thirds of coral reefs are threatened by over fishing and coastal development (Bryant *et al.* 1998). According to the WWF Living Planet Report for the year 2000, the state of the Earth's natural eco-systems has declined by around 33% over the last 30 years, whilst the ecological pressure of humanity on the Earth has increased by 50% over the same period (WWF Living planet index 2000). At the same time, many of the world's poorest people depend upon basic access to sustainable coastal resources, which form the mainstay of their livelihood and survival (Agenda 21 UNCED 1992).

Currently it is predicted that more than half of the world's population (3.6 billion people) live within 60km of the shoreline (UNEP report 1997)[1]; a coastal population which is equal to what the entire global population was in the 1950s (Vallega 2001). A great deal of this burgeoning coastal population exists in the form of 'mega cities' (cities with populations over 10 million). Out of the 20 such categorised 'mega cities' in the year 2000, 16 were considered as coastal (Li 2003) and it is estimated that by 2015 there will be 36 mega-cities globally, with 30 in the developing countries (Li 2003). Coastal population is rising fast, and by the year 2030 it is predicted that almost three quarters of the entire global population will live in the coastal zone, with most of that growth occurring in the developing world (UNESCO/GOOS 1998, Li 2003).

[1] Exact numbers of a coastal population are a matter of debate due to differences in definition about what constitutes a coastal zone (Turner 1999)

In its Third Assessment Report (2001), the Intergovernmental Panel on Climate Change predicted that developing countries, and primarily the poor, will be the most adversely affected by climate change, with particular concern given to sea level rise and storm surge hazards; "tens of millions of people in low-lying coastal areas of temperate and tropical Asia are predicted to be displaced" (IPCC, IISD 2005:1). It seems that if the global drive for poverty alleviation manifested in the UN Millennium Development Goals[2] is serious about eradicating global poverty, coastal sustainability needs to rank high on the agenda.

The pace of change in human population and the accompanying demands on coastal resources have created environmental and social costs that increasingly outweigh the benefits of development and modernisation. As coastal population growth couples economic development, competition for coastal resources also increases and poorer sectors of the coastal community often lose their claims over resources to more economically powerful sectors (Campbell 2003). In the Indian coast for example, the mechanised fishing sector has moved into artisanal fishing grounds (Bavinck 2001), whilst coastal backwaters are increasingly appropriated for private industrial development and aquaculture by city-based investors. It seems that the more development that takes place at the coast, the greater the level of exclusion of the coastal poor (Campbell 2003). At the coast, the sustainability of the coastal environment, coastal resources, and the livelihoods and survival of coastal communities are all threatened by powerful forces of change; "everywhere it seems, coastal zones are under tremendous pressures" (Hinrichsen 1990:1).

The coast and its various components have been studied for decades if not centuries by the world's scientists, who by now, should be well equipped with a vast array of knowledge, theory, data, tools, management strategies, policies and recommendations to tackle coastal threats and degradation. We often have a good scientific understanding of the various problems a coastal area faces, but what is less clear are the ways in which coastal problems are connected, and why management-based upon

[2] The eight Millennium Development Goals (MDGs) were a product of the 2000 United Nations Millennium Summit 6-8 September 2000, held in New York. They range from "halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015 – and form a blueprint agreed to by all the (UN) countries and all the world's leading development institutions" (United Nations 2005)

that disconnected science, is often ineffective. Despite the wealth of research and knowledge that scientists possess, and the wide variety of tools available to coastal managers and policy makers, many coastal areas have been unable to reap the benefits from such efforts. As was stated in Agenda 21, UNCED Conference, Rio de Janeiro (1992) "Despite national, sub regional, regional and global efforts, current approaches to the management of marine and coastal resources have not always proved capable of achieving sustainable development" (Chapter 17, Section 17.4 Agenda 21 1992).

Coastal management as a focus for international policy was only started in the 1980s and cumulated in Agenda 21, UNCED 1992. Agenda 21 called for an 'integrated' approach to coastal management which was to promote the sustainable development of the world's threatened coasts. Such an approach was to "expand research on marine living resources, particularly in the social and economic sciences" (17:93) and "strengthen international and regional cooperation and coordination" (17.1f) (Agenda 21 UNCED 1992). Agenda 21 (1992) put coastal management firmly on the international agenda, and ever since, scientists have embarked on efforts to coordinate international attention to the many problems facing coastal zones.

A large number of 'Integrated' coastal management efforts have evolved since Agenda 21, many of which have focussed on strengthening the international and national capacities for coastal management, and the development of policy frameworks for coastal planning and implementation (Cesar et al 1997). Coasts are both dynamic and diverse, and it is often the case that coastal management responsibilities are scattered over many governmental institutions. This has resulted in 'lacking adequate institutional arrangements' to remain one of the most widely cited constraints to effective coastal management (Shah et al 1997). Coastal policies also frequently lack enforcement, political support and public participation (Shah et al 1997, French 2004). A global view and commitment to coastal management is certainly necessary; the UNEP report (1997) criticised environmental management efforts stating:

"the recognition of environmental issues as necessarily long-term and cumulative, with serious global and security implications, remains limited...The

continued preoccupation with immediate local and national issues and a general lack of sustained interest in global and long-term environmental issues remain major impediments to environmental progress internationally" (UNEP/GRID news release January 1997).

With coastal management efforts igniting global policy, national interest, and political will-power to manage coasts in an international context, it is perhaps not surprising that coastal management remains a top-down view of the coast as it establishes an institutional arena in which to settle.

The cost of this approach has been an oversight of the relevance of local realities and coastal need, and the continued segregation of coastal understanding. Many 'Integrated' forms of coastal management represent an organisational framework for dealing with the varied and often conflicting uses of the coast; the creation of a holistic approach "designed to overcome the fragmentation inherent in the sectoral management approach" (Cicin-Sain & Knecht 1998:39). Coastal management has not however, sufficiently addressed how to cross-barriers within its own conceptualisation of the coast and coastal needs. Amongst the calls for intergovernmental and intersectoral forms of coastal management integration, most discourse around the 'Integrated approach' mentions the need for integrating scientific boundaries. Cicin-Sain & Knecht (1998) specifically call for a "science-management integration (integration among the different disciplines important in coastal and ocean management [the natural sciences, the social sciences, and engineering], and the management entities)" (Cicin-Sain et al 2000:292). This presents a mismatch: whilst coastal management calls for greater integration with the social sciences in a science-management arena, most of the social science research on the coast since the 1970s has been calling for greater integration with people, coastal communities. It is well recognised that "In general, different disciplines concerned with the study of oceans and coasts have operated independently, utilizing different language, and with different underlying worldviews and incentive structures (NRC 1995)" (as cited in Cicin-Sain et al 2000:298).

Cicin-Sain et al (2000) present an interesting paradox in their recognition for the need of better communication between natural and social sciences in coastal management:

"Integrated coastal management, in effect, represents a new paradigm of management for the managers, and a new way of thinking and educating for the scientists. Capacity building efforts thus need to be made in two areas: (1) to re-orient existing managers of ocean and coastal areas toward a more holistic perspective of understanding the interrelationships that exist among multiple human use activities in coastal areas and their ecological impacts; and (2) to train and educate a cadre of coastal professionals in a multidisciplinary manner emphasizing the inter-relationships among multiple human activities, and natural and physical processes in the coastal zone" (Cicin-Sain et al 2000:293).

Firstly, the holistic vision of the connections between people and the coast can too frequently miss the local 'on the ground' realities which so much of social science illustrates. Coastal management needs to join the two rather than provide a holistic vision which is without meaning for coastal people. Secondly, much of the society-based coastal research has disputed the heavy reliance of a 'trained cadre of professionals' to provide a solution, advocating instead that managers need to better understand and learn from coastal people and the rich knowledge that coastal communities possess.

In the discourse of International Development, Blackburn & Holland (1998) state:

"Up until the 1970s, it had been the professionals who had the solutions and the poor who were the problem and much was to be solved by education and transfer of technology; more recently however, the stability of the top-down approaches has been questioned and the balance has shifted...More and more we have been recognised as much of the problem and their participation as much of the key to sustainability and many of the solutions" (Blackburn and Holland 1998:xiii *Foreword*).

Using this analysis, I would argue that approaches to managing the coast have remained firmly fixed in the 1970s era of development; management and policy for sustainable coastal resources have largely remained the responsibility of the expert,

the practitioner and the academic. Crossing disciplines in current coastal management may often be advocated, but is rarely achieved (MacPherson 2003); a direct neglect of the Agenda 21 call for "expansion into the social-economic sciences" and "improved local cooperation". The result is that coastal policies engineered to protect the coast often fail at the implementation phase (Westmacott 2002, Glaser 2003, Islam & Haque 2004), whilst management ideas are poorly matched to the needs of coastal communities and the coastal poor (MacPherson 2003, Campbell 2003).

Perhaps one of the most difficult challenges of coastal management today is the active recognition that coastal problems are becoming less of a lack of scientific knowledge, but increasingly a problem of poverty and a lack of alternative sources of livelihood; thus narrowly defined problems are unlikely to produce solutions (White et al 1997). For example, Indian fishing communities often have poor access to formal education, and lack skills to perform in livelihoods other than fishing. However a fisheries manager may have difficulty convincing a donor agency that to sustain fish catches, one must first build schools and employ teachers. The complex interplay between society and its environment, sustainable resource use and poverty is such that solutions can only be found through an integrated process that directly tackles the politics that often bars collaboration and communication. This requires an appreciation that the many complexities between society and the environment are in fact mirrored in the groups that aim to manage them in a sustainable manner.

A local Chennai student expressed a problem of development as "moving too quickly, thus what our common sense tells us is lost and people have stopped using their heads to think". Some of this may hold true for coastal management; as one witnesses the lack of research done in the field, and the laboratories full of GIS experts and technological computer modellers, one questions its true applicability to an 'integrated' form of management. Indeed these are important tools to use, but in the right way and more importantly, in the company of other tools, rather than allowing coastal management to become solely about programming, framework planning and map digitisation.

Coastal management as it stands today needs input from other sources. As the student further pointed out,

"a botanist can sit at his computer learning all the names of the plant species and memorising their pictures, but on venturing into the field he is soon lost as there are far more species than first anticipated, all at different stages of growth so that he cannot identify them; only the farmer knows how to identify them but he is not listened to, and what he knows has not been taught in a classroom".

The same can be said about coastal management, which despite recently acknowledging the importance of community participation and support, lacks a tradition of learning from and listening to those communities, thus missing a wealth of knowledge and its potential use in management options.

A picture can tell a thousand words but only about one place at one moment of time. Stories about life on the coast can tell much more, and as the reader gains more experience, those words evolve new and deeper meanings for management. A story is told in new interpretations continuously changing and adapting, depending on who are the readers and the listeners and the different experiences of village life they hold. The very real problem of management today is the effective integration and use of adopting a 'listening approach' to practical management. The odds of convincing a coastal policy maker to spend a few days on the beach toiling in the hot sun listening to fishermen stories are not favourable. What is needed is for the coastal management initiative to take a step back and reassess those early concepts that brought about its existence in the first place, 'sustainable' 'interaction' and 'co-operation' and admit it needs another angle, which may be found through interdisciplinary science.

There are many reasons as to why cross-disciplinary research in coastal management, in fact cross disciplinary research in general, is neglected in both academia and the wider policy making arena. The United States National Science Foundation (NSF 2000) "affirmed that scarce funding, institutional traditions and structures, inadequate training and insufficient rewards for interdisciplinary pursuits all contribute to diminishing or discouraging more extensive interdisciplinary collaborations" (Kinzig et al 2000:2). "Moreover, there are many incentives (such as publication in own

discipline outlets) that maintain and reinforce separation among disciplines; own discipline publications are generally more highly regarded than interdisciplinary outlets" (National Research Council (NRS) 1995:45)" (Cicin-Sain et al 2000:293). McGoodwin (1990) suggests that part of the reason why cultural anthropologists and sociologists are not playing a larger role in the organisational climate of many fisheries management establishments is that while governments stress the importance of using sociological and cultural studies in resource management policy, few have followed through by establishing the necessary frameworks that would make this a reality; the important decisions are still being made by those from traditional disciplines of biology and economics (McGoodwin 1990).

A large contribution to developing such a framework lies in interdisciplinary methodology: the combining of quantitative and qualitative interpretations of the coast. One of the barriers to promoting such methodology is that the validation of qualitative research in quantitative terms, and vice versa, is wrought with difficulty. Beck (1994) points out the common inter-disciplinary problem of attribution: "Even if peoples' views are considered as valid in a social context, can they be taken as being representative of anything other than their immediate locality and if not, are they greater value than simply being the thoughts and opinions of a few poor people?" (Beck 1994:70).

Coastal management needs a process which can combine the deductive approach prevalent in the natural sciences, with the inductive approach of the social sciences, to achieve an illustration of reality from different but integrated perspectives. That perspective needs to be able to move between holistic and local levels of interpretation, and combine the people-environment dynamic with management objectives which are informed, and therefore implemented. Coastal management needs to broaden to include understandings of the coast from other scientific sectors, and outside the scientific arena. As Berkes et al (2003) argue "Many of our resource and environmental problems are proving resistant to solutions. A gap has developed between environmental problems and our lagging ability to solve them...There is an emerging consensus regarding the need to look for broader approaches and solutions,

not only with resource and environmental issues but along a wide front of societal problems" (Berkes et al 2003:1).

Another part of the problem is different academic concepts of a 'good scientific understanding', another disputed area between natural and social scientists. Whilst natural science is engaged with creating 'robust research' for coastal policy, many social scientists argue that scientific enquiry is never complete and findings are never certain; where there is room for doubt, there is room for politics (Majone 1989).

"When science, technology, and public policy interests meet, different attitudes, perspectives, and rules of argument come into sharp conflict. Scientific criteria of truth clash with legal standards of evidence and with political notions of what constitutes sufficient grounds for action. Factual conclusions are not easily separable from considerations having to do with the plausibility of choice of methodology. And because there seems to be no objective way of checking the conclusions of analysis, the credibility of the expert becomes as important as his competence" (Majone 1989:4).

Coastal management needs to be better prepared for this fragile transition from scientific research to management options and coastal policy, and acknowledge this is not a straightforward process. Wells (1995) argues in the scientific study of coral reefs that "Many reef scientists are already strongly convinced of the need to communicate their results and the implications of these for management and conservation policy (Hatcher et al. 1989), but they may however need to understand that reef managers are not always able or willing to act on their advice because of political, economic or social factors" (Wells 1995:177). Wells (1995) also argues that "As the complexity of management becomes more apparent and managers themselves call for more scientific support and advice, the role that science has to play in perceiving and defining problems, understanding the mechanisms involved and strategically assessing potential solutions, becomes more central" (Wells 1995:177).

Whilst the central role of 'robust scientific understanding' in coastal management is vital (Cicin-Sain and Knecht 1998), equally important is acknowledgement that 'critical science gaps' can impede coastal resource management (Sale et al 2005). Scientific understanding of the coast, without consideration of the coastal policy

processes to which it must be integrated, has a limited utility (Cicin-Sain and Knecht 1998). Social science again has a key role in illustrating the politics of the policy process, which is largely ignored by traditional natural science based research at the coast. Coastal management and research needs to be done with an approach which engages with the needs of policy makers. As Glaser (2003) points out 'scientific-technical' coastal management planning often results in the 'stacking of unimplemented plans on institutional shelves' (Glaser 2003:265). In reference to better integration of social sciences into coral reef research, Hatcher (1999) states "It does not mean that the natural sciences shouldn't play a central role in natural resource management, nor that natural scientists (or journals) should eschew their specialized research to pursue management objectives. Nobody knows the right mix of disciplines, research and tools required for "best practice" management of coral reefs. We do know that it's not all biology ..." (Hatcher 1999:305)

2. The Challenge - Putting people back in the coast

I use the term 'putting people back into the coast' in recognition that actually people have never left the coast; rather it is we, the scientists and the practitioners put in charge of 'managing' the coast who have seemingly forgotten that people were ever there. People have been a part of the coast since the dawn of man, they have survived the vast array of challenges the coastal environmental continues to throw against them, they have learned to adapt and survive, and they continue to do so despite the heavy coastal changes we see before us today. Despite this, the vast majority of debate, discourse and action encompassed under the 'umbrella' of coastal management have surprisingly neglected to take account of coastal people as an integral part of the management process (as is discussed in more detail in the following chapter).

Interdisciplinary research is one way of addressing the complexity of the people-environment relationship at the coast. As Holling (2003) states:

"Sustainable development and management of global and regional resources are not an ecological problem, nor an economic one, nor a social one. They are a combination of all three. And yet actions to integrate all three in the developed nations have sort-changed one or more. Sustainable designs driven by conservation

interests ignore the needs for an adaptive form of economic development that emphasises individual enterprise and flexibility. Those driven by industrial interests act as if the uncertainty of nature can be replaced with human engineering and management controls, or ignored altogether. Those driven by social interests act as if community development and empowerment alone can surmount any constraints of natural or of external forces. As investments fail, the polices of governments, private foundations, international agencies and non-governmental organisations (NGOs) flop from emphasising one kind of solution to another" (Holling 2003:xix).

Holling (2003) is right to blame a large part of the world's inability to meet the challenges of sustainable development and environmental integrity in seeking only partial solutions to address those challenges. In coastal management, these divisions have largely rested on separation of the natural environment of the coast and the people of the coast.

The above discussion, which is further debated in the literature review (Chapter 2) highlights that although the coastal management approach is evolving from its initial conception in the early 1990s, coastal management as it stands today is ill-equipped to listen to and learn from coastal people. Therefore their needs, perceptions, opinions and knowledge about coastal change, and how to cope with coastal change continue to be overlooked by coastal policy. As has been discussed, this is largely is due to a lack of communication between the various academic groups which study the coast, and also a lack of knowledge transfer between bottom-up and top-down levels of management and coastal understanding. Many uninformed coastal management plans suffer poor implementation because they poorly match what coastal people prioritise in management. Such projects also risk a mismatch with cultural settings and existing coping frameworks, which may already operate within coastal society. Poor consideration of these factors may not only contribute to rejection of planning, but in some cases cause more harm than good (McGregor 1990). This thesis aims to develop a coastal management process which is able to better engage with coastal communities and what they can teach us about surviving the coast, and at the same time, be considerate of the needs of policy makers. In others words, it addresses the gap between people at the coast and the coastal policy making process (see Figure A).

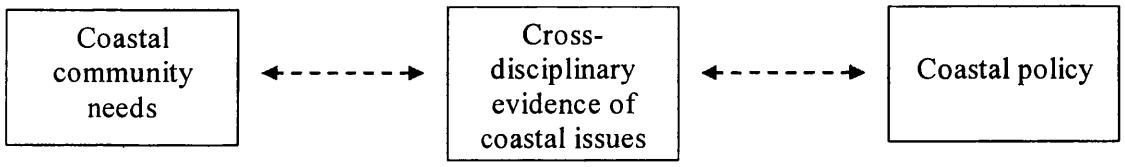
The central question of this thesis is:

Can coastal management be more considerate of the pressures on policy makers, but at the same time take account of the needs and perceptions of coastal communities?

The aim of the thesis *is to illustrate with a case study example, that through crossing several disciplines, and moving between macro-micro interpretations of coastal change, a way forward for coastal policy makers can be achieved, which is more in tune with local community needs.*

Figure A The challenge of a people-centred coastal management process

- To create a two way flow of knowledge between coastal communities and the policy making forum
- To draw upon a range of cross-disciplinary and stakeholder inclusive sources of knowledge to better inform policy of coastal communities' perceptions and needs
- To gain better understanding of the coastal policy making process to effectively apply different forms of knowledge, in a way that is usable to policy makers.



Coastal Scientists need to produce knowledge that recognises social implications and existing political processes in order to contribute to a meaningful set of political processes that use science alongside other stakeholder and political voices. To recognise these key elements requires a multidisciplinary approach that derives effective management options which promote the appropriate policy for the area. Management is potentially far more effective if drawn from maximum stakeholder

support and with full recognition of perceptual differences and political implications. Such an approach could promote a more effective use of science within policy, and ultimately move towards a vision of coastal policy that is effective and implemented.

3. A people-centred approach to coastal management

With ever growing coastal pressures, it has become vital for management strategies to understand the full range of possible interactions between and among humans and their natural environment, and to choose from this spectrum, options which promote long term coastal sustainability that can support both industry and livelihoods (Dooge et al 1992). "The challenge of good management resides precisely in this integrated approach. Investors, developers, farmers, tourists, nature conservationists, policy makers and decision makers all need to communicate and cooperate" (Netcoast.nl 2004). This is a substantial challenge considering that most of these groups, and individuals within groups, will often hold vastly different viewpoints formed by a range of varied influences, persuasions and circumstances in deciding what coastal problems exist and how best to tackle them.

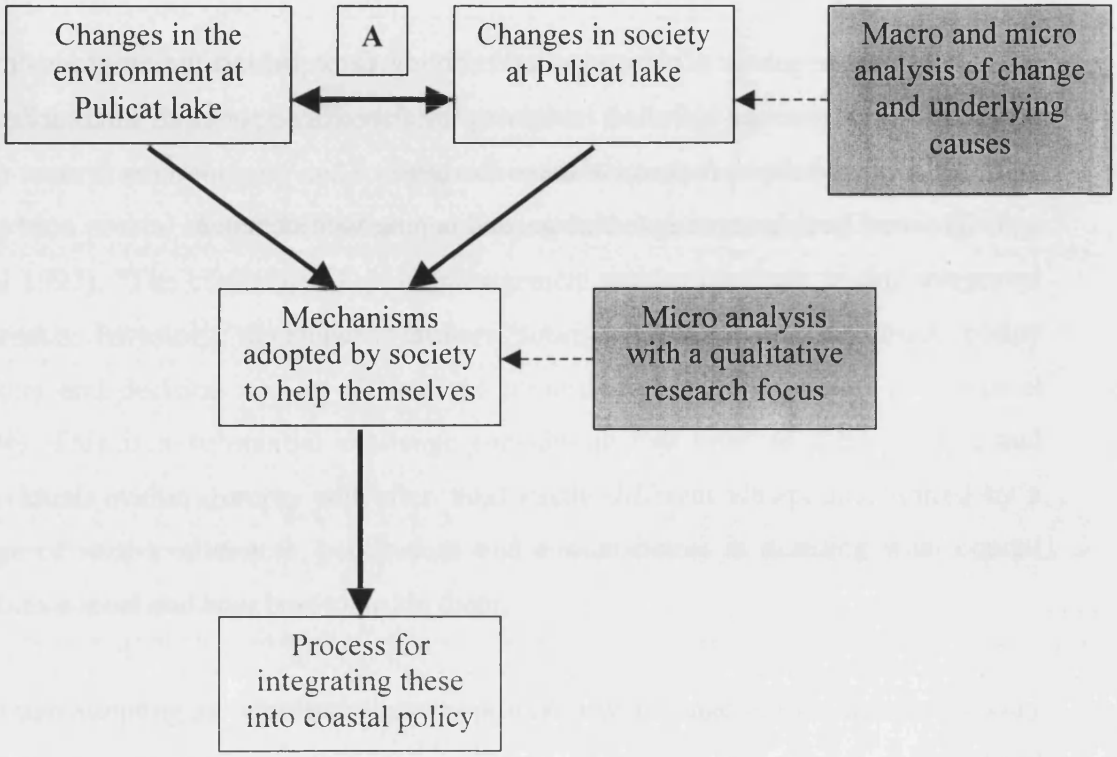
Through adopting an interdisciplinary approach, a wide range of rich literature, theory and knowledge becomes instantly available to inform the coastal management process. The process developed in this thesis draws together these rich fields of knowledge under a cross-disciplinary understanding of 'coastal management'. It uses a case study of a threatened coastal lagoon in South India called Pulicat lake (see following section), with a specific focus on the fisheries sector, the main livelihood of the lake. The literature reviewed in the following chapter describes the wide array of theory, processes, and techniques which are drawn upon throughout this thesis. At the core of the people-centred coastal management is a focus on how people perceive the coast, and how they are able (or unable) to adapt to coastal change. These principles are embedded in cross-disciplinary understanding and the adaptive capacity of local communities (see literature review and below theoretical framework).

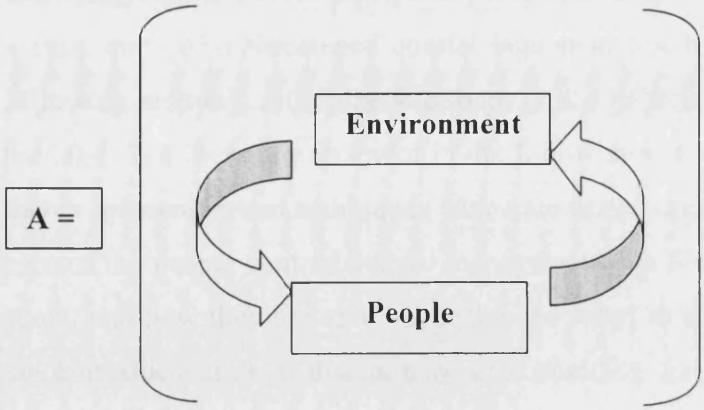
Figure B represents the theoretical framework which is embedded in the development of a people-centred coastal management process; at its core are three sub-questions which are applied in the thesis to the fishery at Pulicat lake.

Sub-questions:

1. What is the interaction between and driving force behind the environmental and social changes at Pulicat lake using the fisheries sector as an example?
2. How do stakeholders perceive these changes?
3. How are people reacting to change, and coping with change?

Figure B Theoretical framework for developing a people-centred coastal management approach





This thesis attempts to present and debate coastal management issues in a way that firstly recognises the linkages between environmental and social change at the lake (represented by Box A), and secondly is considerate of the politics that surrounds those issues and the policy makers who need to understand them. Using the case study of Pulicat lake, the research will produce knowledge that recognises environmental, social implications and political processes surrounding coastal issues at the lake. The framework allows space for a continuous evolution of the process; it is reflective and grounded in its own findings to which the process adapts accordingly. The process draws on methodologies from across the sciences, merging macro-micro interpretations from quantitative and qualitative data sources, and is also reliant in parts on secondary data. Research on adaptive mechanisms used by coastal communities to cope with the social and environmental change in particular is reliant upon qualitative and micro level methods of investigation. Through achieving this balance, the coastal management process developed should be in a position to suggest informed management options, alongside wider political and social considerations, which are in tune with the needs of the community.

It is worth noting here some reflections on the personal journey this PhD represents and implications for my own research skills and understanding. Prior to the start of this PhD I had four years training as an ecologist, a discipline founded in the natural sciences and heavily based upon quantitative and statistical methodology and analysis. Ecology, at least as it was taught in 1999, is largely focussed on people-absent interpretations of ecosystem dynamics – rather like our management of coasts. The PhD started in 2001 with a focus on geomorphology and with initial ideas of assessing physical lagoon dynamics and producing technical coastal management solutions. These topics have an important role to play in coastal management, but have also been the focus of the current research climate in Pulicat lake for many years. Many technical solutions to the large-scale physical coastal changes at Pulicat lake and the wider Chennai coast are collected in the Integrated Coastal Marine Area Management (ICMAM) reports of the Department of Ocean Development & Anna University, Chennai India, and I refer the reader to this collection for further information. Relevant environmental interpretations of Pulicat lake are included in this thesis as an important part of understanding some of the dynamics of change. However, the focus of this thesis is to engage with the vast literature and methodology

offered by the social sciences to better centralise an understanding of people at Pulicat as a way forward for improved coastal management. This has involved a steep learning curve; tackling social science methodology, ideology and language I feel I have achieved an interdisciplinary angle, which is hopefully illustrated in the coastal management process of this thesis.

4. Coastal management at Pulicat lake, Tamil Nadu, India
A good case study

Coastal management as a research topic gives an excellent opportunity to engage with the social-environment nexus, and to apply the varied scientific theories and practices which have emerged in attempts to manage the coast better. The coast is a dynamic and multi-sectored environment, and visualising it as a whole is challenging and complex. Therefore, the lessons which can be learned from applying interdisciplinary science to the coast may perhaps be more easily applied to other areas of natural resource management. Researching coastal management in India provides a complex challenge, which must triangulate interpretations of coastal pressures between rapid economic development, and the influence of a majority poor coastal community steeped in traditional and cultural management structures.

India has the World's second fastest rate of economic growth, which was recorded as 8.1% at the end of the first quarter of 2005; an incredible rise which has largely been fuelled by the development of agriculture, industry and fisheries (Economy watch 2005). India also has the worlds second largest population and yet despite the economic growth, 25% of the population still live under the Poverty line; with a population of over 1 billion, India is home to one third of the world's poor (World Bank 2004). Whilst economic growth is vital in the battle against poverty, much of the economic success is not reaching the poor of India, and the gaps between rich and poor are predicted to grow (World Bank 2004). In many ways the coast of India represents a thin veil separating a 'developed' and 'developing' world. These two worlds live in the same coastal zone, but divisions between rich and poor are plain to see. Whilst large scale coastal industry, lucrative shrimp farms, and modernisation of India's fishing fleet support India's economic growth, living beside this expansion into development are thousands of traditional coastal communities, many of whom

have changed little over the last centuries. The interactions between these two forms of living are both complex and conflicting. In Tamil Nadu fisheries for example, conflicts between traditional 'artisanal' coastal fishermen and the modern mechanised trawler fishing boats fleet have been researched by Maarten Bavinck (2001), who reports on the politics, riots and policy changes which have stemmed from the conflict between modern and traditional sectors. As the poverty gap widens, the conflicts between development, the environment, and people's way of life, increasingly represent a 'modern' vs. 'traditional' dichotomy, which is perhaps most concentrated along the Indian coast. These are conflicts with which, coastal management must be prepared to engage.

The Indian government has already established a large part of the institutional support necessary for a national coastal management directive. In 1981, the Department of Ocean Development (DOD) was created in an effort to centralise responsibility for coastal and ocean affairs, to achieve policy coordination, decrease duplication, and increase the effectiveness of coastal policy performance (Cicin-Sain & Knecht 1998). In 1998, the Department of Ocean Development established the Integrated Coastal Management Project Directorate to build coastal management capacity at both the national level and within the maritime States and Union Territories of India. The ICMAM project (Integrated Coastal and Marine Area Management) is currently being developed in the state of Tamil Nadu to produce a model ICM plan for Chennai. Gupta & Fletcher (2001) argue that "The Indian approach, however, remains reliant upon a single sector, with little apparent interagency co-ordination, and limited prioritisation of the cumulative impacts of multiple uses [Subramanian Pers comm]... The challenge for India is to create an effective coastal and marine area management programme and to encourage government interest in the ICM concept (Cicin-Sain & Knecht 1998)" (Gupta & Fletcher 2001:758).

The responsibility for Indian coastal management has already been wholly assigned to teams of experts, government officials, academics and DOD staff - and yet the Indian culture of coastal people is rich in local knowledge and traditional coastal management practices built up over centuries of community-learning. A central government report recently acknowledged this stating "a result of top-down policy processes limited to a small number of 'experts' and consultants means they often end

up remaining on paper" (MoEF 2000:8). Coastal management in India is full of opportunities to develop integrated and inter-disciplinary types of management approach, which are called for throughout this thesis. People at the coast are adapting and surviving the surge of coastal development and coastal change. A great deal can be learned from their perspectives, ideas and behaviour.

Pulicat lake - the case study for this thesis, possibly represents the Indian coast in its most dynamic and complex form; as Day et al state "In almost all coastal nations, conflicts among the development activities that compete for the occupation or use of coastal environments and resources are most intense around enclosed bays and coastal lagoons" (Day et al 1989:6). Pulicat lake is India's second largest coastal lagoon, lying parallel to the Bay of Bengal in the Southern state of Tamil Nadu. The lake is under stress from a complex web of environmental, social and political factors, which stem from a dynamic and changing coastal environment and a heavily dependent coastal fishing community. Pulicat lake lies just 60 km north of an expanding Chennai city (India's 4th largest city), and in particular its water bodies are directly linked with the chemical and industrial belt of Chennai through the Buckingham canal. This urban encroachment gives a direct conflict with livelihood needs of an important lake fishery. This conflict in turn has generated substantial interest in the future fate of Pulicat at both government, political, activist, NGO and community levels. Urban expansion towards Pulicat, which is perceived as a great risk by the fishing communities, but as a development potential by the Indian government has placed Pulicat firmly within a heated and politically charged agenda. The already complex interaction between the environment and society is further fuelled by politics, future speculation and a great deal of anger as people fight for their rights; the right to fish, the right to a clean environment and the opposing nation-wide right for economic development.

The fishery of Pulicat lake represents a common pool resource[3] (Ostrom et al 1994, Tietenburg 1997, Dasgupta 1996, Ostrom 2002). As has been found in many such

[3] According to Ostrom et al 1994 "Common-pool resources generate finite quantities of resource units and one person's use subtracts from the quantity of resource units available to others (Ostrom et al 1994)" (As cited in Ostrom 2002:1)

resources (Ostrom 1990 & 2002, SRISTI website 2005[4]) Pulicat fishing communities have evolved a traditional institution for managing the fishery known as the *Padu system*. The informal Padu system operating in Pulicat lake is a verbal agreement of traditional fishing rights, largely dominated by the Pattinaver people, a traditional fishing caste whose members dominate the lake. In this thesis, the Padu system has played an important role in understanding how people are able to respond, adapt and cope with coastal change. This advocates Berkes et al (2003) arguments that traditional institutions are a key consideration in applications of resilience and adaptive capacity ideals (discussed in the following chapter).

Pulicat lake as a coastal lagoon presents seasonal, annual and longer term dynamic changes in its physical environment, as is common to many lagoons. A high dependency on monsoon rains, the importance of a linkage to the sea, and the high but variable productivity of fish and shrimp add further complexity to the debate for coastal management needs. These events combined with longer term social changes underway in many of India's fishing communities are cause enough to demand an integrated form of research and management. The picture of Pulicat is diverse and changes according to who is describing it, who is experiencing it, who is researching it, and who is setting the political agenda. A management approach built for Pulicat lake needs to conceptualise the complexity of issues at Pulicat through a focus on the interactions between people, politics and the environment, whilst remaining considerate of the needs of coastal communities, the environment and coastal policy makers.

5. Thesis structure

The coastal management process in this thesis has focussed on the fishing sector of Pulicat lake, primarily because fishing is the main livelihood of the lakes inhabitants and also provides the backbone of the lakes economy (Bhunvaneswari 2003). Furthermore, as the research has progressed, findings have increasingly highlighted

[4] Currently there are over 80 common pool resource institutions spanning over 20 countries, which are documented by SRISTI (Society for Research and Initiatives for Sustainable Technologies) on the "Common Property Resource Institutions Database & Online Information and Interaction System". See www.sristi.org/cpr/index.php3 for further reading.

that concern over the future of the lake fishery is a top management priority at community, academic and policy levels.

A large amount of natural science research has already been conducted in Pulicat lake, particularly on the water quality, hydrodynamics, and fishery productivity. This knowledge of the lake environment is integrated into the thesis, but a lack of social science input to Pulicat knowledge has necessitated that the social aspects of Pulicat become a focus for primary data collection. As will be discussed, it seems a large number of the challenges and opportunities for coastal management at Pulicat are found in Pulicat fishing society, a sector which to date has been largely overlooked by academia and policy makers.

The thesis draws upon a wide range of theory and knowledge from across the sciences and is an example of a cross-disciplinary application to coastal management. The people-centred coastal management approach which is developed places people and livelihoods firmly at the centre of coastal resource management and argues that better inclusion of people's needs, culture and beliefs are vital for informed policy making.

Chapter 2 – Literature review

The following chapter (two) is a review of the literature, theory and practice, which are drawn upon throughout the coastal management process developed in this thesis. Chapter two is an account of how theoretical and practical understandings of coastal management have developed over the last two decades, largely since early conceptions of 'coastal management' were formed in Agenda 21, UNCED 1992. The chapter starts with a critique of general coastal management thinking, with a focus on tools such as Integrated Coastal Management (ICM) and frequent calls for 'increased stakeholder participation' as a solution for coastal management failings. The review then critiques coastal management and its lacking consideration of the wider political processes involved in management decision making, and the complexity of the coastal policy making process. The chapter concludes with a discussion of the benefits of an inter-disciplinary approach to coastal management, and the varied sources of knowledge which become available to managers through looking at other disciplines. Of particular focus is the wealth of knowledge which has already been gained by

academic research into coastal communities, and their ability to cope with change. A way forward for a people-centred coastal management may lie through looking at traditional institutions for management, using theories of resilience and building upon existing 'adaptive capacity' of coastal communities.

Chapter 3 Methodology

Chapter 3 describes how the theoretical framework discussed in this chapter has been applied to the methodology for the field work conducted in Pulicat lake. Methods used in this thesis were drawn from a wide range of primarily social science methodologies, which move between macro and micro levels of investigation. The methodology chapter describes the transition of the research from a survey intensive quantitative approach to a semi-structured or 'semi-qualitative' interview approach to a deeper level of anthropological investigation with coastal communities. With a longer time spent in the field, a period of micro-level investigation, heavily reliant upon qualitative approaches became more prominent. These periods of research were key to revealing the importance of traditional management institutions in people's daily lives.

Chapter 4 Introduction to Pulicat lake

Chapter 4 begins with a short introduction to some of the aspects of Pulicat fishing society, which are important for understanding the implications of change in later chapters. The chapter then gives a historical overview of change at Pulicat lake, with a focus on State-wide policy impacts on the fisheries sector. The chapter then introduces the Padu system, a traditional institution for managing the lake's prawn fishery which has been operational at Pulicat lake for centuries. The chapter presents general social, environmental, and policy change at Pulicat within an arena which connects state, market and community sectors.

Chapter 5 Research villages and perceptions of fishing communities

In order for the problems raised by local people to have meaning and context, a degree of information about the people's ways of life at a micro level is important. This chapter links the previous general descriptions of fishing society with a more in-depth analysis of the village, as a precursor to a discussion of coastal management priorities as understood by the people of Pulicat villages. The chapter presents empirical data from seven villages, which were selected as being a good representation of the different types of village involved in the lake fishery. The perceptions of coastal management needs and priorities are presented and discussed from the seven Pulicat fishing villages. Chapter 5 then widens the discussion of perceived coastal management needs from a community level, to include coastal policy makers, academics and Non Government Organisations involved with Pulicat lake. The chapter describes the complexity of the linkages between coastal management problems and argues that an overall focus for concern is the future of the Pulicat lake fishery, and the livelihoods dependent upon it. The chapter concludes with a closer look at the fishery and illustrates how a lack of clear scientific evidence has created varied interpretations of the health status of the fishery and range of claims as to the cause of its demise.

Chapter 6 A contested soup for coastal managers to drown in

Following on from the subject of uncertainty over the status of the Pulicat lake fishery, this chapter focuses on three key themes: Physical (natural) causes, lake pollution, and fishermen population growth, each of which is a commonly accused cause of a decline in fish catch. Each theme is expanded and debated as to the scientific, political, social and environmental interactions which drive people's belief in each of the causes and its consequences. Chapter 6 is a core chapter of the thesis: it argues that the complexity and contestation over the drivers of coastal change at Pulicat present a barrier to coastal policy makers. And yet, complexity and contestation needs to be accounted for in coastal policy which meets people's needs. Understanding the limitations of 'participation', the importance of local politics and the implications of the complexity of views for policy making are key parts of the people-centred coastal management process.

Chapter 7 People's responses to coastal change - A direction for coastal management

Chapter 7 argues that coastal management can move forward from the barrier of contestation which is presented in chapter 6, by looking at how people are responding, adapting and coping with coastal change. A focus on the traditional institution of *Padu* reveals that a great deal of people's capacity to adapt to change (or societal resilience) is manifested in tradition, culture and issues of status and caste. These are however, the last considerations of typical coastal management approaches.

Chapter 8 Conclusion

Chapter 8 concludes with an overview of the people-centred coastal management process which has been developed in the thesis. The chapter applies the relevance of the Padu system, and social and cultural barriers to adapting to change (presented in Chapter 7) to creating coastal management options for Pulicat lake. Coastal management which is informed of the complexities of the coast and the heterogeneity of coastal people can create better policy which is more appropriate for people's needs, and more acceptable to coastal communities.

CHAPTER TWO

COASTAL MANAGEMENT – A CHALLENGE FOR SCIENCE, POLICY, AND PEOPLE

1. Introduction

A globally recognised need for a co-ordinated management effort at the coast was first formalised in the 1982 Law of the Sea convention and Chapter 17 of Agenda 21, which transpired from the 1992 United Nations Conference on Environment and Development (UNCED) Rio de Janeiro (Cicin-Sain and Knecht 1998). Since then, coastal management has travelled through a wide variety of definitions and several phases of evolution, classified by Christie and White (1997) as "Pre-colonial, centralized, community based, and collaborative coastal management...which have evolved to what today is called integrated coastal management" (Christie and White 1997:155). The evolutionary history of coastal management provides a rich multitude of theories and debates which cross disciplines and subject fields, particularly in development and natural resource management.

Throughout this thesis, discussions refer to the term 'Coastal Management' as an idea; a general understanding of the management needs of people, the coastal environment and coastal policy makers in a combined or 'integrated' way. Extensive literature already exists on developing an integrated approach to coastal management (usually referred to as Integrated Coastal Management 'ICM') through efforts to integrate management across the different sectors and stakeholders of the coast, and across sectoral managerial authorities (Sorensen 1993, Chua 1993, Cicin-Sain & Knecht 1998). ICM exists as a coastal management tool within a wider coastal management discourse; it is not coastal management itself and this distinction is important. The thesis does not apply ICM to the Pulicat case study, rather it utilises a selection of ideas and principles from a wider range of current natural resource management discourse, to develop a community and policy considerate approach applicable to coastal management of Pulicat lake. The development of a people-centred approach to coastal management in this thesis has been largely reflective, grounded in research findings and continuously evolving.

The aim of this literature review is to give an account of how the theoretical and practical understandings behind the various approaches to 'coastal management' have developed over the past two decades. The chapter focuses on those areas of literature which are most heavily drawn upon throughout the process, moving from literature

which first shaped the thesis design, to the state of current thinking and ideas for putting people at the core of coastal management.

The chapter starts with a critique of general coastal management thinking, with a focus on tools such as ICM and calls for increased coastal stakeholder participation, which are popularly argued – but frequently over-simplistic and partial solutions for managing the complex challenges of the coast. The discussion starts with a focus on what the multivalent 'Integrated Coastal Management' actually entails, the difficulties in applying definition and problems in its interpretation. Improved stakeholder participation is a core part of 'integrated' coastal management, and argued by many to be a solution for creating effective coastal management. However, whilst improved stakeholder participation may represent an important precursor to many effective coastal management situations, participation is increasingly recognised as falling drastically short of being the sole 'solution' to coastal problems, which so many have envisaged. As in development studies and natural resource management in general, "the rhetoric has run far ahead of understanding, let alone practice. Requiring participation has preceded a full understanding of its implications" (Blackburn & Holland 1998:xiii Foreword).

Part of the problem of 'traditional' scientific approaches to managing the coast is that they are not considerate of the policy making process, the social and political dynamics which are so often involved, and the difficulties in reaching a 'consensus' through 'participation' alone. In this review, a simple overview of the policy making process is provided to illustrate its lacking in current coastal management ideals of 'integration' and 'participation'. The review then discusses the growing arguments for an 'interdisciplinary' approach to coastal management, and 'newly' emergent disciplines which are now at the hands of coastal managers to better understand complexity of the coast in a social-ecological context. When one considers that policymaking is often neither a linear nor rational process, the need to better understand the complexity of the coastal system becomes increasingly evident. A more profound understanding of coastal problems, the multiple perspectives of those problems and the short-falls of scientific evidence to explain many problems is necessary if effective coastal policy making is to be achieved.

The chapter concludes with a discussion of recent 'ecosystem' approaches to coastal management, which argue to build management upon existing resilience and adaptive capacities of social-ecological systems. The findings of this thesis are well suited to ideas of resilience and adaptation. The coast is a dynamic environment undergoing vast change and a great deal can be learned by policy makers from how communities are coping with coastal change. Looking at resilience and adaptive capacity in a social-ecological system perspective is a useful way of framing the problems at Pulicat lake and as will be discussed in the thesis conclusion, provides a direction for more people-considerate policy making.

2. The growth of coastal management

Up until the 1970s, coastal zones received little attention from policy and science, however the 1992 United Nations Conference on Environment and Development (UNCED, Rio de Janeiro) catapulted growing concerns of coastal degradation and the need for coastal management on the global agenda. Key coastal concerns highlighted in Agenda 21, UNCED 1992 included: (i) the continued coastal degradation and unsustainable exploitation of limited coastal resources, (ii) accelerating human pressure from growing migration to coastal areas, (iii) the predicted impacts of global environmental change, especially sea level rise on heavily populated coastlines, and (iv) poverty, as "many of the world's poor are crowded in coastal areas" (Agenda 21 Paragraph 17.4, as cited in Vallega 1999:6). In addition to stating these global concerns, "Chapter 17 stresses both the importance of oceans and coasts in the global life-support system and the positive opportunity for sustainable development which ocean and coastal areas represent" (Cicin-Sain et al 1995:93). The theory of Coastal Management transpired from attempts to link the dynamic resources, demands, people and development of the coast in such a way that all could be integrated under a single coastal management framework.

The recognition of the need for an integrated approach to coastal management was conceptualised in Agenda 21, which calls for:

- "Integrated management and sustainable development of coastal areas" (17.1a), through realising the need for,
- "expanding research on marine living resources, particularly in the social and economics sciences" (17.93b) and
- "strengthening international and regional co-operation and co-ordination" (17.1f)

(Chapter 17, Agenda 21 1992).

When considering the application of coastal management, the first area of discrepancy encountered is establishing a definition of 'the coast'. Physically, the coastal area is highly interactive with its surrounding environment, the land-sea interface being potentially influenced by factors on a huge scale and dynamism. Physical coastal dynamics often cross the jurisdictional boundaries between states, countries and even continents (as was witnessed in the Dec 2004 Tsunami) and this has large implications for management, coordinated research and implementation. Socially the boundary of the coast is even more complex, as one considers whether coastal fishermen are more or less dependent on the coast as people working in fish markets thousands of miles inland.

Academia's definition of 'the coast', seems be reliant upon the academic discipline. A geographer may define the coast using the physical boundaries of the land-sea interface. For example, Hanson (1998:167) gives a geomorphologic definition of the coast as "the air-sea-land interface zone around continents and islands, inland reaching the maximum extent of sea spray and seaward, the outer extent of the continental shelf". An economist may define the coast using economic earnings from the coast that can benefit an entire country; sociology may define the coast in terms of numbers of households affected by the coast and livelihoods dependent upon it. "Part of the problem is that there is no universal definition of the extent inland of 'the coast' as each specialist will want to put their

slant on it, and furthermore, each coast will be different" (Firn-Crichton Roberts 2000:7). With such lack of clarity over a definition of the coast, it is little wonder that the definition of integrated coastal management continues to be the subject of debate between scientists.

Defining the boundaries of the coast in terms of academic conceptualisation is even more relevant to coastal manages and policy makers since "governments often create administrative systems, or set out policies to guide decision-making that operate within a defined coastal policy area" (Kay & Alder 1999:2). As our concept of the coast varies across scales, institutional involvement in coastal management also varies across horizontal and vertical scales, leading to a fragmentary and uncoordinated institutional responsibility for both researching the coast and coastal policy decision-making. At Pulicat lake for example, policy making is divided between state and central government bodies: the state fisheries and forestry departments being active in protective coastal legislation and fisheries development; the Central Government Institute for Aquaculture (CIBA) and the Central Fisheries Marine Research institute (CMFRI) being responsible for research and fisheries development. At the level of the community, we find that most of the day-to-day management of the Pulicat lake fishery is coordinated by the communities themselves in relative isolation from state and central government policy makers.

This lack of coordination between different levels of resource management and its consequences which are highlighted in this thesis, fit with Berkes (2000) argument that "resource management in many parts of the world has tended towards centralization and the adoption of monolithic resource management science and practice, sweeping away a rich diversity of local practice" (Berkes 2000:1). The typically uncoordinated approach of researching and managing the coast and its multiple problems has been recognised as a major obstacle to effective coastal management (Clark 1996), as such it is widely recognised that "management problems have to be tackled simultaneously at several levels" (Berkes 2000:1).

The need to integrate the ways in which institutions are responsible for the coast, and the ways in which scientists and policy makers conceptualise the coast was really first embedded in the concept of Integrated Coastal Zone Management. "ICZM establishes a process whereby government intervention can be organised, informed, and effective through programs that are integrated with the various economic sectors and resource conservation programs" (Clark 1996:2). Possibly one of the most widely cited definitions of Integrated Coastal Management was stated by Cicin-Sain & Knecht (1998) as "a continuous and dynamic process by which decisions are made for the sustainable use, development and protection of coastal and marine areas and resources" (Cicin-Sain & Knecht 1998:39). The Fisheries and Agricultural Organisation of the United Nations (FAO) offer a definition which highlights the central role of stakeholder participation and management:

"Currently, ICM is a set of operating principles and procedures designed to bring together often diverse and divergent interests to promote the sustainable management of coasts and coastal resources. While the main premises of ICM include management and participation, its primary concern is with human-resource interactions and ensuring that resources are exploited in a sustainable manner. ICM is more focussed on integrated decision making with a focus at the local level" (FAO guidelines 1998).

Since its conception at the UNCED 1992 conference, a multitude of definitions, all containing similar concepts have been given for ICM and coastal management (Sorenson & McCreary 1990, Sorensen, 1993, Awosika, et al., 1993, Bower et al 1994, Cicin-Sain and Knecht 1998, Kay and Alder 1999, Westmacott 2002, FAO 2005). This variation in definition is well reflected in coastal management terminology: Integrated Coastal Management (ICM) is now commonly referred to as Integrated Coastal Zone Management (ICZM), Integrated Coastal Area Management (ICAM), or Integrated Coastal Zone Development (ICZD). As the UNEP attempts to clarify,

"What was for over two decades coastal zone or coastal area management has recently come to be referred to as integrated coastal area management. The new acronym ICMAM 'Integrated coastal marine area management' and the old CZM or ICZM are used interchangeably. There is no consensus about the utility of adding the

word "marine" to pair off with "coastal" and the word "planning" to pair off with "management"" (UNEP 1996: Chapter 3.1).
With no academic consensus over what we should call ICM / or ICAM it is difficult to imagine reaching consensus with a wider audience over ICM aims, direction and strategy.

Pethick (1984) in the context of geomorphology, warns against an over reliance on stationary classification of geomorphologic coastal components stating "classification tends to describe rather than explain, and the task of the coastal geomorphologist must be to understand the relationships between form and process; thus classifications have tended to retard the development of a truly scientific coastal geomorphology" (Pethick 1984: 2). This is perhaps also applicable to the role of the coastal manager whose task is to understand the relationships *between* the environment and stakeholders of the coast, and whilst there are benefits in knowing exactly what we are talking about in the concept of ICM, it is important to concentrate also on its development and utilisation rather than become wedged on producing a precise definition and a never-ending debate over what ICM should and should not include. Firn-Crichton Roberts (2000), argue that,

"no one mechanism fits all, the different types of coast, and the varying degrees of dynamism in the system means that each area will require its own approach and that there is no one template for everywhere...in practice, there may never be a specific generally accepted definition of ICZM as it represents a process tool-box which is interactive, constantly evolving and adapting through a variety of policy and management instruments" (Firn-Crichton Roberts 2000:11).
Perhaps the most useful message we can extract from the colourful array of definitions is the use of common words such as 'dynamic', 'continuous', 'interaction' and 'sustainable'. The FAO definition of ICM representing 'a set of principles...to promote sustainable coasts' is particularly applicable to the process developed in this thesis.

At the core of ICM development is participation of people, as Clark (1996) argues: "The advantage of ICM (multiple use) approach over traditional sectoral (single use) approach is that it provides a framework for broad participation and for resolution of conflicts between a variety of economic development and resource conservation

needs" (Clark 1996:2). Firstly, this implies that broad participation in management automatically leads to a resolution of management conflicts between different coastal resource users. However, many uses of the coast are inherently conflicting: economic development, conservation and livelihoods for example often demand opposing management needs and priorities. ICM theory is increasingly criticised for maintaining that economic development and conservation goals are mutually supportive, providing the right circumstances of regulation through management prevails (Nichols 1999). As Westmacott (2002) argues in her review of tropical ICM initiatives,

"even though ICM is stated as the way to deal with the multi-objective decision-making environment of the coastal zone, there are few examples of its successful implementation...It is an ambitious task requiring a common vision between the different coastal stakeholders...In a world where individual interests and desires hold primary importance, the common good is often overlooked and ICM may face a series of difficulties" (Westmacott 2002:71).

Furthermore, the very nature of ICM to provide a generic state-led framework for managing the coast risks overlooking pre-existing resource management structures, many of which already function effectively at a local level. As Nichols (1999) critiques:

"far from the spatially disorganised and unmanaged frontier that is portrayed in much of the ICM literature, the coast has long been occupied by societies that have in varying degrees, successfully managed resources such as fish under common property regimes (McCay and Acheson 1987)...Interpreted through this lens, Integrated Coastal Management programmes do not heal disabled community resource management systems; rather, they facilitate the further subversion of these systems by encouraging national and global capital penetration" (Nichols 1999:389).

The following section discusses the ideals behind participation in coastal management and questions whether participation acting alone can lead to a consensus over management needs and effectively implemented coastal policy.

3. *Participation in coastal management*

Current coastal management discourse frequently calls for a more 'improved' participation of coastal stakeholders in the management process (Hegarty 1997, Davos 1998, Olsen & Christie 2000). Academic arguments for this need have largely been focussed on the negative implications of missing community involvement in coastal management (Johnston et al 1998, King & Faasili 1999, Zanetell & Knuth 2004), and an inability of traditional top-down government structures to create effective community involvement in natural resource management (Poffenburger & McGean 1996). "The challenge ...lies in developing the political will to improve communication between all stakeholders concerned with the environmental, economic and social significance of the coastal and marine area" (Clark 1996, Burbridge 1997, as cited in Gupta & Fletcher 2001:760). In a recent review on the effectiveness of ICM initiatives, Christie et al (2005) state that "Participatory processes, while challenging to manage and under growing scrutiny, remain the most effective manner to engage broad constituencies and ensure that benefits match expectations" (Christie et al 2005:468).

Research in coastal resource management, such as fisheries, has long argued that "resource conflicts can be diminished and resources better managed when fishers and other resource stakeholders are more involved in management" (Pomeroy 1995:143). Cicin-Sain et al (2000) conducted a global review of ICM academic and short-term training programmes across 30 institutions and found that a major emphasis of programmes included: "setting ICM goals, issue identification, prioritizing issues, setting boundaries, program adoption and implementation, developing an ICM plan, and constituencies/partnerships building" (Cicin-Sain et al 2000:14). This is in tune with traditional approaches to ICM, which slant towards a need to 'educate', 'train' and 'capacity build' in order to reach effective decision making on coastal policy. Coastal management capacity building is defined by Cicin-Sain et al (2000) as "The design and conduct of the range of activities necessary to enhance the capacity of institutions and the individuals that comprise them to undertake effective ICM programs" (Cicin-Sain et al (2000:3). However this does not answer the question over

which institutions and which individuals are to be involved in the ICM capacity building process.

In Cicin-Sain's survey of ICM training courses 'Public participation' had 'major emphasis' in only 10% of the courses surveyed (Cicin-Sain et al 2000:15). In India, fishing communities still have very little to say over their fishing resources and McGoodwin (1990) argues this is the norm in small scale fisheries: "In most fishing nations today there are few institutionalised forums where small-scale fishers can effectively express themselves, and fewer still where they are empowered to influence fisheries policy in any decisive way" (McGoodwin 1990:81). This scenario remains in India, and is well illustrated by the bus loads of policy makers, government officials and scientists who sometimes visit Pulicat lake as part of a Chennai-based ICM training project. In reference to such a visit, a local fisherman told me "people come and look at the shrinking lagoon opening, they don't ask us about it, they just come and then they go away again, nothing gets done about it". In India, forums of debate over ICM are the last place fishermen are to be seen; indeed the inclusion of NGOs is still a hot topic for debate. Furthermore, in many coastal management discussion circles it sometimes seems that officials and academics are themselves far too self-conscious to speak up, lest they say something wrong or in disagreement with a 'senior' level manager. With such an atmosphere existing in a room full of well-educated academics it seems highly unlikely that a similar forum would be successful to elicit views of other players in the coast, such as fishermen.

Whilst this scenario certainly justifies calls for 'better' participation in coastal management, important questions arise over who are the participants, and in what ways are they active in the coastal management process? These are well-debated questions amongst social scientists and development practitioners (Botes & van Rensburg 2000, Cooke and Kothari 2001), and under the wider umbrella of 'community-based resource management' (Kellert et al 2001). In particular, effective participation has been the focus in agriculture development through Chamber's farmer-first innovation (1989) and in community-forestry management (Carter 1996), which have resulted in a vast range of participatory techniques commonly used in development and resource management (Chambers 1992). However, alongside increasing efforts towards better participation, are accompanying concerns over

sufficient acknowledgement of the complexity of the participation process (Beck 1994, Poffenburger & McGean 1996, Blackburn and Holland 1998, Bennet 2000).

Coastal management, perhaps through a natural science based foundation has been slow on the uptake of cautions over 'participation' in decision making. This is gradually being reconciled with an increasing number of coastal management-based research which address the difficulties and complexities of participation in the management process. Hanna (1995) recognises that participation is not easily obtained, and that certain background requirements are necessary for effective participation in fisheries management; "Participation can contribute positively to fishery management performance when there is a history of collective decision-making, the time line is slow enough to allow a full consideration of the issues, educational possibilities are pursued and the condition of the resource allows equitable compromises." (Hanna 1995:23*Abs*). The case of coastal management in Sri Lanka, which is commonly cited as a coastal management success (Cicin-Sain & Knecht 1998, Westmacott 2002), is equally reported to suffer poor implantation of well-constructed management plans (Rajasuriya et al 1999 as cited in Westmacott 2002:71). Foell et al (1999) conducted a comprehensive study of coastal zone management and 'participation' in Sri Lanka and concluded participatory approaches in use faced a multitude of problems. As has been argued in other participation critiques (Cooke and Kothari 2001), participation approaches are not easily sensitive to power dynamics of participant groups (Foell et al 1999).

"Although participatory approaches are now standard elements in NRM [Natural Resource Management] interventions, in practice they are often problematic. They usually elicit the participation of the most visible and powerful and the political nature of 'empowerment' is often not acknowledged. The quality of participation is doubtful, the quantity of participants rather than the quality of their participation frequently being stressed" (Foell et al 1999:1).

Foell et al (1999) argue that vocal 'key actors' in stakeholder groups do not necessarily have the same interests or concerns of the wider population, often whom they are assumed to represent (Foell et al 1999). This is also illustrated by the Pulicat case study presented in this thesis, where stakeholder participation has not produced a consensus over problems, causes and solutions, but has revealed important forces of politics and agenda at all levels of stakeholder groups.

Foell et al (1999) further argue that 'stakeholder analysis', a form of participation which is more encompassing of the competing interests between different groups, or stakeholders of the coast, is confronted by similar problems when faced with complexity. "These include the assumption that the 'local' is a clearly bounded and defined entity such as a village, within which there are clearly defined interest groups whose needs can be ranked and compared. There is a danger of stakeholder analysis becoming little more than rhetoric. This is aggravated by the need of development agencies to strike a balance between empirical complexity and the need for manageable categories" (Foell et al 1999:1). This elicits methodological questions of how to understand the complexity of the coast though participatory approaches. For example, Foell et al (1999) argue that dividing stakeholder groups according to a limited knowledge of the 'expert' "undermines the credibility of any stance about understanding the complexity of interest" (Foell et al 1999: 1.1.2). This conclusion is also relevant to the findings of this thesis; participatory approaches alone were insufficient to reveal some of the more complex issues of change in the Pulicat system, for example the importance of traditional systems of community management to people's survival strategies. As is discussed in the methodology, this understanding required a far longer and more qualitative approach to field work, something which is not the norm in coastal management.

There is some evidence that ICM arguments are acknowledging the limits of participation. For example Hegarty (1997) examines the possibilities for a community based approach to integrated coastal zone management in Ireland, connecting a well established community-based resource management debate (discussed later in this chapter) with ICM potentials. Olson (2003) calls for "new forms of collaborative action among institutions, the actions of state–civil society partnerships, and the behavioural changes of resource users" (Olson 2003:349). Campbell et al (2003) however, argue that although there is increasing participation of coastal communities in the policy process, largely through developments in methodologies such as Participatory Rural Appraisal (Chambers 1994a, 1994b, 1994c), this participation tends to be mainly in the implementation phase of the research. For the majority, coastal communities are still participating in research agendas that are defined elsewhere and in research processes that are planned by formal 'experts' (Campbell 2003). Kellert et al (2001) in a global evaluation of participatory approaches in

community-natural resource management, concluded that, "despite sincere attempts and some success, serious deficiencies are widely evident...Community Natural Resource Management rarely resulted in more equitable distribution of power and economic benefits, reduced conflict, increased consideration of traditional or modern environmental knowledge, protection of biological diversity, or sustainable resource use" (Kellert et al 2001:705). From these accounts it seems that "Participation is not as easy as many believe it to be, it is important to recognise and integrate the forces of politics and patronage and power relations that exist in coastal areas and that can make participation very difficult" (Campbell et al 2003:20).

This thesis draws heavily on methodologies of stakeholder participation such as perception gathering, interviews, and management priority ranking surveys, and it does so well-aware of the limitations of participation in providing a consensus or management outcome. As is discussed in the methodology section, stakeholders at all levels, community, policy making, academic and NGOs are involved from the start of the process and their perceptions of change and management needs form the core of the thesis analysis. As is illustrated in this thesis, despite a more central role of coastal stakeholders in developing a coastal management agenda for Pulicat lake, this does not provide neat management options that policy makers can easily follow: "participation development remains, a complex and difficult, though essential and challenging endeavour" (Botes & van Rensburg 2000:41).

As has been discussed, participation of stakeholders at all levels in the coastal management process is often only partial, being sought by 'expert technicians' at the implementation stages rather than the design stages of the management process (Campbell 2003). Traditional coastal management assumes that a consensus can be reached through training, education of stakeholders and willingness to compromise (Hanna 1995, Cicin-Sain & Knecht 1998) and its holism largely overrules or overlooks existing management structures, which are often community- or tradition based (Nichols 1999). In the present study of Pulicat lake, these two limitations of coastal management, reaching a formal or state-led management consensus and neglect of informal management structures are well illustrated; each is discussed in turn in the following section.

4. Limitations of coastal management – problems for policy

A large part of the limitations expressed from the coastal management and 'participation' discourse stem from a lack of appreciation of the complexity of the policy making process. This is largely because much of the foundations of coastal management originate in a 'technical expert' driven agenda and a natural science perspective. As Le-Tissier & Hills (2002) emphasise, "The principal focus of most Integrated Coastal Management (ICM) programmes is to develop a knowledge base of the natural processes that affect and impact the coastal zone" (Le-Tissier & Hills 2002:245). In natural science, questions are posed, hypotheses are tested, and scientific findings are too often presumed to feed smoothly in appropriate policy for the coast. This stems from a misguided belief that a consensus can be reached through education alone; through informing or 'educating' coastal stakeholders of robust scientific evidence, a best practice can be agreed and achieved. As Warburton (1998) states, "Some environmentalists will still argue that priority should be given to the search for the scientific evidence that will win the technical argument, or the professional solution which will solve the problem" (Warburton 1998:2). If one considers the complexity of the policy making process and the influence of divided agendas and politics within that process, it becomes evident that reaching a management consensus between different coastal stakeholders is a complex and difficult challenge. The challenge is unlikely to be met solely by the 'expert' driven attempts of improved 'participation' and 'education' of coastal stakeholders.

Already this chapter has discussed the complexities which arise in attempting to achieve active participation in the coastal management process. "When the policy process applied to the complexities of the coast with its dynamic and changing nature, its overlapping sectoral activities, its international implications, and its diversity of stakeholders, it is surprising that the policy process works at all" (SCL 2000:1). There are extensive debates in the social and philosophical sciences on the policy making process, which span decades if not centuries. What we can draw from this rich arena are aspects of policy theory, within the context of the coastal management process? As discussed in chapter one, this thesis aims to produce a coastal management process which is better suited to both coastal communities and coastal policy makers needs. This section aims to discuss in the simplest terms, how policy makers operate, and how recognition of this is largely ignored by the coastal management debate.

Rational decision-making

There is much controversy over the way in which policy decisions are made and should be made. Hill (1997) describes how a dispute exists between,

"an approach which is distinctly prescriptive - rational decision making theory - and alternatives of a more pragmatic kind, which suggest that most decision making is incrementalist, and that this offers the most effective way to reach accommodations between interests" (Hill 1997: 99).

Herbert Simon was one of the first to conceptualise the ideal of rational choice. Defining a decision as a choice from amongst known alternatives, Simon states that rational choice involves selecting alternatives,

"which are conducive to the achievements of goals or objectives within organisations...Rational decision-making involves the selection of the alternative, which will maximise the decision makers' *values*, the selection being made following a comprehensive analysis of alternatives and their consequences" (Simon 1957 As cited in Hill 1997:99).

Rational decision-making follows a logical order of steps, from problem identification through to deciding upon a solution via considering the various alternatives and choosing the 'best solution' according to the goals of the project. Although there may be some situations where the assumptions of rational decision making are closer to being met, in the context of coastal management this is unlikely ever to be the case, mostly due to the complex use of the coastal environment and the variety of groups dependent upon those uses.

As Simon (1957) discusses, the first difficulty in rational-decision making is found in assessing "whose values and objectives are to be used in the decision making process" (Simon 1957 as cited in Hill 1997:99). A fisherman for example, may have very different values to those of a government minister, a conservationist, or an industrial developer. Simon (1957) further addresses how complexity poses problems for policy making process:

"In practice, decision-making rarely proceeds in such a logical, comprehensive and purposive manner. Among reasons for this are that it is impossible to consider all alternatives during the process of decision; knowledge of the consequences of the

various alternatives is necessarily incomplete; and evaluating these consequences involves considerable *uncertainties*" (Simon 1957 as cited in Hill 1997:99).
Majone (1989) draws on the difficulties of 'uncertainty' in policy making, in his arguments for a special significance to be given to procedures of decision making rather than final outcomes:

"uncertainty forces a significant departure from a strict orientation towards outcomes...it is no longer possible to determine unambiguously what the optimal decision is. Hence the usual criterion of rationality - according to which an action is rational if it can be explained as the choosing of the best means to achieve given objectives - is replaced by the weaker notion of consistency ... (a procedural, not a substantive, criterion)" (Majone 1989:18).

Blowers (1993) also supports the idea that 'uncertainty' poses great difficulties to environmental policy making. Blowers (1993) argues that uncertainty is manifested in the very inability of science to ever be certain, and gives reasons amongst others in 1) "a difficulty to establish the responsibility for cause and effect" (of environmental problems), 2) "frequent absence or scarcity of environmental data makes it more difficult to provide sound scientific judgements" and 3) "the often fragile interpretations of environmental science can easily run aground on the shoals of politics where conflicts between interests dominate" (Blowers 1993, as cited in Hannigan 1995:82).
In the case study of Pulicat lake, incomplete 'scientific' knowledge has posed a substantial barrier to decision making in coastal management. Where the environment and societies of the coast are inextricably linked and multidimensional, our scientific comprehension of them is often fragmented and contradictory. As is described in Chapter 6, coastal management needs, priorities and agendas are contested at local, academic and government levels, amongst varying degrees of scientific evidence. The intervention of large-scale politics, often at national and international levels on local perceptions of coastal management needs is something rarely considered in coastal management participation efforts.

Hill (1997) criticises Simon (1957) as his theories and rules apply to a singular decision maker, where as the decision making process, according to Hill, is a more complex collective process, which needs to account for more than one viewpoint (Hill

1997). This leads us into the realm of understanding the policy process less as a form of rational decisions based on available scientific information, but rather as a highly political process based on perception, agenda and forms of persuasion (Majone 1989, Lindblom & Woodhouse 1993). Lindblom & Woodhouse (1993) are advocates of reasoned and informed persuasion, arguing "Whenever two or more political participants think about a problem, there is a good chance they will come up with different ideas regarding what, if anything, should be done" (Lindblom & Woodhouse 1993:128). Lindblom & Woodhouse see policy as "a task of conflict resolution" (Lindblom & Woodhouse 1993: 128), and argue that a major tool to resolve this conflict is informed and reasoned persuasion. They argue that policy analysis must play a role in promoting such persuasion within the decision making process; persuasion being defined as "the use of information and thought to move people closer to reasoned and voluntary agreement" (Lindblom & Woodhouse 1993:129).

Current Coastal management discourse follows a similar slant, through emphasis on the role of increased education and information as a rather top-down flow of generating understanding about the coast, and informing coastal policy, a process which is also wrought with difficulty. For example, Mukerjee's (1998) analysis of coastal management 'trainer of trainers' programmes in Indonesia, frequently observed that many 'trainers' were by and large unprepared for the role they were expected to perform, and that although they agreed with the objective of empowering the community, they lacked the training necessary to foster that process (Mukerjee 1998). On questioning a former participant of an ICM 'trainer of trainers' programme in India on what he had learnt, I received the hasty reply "we must learn to consider others and include NGO's"; a suspected premeditated 'appropriate' response, which left me suspicious about how much meaning and understanding actually accompanied the phrase. A commonly held view is that "researchers need to become more active in *informing* decision makers and the public about the results of their work through more accessible publications, the media or public talks" (Shah & Linden et al 1997:227). Whilst co-operation with existing management infrastructure is certainly a step in the right direction, the ability of the *informer* to *accurately inform* and the *recipient* to *accurately interpret* is a delicate and highly fallible process. Again Simon's (1957) arguments on 'whose values and objectives' should be integrated into the policy making process, raise important questions for coastal management.

Majone (1989) writes about the neglect of science and policy makers to consider the influence of politics on the policy process, and the subsequent poor transition of scientific solution through rational thought into rational policy. He puts forward a 'dialectic conception of policy analysis' - a notion that policy has "less to do with formal techniques of problem solving than with the process of argument" (Majone 1989:7). Majone (1989) states that there are three paradigms from which policy is formulated: *Evidence* based policy is needed, but it can not stand alone without the consideration of creating *argument* and effective *persuasion.* Majone argues that even if scientific evidence is good, "to decide, even to decide correctly, is never enough in politics. Decisions must be legitimated, accepted, and carried out. After the moment of choice comes the process of justification, explanation, and persuasion" (Majone 1989:31). Majone criticises the rational-choice model of decision making through a lack of consideration of the processes of persuasion and argument: "If a joint decision is required, different actors will have to resolve their differences through interactive processes like negotiation and persuasion, about which the ('rational choice') model is silent" (Majone 1989:15).

What coastal policy makers in India usually receive is a surplus of highly fragmented and opposing scientific viewpoints, unable to be sure of the 'facts', and lacking a coherent argument. De Jonge (2000) argues that "One of the duties of researchers operating in the field of applied science might be to offer suitable relationships, information and instruments that are usable as a rational basis to decision making in coastal zone management" (de Jonge 2000:1680). De Jonge (2000) emphasizes the importance to modifying scientific knowledge and information into a format that can be used by managers, policy makers and decision makers, which can be aided through tools: "available information about the socio-economic subsystem and the natural subsystem can be integrated in instruments like 'knowledge management systems' or 'decision support systems' to help structure discussions in prioritising between policy options" (De Jonge 2000:1680). Such systems must be more encompassing of politics and the processes of policy making which, according to Majone (1989) are tightly wrapped with 'making a persuasive argument'.

An important point to make at this stage is that although it seems naive to create problem recognition blind of the final politics which it must persuade, to an extent,

science must also retain a degree of autonomy from politics. Majone (1989) argues that this autonomy is an unrealistic assumption of scientists because of the political nature of policy; the linkages between society, the environment, politics, and participation are too great to be ignored. From a coastal management perspective, Ducrotoy & Sylvand (1998) conversely argue that sound scientific knowledge is indispensable to any ICM action, and that strong supporting scientific evidence must be the central force in orientating policy-making (Ducrotoy & Sylvand 1998):

"robust data sets are needed for taking specific conservation measures, necessary for the protection of ecologically important or key biological diversity indicator species and their habitats. The fact that there are many environmental variables playing a role in the marine environment requires sound scientific input to management but difficulties arise when setting criteria for consideration or not of the many pieces of biological work available. This is why it is necessary to take an integrated view and thus assess the action needed" (Ducrotoy et al 2000:430).

This typical natural scientist view of an 'integrated' coastal management is neglectful of the wider politics involved in coastal management. As discussed in chapter one, and advocated by Majone (1989), coastal management needs to create a balance by presenting robust scientific evidence as an argument which acknowledges the political processes of persuasion in order to become useful to policy makers.

The complex needs of policy makers and the complexities of the policy making process are eventually filtering into the coastal management discourse, and a middle ground between the science-policy-politics conundrum is being developed. First attempts of joining coastal management with policy makers needs began with arguments of how best to implement coastal policy (Fleming 1996), i.e. the activation of coastal management in practice. In their study on the role of scientists in developing aquaculture legislation, Kaiser & Stead (2002) acknowledge that "The truth is that scientists are uncertain of all the possible effects that can exist, and it can be difficult to predict the outcome of events and activities, especially when further unknown entities such as global warming complicate the issues at hand" (Kaiser & Stead 2002:479)..."In order for ICZM to be an effective tool in the formulation and integration of policy then information transfer to all interested parties is an important prerequisite; the latter critical to the facilitation of broad debate and subsequent recommendations." (Kaiser & Stead 2002:450). More recently, other coastal

management forums are tackling the debate of complexity and the policy process from a perspective which recognises the inter-linkages between policy, scientists and coastal communities and the importance of a two way flow of knowledge (Olsen 2003, SCL 2000, Campbell 2003). These approaches are all inclusive of 'enhancing' participation as means of facilitating that flow of knowledge; for example SCL (2000) states that in response to the complexity of the coastal policy process, networking should endeavour to include "as many stakeholder as possible, at different stages of the process" (SCL 2000:3).

Calls for improved participation in the coastal management process could be interpreted as a movement towards acknowledging a need for persuasive forms of management, through using participatory tools such as stakeholder analysis. However, it is questionable whether the public participation forum, much talked about in today's coastal management discourse, has yet reached the level where actions of negotiation and persuasion are utilised in the policy making process. At present it seems that stakeholder opinions are often integrated as an afterthought to management, to gauge support or opposition to a pre-determined management strategy. As has been discussed earlier in this chapter, in many cases, coastal policy is still formulated from top down transfers of knowledge and opinion. Currently in ICM as with much development research, 'best policy' is being determined by expert-based rational, rather than selecting the 'correct policy' drawn from maximum available stakeholder support (Davos 1998). Perhaps rather than arranging what we as scientists can teach, the question should be reversed to ask what we as scientists can learn.

5. Bottom up forms of coastal management - starting with what the people know.

There is growing debate amongst scientists involved in the arena of sustainable resource utilisation that the smooth flow of an 'agreed' set of management options into coastal policy is a vastly naive interpretation of the ways in which scientific understanding, coastal stakeholders and policy making interact. The scientific discourse is changing with an emergence of 'civic science', a concept "which recognises that science must become an increasingly interactive process between lay and expert people, reconnecting science and its cultural context, and argues that

science must increasingly be linked to empowerment and activism and involve transfers of respect and power" (O'Riordan 1998, Warburton 1998:3). Berkes et al (2003) argue that "Familiar approaches to developing and testing hypotheses are inadequate because of non linearity, complexity and long time lags between actions and consequences" (Berkes et al 2003:3). "Alongside these new ways of thinking about science itself, conventional professional approaches are increasingly challenged by arguments for more participatory approaches which devolve power to the poor and explicitly encourage professionals to make changes to their personal, professional and institutional values and practices" (Chambers et al 1998, Warburton 1998:3). However, in order to work with existing power structures, we first need to understand what they are in order to facilitate the exchange of knowledge and experience between rural communities and researchers, legitimise local knowledge and promote empowerment (Kuipers *et al.* 2001). As coastal management practitioners and theorists have been calling for increased and better 'participation' in the management process, there has been an accompanying body of literature in the wider field of natural resource management, which argues that management needs to start from a bottom up perspective. This often entails a greater recognition of the wealth of knowledge and value of working with pre-existing traditional and community-based management structures.

Over the past decade there has been an explosion of interest in Community Based Natural Resource Management (abbreviated as CBNRM), reflecting a perspective that local resource users should have a stronger voice in managing their environment (Pollnac and Crawford 2000), however, it is important to remember its basic meaning, i.e. people deciding over their own lives (Mikkelsen 1995). The academic literature on CBNRM has grown into an extensive and rich array of case studies and theories as to how communities are in many cases managing natural resources largely without external intervention (McKay 1978, Mathew 1991, Ostrom 1990, Hannah and Munasinghe 1995). CBNRM has also been utilised as a tool to foster better community-participation in management of resources (Bennet 2000, Nickerson-Tietze 2000) where decision-making power is devolved to local communities. "In other words, the state should retain ownership of the natural resources, while devolving the power to manage and control the resource to the stakeholders. This is referred to as co-management (Berkes et al., 1991; Pinkerton, 1989, 1994)" (Husain and

Bhattacharya 2004:564). As is summarised by Husain and Bhattacharya (2004), CBNRM "found its echo in 'official' pronouncements (WCED, 1987; The World Bank, 1992; UNCED, 1992) and in applied literature (Cernea, 1985; Holloway, 1989; Ghai and Vivian, 1992; Adams et al., 1997; Klooster, 2000; McCarthy, 2000). It was realized that organizational units smaller than the state apparatus – villages, for instance – are better equipped to manage their environmental resource base than are larger external state authorities. They possess greater information about the resource base and behaviour of resource appropriators, and can ensure greater participation of stakeholders by integrating customary social structures into the resource regime. As a result there was a shift away from direct state management of natural resources to a greater reliance on community-based management" (Husain and Bhattacharya 2004:563).

CBNRM and coastal management are not automatically linked, despite both concepts originating from the same 1992 UNCED conference in Rio and the development of Agenda 21. A consensus was reached at UNCED whereby the newly emerged concept of "sustainable development'" should be based on "local-level solutions derived from community initiatives (Ghai and Vivian, 1992; Ghai, 1994)" (cited in Leach et al 1999:225). However, many of the resulting concepts from the 'sustainable development' field have found limited application to coastal management, which is still based upon a top-down state or 'expert' led ideology. Where coastal management initiatives have traditionally been driven by natural scientists, engineers and 'technical experts', the field of CBNRM has had a much larger social science influence, which may in part be a primary cause of the different paths each management ideology has pursued. The relevance of CBNRM initiatives to coastal management is substantial; for example successful case studies of traditional management of 'common property' in coastal resources and fisheries are plentiful (McKay 1978, McKay & Acheson 1987, Kurien 1988, Pinkerton 1989, McGoodwin 1990, Ostrom 1990, Dyer and McGoodwin 1994, Agrawal 2002), and arguments for a devolution to community-level management are well-established (ibid, Pomeroy 1995, Pomeroy et al 1996).

There has been an expanding initiative to join the policy frameworks of Coastal Management to CBNRM ideology and practice (Hegarty 1997, Christie & White 1997, Lowry et al 1999, Courtney & White 2000), in particular, the evolution of Marine Protected Areas as a coastal management tool has presented many

opportunities for devolution of management responsibility to a community level (Gilmore 1997, White et al 2002, Helvey 2004). In their review of ICM initiatives in Asia, Christie et al (2005) argue that "The scaling up of many local initiatives in the Philippines and Indonesia is well underway and warrants ongoing support and monitoring...Attention must be paid to legal and institutional frameworks that support integrative planning on local and national scales" (Christie et al 2005:468). Despite these initiatives, a substantial amount of CBNRM and Common Property research argues that many community-based coastal resource practices continue to be overlooked and sometimes replaced by a top down management perspective, leading to resource degradation (Hannesson 1988, Kurien 1988, McGoodwin 1990, Ostrom 1990, Pomeroy 1995, Pomeroy, Katon and Harkes 1998, Ostrom 2002, Lobe and Berkes 2004). Dyer & McGoodwin (1994) argue that despite this wealth of knowledge,

"indigenous viewpoints have seldom been incorporated into management regimes. On the contrary, as resources have become threatened and users more acrimonious, management policymakers have become more conservative and inflexible (Ward & Weeks 1990). An outcome has been the elimination of local resource control and further decline in the sustainability of fisheries worldwide (McGoodwin 1990)" (Cited in Dyer & McGoodwin 1994:56).

The effectiveness of employing a CBNRM approach to the management and co-management of coastal resources is not without its critics. The shortcomings of CBNRM are similar to those of 'participation' in coastal management; common criticisms reveal that:

"intended beneficiaries are treated as passive recipients of project activities (Pimbert and Pretty, 1995; Arnstein, 1969); a tendency for projects to be too short-term in nature and over reliant on expatriate expertise; ...and suggestions that the interests of certain social groups have been consistently marginalized (e.g., Hobley, 1992; Sarin, 1995)" (Leach 1999:226).

What a people-centred coastal management can adopt is some of the core principles which are embedded in the CBNRM debate; essentially, asking how people are already participating in natural resource management, what they already know and how they are reacting to change. This approach is different to calling for better

'participation' in coastal management, which often means participating in predetermined expert driven management agendas. In essence, it wipes the slate clean and starts with what people are already doing, and how people are reacting and coping with changes and development at the coast. These ideas are well-established in certain fields of development, poverty and natural resource management research. Beck (1994) has long argued that it is all too easy to look at a poor fisherman and see how poor he is, but what is needed, is an approach which looks at what the fisherman has, how he aims to keep and improve the little he has, and how to build mechanisms to assist this development that the fisherman takes on himself (Beck 1994). Klee (1980) states that "modern resource managers should drop their superior attitude and take a closer look at what these societies did to conserve resources" (Klee 1980:238 as cited in McGoodwin 1990:42). However, this communication of knowledge between 'experts' and 'coastal communities' is not, even when sought, easily achieved. McCay (1988) describes the reaction of a fisherman to scientists and fisheries administrators with which he interacted during a meeting: "He left the meeting disgusted at the 'objectivity' of scientists when men's lives are at stake, a not uncommon reaction of non-scientists to scientists" (McCay 1988:329, McGoodwin 1990:77). Despite these difficulties, as Beck (1994) emphasises, research management and development projects must start asking the question:

"What do poor people do already from within power structures to improve the quality of their lives?"...and..."If poor people have learnt how to increase respect or resources from the village elite, to manipulate village power structures to their benefit, what can we as policy makers learn from this?" (Beck 1994:4).

Within development studies, coping strategies of the poor and ability of households to adapt to change have being integrated into global poverty alleviation strategies and policy (Chambers 1989, Ellis 2000, Devereux 2001 & Prowse 2003). Frameworks which are particularly applicable to coastal management are those developed as part of the Sustainable Livelihood Approach (Chambers & Conway 1992, Scoones 1998 & Ellis 2000), which are engineered specifically to target the complexity of people's movements within economic, environmental, social and political domains. "A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations)

that together determine the living gained by the individual or household" (Ellis 2000:10). This concept seems to fit well with the need to develop an understanding of people's interaction with the coast, which encompass the variable 'assets' with which households interact. However, it seems that the larger part of coastal management still remains on the side of biological, technical and natural science interpretation and explanation. As Le-Tissier & Hills point out "The principal focus of most Integrated Coastal Management (ICM) programmes is to develop a knowledge base of the natural processes that affect and impact the coastal zone. While it is vital to understand the natural processes at work in the coastal zone, ultimately management policy is seeking to control, constrain, encourage or modify the behaviours of people whose welfare and livelihoods are dependent on the resources of the coastal zone" (Le-Tissier & Hills 2002:245). It follows that to form relevant policy which can in some way influence people's behaviour, coastal managers must be better informed in the ways in which people are already 'behaving' and reacting to coastal change. As McGregor (1990) points out, "Projects which blunder into involvement with clients, oblivious of the economic and political relationships which make up the (livelihood) portfolio which has helped that household survive up to that point in time, can seriously disrupt that portfolio" (McGregor 1990:13).

It is convincingly argued in the academic literature that understanding the behaviour of coastal communities is key to understanding both the dynamics of and management needs within the coastal arena (particularly in fisheries management) (McCay 1978, McGoodwin 1990, McGregor 1990, Bene and Tewfik 2000 and Kurien & Paul 2001). It is also widely agreed that coastal zones are continuingly degraded (Christie et al 2005) and that most of the world's fisheries are over fished and progressively more unsustainable (Pauly et al 2002, Berkes 2003). With this in mind, it is quite amazing that coastal management has not incorporated understanding of the ways in which coastal dependent societies are reacting, adapting and coping during this crisis of change at the coast. This review has described a brief overview of the rich array of argument, theory and evidence found in the arenas of policy-making, community-based natural resource management and tools in development studies such as participatory approaches and the sustainable livelihood framework, all of which advocate the vast wealth of knowledge that is held through understanding community

behaviour and input. And yet, coastal management seems to have been able to link up with relatively few of the principles described.

Two particular experiences convince me that this largely remains the case in current coastal management and that synthesis between these areas of research is still in the immature phases of development. The first is an opening conference speech given in 2005 by a prominent academic in fisheries management, who was introduced with a reference of his influence in global fisheries policy. His speech asked the question "What does social science do for fisheries"; an unbelievable question in the face of existing vastness of anthropological based fisheries research, which has been highlighted in this chapter. His question was backed up by an internet 'google' search for the words "fisheries" and "social science" which of course led to rather few publications, illustrating a typical difference between 'scientific' language. Had he 'googled' for "community-based management", "maritime anthropology", "folk management in fisheries" for example, the score would surely have been much higher. However, the challenge put to social scientists involved in fisheries at that conference was how to get their research out into the policy arena; essentially, how to fit individual published case studies into a more generic fisheries policy framework. Indeed, the challenge of matching local and often complex interpretations of the specific with universal policy frameworks must be relevant to most forms of scientific enquiry. However, the fact that social science inputs into natural resource management can be questioned in the face of such a vast history of research, means that there is a problem in combining the many different academic perspectives of how to manage the coast. These divisions within the academic sector, can only multiply and widen amongst the varied stakeholders of the coast, who are ailed with differences in priority and need.

The second experience is detailed in this thesis and involves my own experience of ICM practice in India. ICM in India is taught by 'expert' academics and 'technicians' with incentives to 'include' all coastal stakeholders such as NGOs and local communities, as much of the traditional ICM capacity building literature advises (Cicin-Sain et al 2000, Hale et al 2000, Fletcher 2001). However, as is illustrated by this thesis, consideration in coastal management over how communities are already managing resources and, in some situations, adapting to changes in those resources

are at the bottom of the agenda –if on it at all; a far cry from becoming an integral part of a management process. This scenario is possibly the result of an early stage of implementing the idea of ICM in India. The Indian government Department of Ocean Development established a nation-wide Integrated Coastal and Marine Area Management (ICMAM) project directive in 1998 to build coastal management capacity building in selected coastal areas (ICMAM 2002). As Gupta and Fletcher (2001) describe, "The Indian approach, however, remains reliant upon a single sector, with little apparent interagency co-ordination, and limited prioritisation of the cumulative impacts of multiple uses. The challenge for India is to create an effective coastal and marine area management programme and to encourage government interest in the ICM concept (Cicin-Sain and Knecht 1998). In such a situation, the first priority should be to create a framework that has the mandate, human and financial resources, and the political will to put the concept of ICM into practice (Olsen et al 1997)" (Gupta &Fletcher 2001:758). Furthermore, coastal management needs to be considerate of the particular politics, economic and social settings of each individual circumstance (Cicin-Sain & Knecht 1998). In India, as Gupta and Fletcher (2001) point out, "There are no 'best' or 'right' solutions. The framework cannot be constructed (nor dismantled) overnight because of the underlying cultural ideas and power relationships within an organisation (Visser 1999). It raises difficult issues in the distribution of authority, responsibility and power within a nation....Indian society is characterised by social inequality, economic disparity and a general attitude of government dependence (Ninth Five-year Plan Government of India)" (Gupta and Fletcher 2001:758). With this in mind, developing a people-centred approach to coastal management in India faces steep challenges. On the other hand, surely researching how Indian societies themselves are able to manoeuvre within their own cultural settings may reveal a direction for management which is appropriately suited to the Indian situation.

6. A way forward – crossing disciplines in coastal management

It seems that, in general, academic understanding of people and the coast is rich and diverse, but fragmentary and largely isolated from understandings of the policy process. Amongst these rather depressing experiences, there is a welcome relief found in interdisciplinary endeavour. Emerging from the vast range of knowledge we

already possess about the coast is a more joined-up way of thinking, which is rooted in an interdisciplinary approach to natural resource management. The development of interdisciplinary research devoted to understanding environmental problems and formulating solutions is not new. The interplay of the social and natural sciences has been debated for several hundred years and was begun as early as the 17th Century by authors such as Grotius and Spinoza and in more recent times by philosophers such as Popper and Lakatos (Fogelman 1995).

"From Aristotle's biological analysis to recent work in socio-biology and evolutionary psychology, social and political thought has kept close connections with the natural sciences. Many of these encounters have been fruitful, some merely fruity: recognising the difference is not always easy" (Fogelman 1995:1004).

Crossing the natural and social science divide has been an important step in developing an integrated vision of people and their environment. Davison-Hunt & Berkes (2003) argue that the environment-society dichotomy, so present in today's science, was actually a western conception devolved from the 18th century Enlightenment Period: "With the Age of Enlightenment, humans were extracted from the environment. The separation of nature and society became a foundational principle of Western thought and provided the organizational structure for academic departments. Since that time, Western thought has oscillated between positions in which nature and society were treated as distinct entities, and one in which articulations between the two were examined" (Davidson-Hunt & Berkes 2003:53).

Early attempts to view, or re-view, the natural and social systems as a whole were accelerated by 'General systems' theory (von Bertalanffy, 1968 as cited in Berkes et al 2003:5), which has since been advocated and developed as a "'science of complexity" (Costanza et al 1993, Kauffman, 1993, Holland 1995, Levin 1999a)", a form of systems thinking which encompasses "nonlinearity, uncertainty, emergence, scale, and self-organisation" (Berkes et al 2003:5). Interdisciplinary approaches merging society and ecology within a 'coastal eco-system' were furthered by authors such as Bonnie McKay (1978) and her exploration of 'people ecology ', which emphasised the "role of larger political and social processes which affect local fishermen" (McKay 1978: 397). McKay (1978) documented the adaptive strategies of

fishing households to changes in the fishery resource, which was integrated with wider consideration of political, environmental and economical settings (McKay 1978). This is along the same line of thinking as Geertz (1963) who criticized models that used the nature/ society dichotomy, arguing that such approaches reduced the number of variables which might be considered in understanding cultural change. Geertz's argument that humans are just one component of an ecological system led him to first suggest the use of 'ecosystem modelling' in understanding the links between the environment and society through a 'unified systems model' that included both social and biological entities and processes (Davidson-Hunt & Berkes 2000 & 2003). Geertz's attempts to account for human, social and political structures, functions and processes with the biological eventually evolved into 'ecological anthropology' a systems approach towards the study of human adaptation using the principles of ecology (Vayda & Rappaport 1968). From these foundations, a wide variety of interdisciplinary discourses have emerged: 'Ecological economics', which promotes a more integrated view of the relations between economics and ecosystems (Costanza 1991); 'Ethnoecology', the role of perception in the environment (Davidson-Hunt & Berkes 2003); 'Political ecology', which "expands ecological concepts to respond to the inclusion of cultural and political activity within an analysis of ecosystems that are significantly but not always entirely socially constructed (Greenberg and Park 1994)" (As cited in Berkes et al 2003:10). As Grumbine (1994) describes, "Ecosystem management is not just about science nor is it simply an extension of traditional resource management; it offers a fundamental reframing of how humans may work with nature" (Grumbine 1994:27).

Glaser (2003) describes that early coastal management plans, "were often based on mono-disciplinary definitions of resource management aims. This generated conflicts with the objectives of the omitted disciplines and their stakeholders... Today, holistic concepts of sustainability, which go beyond the ecological and economic management targets to also integrate social objectives, are being advocated (Goodland, 1995; Daly, 1990; Adger, 1997)" (Glaser 2003:266). Glaser (2003) argues that lack of attention to work with "local social sustainability priorities" is still resulting in poor implementation of coastal management projects (Glaser 2003). Kaiser and Stead (2002) also call for further work to develop a stronger communication between the

natural and social sciences in order to better inform coastal policy and provide a foundation for better utility of scientific and non-scientific knowledge. They argue:

"It is important to remember that an individuals' objectives will be in part determined by their culture, background and the community structure in which they live – these will influence how they interpret information, and what information they use in making decisions...Knowledge of this process is necessary for establishing new systems of governance. It is important to understand the underlying objectives and decision-making processes so that any related policy is properly targeted and conforms to the expectations and objectives of those affected" (Kaiser and Stead 2002: 482).

Recent research initiatives in fisheries management are combining an improved understanding of the interaction between social needs and fisheries management objectives through adopting 'development' tools such as the Sustainable livelihoods approach (Scoones 1998), (Allison & Ellis 2001, Bene & Neiland 2003, Bene 2003). Allison & Ellis (2001) argue that "both state-led management and some of the newer, community or territorial use-rights approaches, if predicated on an incomplete understanding of livelihoods, can result in management directives incompatible with both resource conservation and the social and economic goals of management" (Allison & Ellis 2001:Abs). The need for better use of concepts such as the sustainable livelihoods approach have been echoed by Berkes et al (2003) who advocate "a need for broader objectives for management that can deal with social-ecological systems, and in particular with social objectives such as sustainable livelihoods and communities" (Berkes et al 2003:7).

These ideas of applying ecological concepts to social behaviour and increasing an understanding of social needs and capabilities have recently been synthesised within a natural resource management setting by Berkes, Colding and Folke (2003). Berkes et al (2003) focus on the forces of evolution from biological, technological, sociological and cultural spheres (Holling 2003) to better understand how people evolve in their societal structures in order to cope with change. Their 2003 volume is dedicated to "understanding the dynamics of ecosystem – institution linkages, with the more

explicit objective of examining ways of building resilience to enhance the capacity to deal with change and surprise" (Berkes et al 2003:22). The 'resilience' approach comes from integration of existing theories in economics, ecosystem science, institutional research and adaptive complex system theory (Holling 2003). Developed by Vayda & McCay (1975), resilience theory argues that both societies and ecosystems have the ability to adapt and change around a point of stability. Ecological systems that have survived are argued to be "those that have evolved tactics to keep the domain of stability, or resilience, broad enough to absorb the consequences of change. The consequence for social systems is that resilience means remaining flexible enough to change in response to whatever hazards or perturbations come along" (Vayda and McCay 1975:229)" (as cited in Davidson-Hunt et al 2003:60). As Davidson-Hunt et al 2000 emphasise, "Resilience moves attention away from whether it is the environment or society which drives change, to a consideration of how the processes linking environment and society across spatial and temporal scales, drives change" (Davidson-Hunt et al 2000).

Berkes et al (2003) draw on resilience theory to illustrate numerous examples of natural resource use across the world and explore the responses of systems 'in crisis' to change. Berkes et al (2003) state:

"The social-ecological system is impacted by change and deals with it as a function of its capacity to adapt to change and shape it. We look for effective ways of analysing the phenomenon of change and how to respond to change in a manner that does not lead to loss of future options. We seek to analyze social-ecological system adaptability to meet novel challenges without compromising sustainability. The approach....does not focus on merely environmental change or on social change but rather on social-ecological system change" (Berkes et al 2003:4).

Researching the coast as a social-ecological system undergoing processes of change using a lens which is focussed on people's capacity to adapt to change is a valuable step forward in coastal management. Not only does the approach require understandings of 'community level' institutions and household coping strategies, but it is set within a wider social-ecological framework. Berkes et al (2003) argue:

"Resilience is an important element of how societies adapt to externally imposed change, such as global environmental change. The adaptive capacity of all levels of society is constrained by the resilience of their institutions and the natural

systems on which they depend. The greater their resilience, the greater is their ability to absorb shocks and perturbations and adapt to change. Conversely, the less resilient the system, the greater is the vulnerability of institutions and societies to cope and adapt to change (Adger 2000)" (Berkes et al 2003:14).

Concepts of 'resilience' as a means to understanding capacity of people to cope with change also echo throughout the poverty and development discourse. For example, Moser (1998) argues that concepts of societal 'resilience' and 'adaptability' to change are key in reducing people's vulnerability to poverty (Moser 1998) and play a substantial role in the 'sustainable livelihoods' approaches (Chambers & Conway 1992, Scoones 1998 & Ellis 2000). Many of these themes are now adopted by development think tanks and organisations around the world. For example, the International NGO CARE's approach to household livelihood security focuses on "livelihood promotion (improving resilience of households using participatory and empowering methods) and livelihood protection (preventing declines in livelihood security by supporting work on vulnerability mitigation)" (Care 2005). Within the study of poverty, "...ecological notions of an ecosystem's 'fragility' to external pressure and ability to bounce-back from stress have been applied to individual or household systems" (Ellis 2000:62-63, Prowse 2003:23).

An example of a policy process which has used 'adaptive capacity' is illustrated by the international policy orientations of climate change. The Intergovernmental Panel on Climate Change (IPCC) is involved in assessing the impacts of predicted climate change on the world's poor, and at the core of its approach are concepts of 'vulnerability of communities' and 'adaptive capacity' – defined as a community and country's "capacity to effectively prepare for and respond to changes such as those that will occur as a result of climate change" (IISD 2005). "This focus has emerged from the fact that while there is general agreement on the expected impacts of climate change at the global and continental level, uncertainty remains regarding the specific effects it may have on a regional or local scale. As we currently cannot predict exactly how a community will be impacted by climate change, emphasis is put on increasing the capacity a community has to respond to a range of possible impacts" (IISD 2005). Because climate change is so uncertain in the scientific and policy arena, adaptive

capacity has become a way of moving forward from that uncertainty, to build management upon how people are already reacting and coping with change.

The question of adaptation or 'coping' ability is also dealt with in the study of common property institutions (King 1995). "Although common property is no guarantee of prudent ecological practice, one of the ways in which common property institutions are supportive of resilience is through locally adapted practices based on ecological knowledge and understandings (Folke et al 1998)...local-level institutions learn and develop the capacity to respond to environmental feedbacks faster than do centralised agencies. Being on the 'ground', they are physically closer to the resources, there is no separation of the user from the manager, and there is more learning–by-doing in accumulating a base of practical ecological knowledge (Berkes & Folke 1998)" (as cited in Davidson-Hunt & Berkes 2003:67). An integral part of improving the resilience of dependent households to changes in coastal resources is through assessment of those mechanisms already in place within households, societies and institutions, which are already functioning as protection systems for people's livelihoods.

Here we see the linkages between a vast set of arguments and knowledge on resilience and ecosystems theory, CBNRM, and participatory approaches, which can be integrated and selected to better inform coastal management and coastal policy making. Acknowledging local institutions which may already be providing coastal management, not only gives understanding of what mechanisms for management may already exist, but also act as a link to understand how people operate within their own adaptive capacity to coastal change. How coastal managers can learn from this wealth of information is not immediately obvious, hence the importance of improved participation in the management process. Coastal stakeholders need to become significant 'actors' in the coast, and coastal management must be based upon an equal flow of knowledge and experience which moves in all directions between people, managers and policy makers.

7. Conclusion

Coastal management has been developed as "a conceptual framework to address the complex socio-economic and ecological policy problems of coastal areas. Over the past decade, it has gained significant importance as a policy tool and today it is generally recognised as the framework in which national development agencies and administrations develop their policies towards the coastal areas...however, CZM plans are still often unable to prevent continued environmental degradation and damage to local livelihoods" (Foell et al 1999:4). "Ironically, where social problems, politics and policy making needs are most, understanding of social aspects of management becomes more essential – and is the most frequently lacking" (Foell et al 1999:5). Management that is based upon understanding how adaptive capacities of people at the coast can add or detract to a whole coastal system's resilience is a potential direction which a people-centred management process could follow. Such a process must recognise the values of local visions and mechanisms and strategically support and build upon these local safety systems. As Thompson (1983) states, "we have no escape from having to 'manage the unmanageable'" (as cited in Gunderson 2003:38).

"Given that humans will continue to cope with systems that are partly unknowable, the ways in which people begin to make sense and develop dynamic responses are linked to the types of surprises and crises. The relationship between different types of uncertainty is key: how people choose to deal with uncertainty appears to either increase or decrease the resilience of an ecosystem. It is the ecological resilience that allows managers a margin of failure" (Gunderson 2003:38)

The people-centred approach to coastal management in this thesis moves across disciplines and links a multi-directional flow of information between all coastal stakeholders and a variety of different forms of knowledge and data. It is a methodological journey which moves from a participatory approach to considering policy needs, from acknowledging barriers to policy making to dealing with coastal complexity. The literature provides a rich array of theory, tools and perspectives with which to build a people-centred coastal management approach. The thesis utilises the concepts of 'adaptive capacity' and 'resilience' alongside qualitative and quantitative methodology, to create a multi-disciplinary understanding of change at Pulicat lake, and offers suggestions for coastal management.

CHAPTER THREE

METHODOLOGY

1. Applying cross-disciplinary research to coastal management

The aim of the thesis is to develop a coastal management process which is more usable to policy makers, and more in tune with local community needs. To achieve this goal it requires methodological and theoretical input from both the social and natural sciences. The aim of this chapter is to illustrate and justify the methods used in this thesis. I discuss which combinations of methods worked, which were problematic when applied in the field, and how problems were overcome through applying a triangulated and flexible methodological approach. Pulicat fishing communities present a sensitive and challenging research environment. This chapter illustrates how the methodology process evolved to create an appropriate research approach, which involved combining quantitative and qualitative research techniques and a progression from a holistic to a more in depth research perspective.

The chapter first discusses the input from 3 broad areas of cross-disciplinary research ideology: natural science inputs, a positivist approach to social science, and concepts of grounded theory. It illustrates how the methodology process in this thesis has moved between different approaches to tackle the series of research questions laid out in the conceptual framework detailed in chapter one, which assess; change in the environment, change in fishing society, and mechanisms adopted by society to adapt to change.

Section 2 describes the earliest parts of the field work period, much of which was Chennai based and preceded village level research at Pulicat lake. The section details how a participatory approach to field work was established and how stakeholders of Pulicat lake were identified and organised.

Section 3 discusses the process of entry into Pulicat lake fishing society, and the benefits of conducting a one month pilot study before starting the main field work period of 6 months in January 2003.

Section 4 forms the bulk of the chapter, describing research methods used during a 6 month residential field work period in Pulicat lake. The section starts with a discussion of the village household survey, which was a central part of the

methodology. However, the survey experienced many limitations; overcoming these directed the research to adopt a more qualitative approach, which was found to be more suitable for both myself and the researched communities. In particular, the use of repeat focus groups and history time lines were key methods which facilitated a deeper level of insight and understanding.

Finally some of the practical challenges of conducting field work are discussed, which include working with an interpreter and ethical considerations of the research.

1.1 The research process

This section describes the overall research process, explaining the different areas of methodology and ideology which were applied in the research. The section describes how the research process was able to move between different scientific disciplines and evolve from a 'data intensive'/ positivist approach to a more 'depth intensive', reflective and grounded theory means of collecting different types of data.

As is discussed in chapter one, the conceptual framework to develop a people-centred coastal management process is focused upon three core understandings of change based around the lake fishery:

1. Change in the environment at Pulicat lake
2. Change in society at Pulicat lake
3. Mechanisms adopted by society to adapt to change

Accordingly, three areas of research methodology were drawn upon in researching these areas of change; natural science inputs, a positivist approach to social science, and concepts of grounded theory with a focus on qualitative research methods.

Methods from each of these broad methodological ideologies were triangulated to create a picture of change at Pulicat from different perspectives. "Triangulation, or multiple strategies, is a method to overcome the problems that stem from studies relying upon a single theory, single method, single set of data and single investigator" (Mikkelsen 1995:81). Triangulation was a particularly important concept in designing research at Pulicat, firstly because the nature of the research demanded a cross-

disciplinary approach; using natural and social science methodology is a form of 'discipline triangulation' (Mikkelsen 1995). In the application of social science research, finding the appropriate methodology in a sensitive research environment was a long process. Triangulation of several techniques from the outset of research reduced the risk of relying upon only one source, of potentially problematic data – both in its collection and interpretation. Triangulation also infused a degree of flexibility in the methodological process, allowing the research process manoeuvrability to address concerns and issues for coastal management which emerged from the data – a grounded theory approach.

Natural science inputs – assessing change in the lake environment

Natural science methodology and theory were used to establish an understanding of the Pulicat lake environment around the following themes:

1) Water quality of the lake and potential impacts of pollution
2) The status of the lake fishery in terms of fish catch production
3) The biological dynamics of Pulicat as a functioning coastal lagoon, in particular investigating the significance of the lagoon's connection with the sea to fishery dynamics.

These themes were prioritised before entering the field, drawing on existing publications and preliminary conversations with scientists who had previous research experiences at the lake.

Environmental knowledge was obtained largely through sources of published and unpublished secondary data where available, as well as drawing from current lagoon dynamics theory and other published lagoon case studies. Where necessary, water quality surveys were conducted to support secondary data. Knowledge on changes in the Pulicat fish catch were enriched by inputs from local fishing communities, both through their provision of historical village catch records (previously unused by the scientific community) and also through historical accounts given by local fishing communities. The field work period was insufficient a time period to induce any reliable longer term understanding of changes in catch through monitoring alone.

Discussions with fishermen were an effective means of gauging seasonal changes within the year on catch species and relative quantity variations.

Social science inputs – Village surveys and a positivist approach to research

One of the first priorities for social science research in the fishing communities of Pulicat lake was to gain a rapid overview of the fishing society; who was involved in the fishery, and how were people fishing? Whilst secondary data on the Pulicat lake environment is fragmentary, data on Pulicat society is scarce. The exception is a handful of key publications on fishing society, which are drawn upon throughout this thesis, and official census data where available[5]. As a result of this scarcity, there was immediate emphasis on a need for comprehensive data collection on Pulicat fishing societies.

The main focus of early research at Pulicat lake was in the form of a rapid random household survey. As is detailed later in this chapter, this approach was wrought with difficulty and challenging questions, such as which and how many villages to survey? A balance had to be achieved between macro and micro levels of understanding at Pulicat lake, but how to reach this balance was not immediately obvious during the first stages of research.

"An 'Epistemology' issue concerns the question of what is (or should be) regarded as acceptable knowledge in a discipline" (Bryman 2004:11). As a natural scientist by training, I was aware of running the risk of taking an over-positivist approach[6].
This has been a tendency at various stages of the thesis process. The heavy focus on representative sampling of household surveys in the early stages of the research is a good example of an overemphasis on quantitative data collection, which with

[5] The Census of India – District village and Town Directory 1961-1991 provides continuous records for only a few of the larger fishing villages at Pulicat, and contains wide categories of livelihood. The State Fisheries Department Marine Fisherfolk Census 1970-2000 has only included lake-side fishing villages from the year 2000. The lack of detail regarding fisheries, and inconsistency in census records limits the use of census data in understanding social change, a problem which is further discussed and illustrated in Chapter 6.

[6] Positivism, a term accredited to the French Philosopher Auguste Comte (Benton & Craib 2001), is the notion that the social world can and should be studied according to the same principles and methodologies as in the natural sciences. Positivist approaches test a predetermined hypothesis; employ objective methodologies; focus on a deductive rather than inductive approach; and are heavy reliant upon quantitative analysis (Bryman 2004).

hindsight, perhaps contributed less than other approaches more suited to the research environment. In the analysis of household survey results, I recall particularly well the frustrations of trying to explain, thorough Probit modelling, that a fisherman from village A was statistically more likely to prioritise the need for drinking water than a fisherman from village B. Village B had a well, village A didn't, however, it was not easy to link how knowing this could contribute to improved consideration of people in coastal management and policy making. Such detail revealed little as to why village A didn't have a well, what people were doing to cope without a well, and why they had not built their own well.

Mikkelsen (1995) warns against over-reliance upon statistical analysis of random selected surveys which seems particularly relevant to the described difficulties above. He states that, "One criticism that is often levelled at formal surveys is that, whilst the random sampling errors are very small, the non-sampling errors resulting from poor wording of the questions, poor choice of question order, lack of sufficient attention to the context in which the question is asked, and poor choice of time of day for holding the interview, can be much more damaging than sampling errors. The sample for the survey may be picture–perfect, but the data that result from the survey are erroneous and useless" (Mikkelsen 1995:205). Researching fishing society necessitated an effective combination of quantitative and qualitative research methods and triangulation of several techniques.

As is detailed in this chapter, a set of social science techniques were employed spanning quantitative and qualitative approaches to data collection. Methodologies were largely adopted from other experiences in small-fisheries social science research. In particular, Bunce & Townsley's et al (2000) 'Socioeconomic manual for coral reef management' and McGoodwin's (2001) 'Methods for studying the cultures of small-scale fishing communities' (FAO publication 2001) provided a wide ranging tool kit from which several techniques were triangulated.

Moving towards grounded theory in the research process

The third methodological approach is based upon grounded theory (Glaser and Strauss 1967), which has been employed as a self-learning and evolving capacity throughout the thesis. Developing a people-centred process for coastal management

required a large degree of flexibility and encouragement of change, adaptation and evolution in the methodological design. Grounded theory (Glaser and Strauss 1967) allows theories to be a product of research, rather than the pre-determinant. The process is inductive, largely supported by in-depth qualitative methodology; focus groups, unstructured and semi-structured interviews with room for reflection, modification and intuition. The role of participation by local stakeholders in the research is considerably enhanced through grounded theory, which allows peoples' contributions to become a central part of the research process. Focussing research on outputs from stakeholder involvement allows a degree of agenda setting power to be passed to the participant.

Grounded theory was particularly useful in appreciating the relevance of people's responses to environmental and societal change to the coastal management process. In this thesis, the focus on 'adaptive capacity' (Berkes et al 2003) of fishing communities as a step towards better informed policy making, emerged from the research findings to represent a core argument. At the start of the thesis in 2001, applications of resilience theories to natural resource management were a relatively emergent concept, and a substantial amount of the literature in this thesis is drawn from work published since 2002. This is typical of the inductive and iterative research approach for which I was aiming, "it involves weaving back and forth between data and theory...a process particularly evident in grounded theory" (Bryman 2004:10).

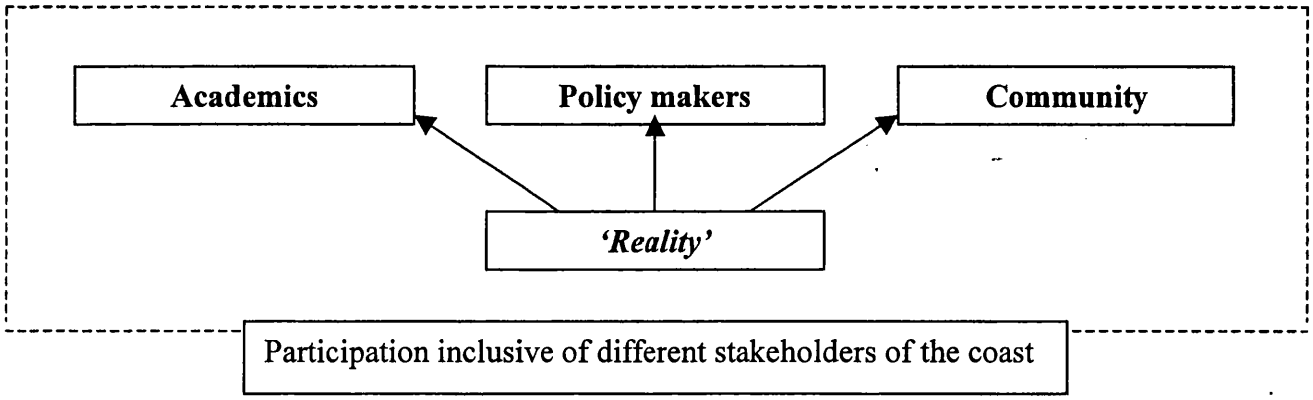
'Sustainability science' is a concept used by Berkes et al (2003) to re-define our scientific approaches to understanding complex social-ecological systems, and how to maintain their sustainability for future generations. Berkes et al (2003) "consider sustainability as a process, rather than an end product, a dynamic process that requires adaptive capacity for societies to deal with change. Rather than assuming stability and explaining change, as often done, one needs to assume change and explain stability (van der Leeuw 2000)" (Berkes et al 2003:2). In their quest for 'sustainability science' Berkes et al (2003) argue that "By structure, method, and content, sustainability science must differ fundamentally from most science as we know it. Familiar approaches to developing and testing hypotheses are inadequate because of nonlinearity, complexity, and long time lags between actions and consequences" (Berkes et al 2003:3). By drawing from this interdisciplinary concept and

triangulating the three areas of research methodology, the coastal management process has a clear direction, but also sufficient room for manoeuvrability, learning and evolution.

2. Participation in field work

As is discussed in chapter 1, a key aim of the thesis is to create understanding of both the drivers of and inter-linkages between environmental and social change at Pulicat lake. A large part of this process is dependent upon understanding how stakeholders perceive these changes, and what people prioritise as important for coastal management. Therefore, the structure of research methodology is highly participatory in nature, which is concurrent with current coastal management discourse which advocates better integration of coastal stakeholders in the management process (Christie & White 1997, Wescott 1998, Kay & Alder 1999, Visser 1999, Gupta & Fletcher 2001). Participation was structured around a central framework (Fig C) which spanned three groups of Pulicat stakeholders: Academics, Policy makers and Pulicat Communities. Non Governmental Organisations were also regularly included, and are portrayed in the Stakeholder Diagram (Fig D); they are not included as a separate category in Figure C because they frequently spanned all three categories, depending upon the organisation. Some NGOs conduct scientific research in collaboration with academic institutions, others have substantial connections with policy makers through their ability to effectively lobby the environmental – fisherfolk welfare campaigns (as is discussed in chapter 6). One of the NGOs was based in the Pulicat community and integrated with villagers on a daily basis; such institutions often regard themselves as providing a voice for village communities.

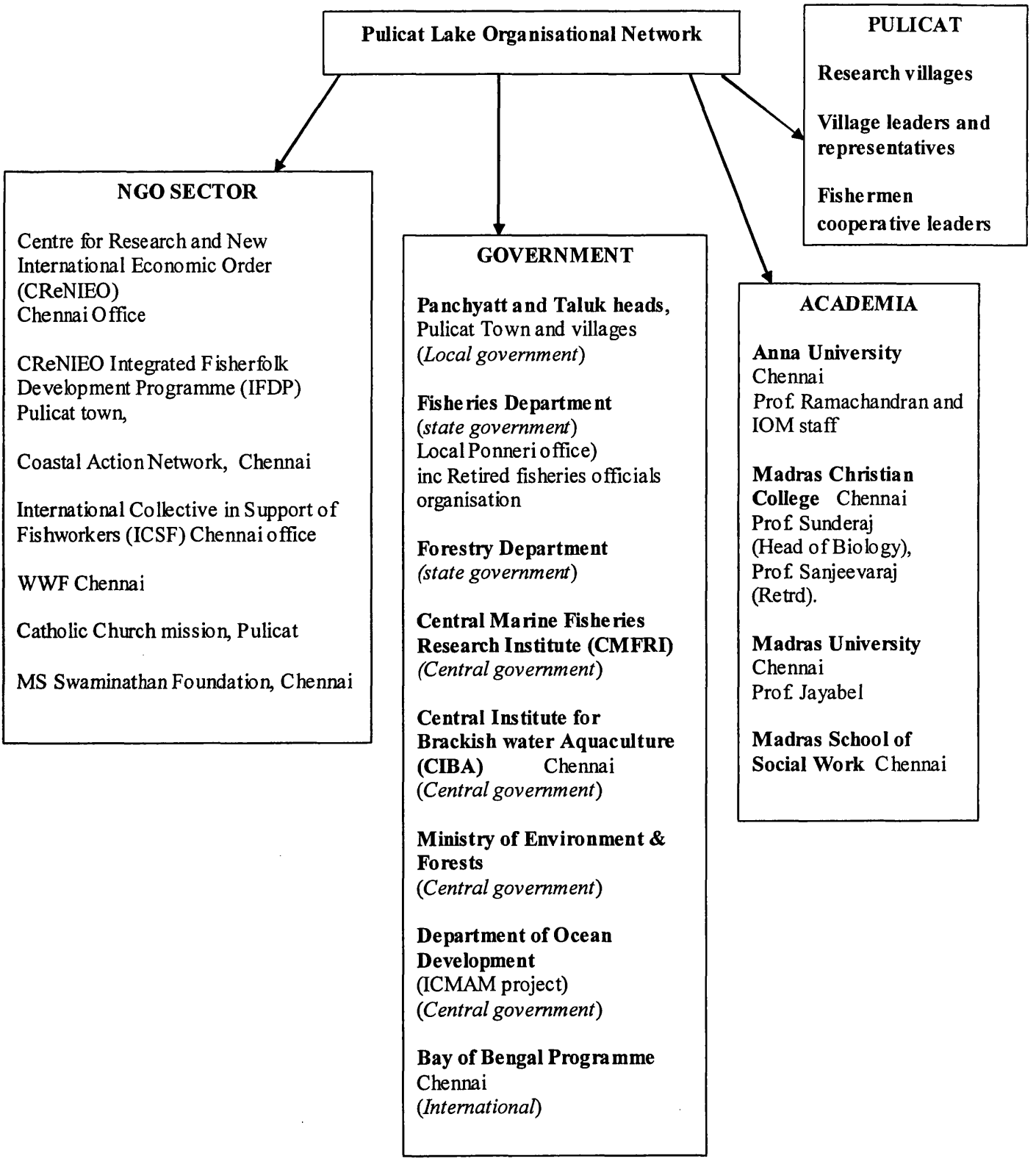
Fig C Participation in the coastal management process



The *'reality'* of the coastal environment (Pulicat lake and its people) is what academics, coastal policy makers and communities are trying to understand, portray, adapt to, live with, and include in an informed coastal management process. To a large extent this is being done in isolation from each other (hence the individual boxes). Increased participation of all the groups in coastal management gives a potential mechanism to reach a consensus over 'the reality' and a direction for management to follow. Chapter 6 discusses the difficulties of reaching a consensus in defining management needs for Pulicat lake, despite high levels of participation from all coastal stakeholders.

The practical application of this framework of participation for Pulicat stakeholders led to the establishment of a Pulicat Lake Stakeholder Diagram (Fig D). This was created initially by snowball interviewing and tracing relevant publication authors. Starting at my base of Anna University, Chennai, I worked outwards contacting new research institutes, NGOs and government departments who had a stake or interest in Pulicat Lake. Relationships were built with Pulicat Lake stakeholders from an early stage, both with directors and with staff. Contacts were regularly consulted and frequently updated on my research, which involved presenting initial findings and gaining feedback. The network of stakeholders at Pulicat Lake evolved throughout the field work, and the chart was regularly updated. A large part of the academic and policy making sectors are based in Chennai city and establishing these groups in the network was completed in the first 6 months of field work. Interacting with Pulicat fishing communities was a more lengthy process, which is described in more detail in the following part of this chapter.

Fig D Pulicat Lake Stakeholder Diagram



3. Entry to the field site, Pulicat lake

During the first six months of field work, whilst I worked on establishing the wider Pulicat stakeholder network based in Chennai (as detailed above), I also took opportunities to establish my first connections in Pulicat lake. My base of Anna University, Chennai, employed several scientists who had conducted environmental research at Pulicat lake and were able to accompany me on my first visit. Contacts I made in other organisations also provided important insights as well as company during the first months of approaching Pulicat communities. However, many of the City–based researchers advised against any long-term field work which involved a residential period in fishing villages. The majority of city-academics view fishermen as an unruly crowd, usually intoxicated by an over consumption of Arrack. Whilst this proved to be an exaggeration, matters of safety were paramount. Furthermore, rumours of inter-village conflict and out-breaks of fighting, alongside frequent intra-village family feuding, made it clear that I could not rush into an accommodation blind to the political context of potential village residences. The first 6 months of field work were effectively used to probe Pulicat society, learn some essentials on 'Pulicat etiquette' and make important first contacts, as a means of gradual entry into fishing society. One visit to Pulicat town every 1-2 weeks helped to create less disturbance of my sudden appearance, whilst my improvements in speaking Tamil also facilitated the processes of acceptance.

My point of access into Pulicat fishing society was through a small NGO field project, which has been operating for over a decade in Pulicat town, a central marketing point of the lake. The Integrated Fisherfolk Development Programme, part of a small Indian NGO - CReNEIO (Centre for Research and New Economic Order), is run from a small office establishment on the edge of Pulicat town. After several negotiations it was agreed that I could rent a visitor outbuilding in the NGO gardens, which came equipped with night watchman (and bathroom!).

The common tendency for village feuding meant that I needed to maintain a degree of autonomy from both village association and family association[7], particularly since I planned to conduct research in more than one household, and in more than one fishing village. Living in Pulicat town was a good compromise. The town is a point of fisheries export, marketing and many non – fishing occupations, whilst active fishing is mainly an occupation for the surrounding villages (see chapter 4 for further description). Therefore Pulicat town remains relatively detached from fishing feuds, which are concentrated in the fishing villages.

On working closely with NGOs in Bangladesh, Devine (1999) describes some of the recognitions which are necessary on the part of the researcher. Of particular relevance here are his experience and concerns of "staged meetings", positive recollections of NGO work, and the "anxiousness" often displayed by NGO workers about his presence in their environment (Devine 1999:116-117). These scenarios also occurred in my own early experiences of interacting with the NGO at Pulicat. The NGO at Pulicat has quite a powerful and influential role in certain sectors of the Pulicat fishing community. Hacker's (1990) descriptions of turning a 'gatekeeper' of information into a 'gateway' of access to information were useful concepts in working out how to deal with substantial local NGO-community politics.

After a month's pilot study (detailed below) I was able to acquire a degree of separation from NGO staff, many of whom became friends, but were not deeply or 'officially' involved in my research. This worked well; in time I was able to witness from the sidelines the 'staged' encounters between the NGO and visitors to Pulicat, and appreciate better how and why things ran as they did. I was not in Pulicat to research or assess the workings of the people or organisation which was hosting me, and as this attitude became clearer to all (including myself) I was able to conduct my research with reasonable autonomy from Pulicat politics.

[7] Initially, I had planned to live with a family in one of the fishing villages who were introduced to me through a contact from Chennai. However, it was soon unearthed that the family was at war with other families within the village. During the fieldwork period, the family where actually evicted from the village along with 16 others following an argument over a stolen diamond.

Devine (1999) also describes some of the implications of being associated with an NGO by the 'researched' local community. He describes, for example, the distinction between being considered as 'one of them' or as 'one of us' (Devine 1999:121). Whilst I initially assumed some identification with the NGO through living in its grounds, because I was able to work with non-NGO staff and had little to do with the NGO's activities or multiple politics I believe this association by the general fishing community was soon reduced.

3.1 Pilot study

A one month pilot study was an important part of setting up access to research villages for the intensive field work period which followed. Firstly, I was also able to test out parts of my toolkit of methodologies (including a pilot questionnaire) to establish which methods were likely to work, which needed modification, and which methods were unsuitable. Secondly, during this period I worked with several interpreters and I was able to find one suitable local person (Magesh) to act as my interpreter for the remainder of my time in Pulicat (as is discussed shortly). Thirdly, the Pilot study allowed time to introduce myself to potential research villages, seek permission from village leaders, make contacts with key people in those villages and improve my own general understanding of the area. "Field relations can make or break the fieldwork experience, and so it is important to carefully negotiate research positions" (Devine 1999:121). Gaining initial acceptance, support, and agreement from Pulicat fishing communities was an important preliminary step in the pilot fieldwork stage (see below diary exert and the Ethics discussion later in this chapter for further details).

Dairy notes Pilot study November 2002

First pilot survey attempt during an early visit to Arangankuppam village

"Although I am welcomed with the friendliness and warmth which seems second nature in Tamil Nadu, many people are uncomfortable about being questioned. People are shy; this morning in Pulicat town a lady turned on her heels and ran on seeing me, making the sign of the cross as she vanished around the corner! It seems desperately inappropriate to knock on doors of randomly selected houses with my clipboard in hand. In fact, having tried this today most people didn't answer and Magesh felt very awkward to be accompanying me. Those people who are keen to answer my questions put themselves forward, often announcing themselves as one of several village leaders"

Village interactions after a one month residential period in Pulicat town

"Magesh and I both feel much better received by people if we take the effort to introduce ourselves and explain at length my reason for being here. This has been done prior to conducting any survey or asking any 'research' questions in the village. This process can take days of justification and explanation in village meetings. (In fact I dedicated most of the pilot study month to making introductions in potential research villages)

...The villagers know I will be returning at the start of next year to spend 9 months with them speaking more at length about the changes underway at Pulicat lake. Villagers now know about me, where I am from and what I am doing here. They are also the people who have granted permission for my now expected and anticipated return in January. The villagers, I hope, will feel they have more ownership over the work, and thus be more interested and inclined to take part.

...Also the village structure is more revealed to me. Village leaders (Chettiyar) are visited first as a matter of respect. The rest of the village know I have the leaders' permission to ask my questions, but also are aware that I am not working for the leader directly, an important distinction to make."

3.2 Selecting research villages

As time in the field progressed, so did the number of villages involved in the research. This was due to evolving the fieldwork around a deeper understanding of the connectivity and relationships between fishing villages. The importance of caste, traditional fishing status, and varied fishing access rights created a substantial degree of heterogeneity amongst villages involved in the Pulicat fishery. This was an emergent process, heavily grounded in learning from the Pulicat community's own perceptions of the lake fishery and the divisions within it.

In selecting villages for in depth research I was initially concerned with adequate representative sampling. However, once again it is important to stress this thesis was not aiming to define the coastal management needs of Pulicat lake. It uses Pulicat lake as a case study example to develop a process with which to extract coastal management needs from the micro-level community perspective, and match them with a more macro view of the management process. Hence, it was not necessary to have produced a survey involving all villages of Pulicat lake, which would have only skimmed the very surface of village issues and achieved relatively little in terms of our understanding those issues. Time constraints and travel also made such an idea impossible. The realisation that inter-village dynamics in the Pulicat fishery play a definitive role in creating appropriate management, called for a cross-village approach which was sufficiently in-depth to explain the divisions recorded.

The divisions between Pulicat fishing villages are the result of a complexity of wider historical changes in Tamil Nadu, which is the focus of the next chapter (Chapter 4). Preliminary studies identified appropriate potential research villages, which were categorised (according to fishing access rights) with help from the fishing communities, local NGO workers, and other independent research groups active at Pulicat. Village categorisations were repeatedly discussed and re-checked with inhabitants from each village and also Pulicat town inhabitants, to increase the accuracy of my interpretation of fishing village interaction.

4. Village research methods

A selection of seven research villages was identified which illustrated different roles in the Pulicat fishery (see Chapter 4). As has been discussed, the number of villages involved in the research evolved as research progressed, therefore the final selection of villages was largely a product of early research findings in the first few villages.

I wanted to achieve an overall view of each of these villages, and combine this with a detailed interpretation of perceptions of change in the lake's society and environment, and responses to change. In each village, quantitative and qualitative research techniques were triangulated and deployed in the same manner, to ensure that any relevant comparisons made between villages remained unbiased. The benefits and limitations for each methodology are discussed in the following section, with detail about how methods were optimised to achieve effective collection of data and knowledge from different sources.

4.1 Semi-structured village household survey

The random semi-structured household survey acquired data which was representative of the research village as a whole. Information on fishing behaviour, fishing dependency, and fishing practice, was the focus for quantitative data collection using semi-structured questionnaires. Open questions invited respondents to state their priorities for coastal management needs (*see Box 1*). Whilst lacking in depth, the survey provided a quick overview of general management needs in the area from a representative population of the research villages. Issues raised were then explored further using more qualitative methods such as interview and focus groups (discussed shortly)

The design of the household surveys were based on McGoodwin's (2001) discussion of rapid assessment of fishing communities, which is also referred to as "rapid rural appraisal" or "RRA" (McGoodwin 2001). Rapid Rural Assessment was first conceptualised by Chambers (1980, 1992) and has since been applied in coastal resource management research (Pido & Chua 1992, Pido 1995, Pido et al 1997, Zanetell & Knuth 2002). McGoodwin's (2001) guidelines of using RRA are

particularly useful because they are specifically engineered for researching small-scale fisheries from an anthropological perspective. McGoodwin (2001) states that rapid assessment "is a multidisciplinary, semi-structured, and comprehensive research method that is designed to quickly document and evaluate important components of local culture, management needs, and community-based fisheries-management systems" (McGoodwin 2001: 4).

Box 1
The semi-structured household survey combined the following question themes:

1. Livelihood practiced
(Almost all inhabitants in the research villages are involved in full time fishing, which structured the remaining survey questions)

2. Fishing gear ownership (amounts and type)
3. Fishing practice (where possible – in some of the more sensitive Padu fishing villages, this question had to be removed as people were unwilling to give a response)
4. Other sources of income to the household – source of income and who is involved in earning it.
5. Whether the household head had a past occupation that was different from fishing
6. A series of open questions where the household head was invited to state 3 top priorities for management needs in his village and 3 possible solutions.

The idea of eliciting "top management priorities" was difficult to interpret to fisherfolk. After several attempts at rephrasing, the question was adapted to ask in simpler terms:

"What are the top 3 problems that you feel people in your village are facing, which coastal managers should be prioritising?" (Stating the most important / prioritised problem first)

It was important to avoid asking directly about peoples' "problems" - a far too invasive question to include in an impersonal survey, and one which often resulted in a long list of personal problems in response. Targeting the question at village level problems combined with the need to prioritise those problems, encouraged a degree of thought and ordering prior to giving a response. Making reference to "coastal managers" ensured that respondents were aware of their participation in a coastal management process, which facilitated local opinion on coastal issues and problems – the aim of the survey.

See Appendix 3.1 for further details and an example of a village household survey

Household surveys were carried out by a trained survey team (discussed below) at random on a target sample size of approximately one quarter of the households in each village (selecting every 4th house for interview along each street), as recommended for survey populations of under 1000 people (Rea & Parker 1997, as

cited in Bunce & Townsley et al 2000:233). However, as is further detailed in the 'problems with survey techniques' section in Appendix 3.2, this target sample was rarely achieved. The largest village Nadoor Madha kuppam had a much smaller sample size of 50 households and Annamalaicheri village which was visited during a single day-trip, only obtained 20 respondents.

Problems with random household sampling frequently included: a lack of answering doors, absent household heads, poor coordination of survey visits with fishing and sleeping patterns of fisher households, and the 2003 Cricket world cup – daily shown on a communal TV in the village square for 6 weeks. In some villages, over-sampling occurred due to people requesting to be involved in the survey and also through inclusion of friends, relatives and neighbours of the survey team (discussed in Appendix 3.2).

In general, this means that variation between village survey sample sizes is substantial (see Table 1) and sample bias are likely. These limitations have been considered in the analysis of survey data, discussed in Chapter 5.

Table 1 Village household survey sample sizes

Village	No. of household heads interviewed/ village population	Percentage of total village households
Arangankuppam	75/450	17%
Nadoor Madha kuppam	50/ 635	8%
Kottaikuppam (women orientated survey)	95/300	32%
Annamalaicheri	20/600	3%
Dhonirevu	120/129	93%
Edamani	70/90	78%
Kulathumedu	80/99	81%

In the first months of the fieldwork I conducted the 'rapid household assessment' in person. However, it was not long after this commencement before I started

questioning how and when the '*rapid*' part of the process might materialise. My own experiences of completing a 'rapid assessment' using household surveys related little to the shining examples of efficiency which were described in the text books. Each household visit involved lengthy introductions, usually a form of meal (if not two), long-debates which almost always included additional contributions from the crowd that gathered on the doorstep, and on average it took half a day to complete a single questionnaire. Furthermore, entering houses in a random manner proved difficult. Often villagers were uneasy to see us approaching the door with a clipboard in hand and my interpreter and I both felt uneasy in doing so. The pressure to 'sample' households quickly in order to get a 'representative' sample meant missing out on the important knowledge that could be gained from sitting in a house for an afternoon, actually listening to the debates rather than pressing for my next question. It also made difficult the creation of friendships and trust, which are vital components of a deeper understanding of behaviour (Dawes et al 1989, Miller 2004) and both of which require time and patience.

Glaser (1989) mentions a similar dilemma in conducting surveys in Bangladesh. She writes: "In the course of the fieldwork, the quantitative 'survey' approach and the anthropological 'understanding of meanings and functions of relationships' clashed repeatedly. To obtain anthropological data I needed to be 'part of' the village. To obtain comparable qualitative data I needed to act as an outsider..." (Glaser 1989:52). To avoid this dilemma, I decided to train two local people to conduct the household survey[8]. To avoid the problem of village politics and issues of status between the surveyor and the respondent, I chose research assistants who were young fishermen. The assistants were both well known to me (and my interpreter) and also had prior experience of assisting in census data collection.

I oversaw the process on the days of survey; people therefore knew where I was, who I was, and why my survey was being done. I remained however in one central location in the village, whilst my research assistants collected the data from each

[8] It took several months to find two appropriate research assistants in Pulicat who were sufficiently removed from village politics, and whom I knew well enough to trust to conduct the survey responsibly. The two assistants were able to conduct research in all the villages, except Kottaikuppam which was surveyed by women (see *Gender considerations* detailed below). Using the same interview team across villages ensured that error due to 'interviewer variability' was at a minimum (Bryman 2004); biases associated with interviewing techniques would be the same in all villages.

household[9]. This meant I avoided the chaos which ensued around my personal survey completion, and the research assistants were able to collect the information I needed quickly and without fuss. It also avoided the risk of insulting respondents by rushing their replies or by spending too little time and attention on their family and home.

The household surveys proved useful in gauging a first level picture of the household through recording fishing assets, livelihood habits and dependency upon the lake fishery (discussed in chapters 5 and 7). Surveys also provided a representative, if somewhat shallow perspective of coastal management needs for a relatively large population of Pulicat fishers (detailed in chapter 5). However, gaining a deeper meaning to management needs at Pulicat lake required strengths from other methodologies; as later chapters reveal, different approaches can result in quite different interpretations. The household survey provided a foundation from which deeper interpretations could be explored, which as McGoodwin (2001) states, is one of the main functions of the rapid assessment methodology. "Rapid assessment offers possibilities for quickly getting a rough understanding of a fishing community's informal system of management. At the same time, it can quickly illuminate a fishing community's main cultural components, pressing problems, and management needs. Thus, while it is not a substitute for detailed studies, rapid assessment is a method that can provide important information on a short-term basis while also providing direction for more detailed studies" (McGoodwin 2001:4.2).

Interviewing the household head and gender considerations

The household survey was carried out (in all but one village) with the male household head – that is the husband of the current family. The majority of households in Pulicat fishing villages show a nuclear family structure, comprising a husband, wife and children (SFD Census 2000[10]). Many families also have a dependent grandparent constituting an *extended* nuclear family, and this is common throughout Tamil Nadu

[9] All surveys were written in both English and Tamil and some of the open-ended questions had to be translated from Tamil into English. This was done by my interpreter and spot-checks were made in Chennai to assure accuracy.

[10] The State Fisheries Department Census (2000) records family sizes as being between 4-5 people per family, and records the same values per house.

fishing communities (Drewes 1982, Bavinck 2001)[11]. Although brothers can often be found living within the same compound or 'group house' within the compound, separate households still constitute nuclear family structures. Identification of the household head is relatively straightforward and was an efficient way of conducting village wide and rapid survey of Pulicat fishing households.

Although interviewing only the household head allows a wider coverage of village households and a more rapid survey, it excludes input from other members of the household, particularly women. Although gender is considered in this thesis (see Chapter 4 'Gender issues in Pulicat') it is acknowledged that this input could and perhaps should have been larger. However, the direction of the thesis has evolved to focus on the fishing institution of Padu and its implications for social resilience and adaptive capacity. As is discussed in later chapters, Padu is an elite and entirely male society, which in part has contributed to the marginalisation of women's input to the thesis.

The household surveys are perhaps the worst perpetrator for neglecting issues of gender. Interviews were only conducted with the household head, which in most situations was a male fisherman. Active fishing in Tamil Nadu is for the most part a male domain (Bavinck 2001) and in most Pulicat fishing villages, even if the household head is a woman, she is unlikely to actively go fishing. As is explained in Chapter 4, this is due to culture and the low social status attached to women fishers; women are much more involved in the fishery post-landing, in activities such as marketing, transportation and export.

The household survey included questions on additional household incomes (to that of the household head), how these were made and who brought additional income into the household. Whilst this question was designed to assess dependency on the lake

[11] Drewes (1982) found that 90% of all households in 3 marine fishing villages south of Chennai city consisted of nuclear families (with an average of 5 people per family), whilst 25% of those had a dependent grandparent (Drewes 1982). Although she states that, "the predominance of households consisting of nuclear families is said to be recent and the proportion is said to be growing" (Drewes 1982:13). Bavinck (2001) in his study of a marine fishing village also South of Chennai found similar family structure again, 73% of his research village constituting the nuclear family, 20% as extended nuclear families (Bavinck 2001:83).

fishery, it also captured those households where incomes were earned by other members of the household, including women and children. However, extracting information from the household head on the earnings of the rest of his household is wrought with difficulty. The cultural sensitivity required in researching women's household role in the presence of men is well documented (Kabeer 2000, Martin et al 2002). In this survey, women's contributions to the household income as informed by a male household head may have been underrepresented.

A focus on the household head also excluded many women from contributing their opinions on management needs and priorities at the lake as part of the household survey. To redress the gender balance a little, in the village of Kottaikuppam the survey was carried out and completed entirely by women with the help of a local microfinance women's group. As discussed in Chapter 5, the results of the women's survey showed different priorities for management, which may in part support Bavinck's (2001) justifications of gender bias in his study. Bavinck (2001) states "The beach and the sea are male spaces, rarely visited by women. And the activity of fishing – other than the marketing of the caste – is a male occupation, the details of which women are often (kept) oblivious of" (Bavinck 2001:371). However, the presumption that fishermen would be the best people to ask about changes in the fishery should perhaps have been more firmly addressed and substantiated.
In acknowledgement of this shortcoming in the survey methodology, many discussions were held with women both through focus groups (as is discussed shortly) and through several friendships. As is discussed in the concluding chapter, women may have a vital role to play in building coastal management upon skills of adaptation and livelihood manoeuvrability.

4.2 The Management priority rating Survey (distributed through Pulicat schools).

Following the successful employment of local people to assist in gathering field data, a further survey was carried out with the help of the older school children in two secondary schools in Pulicat town: the Pulicat National English Medium School and

St Josephs Catholic School[12]. Rating surveys (see Appendix 3.1) were distributed which asked people to rate a list of 10 priorities for coastal management in order of their importance. This was done towards the end of the fieldwork and the list of options was derived from priorities already identified by previous village interviews and the open-ended household survey questions on management priorities. The students were given instructions to take the surveys home and complete them with their families. This strengthened insights into the representation of household surveys, and the accuracy of my interpretation of problems faced by Pulicat communities.

Employing other people to carry out surveys, although providing a few problems (as discussed in Appendix 3.2), avoided the uncomfortable scenarios created from fast-survey work in a sensitive community. Most importantly perhaps, it gave me the precious time to focus on more qualitative approaches to this research: longer interviews, focus groups and observation, which in general were much more suited to the sensitivities of the community environment.

4.3 Key informant semi-structured interviews

"The semi-structured interview is one of the most powerful methods, allowing the facilitator flexibility to probe for answers, follow-up the original questions and pursue new lines of questions" (Bunce et al 2000:96). It differs from surveys, which allow only limited responses to pre-determined questions. Key informants can be defined as interviewees "who have special knowledge on a given topic" (Mikkelsen 1995:104).

In this research, key informants consisted of two groups:
1. Village leaders and elders
2. Contacts (and friends) through my interpreter / other research groups / the NGO

Key informant interviews played two roles. Firstly, they provided an initial route of access into a new research village. One of the assets of having Magesh (a local school teacher) as my interpreter was that he knew many of the younger village inhabitants, as well as many of their parents. In most villages, we were able to commence research

[12] See Research Ethics - Part 7 this chapter - for further information about the involvement of school children in the research

by interviewing known people (contacts), which facilitated the trust of other villagers and enabled a point of contact in the village to be established. Village leaders, who had been approached earlier during the pilot study, were already aware of our research activities in the village. Secondly, key informant interviews provided an initial picture of the situation of the village.

Semi-structured interviews were vital in gaining a more in depth vision of change and reactions to change than could be provided by survey techniques alone. Since the household survey was responsible for providing details on the more quantitative aspects of fishing life, such as fishing gear types, income sources etc... I could focus on fewer and more focussed points of questioning in the interviews *(see Box 2)*.
Due to the uncomfortable environment created by working with long sheets of paper on a clip board, as was experienced during the household survey, questions were written down on an unimposing piece of cardboard.

Box 2 Focus questions for interviews:

- Changes people have seen occur over the years (both beneficial and negative)
- The main problems people in the village face
- Reactions and responses to change by villagers
- If they were in a position to do something to improve life, what would their priorities be and why?

All interviews were tape recorded which gave me the chance to engage with discussions rather without risking an over-focus on writing everything down (see section on translating and interviews – this chapter)

4.4 Village mapping

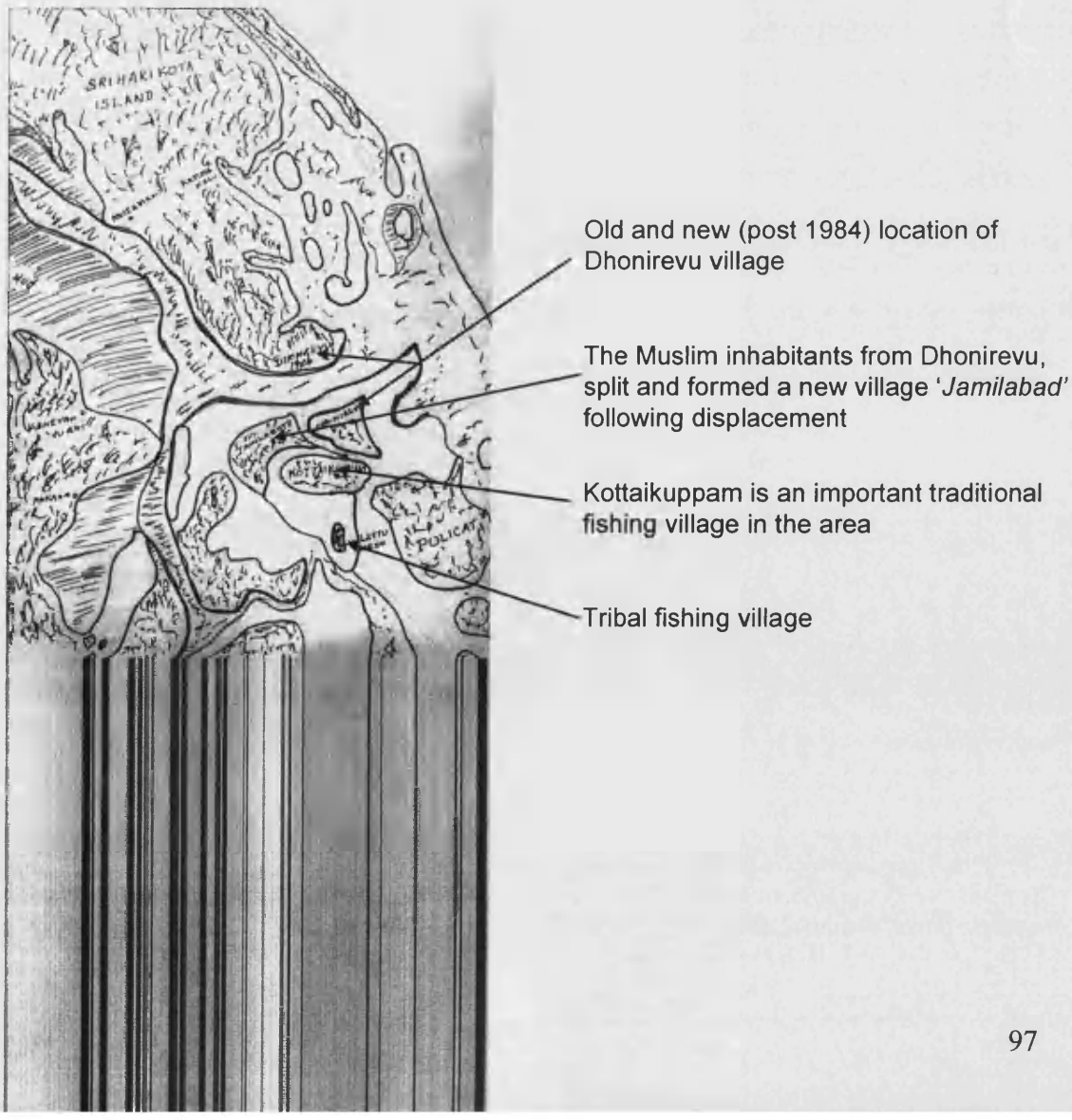
Village mapping also contributed to building an early picture of each research village. Mapping exercises were particularly useful in checking my own interpretation of inter-village dynamics and also in learning about historical changes in those

dynamics. For example, Figure E illustrates village displacements which occurred in 1984 (discussed in chapter 4).

Mapping exercises established: who lived in the village; which occupations were carried out; the administrative structure; existing group divisions in the village; and external influences such as the NGO and external money lenders. Maps were drawn by naturally formed focus groups (see following section) and key informants (see above) in each village. Where possible, different groups of people within a village were used to draw maps to try to highlight how people can perceive their village differently depending largely upon gender and village status.

Fig E Village map compiled by local fishermen

The map shows the changing position of displaced fishing villages as well as other key fishing villages in the southern Pulicat area



4.5 Focus group meetings

The focus group method can be defined as "a form of group interview in which: there are several participants (in addition to the moderator/ facilitator); there is an emphasis in the questioning on a particular fairly tightly defined topic; and the accent is upon interaction within the group and the joint construction of meaning" (Bryman 2004:346). Discussion as a group is a powerful participatory tool. It can elicit new lines of inquiry as a product of the debate, and can also illustrate in one meeting, coastal management issues as perceived from different perspectives. "The focus group practitioner is invariably interested in the ways in which individuals discuss a certain issue as members of a group, rather than simply as individuals" (Bryman 2004:346).

Focus group discussions followed the same lines of questioning as the semi-structured interviews[13] (See Box 2). However, whereas semi-structured interviews and surveys produced quite clearly defined coastal management priorities, discussing management needs as a group elicited a different response. Discussions of management priorities usually resulted in a divergence of opinion as to the changes, causes of change and management needs in Pulicat lake. This gave a useful illustration of the lack of consensus which exists over management priorities at the village level, the implications of which are discussed at length in chapter 6.

An important strength of using focus groups as a forum for debate was the ability to gain information on people's responses to change. Through group recollections of past crises in the fishery, a consensus could be agreed upon how people had managed change in the past, and what enabled them to do so (discussed in the following section – tapping into social memory). The progression displayed in focus group debates, of a movement from the stale-mate in prioritising coastal management priorities, to reaching a consensus over how people have coped with change acted as a first springboard for the thesis arguments on adaptive capacity as a direction for coastal management.

[13] An additional theme of discussion in focus groups involved more community-level matters such as village administration, general livelihoods in the village, types of fishing, and (non-sensitive) inter-village differences. These were more successfully visualised through focus group debates; asking village-level questions in individual interviews tended to create many versions of the same story.

Choosing focus groups

Originally I planned to form sets of focus groups from randomly selected people within each research village. However, village mapping and key informant interviews gave some insight into the hierarchy of power dynamics of the village and the subsequent need to be fully aware of which participants might be involved within the focus group. Billson (2002) argues that hidden power dynamics within focus group debates can largely influence what is said in the debate, and whose view points are expressed (Billson 2002). Village networks are highly complex; it is common in some villages for richer fishing families to give loans to the less wealthy, whilst larger families (especially those with many males) are often politically influential (Bavinck 2001). Therefore, it was difficult to always be aware of who is related to whom, and underlying power dynamics within artificially constructed focus groups. Given that the potential for hidden and complex power dynamics was quite high, I chose to triangulate three types of naturally formed focus group meetings:

Naturally formed focus groups - These group interviews were conducted by walking through the town and joining naturally formed groups of people to conduct a group discussion. Often the groups involved fishermen sat together mending their nets or sitting in a general meeting point (such as the temple) playing cards or chatting.

Repeated focus groups. In each village, a naturally formed focus group once established (as above) would be reformed and revisited on many occasions. Repeated focus groups consisted of: groups of village elders who were no longer fishing (and therefore had more free time); women's micro-credit self-help group meetings; and also (as time progressed) group meetings with established groups of friends.

Selected focus groups. These were groups of people who were directly targeted; for example, if they owned a certain type of expensive fishing net, or if they lived in a poorer section of a village. Divisions in village society were illustrated using the mapping, survey and key informant interviews. Forming focus groups with the following groups, aimed to include the divisions which were increasingly highlighted from the research outcomes.

Selected focus groups were formed from the following social groups:

- *Leadership figures*
- *Working fishermen*
- *Village elders (often retired fishermen)*
- *Women (through existing self-help groups)*
- *Groups with ownership of a specific fishing equipment (village specific)**

** As is discussed in later chapters, the type of fishing gear owned can often be indicative of the wealth and social status of the owner. Large and expensive net types were often owned by a consortium of fishermen (not always related) and these provided useful naturally formed groups with whom to hold focus group discussions.*

Focus group meetings were semi structured and generally lasted between 30 minutes and 2 hours. All groups were asked the same questions in each village, however sometimes conversation led to specific village matters which were touched upon but did not become the main focus of the interview. This primarily was due to most village specific problems being of a highly sensitive and often personal nature. As is discussed shortly, repeated focus groups provided the most comfortable setting in which to discuss in detail, sensitive 'village' issues.

4.6 History time lines – tapping into social memory

"Social memory refers to the long-term communal understanding of the dynamics of environmental change and the transmission of the pertinent experience...It is the arena in which captured experience with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision-making processes into appropriate strategies for dealing with ongoing change" (McIntosh 2000 as cited in Berkes et al 2003:20-21). Berkes et al (2003) stress the importance of 'social memory' in understanding adaptive capacity and resilience of social-ecological systems arguing that "It captures the experience of change and successful adaptations" (Berkes et al 2003:20). Historical time lines (see figure 4) were initially used to document social and environmental changes in a

historical context. What the method unearthed was a detailed account about the ways in which people and in some cases entire communities responded and coped with changes in the lake fishery.

In general, using a time line to document the responses of people to social and environmental change at Pulicat lake, was most productive when applied to the *repeated focus groups,* which had been revisited on several occasions and good rapport was well established. The method was at its most productive when used amongst the elders of the village community, as they were able to recall a longer historical time period and also had more time (and patience) with which to relate it.

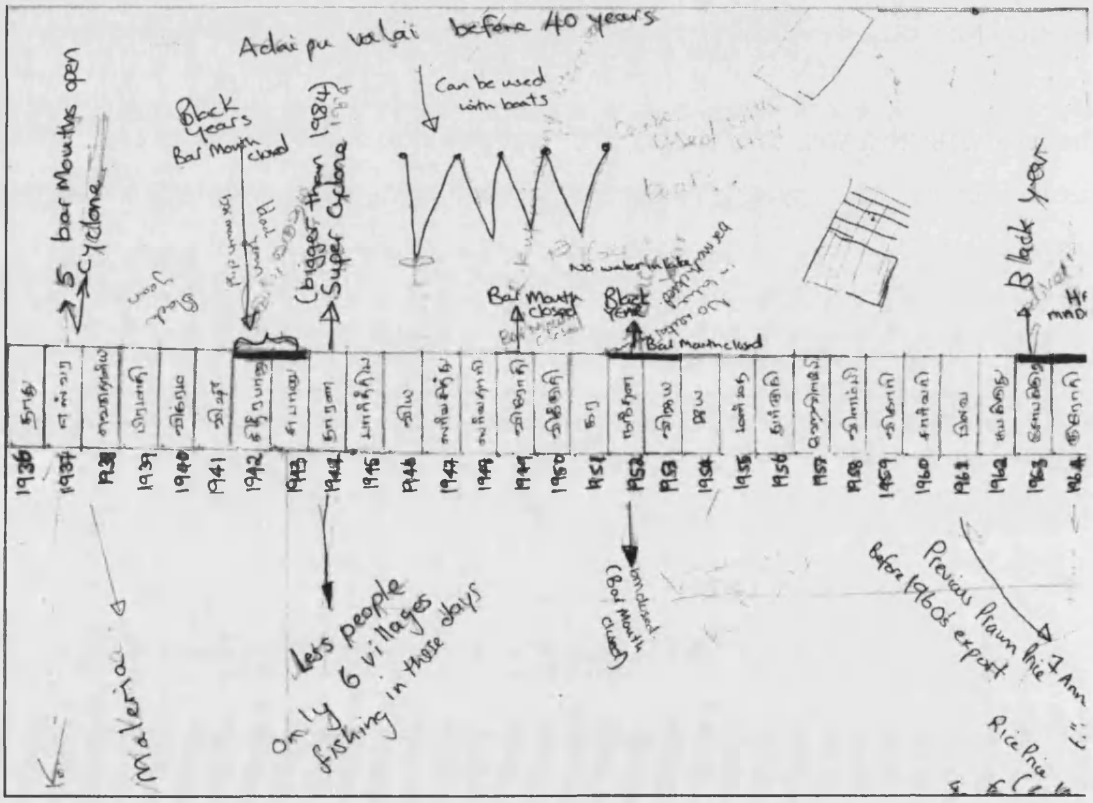
The most effective way of eliciting social memory was through using the 60 year Tamil Calendar, which gives an individual name to each year and revolves around a 60 year cycle. Village elders are able to recall events quite clearly when they use the specific name for each Tamil year; the western roman calendar holds much less meaning for the older Pulicat population. Unfortunately, not all villages were knowledgeable about the Tamil 60 year calendar due to lack of education and the phasing out of its use in the modern day. Therefore a mixture of both calendars was used to construct a historical time line which depicted historical events in each village.

Village history plays a major role in the acquisition of fishing rights, as well as the shaping of people's perceived management needs. Discussions about the main changes in a village were often based around a singular event such as a cyclone, closure of the lake opening to the sea (bar mouth), village displacement or a village feud. These discussions gave rich insight into the responses of people and communities to the events of change at the time.

Forming a village history timeline is a highly participatory task. This also allows the villagers themselves some flexibility to set the agenda for topics of discussion, as it is the events that they deem significant that will form the centre of the following discussion. Thus the time line becomes a continuously evolving picture of each village, and gives structure to the vast amount of information available. As shown in figure 4, village elders were able to draw a historical representation of change,

including changes in lagoon dynamics (the relevance of cyclones and closure of the lagoon mouth to fishing productivity), changes in fishing technology (introduction of new fishing net types 'valai'), and years when fishing was very poor (referred to as 'black years'). Discussion over the responses of the participants themselves and the community as a whole were vital parts of understanding adaptive capacity in different situations and in different villages.

Fig F History time line completed by Dhonirevu village elders during fieldwork



5. Moving research methods to a deeper level of insight

So far this chapter has discussed methodology which has combined participation with quantitative and qualitative research methodologies. Whilst survey techniques have been useful in gaining a representative sample of people's management needs in the research villages, insights into the adaptive capacity of people's capacity to cope with change required a more qualitative approach. Using history time lines with repeated

focus groups represented perhaps the most effective method to elicit an understanding of capacity to cope with change. However, these insights only started to emerge after a longer time in the field and this deserves some mention here. The movement from data intensive research to a more depth intensive research is an important part of this coastal management process. Lessons for coastal management that can be drawn from this progression into a greater depth of insight are included in the thesis conclusion.

Berkes et al (2003) argue that the processes of resilience are not easily predicted or identified (Berkes et al 2003). Qualitative research methodologies play a central role in exploring and defining the ability to adapt and cope with change. As Berkes et al (2003) state, "qualitative analysis is vital for dealing with complex system phenomena in natural resource management, and understanding the system's behaviour sufficiently to enable guidance of management directions" (Berkes et al 2003:7).

As is illustrated in future chapters, sensitive coastal management issues such as the traditional fisheries management system at Pulicat lake - the Padu system, were completely overlooked by quantitative survey methodology. Traditional fisheries management plays a central role in defining adaptive capacities in different fishing villages at Pulicat lake. However, its sensitivity as a subject for discussion meant that the Padu system and its implications emerged only towards the later stages of research when trust and friendships were better formed.

Insert from diary March 2003

"The Padu system seems to be regarded as a 'village matter' and people are in general uncomfortable discussing the Padu system. Today, I brought up the Padu system with a group of fishermen, whom I do not know very well. One of the men seemed to almost shrink from the conversation, unwilling to comment and obviously feeling uncomfortable at discussing Padu issues. I feel like I want to steer clear of sensitive issues like this, to maintain a good atmosphere, and yet, how important are they to coastal management at Pulicat?"

Discussions over sensitive management issues such as the Padu system[14], emerged in different villages in different ways, and comments were often the result of open conversations, where the interviewee put Padu on the agenda for discussion, rather than directed questions directed by myself. It is well documented that the development of trust over time spent in the field is essential if information is to be gathered, which reflects accurately a community's feelings and experiences (Dawes et al 1989, Miller 2004).

In view of my involvement in discussions of sensitive topics such as the Padu system, Erving Goffman's 1959 metaphor of *Front stage performance* and *Back stage behaviour* comes to mind, which has been used to illustrate the importance of gaining "backstage access" to communities that are often closed to outsiders (Miller 2004). Goffman (1959) describes people and communities as having three regions, which he argues can be found everywhere in society. The front region "where a particular performance is or may be in progress" i.e. what people would like you to see, a back region "where action occurs that is related to the performance but inconsistent with the appearance fostered by the performance" (Goffman 1959:107)...and the 'outside'; "those individuals who are on the outside of the establishment we may call outsiders" (Goffman 1959:117). Goffman (1959) argues that these front and back regions are illustrated in every day life, for example a polite 'telephone manner' with which a person may receive a call, is not necessarily the same voice spoken in normal day to day conversation. In other words, there is that which people are happy for you to see, the front stage performance, and that which is hidden and obscure, the back stage region (Goffman 1959).

A Chennai based Government official once passed on to me a familiar Tamil saying which seems to depict Goffman's concepts of 'front' and 'back' regions quite well:

"A Tamil will first tell you what he thinks *you* want to hear, second what he thinks he *should* be heard telling you, third what *he* wants you to hear and only what he actually *thinks* if you are very lucky".

[14] In many villages, a large part of the reluctance to discuss Padu may stem from a fear of repercussions from doing so. These may relate to village management interventions, but are more likely to be grounded in an overall fear of the system being abolished by outsider management intervention.

In reference to Goffman's concept of the 'Outsider', as a foreign female researcher in the very male domain of Pulicat fishing, I would forever remain a clear outsider to the communities with whom I spoke. However, in gaining insights on sensitive issues such as the Padu system, it occurred to me whether this new style of speaking was probably not the back stage access, but perhaps a first glimpse at least of a front stage performance – a movement from an outsider position, to a performance that I could actually observe and watch unfold before me. Insider views were not revealed until later stages of the research, when issues of population change, the importance of the Padu system and divisions between non traditional and traditional fishing people came to the fore.

6. Translation and interviews

6.1 Choosing an interpreter - local (rural) vs. university (urban) based

Finding the 'right' person to interpret for the fieldwork in this research was possibly the most important task of the entire project and one from which I have learned a great deal. Careful choice of a interpreter can drastically enhance the research findings, improve the ethics of the way research is carried out, contribute to leaving a 'good feeling' post-research in studied communities and maintains the general day to day good relations of both the researcher and interpreter involved.

Choosing an interpreter from a university or from a professional source is sometimes the easiest and better option, in terms of ensuring translation is accurate and of a high standard and that a professional working relationship is achieved. However, the feasibility of this is largely dependent upon the research topic, aims of data collection and the communities in the research area (especially the familiarity of communities to foreigners and research activities). In Pulicat, people are generally very wary of 'outsiders'. They are a sensitive and, at times, insular people who do not enjoy discussing their business with people from 'outside' the region. 'Outsiders', whilst being warmly welcomed as a guest by the renowned Tamil hospitality, on asking questions can be viewed with suspicion and mistrust. There are also issues in India over caste differences and an inbuilt hierarchy can exist between people found in the cities from a privileged background (especially in Universities) and those members of fishing communities who are of a substantially lower caste with far less opportunity.

Eventually, this can create barriers to building relations between people of a vastly different social status and background. It is a question of balancing the negatives and positives of each method, and the weight of the balance depends on the research topic and data priorities.

Fishing in Pulicat is a volatile subject, and tact, prior-information, and sensitivity were vital when discussions sometimes touched on the conflicts that regularly erupt over the traditional fisheries management regime of Padu, and ongoing changes within the system. Whilst probing into the fishery conflict was not a priority of the thesis, and in most situations was purposefully avoided, the Padu system – which is so intertwined with conflict - became an important route to understanding change and adaptive capacity of fishing communities. Trust and a sense of security to speak were vital to gain insight into the reality that people face in the Pulicat and hence, insight into the lake's coastal management needs and priorities. After conducting many interviews with prospective interpreters in Chennai (usually research students) it was decided that it would be preferable to use a local person for interpretation and translation.

Choosing a local interpreter brought with it many issues: availability, ability, gender, local reputation, and involvement in existing power struggles and inter-intra village conflicts. Consulting with local NGO workers and other local contacts was greatly useful to gauge an idea of suitable and non suitable persons from the community. In addition, ability to speak English was vital and largely restricted my choice. In Pulicat, my interpreter was one of only five people I knew from the area who could speak English well enough to interpret and translate to a high standard. It was perhaps sheer luck that he turned out to be a good match to all my categories, or perhaps my categories ended up matching with what was available? In either case, interpretation worked with extremely good results.

Magesh is 30 years of age and is from Pulicat Town, a non fisherman and independently employed in starting his own business in creating internet availability in Pulicat. Thus he was able to enter most villages free from bias or prejudice over existing village feuds and fishing conflicts, of which there are many. Alliances with villages are difficult since feuds often involve all members of an entire village rather

than feuding between particular families. For example, it is not uncommon to find a blanket 'ban' preventing all inhabitants from one village from interacting with inhabitants from a neighbouring village, but more will be said of this in later chapters. In addition to this autonomy from villages and fishing politics, Magesh was a school teacher for several years at the high school in Pulicat. This meant he knew many people as his former pupils, and since he has spent his entire life in Pulicat (except a short stay working for an NGO in Andhra Pradesh), many of the fishermen and women are his old school friends. This was an extremely useful way of gaining entrance into research villages where Magesh had existing contacts and friends. Furthermore, those people unknown to him were often welcoming since the village children recognised him as their old school teacher; he was a pretty popular teacher by all accounts.

Part of the research involved working with all women groups, some of which have been running as self-help groups for several years as part of a money saving scheme in the villages. It was recognised that interpretation in these meetings may have required help of a female assistant as the women in the groups may have felt uncomfortable having a male invade the sessions. Hence, it was considered for a member of staff to travel from Anna University (Chennai) to Pulicat Lake on scheduled days for planned meetings involving the women's self-help groups. However, women seemed happy and comfortable to talk in front of Magesh, possibly because he was quite young and from a well respected family, and also because he had good interaction with their children. Some interpretation was done with a local lady named Meena towards the end of the research with women only groups, but since gender was not a focus of this research and the topics were not pertained to gender issues, I felt it worked well to work with Magesh during most of the women's meetings that we organised.

6.2 Working with an interpreter

No work with interpretation can be done without a hiccup, especially when daily research is being carried out and a lot of time is spent together with the interpreter. What I learned here is that a happy interpreter is the only interpreter worth working with. If the person interpreting is feeling despondent with the work, uninterested or unhappy with the way the work is being carried out, it is likely that the efficiency and

accuracy of the interpretation can be compromised, and furthermore ideas and initiative from the interpreter will cease to flow. Hence to keep the interpreter happy and interested is important and almost wholly the responsibility of the researcher.

I learned a great deal from working with Magesh. If he felt uncomfortable with questions I was asking or the way the research was progressing, I listened to his reasons, which were usually founded in my own failure to realise when I was asking inappropriate or impolite questions. In a world in which I was continuously discovering and learning about culture and custom, this ability to listen was essential to my own building of friendships with local people. If Magesh was unhappy, 9 times out of 10 this was down to me doing something inappropriate, and hence it was up to me to learn what it was and to adapt and learn from the experience. With this understanding, I was able to manage the work with Magesh and improve my own research abilities and work ethics far better with a basic understanding of the impacts my research were having on local people. In addition, through encouraging debate with Magesh I was able to generate a feeling of ownership and involvement in the actual research and good understandings of the meaning behind questions, which enriched my research techniques and findings substantially.

6.3 Learning to manage the gabble

Interviewing people of Pulicat Lake was a wonderful experience and one from which I learned a great deal. My supervisor advised me before embarking on this fieldwork to "learn to manage the gabble", which showed some insight into the fact he knew exactly the problem I would be facing. Sometimes it was difficult to 'manage the gabble', a phrase that very nicely describes the event when your interpreter suddenly forgets you are there to interpret to, and starts a conversation with the fishermen in Tamil on his own. It equally can refer to when a conversation changes topic and runs away into new unexplored territories, which may or may not hold relevance for the research in hand. There is no more frustrating feeling than to suddenly find yourself being thrown from the conversation central command to a peripheral side line desperately trying to throw yourself back into control.

The difficult thing to learn in these situations is judgment. Sometimes Magesh would be having a very good conversation about a particular piece of village information he

knew I had been after for sometime. On cue, I would wade in to remind him to interpret it for me and thus break the line of the respondent's thought and conversation, only to find out later he was speaking about something highly relevant. When this happened, I found that asking the respondent to continue from where I interrupted him often failed, the respondent saying he had forgotten what he was saying or to leave it for a later time. Breaking the flow of a conversation sometimes seemed to risk losing the entire will to converse. Issues of gender, the fact that Magesh was male and I was a female, an outsider and a foreigner, sometimes divided the information they would tell myself and Magesh. The best example of this came from John, a fisherman whom I had known for many months. We had a very informal and comfortable meeting with his entire family in his living room.

During the transcription of the recorded interview later that day back at my office, Magesh revealed to me part of the conversation about income:

"Actually, last month we earned Rs 6000 (around £70), but for god's sake don't tell her that. What she will think of us asking for extra jobs on such a wage"
(Earnings from 4 fishing trips)

The problem with managing the gabble is knowing when it is more productive to let the gabble flow and when to intervene again to retake control, without interrupting the flow of conversation. Generally this depended upon the type of group I was interviewing. Interviews with village leaders, groups of women or strangers to Magesh were interpreted line for line. However, often Magesh would ask questions of his own or pick them up on some thing and ask a question himself. Generally this was extremely useful as Magesh understood the issues people spoke of better than me and could offer an insight from an angle not possible from my own 'outsider' interpretation. Allowing conversation or 'gabble' to occur sometimes made the interviews much richer. All interviews were taped so I could obtain full explanations in detail post interview, and it created a comfortable atmosphere as the people knew they were speaking with a local person who understood their problems as well as they did themselves.

Generally the best way to manage translation effectively was to request from respondents pre-interview, that in order for me to understand fully, that they speak making short breaks to give time for Magesh to interpret our words. I would then spend some time 'breaking in the interview' to create an easy and comfortable atmosphere, instead of charging in with direct questions.

Interviews would often begin with me asking the fishermen about themselves, a fishing tale they had to tell or equally, a story I had to tell about English society. On occasion I used an analogy of the conflict between European countries over the North Sea fishery, which seemed to strike a cord of commonality in the problem of lacking fishing space, as well as admitting my own country's imperfections at solving unsustainable fishing practice. Generally, I found the atmosphere improved considerably if interviews were initiated with informal conversation, by which time I had usually gained the interest and enthusiasm of the group to be able to continue asking my original questions and generally receive much better and longer responses.

Taking time to infiltrate the group informally was, in my opinion, a highly valuable exercise which meant that subsequent visits, in general, were much better received. After some time I started to change my own thoughts to prioritise 'people' in the research rather than 'the data', and this resulted in achieving higher quality of data rather than quantity. Additionally, I felt that people who were willing to give up their time to explain their lives for my research, had a right to also talk to me about their own interests and to be given a degree of control over some of our conversations. I felt that there should be a place for their stories in the thesis; stories are still data pending on how they are interpreted and portrayed and give much insight into the reality of life at Pulicat.

All interviews were done with Magesh acting as interpreter and all were fully recorded using a mini cassette. This made it possible to concentrate on maintaining good eye contact, being observant, watching the debate and keeping an active role in facilitating discussion. It is not possible to carry out any of these functions whilst trying to write down every word that is spoken. Almost all villagers were happy to be recorded with the tape recorder, although this sometimes necessitated some dramatic

performances prior to interview. Generally these included taping songs and poems and recording each other in an informal and often highly amusing manner.

Once the interviews were completed, the next day would be spent transcribing all the interviews with Magesh. Although this was very time consuming, it was time well spent since Magesh was able to give his own interpretations alongside the fisherman viewpoints (which were clearly segregated in the text). This gave a clear and detailed insight into life at Pulicat lake and also a good balanced opinion to compliment the interviews from Magesh, who although is not a fisherman, has spent his life in Pulicat town.

7. Research ethics - Doing research but making no promises

One of the most difficult parts of researching Pulicat lake is the high expectations people automatically have for you and your research, and the challenge to realign those expectations to a realistic minimum. Apparently, I am one of few westerners who has conducted residential fieldwork in that region, thus expectations seemed automatically high. There is substantial tension in some research villages and people feel badly treated by the government for failure to address their needs, a common complaint in all villages. Since my first port of call was often the village elite, much justification was needed on my behalf to convince the fishermen to cooperate with me; a mere student with no power to change anything. The understanding that 'it is better to promise nothing and hope to achieve more, than to promise the earth and achieve nothing' (an old Hindu proverb) generally was agreed upon by the villagers. Cooperation was usually won by my insistence that I ensure to write truthfully and accurately their opinions because it is their opinion I am trying to document...them being the experts of the fishery and I being there to learn from them. I could not however ensure them that anyone would read my work once it is completed.

Generally by telling the fisher folk they were the experts and I was there to listen to their ideas created a good feeling and productive atmosphere. My thesis was a way to project their voices and views out into the wider world, and thus it was well received and people were nearly always happy to cooperate and often instigated their own

cooperation by coming to my home to have their say about a certain issue or matter in the village.

This feeling of cooperation was further enhanced towards the end of the field work by giving to the village leaders their own copy (in Tamil) of my work: what I wrote about their village and my interpretation of their coastal management needs (see Appendix 3.3). Leaders in all research villages held a meeting where the report contents were discussed with village inhabitants. I then held feedback sessions at a following village meeting to hear their comments on my work. This not only informed villagers on what I was going to write about them in my thesis, it gained their approval and also served as a check that my interpretations were accurate.

Before leaving India, I also provided a report and made several presentations of preliminary findings of the thesis to Chennai based academics and policy makers. I gained their responses and thoughts through follow up interviews. Respondent interest levels were good since most recipients of the report had been aware and mostly involved in the research from an early stage. A degree of research feedback to the participants of the research was an important ethical consideration; I hope to continue further feedback of the final thesis through post doctoral study.

7.1 Anonymity and participation of Pulicat inhabitants in the field work

All persons referred to by name in this thesis have been given a false name to protect identity. The exceptions to this are Magesh (my interpreter) and the names of Pulicat stakeholders who gave consent for their real names to be used.

Whilst it is common practice to use pseudonyms for village names in research, I have chosen to use the real village names throughout the thesis. This is because villages surrounding Pulicat lake play a particular role in the fishing system and the presence of different village 'types' is highly relevant to the future management of the area. If false names were assigned to villages at Pulicat this research would hold little meaning, particularly for other scholars or practitioners in the field who might want to understand the complex jigsaw of village types at Pulicat and the fishing laws which operate in the area. Where sensitive data (such as fish catch) is presented, village names remain anonymous.

I involved children from two schools in my research to help with distribution of a ranking survey. This involved only the elder classes of children (age 10 plus) and the surveys were given, in collaboration with the school head master and teachers, to be taken home by the children for their parents to complete. Children often take home letters and reports to their parents – the surveys were distributed in the same way as usual school documentation. Participation was voluntary and any children who did not want to take part were free not to participate. The children returned the survey to their teachers. I gave presentations to each class involved in the survey as to why I was conducting the research and how a survey can be a useful tool. I also fed back to the school information on what the results of their survey had produced. Participation of school children in my research was well received by children, teachers and parents who were interested and enthusiastic to be involved.

CHAPTER FOUR

INTRODUCTION TO PULICAT LAKE

Introduction

In order to engage with people's perceptions of change and perceived coastal management needs, a degree of historical and background information is necessary to add context to the present day situation at Pulicat. The following chapter aims to 'set the scene' of Pulicat lake and its fishing society. The chapter discusses background aspects of the lake and fishing society norms, assesses external changes and potential impacts on those norms, and finally, describes the societal divisions which exist in Pulicat fishing society in the present day. This provides important background understanding as a precursor to discussions on people's perceptions of change, responses to change, and implications for coastal management at Pulicat as are discussed in chapters 5 and 6.

The chapter is split into 4 sections:

Section 1 - General introduction to the Pulicat lake and Pulicat fishing villages

This section serves as a general introduction to the case study of Pulicat lake. Physical and administrative aspects of the lagoon are discussed followed by an account of the most relevant aspects of the fishing villages, which surround the lagoon.

Section 2 - Introduction to the Padu system

This section introduces the basic functions of the Padu system, a traditional form of fisheries management at the Lake. Understanding how the Padu system works, why it works and how the system is changing is central to many issues and arguments that arise in this thesis. In this chapter, background knowledge of Padu with details of its operation at Pulicat lake provides a foundation of understanding upon which future arguments are built. The Padu system is explored with more depth in later chapters, since it plays a substantial role in defining how people respond to change at Pulicat.

Section 3 – Changes in the Pulicat fishery: policy interventions and historical events

Section 3 describes some of the changes underway in the Pulicat fishery using a historical perspective, with particular focus on the impacts of Tamil Nadu fisheries development policy on Pulicat fishing society.

Section 4 – Conclusion – Shaping divisions in fishing society at Pulicat lake

The concluding section draws on all of the background information discussed to illustrate how and why Pulicat lake fishing society is structured in the present day. Fishing villages at Pulicat show substantial differences in the way a particular village conducts its fishing and variations in access to the Padu system. These divisions are a product of combined historical, policy and development factors at Pulicat, and categorisation of fishing village 'type' must be considered alongside wider drivers of change. The chapter develops an integrated understanding of change in the Pulicat lake fishery from historical and fisheries policy perspectives, and an interpretation of traditional aspects of fishing life. This insight can then be applied to better understand the divisions which exist between Pulicat fishing villages.

The next Chapter (Chapter 5) then focuses on 7 villages from across this spectrum in more detail to engage with inhabitant's perceptions of coastal management needs. An understanding of how events in the past have affected fishing society and culture are vital to add meaning to perceived management needs.

SECTION 1 Pulicat lake and Pulicat fishing communities

1.1 Aspects of Pulicat lake as a coastal lagoon

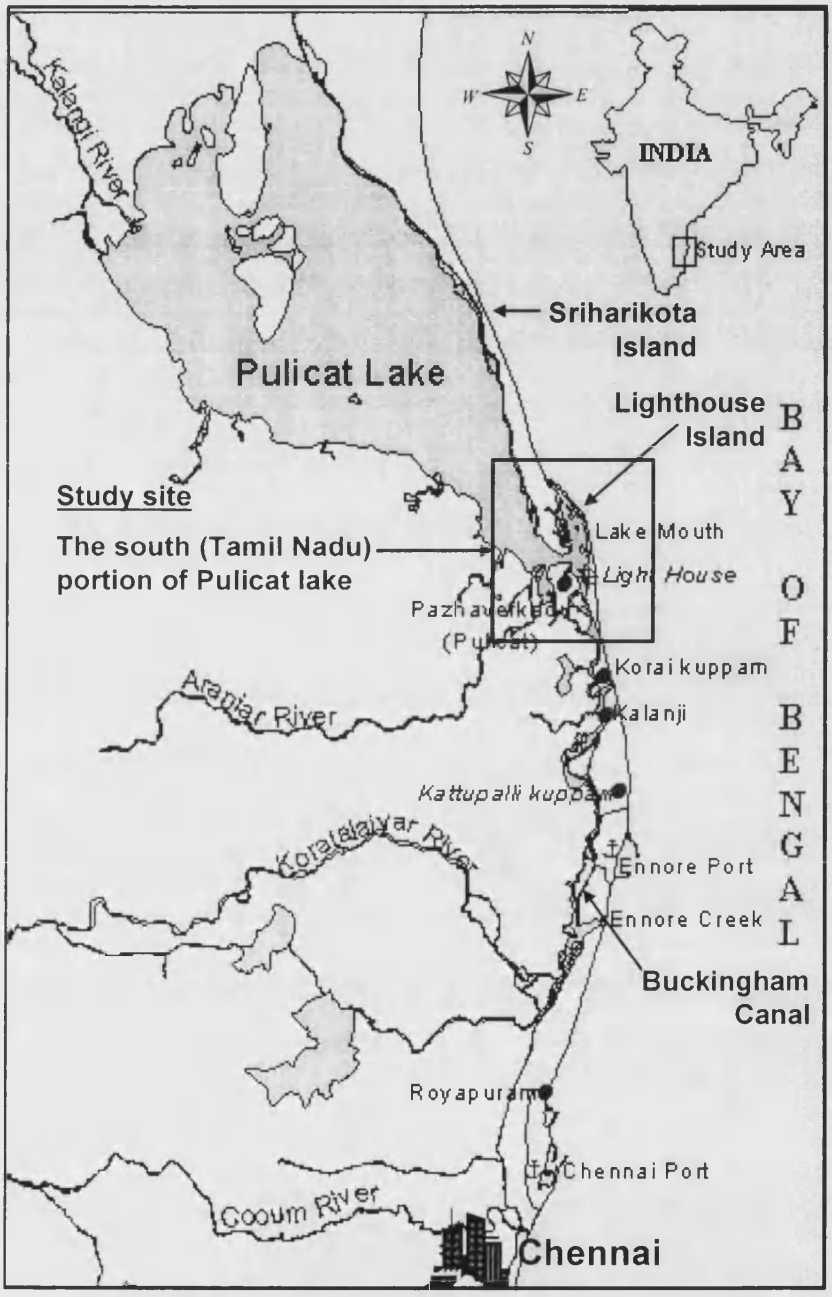
Pulicat lake in the S.E. Indian state of Tamil Nadu is the second largest coastal lagoon in India. Lying parallel to the Bay of Bengal, it is separated from the ocean by a thin sandbar, which gives the lake its 'lagoon' definition (Packer 1984). The lake is joined to the sea through a narrow opening, known as the 'bar mouth', which is located around 4km north of Pulicat town (located on the lake's southern shore). The sandbar which extends north of the bar mouth is Sriharikota Island; the sandbar section to the south of the bar mouth is locally known as 'Lighthouse Island', due to the presence of a prominent lighthouse built in the 19th Century. Pulicat lake is approximately 60km in length and has a water spread area of 254 square km (IOM 2001), which can almost double in size during the annual monsoon period from fresh water inflow.

The lake has an average depth of only 1 meter (IOM 2000) and productivity of the lake fishery is both spatially and temporally highly variable, being influenced by

water depth, tidal influence, and seasonality (discussed further in chapter 6). As shown in Map 1, Pulicat lake is only 60km north of Chennai, India's 4th largest city. The water body of Pulicat is linked with the Buckingham canal, which flows into the southern section of the lake. The Buckingham canal is 200km long and extends from Pondicherri Union in the South of Tamil Nadu up into the state of Andhra Pradesh, North of Tamil Nadu. On its way to Pulicat lake, the Buckingham canal flows through Ennore creek, a heavily industrialised region of North Chennai. As is discussed in Chapter 6, this connection between Ennore and Pulicat water bodies has many implications, the greatest being a fear over pollution of the lake – a product of its close proximity to Chennai coastal development.

Map 1 Pulicat lake and the study area

Adapted from source: PhD thesis Dr K Pandian, Anna University, 2002



1.2 Coastal legislation at Pulicat lake

As a coastal lagoon, Pulicat lake lies directly on the interface between the land and the sea. Rana et al (1998) argue that in terms of fisheries, coastal water bodies such as estuaries and lagoons often represent 'grey zones' for fisheries monitoring, research and policy making. Lagoons represent neither 'marine' nor 'inland' fishery habitats,

but a mixture of both, and as such, lagoons risk being overlooked by fisheries policy (Rana et al 1998).

In Tamil Nadu fisheries, processes for regulation and research are highly segregated by nature, and responsibilities are divided between two distinct central government administrative authorities: the Central Marine Fisheries Research Institute (CMFRI) and the Central Inland Fisheries Research Institute[15] (CIFRI). Both institutes are involved in research of their respective marine and inland fishing areas and as a result, Pulicat lake is not a central focus for either. At the state level, fisheries administration is also the responsibility of the Tamil Nadu Fisheries Department, however the role of this institution to date has largely been focused upon development of the marine fisheries sector.

A good example of the department's neglect of Pulicat lake is the exclusion of Pulicat *lakeside* fishing villages in the Tamil Nadu State Fisheries Department 'Marine Fisherfolk Census' prior to the year 2000, and a seeming lack of any equivalent census initiative for inland fisheries. The creation by the state of a 'marine fisheries policy' in 1983 (the Tamil Nadu Marine Fishing Regulation Act), which was tailored to specifically address some of the conflicts in the marine fisheries sector (Bavinck 2000), has no such equivalent legislation for inshore fishing conflicts.

At Pulicat lake, this oversight is accentuated because the water spread area of the lake also spans across two coastal Indian states: Tamil Nadu and Andhra Pradesh. Approximately 20% of the lake lies in the state of Tamil Nadu, which is the focal point of fishing activity, whilst the remainder of the lake falls under Andhra Pradesh government jurisdiction. As a result, Pulicat lake lies on the interim of several policy making circles which are divided between two state authorities. Pulicat fishing communities therefore represent a grey area in both political considerations, policy

[15] CIFRI has now changed to CIBA (Central Institute for Brackish water Aquaculture), which focuses primarily on expanding shrimp farming opportunities in Tamil Nadu. In the past, CIBA has conducted sporadic research in Pulicat lake to assess its capacity for aquaculture development.

impacts and governance responsibilities, which in general seem vague and disbanded[16].

Aside from fisheries policy, Pulicat lake is given some protection under national coastal legislations. Coastal legislations relevant specifically to Pulicat lake are the national Coastal Regulation Zone (CRZ) law created in 1991 as part of the Environmental Protection Act (EPA 1986), and the Supreme Court ruling on Aquaculture established in 1996[17].

Pulicat lake is a coastal backwater and an important breeding nursery for fish, and as such it is classified under the highest protection of Category 1 (CRZ1), which states that:

"No new construction is permitted within 500m of the *High Tide Line*"

CRZ notification Section 3.1 of the 1986 EPA (amended 1991)

The 1996 Supreme Court ruling on Aquaculture extended this law to prohibit prawn farm construction within 1000m of Chilka Lake (State of Orissa) and Pulicat Lake (Tamil Nadu) with the exception of "traditional and improved traditional types of ponds" (Spreij 2005:1). The Court ruling ordered the closure and demolition of

[16] This problem was highlighted by my own research efforts to establish a network of government bodies interacting with Pulicat lake (as is detailed in the methodology chapter of this thesis). During many interviews and conversations I held with government officials at both central and state government levels, I was passed between departments, neither one taking responsibility for collecting information I sought. This sense of poor co-ordination of research was reciprocated by Vivekanandan (1997) in his research on aquaculture in the state of Andhra Pradesh. He writes "Only under pressure do agencies bother to collate information into a particular format. Whatever data is available thus exists in an inert, unformatted and poorly presented fashion" (Vivekanandan 1997:29).

[17] The Supreme Court ruling on Aquaculture in India materialised under pressure from national and international campaigns against shrimp farming. In Tamil Nadu, the campaign against shrimp farming has been particularly strong through the Tamil Nadu Campaign Against the Shrimp Industry (CASI) and with figure heads such as Shri Jagannathan, chairman of the powerful Gram Swaraj Movement (a Gandhian philosophy of self-rule) (Ahmed 1997). It was through this movement that Shri Jagannathan filed a public interest litigation (Writ Petition (Civil) No 561 of 1994) under Article 32 of the Constitution of India praying inter alia for enforcing the Coastal Regulation Zone Notification dated 19 February 1991 (Tamil Nadu Aquaculture Authority 2005). This litigation effectively tried to re-enforce the existing but neglected CRZ legislation banning prawn farm development within 500 metres of the High Tide Line (HTL). The Tamil Nadu Campaign against Shrimp Industry (CASI) subsequently filed intervention applications as part of this petition and in March 1995, the Supreme Court ordered that no further shrimp or aquaculture farms be permitted (Mohan 1997).

existing aquaculture within the 1000m area before March 1997[18] (Aquaculture Authority, Tamil Nadu 2005) and the Government of India established at the same time the 'Aquaculture Authority' to carry out the Court directive.

The Tamil Nadu government has experienced many difficulties in enforcing CRZ legislation, primarily due to persistent controversy over what constitutes the 'High Tide Line'. The problem occurs in defining who decides what is permissible and what is not, leaving the legislation open to failings from both confusion and potential corruption providing an ever existent 'get out clause' in legislation.
The official 2002 figure of CRZ violations in Chennai city was 1400 buildings, which had been built inside protected coastal zone areas without a legal permit (IOM 2002).

The Central Government Aquaculture Authorities continue to face challenges in implementing the order on prawn farm dissolution, since the order is still contested in the courts through protests from aquaculture developers. At Pulicat lake, there are several prawn farms in the southern and Buckingham canal sections in blatant violation of both sets of regulation.

It is difficult to assess the impacts of state coastal policies (the CRZ and the Aquaculture ban) on Pulicat lake; certainly should Pulicat have been the target of heavy aquaculture, today's set of perceived management needs may have looked quite different. Whilst some illegal aquaculture continues to create problems for fishing villages in the near proximity, aquaculture is not widespread throughout Pulicat lake and it is largely confined to the southern Buckingham canal (see chapter 5 for further details for perceived problems regarding aquaculture).

The well-publicised events and successes of the campaigns against aquaculture and other coastal developments have perhaps had a more substantial impact on Pulicat

[18] "According to data provided by the Tamil Nadu Pollution Control Board to the Madras High Court in December 1996, out of the 910 prawn farms in Tamil Nadu, 744 farms had not even applied for a license" (Mohan 1997: 37). Since then there has been a series of petitions by the aquaculture industry claiming, for example, that they should be considered as traditional farms, and therefore outside the scope of the legislation: "When the full impact of the Supreme Court order was understood by the industry, it started laying claims that the majority of the farms were held by small farmers. Actually, only a few farms involve investment of under Rs 200,000" (Mohan 1997:39).

lake fishing communities. As is discussed in chapter 6, the power of activist groups in shaping the opinions of the local population is an important factor which needs better consideration in coastal management and its adoption of participatory techniques.

1.3 Aspects of Pulicat fishing communities

1.3.1 Pulicat town

Pulicat town, located on the southern shores of Pulicat lake is a key fish landing and trading point for the lake's fishery; the closest major market (Tada) being located much further north in Andhra Pradesh, or Chennai city 60km to the south. The town's elaborate history is rich and well documented since Pulicat was an important trading post for the Dutch in the 17th Century and later the English in the 19th Century. However, this once international legacy of wealth and trade of Pulicat town has today dwindled to a village sized agglomeration of houses. The town has survived the 19th and 20th Centuries on trade between Chennai and Pulicat in the export of woven cloth, but the arrival of mechanical 'power-weaving looms' and changes in export demand facilitated the decline of this industry, which has not operated in Pulicat since the 1970s (Bhuvaneswari 2003).

A common feeling expressed by the town's inhabitants is that eventually all people leave Pulicat town. State census records show a substantial decline in Pulicat town population from over 7000 inhabitants in 1981, to less than 5000 in 1991, a fall which is reflected by its subsequent downgrade from town to village status in the 1991 state census. It is a place held in existence by a thread and that thread is largely represented by the Pulicat lake fishery embedded in the fishing villages surrounding the town[19].

The picture of decline in Pulicat town is certainly not reciprocated in the vibrant and heavily populated fishing villages that surround it, and it is largely the trade of fish caught by the villagers that keeps the town alive. Whilst the population of Pulicat

[19] The well preserved Dutch cemetery at Pulicat hosts many elaborately decorated gravestones from this historical period. Several tombs are engraved with pictures of a central Pulicat town being surrounded by small clusters of traditional thatched huts. From these engravings, it seems that in the past as in the present day, Pulicat town has long been surrounded by a series of small fishing villages.

town has diminished substantially, the population of the surrounding fishing villages has reportedly increased, with more villagers and even entire villages turning to the lake fishery for a livelihood[20].

1.3.2 Pulicat lake fishing villages

India is often described as a nation of villages. There are 52 villages surrounding Pulicat lake which have been classified as 'fishing villages' with an estimated total population of 30,000 people (Sanjeevaraj 1993, IOM 2000). Around 40 of these fishing villages are located in Tamil Nadu (Sivasubramanian 1987, Mathew 1991), which illustrates the concentration of fishing in the Tamil Nadu sector. This distribution of fishing communities is primarily due to the location of rich and all year-round fishing grounds. Sebastian Mathew's research on Pulicat describes: "Whilst all the Pattanaver's[21] (people of traditional fishing caste) living in the settlements near Pulicat town are full-time fishermen, those living further north are not. This is because throughout the year the fishing grounds off Pulicat town are productive...Since the lake dries up in some of the northern parts in the summer, fishermen in those areas can undertake fishing only during monsoon time" (Mathew 1991:4).

There is a substantial degree of homogeneity inherent *within* fishing villages at Pulicat lake. The State fisheries department Marine Fisherfolk Census (2000) illustrates occupational homogeneity of fishing within Pulicat lake villages. Out of 17 villages identified[22] as bordering the southern area of Pulicat lake, all 17 showed over 75% of their adult male population to be engaged in full time fishing and, among these, 15 villages had over 90% of the male population involved in full time fishing (SFD

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[20] An assessment of population changes in Pulicat lake fishing villages is discussed in Chapter 6, since this is a major change at the lake with large implications for the lake's fishery and fishing population.

[21] Pattinaver is the traditional fishing caste of Pulicat lake society. According to Mathew (1991), Pattinaver come from the Tamil word '*Pattanam*' – meaning a dweller in a town: "The Pattanavans have two main divisions, *Periya* (big) and *Chinna* (small) Pattanavans. In the caste hierarchy *Periya Pattanavan* is regarded as superior...Most of the Pattinaver fishermen of Pulicat are *Periya Pattanavan*" (Mathew 1991:4).

[22] Identification of Pulicat fishing villages was achieved using a map and personal knowledge of Pulicat fishing village locations; village information was dependent upon inclusion of the village in the state census. The limitations of using census data to assess changes in fishing villages are discussed further in chapter 6.

Marine Fisherfolk Census 2000). Therefore, the term 'fishing village' quite accurately depicts a village which has extremely high fishing activity.

Using the term 'fishing village' does not automatically exclude other forms of work in the village, and the extent of full-time fishing can vary depending upon season, year, lake productivity, and additional household income availability. These factors are included in later chapters of the thesis as part of discussions on the fishing dependency of different types of fishing village, and implications for adaptive capacity to cope with change.

1.3.3 Religion and Caste in Pulicat

The dominant religion in Pulicat Lake is Hindu. Muslim and Christian religions do exist and are often - but not always - concentrated in specific villages. Whilst many Pulicat lake fishing villages show a high degree of religious homogeneity (SFD Marine Fisherfolk Census 2000), Pulicat town consists of a mix of Muslim, Hindu and Christian inhabitants. In general, the Pulicat area seems to have largely escaped the religious tensions and conflict that plague so many other parts of India. In its place, conflict over fishing rights are largely caste-orientated as is detailed later in this chapter. Lack of religious conflict is well illustrated by the tendency of Pulicat communities to celebrate each others beliefs and festivals regardless of religious origin[23].

The role of the caste system[24] in Pulicat lake fisheries is central to understanding change and 'adaptive capacity' within different fishing communities. As is discussed later in this chapter, caste is a determinant of access into the Padu system, a traditional system of fishing access rights in operation at Pulicat lake. Understanding the

[23] For example, the Muslim festival of *Dhaga*, is annually celebrated in a marine fishing village with 250 Hindu families and only 1 Muslim family. Easter services in the Christian church at Nadoor Madha kuppam are also attended by people from all the villages, regardless of faith or caste. The locals also commonly boast to having one of the only sites in India that houses both a Mosque and a Hindu temple within the same building. On one occasion I discovered a house decorated with the Islamic crescent, only to find the inhabitants to be Hindu stating they just liked the design as a house decoration!

[24] The caste system in India is part of an ancient Hindu tradition dating back to 1200BC, however the actual term 'caste' originates from the Portuguese word 'casta' used to describe social divisions or lineage and was introduced to India by Portuguese settlers in the 16th Century. There are 3000 castes and 25,000 sub castes in India (Daniel 2005), each relating to a specific occupation and which fall under four basic Varnas: Brahmins – priests, Kshatryas – warriors, Vaishyas – traders and Shudras – labourers.

relationship between Caste and the Padu system helps recognise the divisions which exist in Pulicat fishing society. Here, a brief description is given of the make-up of castes currently inhabiting Pulicat lake fishing villages as background information for the next section.

Definition of the different Castes involved in the Pulicat fishery:

- Pattinaver caste (a subsection of *Most Backward Caste*) is the dominant traditional fishing caste in Pulicat lake and much of the northern Tamil Nadu coastline (Bavinck 2001). Although this is traditionally a marine fishing caste, in Pulicat it seems to have been extended to include traditional lake fisherman and has become a sign of having a traditional 'right' to fish in the lake. Pattinaver fishermen consider themselves to be superior to other fishing communities; their fishing operations a hereditary legacy handed down by their ancestors, whilst other caste groups have more recently switched over to fishing as a livelihood (Sivasubramanian 1987).

  It is plausible that Pattinaver caste does not necessitate Hindu faith, as Christian and Muslim fishermen also can consider themselves as Pattinaver caste in that they have traditional Padu fishing rights.

- Scheduled caste (also termed Dalit or Harijan) represents the lowest sector of the caste system[25]. It includes within it 'Untouchables' or 'Dalits' (meaning 'depressed'). Untouchables were renamed 'Harijan' (Children of God) by Mahatma Gandhi who raised their social status considerably during the 1930s. Scheduled caste inhabitants of Pulicat are mostly congregated in specific 'scheduled caste villages'. Scheduled caste is not a traditional fishing caste, however many people within this caste have moved into full-time fishing livelihoods.

- Scheduled Tribes (ST) (also termed Tribals, Irular or Adivasi - meaning aboriginals). Tribal people are external to the caste system since these groups are considered communities for whom caste is difficult to define, with unknown occupation and often including communities who traditionally live

[25] Scheduled caste falls below the 4 Varna system of caste; in essence scheduled caste people are seen as caste-less (Hutton 1963)

in remote locations. Tribal communities form the lowest type of social class in India. Several 'tribal' villages have established around Pulicat lake, migrating from inland areas to start active fishing.

Positive discrimination attempts by the Indian Government to raise the opportunities for both scheduled caste and scheduled tribes, particularly within the education and government sectors have been ongoing since the 1930s (Ghosh 1997). However caste prejudice and inequality are still prevalent throughout India (Ghosh 1997)[26].

As Pulicat lake fishing villages show a high degree of *within-village* occupational and religious homogeneity, the same can be said for caste homogeneity, which is a likely result of the strong linkages between caste, religion and occupation (Paz 1997). Sivasubramanian (1987) describes that Pulicat lake inhabitants of the same caste tend to live together in the same village, whilst the 2000 Marine fisherfolk census also depicts that most villages in the Pulicat areas are caste-specific (SFD Marine Fisherfolk Census 2000). From his study of Tamil Nadu marine fishing communities, Bavinck (2001) states: "Social homogeneity characterises their settlements as well. Fishing hamlets to be inhabited only by persons of the fishing castes, which encourages a higher measure of social cohesion than in most Indian villages" (Bavinck 2001:51).

Cohn (1965 & 1987) argues that in multi-caste villages "loyalties are divided, multi-caste villages sometimes suffer from a lack of community identity and an inability to take collective action" (Cohn 1965 & 1987 as cited in Bavinck 2001:51). Bavinck (2001) further argues that single-caste villages are perhaps more focused in achieving collective action for joint interests (Bavinck 2001), an argument also developed by Rajagopal (2001) in his study of caste and the effectiveness of institutions involved in water irrigation in South India.

[26] See Hutton JH (1963); Anant Singh S (1972); and Stern RW (2003) for a progression of texts depicting the changing caste system in India

As is discussed later in this chapter, at Pulicat lake the collective action which is installed through the Padu system has functioned effectively for many generations. This may be attributable to the high degree of identity attached to fishing villages involved in the Padu system, founded in a tendency for single-caste villages. Although here one is faced with the conundrum of knowing which came first: are single-caste villages at Pulicat a product of the Padu system or a precursor to its evolution? Since single-caste fishing villages are prevalent throughout the entire Tamil Nadu coastline (Bavinck 2001) including those areas which do not practice a form of the Padu system (at least to my knowledge), I am inclined to think that single-caste villages dominate due to more complex reasons of caste hierarchy, and identity, rather than forces of collective action alone. Either way, single-caste villages, and in particular the social status which accompanies higher caste villages, have certainly played a role in maintaining the Padu system and enforcing its laws. The degree of homogeneity which exists with Pulicat villages may, over time, have been reinforced by the caste-orientated fishing practices of the Padu system.

Contrary to the general trend of single–caste fishing villages, this study found exceptions to the norm where some Pulicat fishing villages displayed mixed populations of caste and also religion. For example, in two of the largest higher fishing caste villages, smaller groups of lower 'scheduled caste' inhabitants have settled around the village periphery. This may be a sign of change, which is discussed later in this chapter alongside a more detailed explanation of historical drivers of change. In one other village (which was not included in this study) Muslim and Hindu inhabitants lived side by side, although only the Hindu sector was involved in fishing.

1.3.4 The role of Women in the Pulicat lake fishery

As role of women in 'development' progressed from a Women-in-development (WID) to Gender and development (GAD) discourse[27] (Kabeer 2000), in fisheries research a similar transgression has occurred. For example, at ICLARM (The World Fish Centre) the 'Women in Fisheries' (WIF) program is reportedly moving towards

[27] Kabeer (2000) describes the evolution to a Gender-In-Development (GAD) 'perspective' which transformed gender issues into an active and central part of development programmes, a step forward from the marginal and largely policy orientated Women-In-Development discourse (Kabeer 2000).

'Gender and Fisheries' (GAF) initiatives (Williams et al 2002). The scope of this thesis is insufficient to discuss the growth in recognition and value of the role of women in fisheries as a general debate. Here I merely point out the role of women in the Pulicat lake fishery, as a foundation for future management ideas discussed in the thesis conclusion. I refer the reader to key texts for further information on the role of women in South Indian fisheries, and the progression of the more general 'gender in fisheries' debate[28].

Bavinck (2001) argues that fishing in Tamil Nadu is a male domain and that this correlates well with global research findings by McGoodwin (1990) who also argues that women, whilst having a large responsibility over shore-based fishing associated activities, remain distant from active fishing (McGoodwin 1990, Bavinck 2001). Ram (1991) describes the gender division in South Indian fisheries in terms of space and cultural norms: "Norms related to space prohibit women from gaining access to the sea, and even to the spaces most intimately associated with the work of fishing: the sea-front and the beach" (Ram 1991:48, as cited in Bavinck 2001:87).

The role of women in the Pulicat lake fishery holds many similarities with existing research on women in fisheries. Whilst the majority of women at Pulicat lake do not play a large role in direct fishing, women have an extensive role in on-land fisheries occupations. Women play central roles in the marketing and auctioning of fish, fish drying and sometimes the export of fish. In the fishing villages, many wives of fishermen transport their husband's catch from the beach landing site to Pulicat market. Some fisher-wives transport the fish to markets as far as Chennai on a daily basis; if the sea if a space for fishermen, then the fish market can perhaps be considered as a space for women.

Many women have also established their own dried fish business in Pulicat town. From conversations with women drying fish in Pulicat, it seems that most of the women involved come from inland areas to the lake specifically for this industry. Interviews revealed that several fisher-wives resident in Pulicat fishing villages also

[28] Useful texts on the role of women in fisheries specifically in South India include writing by Kalpana Ram (1989, 1991) and Holly Hapke (2001, 2004). Williams (2002) gives an overview of the general development of women and fisheries discourse and Kyprianou (2001) gives an up to date bibliography on global research papers on Gender and Fisheries (1990-2001).

dry fish, but more often this is done at a smaller scale for general household consumption, rather than trade. Fresh fish is bought from the fishermen directly (usually those species fished as a surplus and thus at low market value) and are then dried out on the landing sites at Pulicat town and often taken to markets inland for sale. Several women have rented small sheds alongside prawn exporters for storage of baskets and dried fish awaiting transportation. Some of these small sheds now host women who are involved in exportation of prawn, although this form of enterprise still seems quite rare[29].

A substantial amount of gender based research into South Indian fisheries illustrates that women are rarely involved in direct fishing, which is largely the result of cultural norms and restricted association between women and the domain of the sea (Ram 1991, Nieuwenhuys 1990, Stirrat 1988, as cited in Bavinck 2001:87).

Whilst these norms seem to hold true for a large number of women at Pulicat, they are not exclusive, and this research has found that under certain conditions, women can be involved in direct fishing. Women can sometimes be seen fishing on Pulicat lake on a kattumaram (a small boat) accompanied by their husband, but most often can be seen hand fishing for prawn in large groups. In particular, women are involved in collection of prawn seed – juvenile prawns which are sold to shrimp hatcheries along the coast.

Most of the authors studying women in South India fisheries relate to the male domain of fishing in marine or sea fisheries (ibid.) Pulicat lake is a lagoon/ or backwater fishery, and, as such, may define a greater opportunity for women in direct fishing. Shama (2004), for example, states that whilst fishing by women is extremely rare, "Thousands of women are working in intertidal areas and inshore zones, collecting crabs, shellfish, seaweed etc. for income and domestic consumption" (Sharma 2004:28). It seems that defining the role of women in fishing is largely dependent upon the definition of what constitutes fishing.

[29] Women involved in net making and repairing has been reported in some Indian fishing communities (Sharma 2004), however this did not seem to be the case at Pulicat, which may represent something of a change spurred by modernisation of the fishing sector. In the past, some village elders recall that both women and men would be employed in net making, now however most nets are brought ready-made with synthetic nylon. In Pulicat fishing villages, men can be seen mending and tending nets on most evenings, however I did not see any women involved in this activity.

Perhaps the most useful concepts in regard to women in Pulicat fisheries lie in Ram's (1991) depiction of the cultural norms associated with women and prohibited access to the sea. In Pulicat lake, women involved in active fishing seem to originate from only the most poor and low status fishing villages, such as in the scheduled tribe (or tribal) villages which have established around the lake. Women involved in direct fishing are often frowned upon, particularly by people of traditional (and higher) fishing castes and in general fisherwomen are viewed as a sign of poverty, desperation and low status. This seems to fit within Ram's reference to the cultural boundaries which segregate many women from direct fishing, and the poverty that forces some women to cross those boundaries regardless of the social stigma they receive.

Whilst a degree of social stigma is certainly evident in local Pulicat views of women fishers, this stigma is not as rigid as one might expect. During heavy rains, when prawns become plentiful in the lake, it is not unknown for women of higher fishing castes to partake in occasional fishing. Conversations with women in marine fishing villages revealed that even though they thought it beneath them to do so, in good rains and plentiful prawn supply, many could not resist the temptation to go fishing by hand, despite the low social status with which it is so commonly associated.

Women in the Pulicat fishery show a degree of flexibility within structures which are usually rigid and hierarchical in terms of social and cultural norms. Women also occupy the Pulicat fishery using many forms of livelihood, from collection of prawn seed to marketing and export of prawns and fish. It is this diversity in occupation which puts women in the spot light for potential management solutions to Pulicat lake, an issue which is returned to in the concluding chapters of the thesis.

1.3.5 Village administration – the Panchayat systems

Insights into the role of the Panchayat system hold important relevance to understanding internal power structures within the village and the significance for gathering people's perceptions and effective participation in coastal management.

There are two forms of administration in villages in Tamil Nadu, the formal government system of Gram Panchayats[30] and the informal non state system of village council or 'Village Panchayat'[31].

The Gram Panchayat

The Gram Panchayat is a form of village administration installed by the government. A single Gram Panchayat council usually consists of between 5 to 7 villages, and council leaders are voted in through formal government run elections. The winner of this election is known as the 'Panchayat President' and below him is a Panchayat council consisting of all the ward (constituency) members. In discussions with local people, it was sometimes noted that despite a state-led democratic system of voting, there were problems during the Gram Panchayat elections at Pulicat lake. Villages within a single constituency often have an uneven distribution of population. The argument is that people tend to vote for those candidates from their own village believing that they will put their own village matters as a priority, especially in regard to village conflicts over fishing. As a result, candidates from the largest fishing villages will automatically receive more votes.

Bavinck (2001) describes a period of uncertainty in Gram Panchayat operations; the state government has intermittently dissolved and restarted Gram Panchayat elections over the last several decades (Bavinck 2001). Elected Gram Panchayat council members were certainly active in Pulicat villages during research in 2003, however far more influence over village affairs seemed to stem from traditional village Panchayat councils, whose leaders were directly active in dealing with fishing matters, quarrels, and law and justice in the village.

The Village Panchayat

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[30] Gram Panchayats are part of the Panchayat Raj system. Whilst Village Panchayats have always existed in Indian society, in the 1940's Mahatma Ghandi advocated their return in a more formal drive towards better community involvement in democratic development and self-management.
A means of government decentralisation, the Gram Panchayat system has since been used as a window of development for disadvantaged groups. For example, the 73rd Amendment to the Constitution of India in 1993 meant positive discrimination for political seats in Gram Panchayat councils for both women and low castes such as Scheduled castes and Scheduled tribes (see Jain 1996). Panchayat Raj has also been an outlet for decentralised natural resource management; see Baumann (2000) on the use of Panchayat Raj as a form of democratic decentralisation towards decentralised natural resource management in India.

[31] Panchayat are forms of village council, they are not to be confused with other types of village membership such as informal fishermen membership 'Talekettu' and the formal government run fishermen cooperatives, which are separate entities explained in the next section of this chapter.

Village Panchayats are non state 'traditional' village councils with a set of 'Panchayat members', known as village Chettiyar[32]. In Pulicat fishing villages, the village Panchayat represents the main village authority.

Although village Panchayats claim to be democratic in that council members are elected by the village, it is the general trend that the more wealthy and powerful people obtain council positions. Villagers vote for Chettiyars, but since many will already depend on a candidate's past legacy for favours (such as lending money), the support for the same Chettiyars remains strong; once a Chettiyar has been in power, re-election is quite likely. As Sivasubramanian's (1987) research on Pulicat villages describes, "Chettiyar are elected by village members and village members give preference to the appointment of hereditary based people" (Sivasubramanian 1987:24). Bavinck (2001) also describes that Village Panchayats seem to revolve heavily around influential families and kinship lines or 'Pangaali groups' defined as "a social group encompassing all relations in the male line of descent" (Bavinck 2001:377)[33]. Once elected, Chettiyar represent a dominant force in village affairs. In many Tamil Nadu villages, the Chettiyar act as judge, jury and protector, provider and conflict solver; in Pulicat, some have even adorned the role of marriage guidance councillor.

As a local inhabitant explained:

"In every village they will have their own Chettiyar. These Chettiyars manage the village problems, like quarrels between one another within the village and they distribute loans (*kuthagai*) between fishing groups and keep the village accounts. During very dry seasons when fish catches are low, the Chettiyars will distribute rice

[32] Bavinck (2001) defines a Chettiyar as "a fishing village headman's honorary title" (Bavinck 2001:376). Similarly, in Pulicat villages the term Chettiyar was used to describe a member of the village council or 'Village Panchayat'. Usually around 5-8 Chettiyar exist within a single village, not including the additional Gram Panchayat leaders, who add a further dimension of village leadership. The term 'Chettiyar' also refers to a caste of businessman, in Pulicat town those involved in 'business' through trading goods are referred to as Chettiyar caste.

[33] Bavinck (2001) has an entire chapter dedicated to discussing the role of Panchayat in the regulation of artisanal fishing in the marine sector of Tamil Nadu, which in general seems very similar to the structures in place at Pulicat lake (See Chapter 5 'Panchayats and the regulation of artisanal fishing' pp 141-169 (Bavinck 2001).

to the villagers and all these costs will be added into the village accounts. On the 7th day of each month they sit down and look over their accounts and this in itself can start a village quarrel. If they find some persons guilty of a crime at this time they will be fined, but most of the time the fine will be buying of liquor for the whole village[34], or to pay money to the temple. Most of the village influential people will become Chettiyar at one time or another".

Sivasubramanian (1987) documented a similar role of the Chettiyar stating: "Their Chettiyar govern the entire affairs of the village – social, economical, cultural etc. They function as the village judiciary and decide cases of civil and criminal nature and award punishment. During the lean season they make arrangements for feeding the community by borrowing. They assure responsibility for the repayment of the loan with interest through levy of contributions from members of the village. They preside over meetings and conduct the festivals and other social functions" (Sivasubramanian 1987:24).

Village leadership structures are changing, but it seems that most of these changes involve increasing complexity and additional positions of power. As Bavinck (2001) argues, "With internal changes and the arrival of new-style leaders, administration in the fishing settlements of the Coromandel coast has become even more complex" (Bavinck 2001*b*:6). For example, developments in State fisheries policy created the evolution of 'fishermen cooperatives' and the president of such cooperatives is an additional leadership figure to traditional Panchayat dynamics.

A good example of the powerful grip that some cooperative leaders hold over their fellow fishermen is well illustrated by the case of Government fund distribution within fishing villages. Currently the State Fisheries Department operates a Savings-cum-relief scheme[35] intended to provide fishermen with income relief during lean

[34] I witnessed one such occasion in Arangankuppam village. An inhabitant had been found guilty by the village Chettiyar of beating his wife. The punishment fine allocated was to buy each male household head in the village a half measure of brandy. For a population of over 450 male household heads, this fine was extremely large and the criminal was unable to pay and was therefore driven away from the village.

[35] Although this scheme was primarily aimed at marine fishermen to cover the gap in earning income during the monsoon season when many marine fishermen do not go for fishing due to high seas (Bavinck 2001), lake fishermen utilise the fund as a support during the summer months when the lake productivity is low.

fishing periods. In all villages, the fund is administered through the leadership of the fisherman cooperative, to all members of the cooperative. However there are many claims that this fund is largely filtered by corruption at many levels of government and within the fishing cooperatives themselves[36].

These central roles of the villager 'leadership' in every day village life evoke a hefty degree of power and persuasion over village inhabitants and Chettiyar figureheads evolve strong support networks within the village. As Bavinck (2001) argues, this dominance and dependency upon the Chettiyar has consequences for ordinary villagers. Some of these consequences are discussed in later chapters in reference to effective 'participation' approaches to coastal management, the role of personal agenda and village politics on people's perceptions of management needs and coastal change.

These descriptions of power relations within the village give a relevant prelude to understanding power relations between villages and the role of the Padu system. The following section introduces the workings of the Padu system, a traditional fisheries management institution in operation at Pulicat lake for many generations. The Padu system represents an exclusive caste-specific membership into the most productive parts of the lake fishery, and, as such, it can perhaps be considered as the most significant force of conflict and power struggles for social and fisheries dominance that exists at Pulicat lake. Whilst this chapter so far has discussed within-village homogeneity, understanding the Padu system clarifies the large degree of heterogeneity which exists between fishing villages at Pulicat lake, discussed towards the end of this chapter.

[36] One villager I spoke with claimed this fund was monopolised by government officials in league with leaders of fishermen cooperatives. Savings-cum-relief funds are collected by every fisherman within a cooperative donating Rs45 a month over a period of 8months. The state government matches this amount with an equal Rs45 and the combined totals are distributed during lean fishing periods. The claimed scam involved the leaders of the cooperative putting forward 45Rs for each member out of their own pocket and claiming most of the returns for themselves. The uninformed fishing society members simply received 'free' but much smaller amounts of money from the society leader during lean times, for which they are very grateful. Of course they are unaware that the amount received would be far more had they been an active participant.

SECTION 2 An introduction to the PADU fishing system[37] – a traditional community system of fisheries management at Pulicat lake

As is discussed in the thesis introduction, Pulicat lake can be defined as a common pool resource (Schlager & Ostrom 1992, Dasgupta 1996, Tietenberg 1997) and the Padu system can be considered as a Common Property Resource Institution: a defined set of user rights and traditional management system (Dasgupta 1996). The well researched field of Common Property Resource management provides a rich arena of debate to which the following account of the Padu system is well suited. However, the focus of this thesis is not the creation of an additional account of community-based fisheries management. The inclusion of Padu in this thesis follows a broader line of enquiry, asking how changes in the Padu system are affecting local people living within it, rather than focussing only on whether the system itself is an illustration of effective collective action.

The informal 'Padu' fishing system operating in Pulicat lake is a verbal agreement of traditional fishing rights largely dominated by the Pattinaver traditional fishing caste. In Tamil, the term 'Padu' means 'fishing place' and the Padu system is the way in which both fishing spaces (Padus), and fishing equipment are regulated in the lake. Mathew (1991) defines the Padu system at Pulicat as:

> "A traditional system of granting entitlements to eligible members of a particular community for undertaking specified fishing activities in certain designated fishing grounds in the lagoon"
>
> (Mathew 1991:5).

[37] Contrary to popular belief, the Padu system is not unique to Pulicat lake. Whilst Mathew (1991) offers the only comprehensive work on the Padu system as it is operated at Pulicat, there are several publications documenting other regions that employ the Padu system as a means of fishing regulation. Lobe and Berkes (2004) studied the padu system in Cochin, Kerala (South West India), whilst Padu has also been documented in Sri Lanka by Alexander (1982), who recorded the application of Padu rotational beach seine rights in marine fishing communities (Alexander 1982). Amarasinghe et al (1997) documented the Padu system in Sri Lanka's Negombo lagoon where religion as well as caste plays a role; all Padu participants are Roman Catholic and the Roman Catholic church facilitates the sharing of the fishing grounds (Amarasinghe 1997, Lobe and Berkes 2004). In Tamil Nadu, Bavinck (2001) found the Padu system to be used in the rotational allotment of beach space for beach seine fishing in marine fishing settlements, describing similar rules as those seen in Pulicat lake (Bavinck 2001).

Traditionally the Padu system at Pulicat is caste specific, location specific, fishing gear and species specific (*see Table 1),* and it has existed for many generations as the traditional law of the lake. It is not written down, nor is it recognised by any state institution, and yet it seems every single fisherman at Pulicat lake from an early age understands how the system operates, knows with great accuracy the location of each Padu boundary, and usually strictly adheres to its legislation.

2.1 Regulating the Pulicat lake fishery through the Padu system

Table 2 The specifications of the Padu system

Regulation	Operation
Caste specific	Traditionally only the *Pattinaver* fishing caste is included in the Padu system. However, Scheduled caste fishers have claimed Padu rights since as early as 1920. Pattinaver fishers, however, remain the dominant group within the system and hold the better Padu fishing grounds.
Location specific	Regulation of fishing access is through *rotational access* of specific fishing grounds or *Padu's* between Padu fishing villages. Each village in the Padu system goes for fishing (as a whole village) on their specific allotted fishing day.
Gear specific *(See Appendix 4.1 for further details of key fishing gears)*	Only eligible 'Padu fishermen' are able to use **Padu fishing gears** which are highly efficient at catching large quantities of prawn (and fish): ❑ Stake nets (Suthu valai) and ❑ Beach seine (Badi valai). Only Padu fishermen can use these two net types. Those without rights must adopt other less efficient **'Non Padu' fishing gears**: ❑ Cast nets (Mani valai) ❑ Gill nets (Araivalai) ❑ Hand fishing Non padu fishing gears, which are not regulated under the Padu System, are less efficient, catching smaller quantities of fish and prawn. Fishing with non padu gears is locally known as '*Sirutholil fishing*' (meaning 'small profession') and it is seen by many as a '*poor man's fishing*'
Species specific	Stake nets are specialized in catching the valuable prawn. The Padu fishermen monopolise the Prawn fishery at Pulicat lake.

2.2 Allocation of Padu fishing grounds

The Padu system is founded upon specific fishing grounds known as 'Padu grounds' or 'Padus', where eligible fishermen can place their stake nets for prawn catching. The allocation of Padu grounds is done thorough an annual meeting, the 'Padu *Kulukkal* day' (Mathew 1991). At the meeting, lots are drawn for each fishing unit (a boat with 3 men), a task carried out by the village Panchayat (Mathew 1991). During these meetings, the list of 'padu' fishing units is also updated where new fishermen (those having reached the Talekettu criteria – see below) are added, and deceased fishermen are removed. Each fishing unit of the village is allotted a specific place in the rotation of Padu fishing grounds.

Using this method, each fishing boat has the opportunity to fish at least once in all the Padu grounds throughout the entire year. Since Padu grounds vary in terms of productivity, this is a fair system which evenly distributes richer and poorer fishing grounds amongst all *Padu* fishermen. Once Padu grounds have been allocated to a fishing unit from the Padu village, no other fisherman outside the rotational system of Padu can fish.

2.3 The purpose of Padu

The Padu system is a monopolisation of the valuable prawn fishery of Pulicat lake, restricting access to the best 'prawn' fishing grounds with the most effective fishing gears. Its main function is to evenly distribute the best fishing grounds amongst the villages of Pattinaver 'traditional' fishing caste (Mathew 1991). Padu exists to reduce conflict between fishers, but in doing so, the Padu system also restricts the level of Padu fishing effort in the lagoon. "Sustainable fishing of the lake through the Padu system is a definite consequence of the system" (Mathew 1991), although Padu cannot restrict non-padu fishing pressure, external to the system.

MaCay (1981) argues that "most known cases of indigenous fisheries management hinge upon the management of access to fishing space rather than levels of fishing effort" (as cited in McGoodwin 1994:46). McGoodwin (1994) argues that traditional fisheries management institutions are often established from the need to minimize conflict amongst fishers, rather than any attempt to limit overall fishing effort

(McGoodwin 1994). The Padu system of Pulicat seems to fit well into this general understanding.

2.4 Talekettu village membership and Pattinaver caste domination

To become eligible for Padu fishing rights and access to Padu fishing grounds, a fisherman must first be a member of the Talekettu, "In other words, Padu is subsumed under the institution of the Talekettu" (Mathew 1991:5). Talekettu is a form of village membership based upon gender (only men can participate) and caste (only Pattinaver caste can reach Talekettu status).

In Pattinaver villages, Talekettu membership is bestowed on a male in a village providing he meets three criteria: 1) He is a member of that village 2) he has reached the age of 21 years and 3) he is married. Mathew (1991) adds to this and states that Talekettu rights are also "dependent on the general level of skills of the candidate and the degree of acceptability by the village" (Mathew 1991:5). The Talekettu involves reaching a certain social position in Pulicat fishing society and membership means becoming part of an elite 'fishing' group. Talekettu should not be confused with merely living within a fishing village; inhabitancy does not automate Talekettu status[38].

In my analysis it is clear that today many non Pattinaver caste people have significant Padu fishing rights and access, such as the Scheduled caste fishing villages of Dhonirevu and Edamani at Pulicat lake. There is no evidence however that these villages have also adopted the Talekettu membership culture which dominates in the traditional 'Pattinaver' fishing villages.

Villages involved in fishing but excluded from the Padu system are banned from using Padu fishing gears. If fishermen without Padu rights fish using Padu fishing

[38] Stoffle et al (1994) report, in the Dominican Republic, a similar sense of group 'membership' as a means of acquiring fishing access rights, which was also associated with greater responsibility and social obligation in village matters (Stoffle et al 1994). The increase in status which accompanies Talekettu membership at Pulicat may be as significant as the access to lucrative fishing grounds that Talekettu membership bestows. This issue is discussed further in Chapter 7, which provides a more in-depth interpretation of the Padu system alongside other evidence which considers the influence of Talekettu membership on fisher behaviour and adaptive capacity of fishermen.

gears (stake nets or beach seine), the Pattinaver fishermen usually take matters into their own hands. Large traditional Pattinaver villages are seen as the local policing force of the Padu system of Pulicat. There are many reports of beatings, removal of 'illegal' fishing gears and even destruction of entire villages by the Pattinaver fishermen.

SECTION 3 A changing Padu system – external influences of policy and development at Pulicat lake

Despite its traditional use being a reservation only for the Pattinaver fishing caste, the Padu system is now opening up to villages of non Pattinaver caste. At Pulicat lake, the laws of Padu remain intact and fishers without Padu rights can not use padu fishing methods. However, the caste-specificity is breaking down, and non-Pattinaver fishing villages are 'winning' legitimate fishing rights through negotiation. Understanding how and why the system has opened to other castes requires a short delve into Tamil Nadu fisheries policy and particular historical events at Pulicat lake.

3.1 The influence of state fisheries development policy on Pulicat lake fishing society

Over the last century, government policies on fishing have had a powerful impact on the fisheries sector throughout India and represent a driving force for social and environmental change at Pulicat lake. There is a rich existing academic literature on the development of Tamil Nadu fisheries and impacts of fisheries policy on fishing communities in India[39]. My aim here is to illustrate impacts of state fisheries policy specifically for Pulicat lake society, changes in the Padu system, and how understanding these changes allows a more informed insight into Pulicat society divisions.

In terms of Indian fisheries development the most relevant aspect for Pulicat lake has been the development of species specific exportation markets, in this case the global

[39] John Kurien has done extensive work spanning several decades in a selection of Indian states including Gujarat, Kerala and Tamil Nadu; See Kurien 1980, Kurien & Achari 1988 and Kurien 2000. Maarten Bavinck has more recently carried out research on the impacts of state fisheries policy on the marine fishing sector in Tamil Nadu, which includes a complete chapter "The Blue revolution in the Coromandel coast fisheries", depicting the development of Tamil Nadu fisheries policy since the early 1960s (Bavinck 2001 Pp 46-76).

export market for Prawn, which today represents the lake's main fishery product. Many fishermen argue that fishing in the lake is wholly focussed upon catching the valuable prawn, and most are not interested in fishing for anything else. This has certainly not always been the case and understanding this change and the loss of diversity in fishing catch is crucial to understanding many of the problems fishermen now face (which are discussed in later chapters).

3.1.1 'The Pink Gold Rush'

The development of the Prawn market in India was a key part of India's blue revolution in the 1960s, which was ventured to compliment India's green revolution in Agriculture (Bavinck 2001). In inland and backwater fisheries (such as Pulicat) the fast pace development of India's prawn export market was primarily achieved through new investments in aquaculture (prawn farms), modernisation of nets (mechanisation of crafts was mainly a marine fishing affair), and creating incentives for people to fish prawn. The development of fisheries for export was a national objective and the target species of prawn (both from inland and marine fisheries) earned the term 'the *Pink Gold Rush*' in India (Bavinck 2001).

A key government aim was to create incentives to fish for prawn. As Bavinck (2001) emphasises, "All and sundry who ventured to take risks of entrepreneurship were encouraged" (Bavinck 2001:56). This point in particular has high relevance for the current situation at Pulicat lake, where non traditional fishermen have been actively encouraged by government policy to form cooperatives and start fishing for prawn.

3.1.2 Development of government driven fishermen cooperatives[40]

The government initiative to form fishermen cooperatives provided the main instrument through which change by fisheries development policies could be

[40] The establishment of Fishermen Cooperative Societies was spearheaded by the government organisation FISHCOFED (National Federation of Fishermen Cooperatives) (Bavinck 2001), which registered in 1980 and started its operations in 1982 (Prakash 2004). Its main functions are described: "to serve as a spokesman of the sector, support to training programmes, transfer of intermediate technology to fishermen, leadership development, service to member-institutions by setting up technical and promotional cells, retail marketing of fish, inland fish production, insurance schemes for fishermen, and international trade negotiations" (Prakash 2004:7).

implemented in fishing society. Loans, subsidies and incentives for fishing modernisation reached Pulicat fishermen through these fishermen societies, of which almost all fishermen are today members. In fact, membership of a cooperative society is prerequisite to the right to participate in government development programmes (Bavinck 2001). However, fishermen status by either caste or occupational tradition was not a requirement to form a fisherman cooperative and all parts of society were actively encouraged to do so. Evidence of this at Pulicat is ample; in the researched non-traditional fishing villages, village elders often explained how they were able to gain a significant amount of Government funding for nets, and even access rights to the lake's Padu system through the formation of these government supported groups.

Fishermen cooperatives gave some degree of verification in the fishing sector, and this has acted as a catalyst to non traditional fishermen fishing Pulicat lake[41]. A similar scenario to this is explained in the break up of the Kerala Padu system (Lobe & Berkes 2004), where all fishing access rights have been subsumed under government license. As a result, many new forms of 'traditional' fishermen are in a position to claim rights to fish (Lobe and Berkes 2004), a venture that was seemingly better controlled under the traditional 'village level' administration of fishing rights.

Bavinck (2001) describes the unexpected dynamics which have divided Tamil Nadu marine fishing society: "The policy-makers expected that the new technology would contribute to the social and economic welfare of the artisanal fishermen. However, the blue revolution unleashed new forces and generated new dynamics. The basic problem was the boat (trawler) fishermen exploited the same ecological niche upon which artisanal fishermen depended, and this set a spiral of conflict into motion" (Bavinck 2001:76). On a smaller scale, at Pulicat lake a similar thing seems to have happened. Through actively encouraging the formation of fishermen societies and the accompanying provision of nets and loans, policy makers have opened up the Pulicat

[41] I refer here to the increase in the number of non traditional fishermen utilising the Pulicat lake fishery, which is discussed in more detail in later parts of this thesis. Whilst I believe that formation of fishermen cooperatives did act as a catalyst to non traditional fishermen coming to the lake, it is important to realise that non traditional fishermen have been visiting Pulicat lake for at least the last 100 years (according to village elders), particularly from the agricultural sector during periods of drought and poor agricultural crops yields. The 1950's formation of fisheries cooperatives has merely escalated this venture, providing a full-time and more permanent angle to fishing encouragement. It did not however introduce non-traditional fishermen to the Pulicat lake fishery.

lake fishing niche to non–traditional fishermen. Prior to the policy intervention, a fishing livelihood may not have been such an easy option for those outside the traditional fishing hierarchy.

3.1.3 Policy driven fishing gear changes[42] *- Modernisation of nets*

A key change in fishing technology of Pulicat lake fishers is the replacement of natural fibre fishing nets with synthetic nylon nets. According to fishermen in Dhonirevu (a non-traditional fishing village), the government equipped fishing cooperatives with nets from 1962 and also provided loans to buy thread to make nets (Dhonirevu elders focus group 2003). Prior to this time, natural fibres were used and nets were largely hand made by the fishermen. This is concurrent with Bavinck's study of the Marine fisheries sector in which he states: "One of the Fisheries Department's first goals was to replace natural fibres with synthetic ones which were stronger and had a longer lifespan. To this end, it started distributing synthetic twines and filaments to fishermen cooperatives at subsidized rates. Fishermen were quick to adopt these new materials, as they had a positive effect on catch levels" (Bavinck 2001:65).

Greater accessibility to better twine and ready made nets provided by the government has had a dual impact on the way people fish today. Not only were nets made available to non traditional fishing groups through fishermen cooperatives, but also availability of 'ready-made nets' could have made changing net type a lot easier. The earlier practice of hand making nets by fishermen was associated with a high degree of personal value over these nets; nets were cared for and once made, the nets were repaired and kept in good condition to be used over many years (Padu fisher elders focus group 2003). An easily accessible source of nets could have changed these traditional practices and opened up possibilities for fishermen to change nets, and of

[42] Lake fishing villages at Pulicat were not affected by the encouragement of boat modernisation which affected the Marine fishing sector in Tamil Nadu. Lake fishermen continue to use traditional wind-powered wooden sailing crafts (known as country boats) or kattumarams for lake fishing, as they have done for centuries In all fishing lake side villages studied, the only households which owned engines were those involved in providing transportation services for villagers crossing Pulicat lake, and these constituted only a handful of families in the area (there were approximately 5 transport boats in operation during 2003). Both the household survey data (this project), village census data from the 2000 State Fisheries Department and interviews with fishermen state that lake fishermen do not use engines.

course, inclinations would be to change towards using the more productive, profitable and lucrative net of the time – the stake nets used to catch prawn.

Evidence for change in type of fishing net used at Pulicat can be found through Hornell's 1924 description of fishing net types in use in Pulicat lake[43], in which he mentions a far greater diversity of nets, most of which were not found in the present study. Admittedly, these nets may have been in use in other villages not included in the research[44], however the point to make here is that those nets which Hornell describes as being of particular importance to Pulicat are all used for catching fin fish. Nets described today as being of importance by Pulicat fishermen are prawn fishing nets. There is one exception to this which is the large beach seine 'Badi valai' which is still in use in Pulicat, but in far lower numbers compared to the past (Mathew 1991).

This gives a basis for an argument that fisheries policy implications of the 'pink gold rush' have contributed to an increased dependency on the prawn within the fishery of Pulicat lake. The implications of these changes for fishermen at Pulicat as one might imagine are substantial, and evidence from this research contributes to understanding the affects of policy change on fishing practice specifically on different types of fishing community at Pulicat, detailed in later sections throughout this thesis.

3.2 Changes in fisher identity – 'Non traditional' vs. 'traditional' fishermen

In Bavinck's (2001) description of fisheries development in the Marine fishing sector, he argues that artisanal fishermen have been marginalised by rich new-comers to the industry, profiting from the now lucrative business of fishing and export. Bavinck argues that the take over by private investors, especially in the aquaculture and the marine fishing sectors, has created a "dual fishing economy" (Bavinck 2001:47)

[43] Hornell's 1924 study of fisheries at Pulicat states that major nets in use at the time included *Kala valai* used for catching *Kala fish* (Polynemus sp), *Koduwa valai* (used in catching *Koduwa* (Lates calcarifer) and *Pusal valai* (a derivative of gill net with fine mesh used in juvenile mullet fishing) (Hornell 1924). *Valai* is the Tamil term for *net.*

[44] State census data detailing fishing equipment ownership is not available for Lakeside fishing villages until the 2000 Fisheries Department Census, which categorised all non-marine fishing net types as 'other'.

where wealthy entrepreneurs, new to the fishing business, (which even includes movie stars in Chennai), have made fortunes from the fisheries development through investing in mechanised fishing and aquaculture. The artisanal fishing population continues to fish much in the same way as they did prior to the fishing developments (Bavinck 2001) and most are well aware of the profits being made by non traditional fishermen.

This feeling of resentment over non-traditional fishermen coming into the fishing sector is an important concept for coastal management at Pulicat lake and resounds throughout the state in different situations. At a state-wide scale, the anger from the artisanal marine fishermen in Tamil Nadu towards the appropriation of mechanised fishing boats by 'non traditional fishing entrepreneurs', mainly from Chennai has resulted in several decades of violent conflict, which peaked in the 1978 Chennai riots (Bavinck 2001).

At Pulicat lake, the subject of conflict may be different, but the feelings towards a hereditary right to fish through the Padu system are very close to those documented by Bavinck (2001) in the marine sector. At Pulicat however, the roles are reversed. Whereas in the marine fisheries sector the artisanal fishermen are marginalised and the newly incoming fishermen are wealthy entrepreneurs, in fact it is the opposite situation at Pulicat. New incoming fishermen are generally of poorer and lower caste status; many have agricultural or tribal backgrounds and are seen as an unwelcome encroachment on an established fishing system practiced by a higher fishing caste. This feeling of 'fishing access' as a birth right to a particular fishing caste, however, is very much the same in both situations, and its relevance to coastal management at Pulicat is revisited in future chapters.

3.3 Implications of historical events in Pulicat – additional drivers of change

Whilst state-led fisheries policy development has represented a central driver of change in the Pulicat lake fishery, it is important to note that other aspects of change have contributed to the divisions between fishing society. Two historical events, which are specific to Pulicat lake and have contributed to the pattern of change, are:

1. The longer term acquisition of Padu fishing rights for non-traditional fishing villages

It is important to distinguish that the acquisition of lake fishing rights by non traditional lake fishing communities is not solely the result of encouragement through formal fisheries policy and developments in the global prawn market. Whilst these factors may have facilitated the process, redistribution of Padu rights can be traced back as far as the beginning of the Century. Peace committees under Colonial rule may have played a more substantial role in re-defining Padu rights than they do today, although evidence for this has not been solidified by the current research. Furthermore, the particular success of Scheduled caste fishing villages in acquiring Padu fishing rights in the lake may imply connections with their increasing political status, particularly through positive discrimination for scheduled caste members in local government.

The process of winning Padu fishing rights also heavily involves village politics and power. In historical recollections of successful acquisitions of Padu rights, village size, alliances with larger villages, influential village families and links with politicians have all played important roles.

2. *The 1984 displacement of villages from Sriharikota Island*

A land displacement in 1984 of Sriharikota Island in Pulicat lake has added further complexity to the use of fishing space in the lake. The SHAR rocket station was commissioned on Sriharikota Island in October 1971. In 1984, due to extensions and safety necessities at the station, all villages on the island were displaced to the southern part of Pulicat lake close to Pulicat town. A total of 7 villages were displaced at the same time leaving the entire island (which is 60km long) clear of any type of settlement. Whilst some of the smaller villages merged with existing villages in the area, the larger villages such as Arangankuppam encroached on already established Padu fishing grounds of existing villages, who were new neighbours. The result of this has been continual conflict over lake fishing space.

As well as conflict, the clearance of Sriharikota Island meant that many scheduled caste communities lost their traditional livelihood of working in Casuarina plantations which covered the island. This in turn has spurred increasing numbers of Scheduled caste fishing communities to demand Padu fishing rights in the lake. Although the Sriharikota Island displacements are not the initial cause of conflict over Padu fishing rights, the situation further fuelled an already overcrowded Padu fishing system; a system which was already starting to buckle under pressures created by new state fisheries policy.

SECTION 4 Applying an integrated history of change at Pulicat to today's fishing society divisions

This chapter has firstly given a general background to Pulicat fishing villages, and detailed the informal policy mechanism of the Padu system. Secondly, it has considered some of the historical events and policy implications in shaping the current situation of the Pulicat lake fishery.

A clear driver of change has been the Tamil Nadu state fisheries policy, which actively encourages the formation of fishermen cooperatives by both traditional and non-traditional fishing groups. Anyone can form a cooperative, providing they have large enough number of group membership. Through fishermen cooperatives, loans and subsidies are available for buying and modernising fishing gear and boats. This means that synthetic 'ready made' nets are easily and quickly appropriated.

This policy change has, in part, been driven by global developments in the prawn export market ('the pink gold rush'), which has led to the encouragement of traditional fishermen at Pulicat lake to focus on catching the increasingly valuable prawn. Easy access to ready made fishing gears facilitates faster specialization of fishing gear to focus on solely catching prawn species. As fisherman at Pulicat often state, Pulicat lake is today dominated by prawn fishing.

This in turn has created a neglect of fishing diversity (using other nets) which may have been used in the past by traditional fishers, for example, the decline in the use of fishing gears designed for catching (now less valuable) fin fish, and the fall in Beach

seine (Badi valai) use. The resulting high dependency on prawn and stake net fishing has serious consequences for traditional fishers, which are discussed in more detail in later chapters. The high market value of the prawn combined with active encouragement into the livelihood of fishing by state policies, have simultaneously attracted many non-traditional fishers to Pulicat lake.

A growing number of fishers in Pulicat lake, who are attracted by the lucrative prawn fishery and encouraged by the state, increase fishing competition in an already heavily utilised resource. Access rights to the most productive parts of the lake fishery through the Padu system are fought for by non-traditional fishers, and vehemently defended by traditional Padu fishermen. This has created a split between traditional lake fishermen and non-traditional fishers, a conflict between Pattinaver and non Pattinaver caste over fishing rights.

Furthermore, the wealth and accompanying social status gained by Pattinaver communities through the lucrative prawn fishing business have rapidly increased over the last 40 years. This, in turn, exacerbates the desire for Padu status in non-Pattinaver caste groups. Exclusion from the Padu system and the use of non-Padu fishing gear have become increasingly lower status, and a sign of poor non-traditional fishers. Whilst diversity in fishing techniques is considered key to survival in artisanal fisheries (McGoodwin 1990), the combination of state, market and community changes has driven Padu fishermen to over-dependency on a specialist fishing strategy.

4.1 Categorising fishing villages with an understanding of the forces of change

The establishment of this integrated understanding of change in the Pulicat fishery allows a better insight into the current divisions which exist between fishing communities at Pulicat lake today. Understanding the role of Padu access rights in the lake fishery, the interactions between fishing villages and how change affects different groups of fishing community are important aspects of a coastal management process which has people at its core. Before engaging with people's perceptions of change, management needs and responses to change, a degree of understanding about

the structure of fishing communities is required. The background of change explained in this chapter highlights the heterogeneity which now exits between fishing villages at Pulicat.

Bavinck (2001) describes in the marine fishing population of Tamil Nadu that despite some divisions between *Chinna* (small) and *Periya* (large) Pattinaver caste subgroups, the marine fishermen population of the coast as a whole is relatively uniform (Bavinck 2001). At Pulicat lake this is not the case and there is great heterogeneity *between* fishing villages, which is a product of historical change. Sivasubramanian (1987) categorised Pulicat fishing villages as being easily split between marine fishing villages (those fishing in the sea) and lakeside fishing villages (those fishing in the lake). As other caste groups have moved into the Pulicat lake fishery, this categorisation is no longer sufficient. Mathew (1991) categorised Pulicat lake villages to be comprised predominantly by Pattinaver fishermen – a traditional marine fishing caste, Harijan - scheduled caste who Mathew describes as being predominantly involved in the fishery, and Tribal – Irulas who have moved into the lake fishery from the agricultural sector (Mathew 1991).

The diagram below represents the divisions between Pulicat fishing communities as understood today. Key factors underlying categorisation of fishing villages are the degree of Padu access rights, history, tradition and caste. As is discussed in the methodology, these categorisations were heavily supported by villager interpretations during fieldwork.

Fig G Interpretation of fishing society divisions in the Pulicat lake fishery

Villages directly involved in the research are **highlighted**

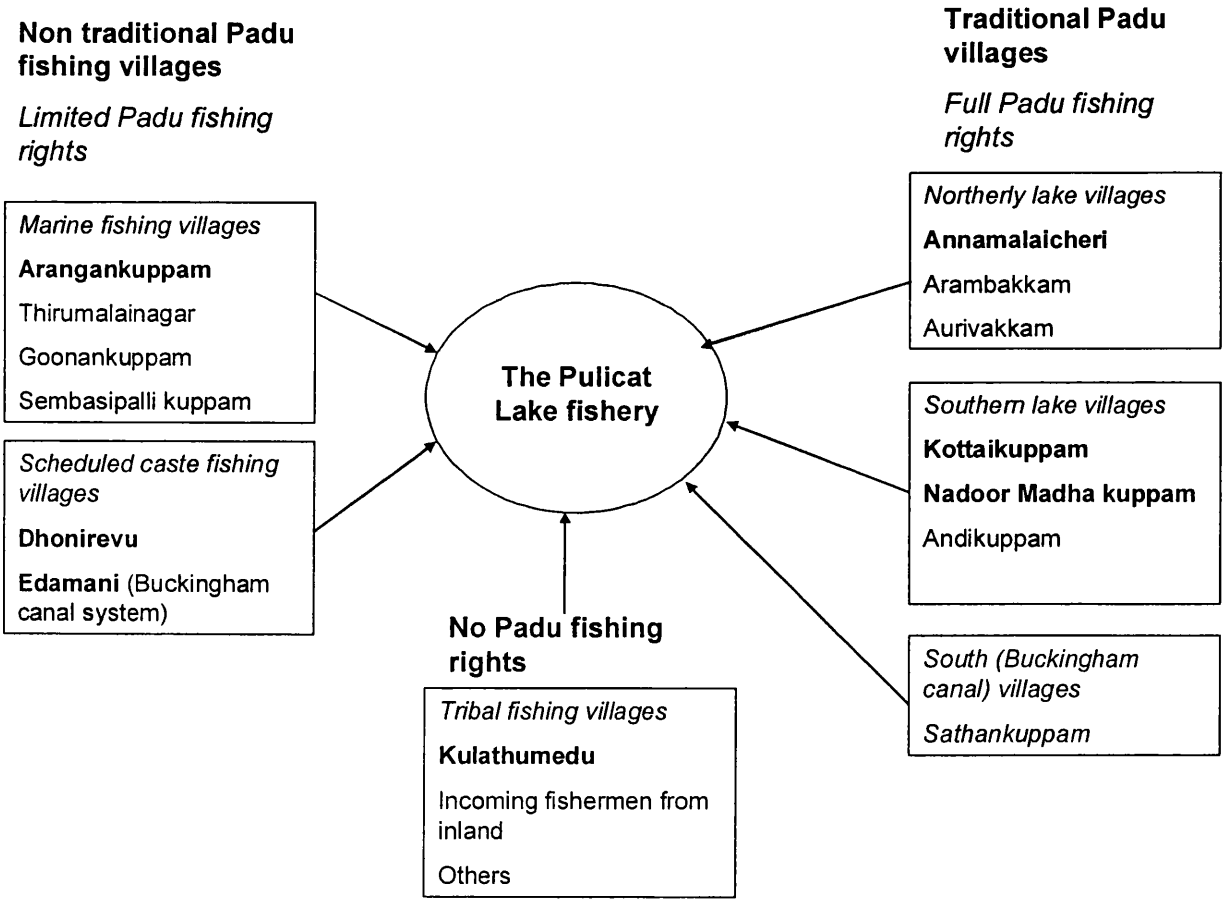
Full Padu fishing rights – defined as those fishing villages who have Padu fishing rights 'from time immemorial' through 'Pattinaver caste'. In Traditional Padu fishing villages, access to Talekettu membership and Padu fishing grounds are considered a hereditary 'birth right'.

Limited Padu fishing rights – are given to those villages whose Padu fishing access has been acquired within the last 100 years (usually following a dispute). Categorised as 'Non traditional fishing villages' two types can be distinguished:

i) Predominantly marine fishing villages of Pattinaver fishing caste which have won limited rights to fish in the lake

ii) Scheduled caste fishing villages which have won rights historically through negotiation.

No Padu fishing rights - applies to those villages who fish outside the Padu system with small scale (non padu) fishing gears, locally known as *Sirutholil,* 'small scale fishing'.



What is important to note here is that whilst non-traditional padu villages operate stake net fishing at limited times of the year, all have access to marginal and low productivity Padu grounds, when compared to Padu grounds utilised by the Traditional Padu villages. Acceptance of Padu rights in poorer areas is a possible factor in their successful acquisition of these rights from Pattinaver caste fishermen in the first place.

Usually limited access to the Padu system must be supplemented by another form of fishing or non fishing income. Often the Padu rights are marginal and in some way dominated, monitored and regulated by the higher Pattinaver caste fishing groups. Traditional Pattinaver caste fishing villages are clearly dominant of fishing rights and as is discussed in later chapters, this dominance and control over Padu is regularly felt by 'non traditional' fishing villages, both those with and those without Padu rights.

More villages than those listed in the above diagram exist around the Southern area of Pulicat lake. The listed villages however, represent the main forces fishing in the lake system when one combines consideration of historical change, caste and the Padu system. In the non Padu fishing sector many more villages may be turning to fishing[45] and these are categorised under 'other' in the non Padu rights sector.

5. Conclusion

Today, the fishery at Pulicat represents a dual fishing system: those with Padu fishing rights and those without Padu fishing rights. Traditionally, caste has been a determinant of entrance into the Padu system. However, over the last century, the Padu system has expanding to include 'non-traditional fishing castes' and is in effect both opening up and/ or breaking down as an institution (Mathew 1991).

When coastal changes through forces of community, market and state sectors are considered, it becomes clear that many inter-linked changes have facilitated the expansion of the Padu system. This expansion has in turn created divisions between

[45] An example here would be the village of Jamilabad, which traditionally is not a fishing village but which in recent years has started small scale fishing of the lake. Jamilabad, once joined with Dhonirevu village is almost 100% Muslim, and is by tradition a boat making village. Although still active in boat making, many of the villagers are now also turning to fishing with non Padu fishing gears, such as cast nets.

fishing societies at Pulicat, which can be conceptualised at a village level. These historical changes have clearly defined 'traditional fishing communities' and 'non-traditional fishing communities'. This division is influential in shaping both people's perceptions of coastal management needs at Pulicat lake, and their ability to adapt to cope with change. These topics are the focus of the following chapters.

CHAPTER FIVE

PERCEIVED COASTAL MANAGEMENT PRIORITIES FOR PULICAT LAKE

Introduction

So far we have looked at Pulicat lake from a general background perspective. The previous chapter explored some of the established fishing society norms and addressed the importance of the traditional Padu system as the major form of fisheries management in operation at the lake. The chapter also detailed wider coastal legislation and fisheries policy and discussed how developments through history may have contributed to changes at Pulicat lake in shaping social divisions between different fishing communities.

As is argued in the introductory chapters of this thesis, centralising people in a coastal management process demands a thorough consideration of perceptions and viewpoints held by the different actors of the coast. The aim of this chapter is to engage with coastal management priorities for Pulicat lake as perceived by the lake's stakeholders, giving substantial focus on the primary stakeholders of the lake, the village residents. The perspectives of non-resident lake stakeholders are also considered throughout the chapter where appropriate, however the aim of this part of the PhD is to discover what Pulicat fishing communities regard as being important for coastal management. To date, research and management planning for Pulicat lake have wholly excluded local Pulicat fishing communities, overlooking a primary and key stakeholder. As a result (as is discussed in later chapters), formal management interventions rarely take effect in the lake and the area remains dependent upon informal traditional fisheries management policy. This chapter redresses the balance to better include the opinion of local communities in the management process, and combines their opinion with the more frequently heard viewpoints of policy makers and academics, through publications and interview.

The first part of this chapter presents the main results from the semi-structured household village survey and the management priority rating survey. As is described in chapter three, the methodology chapter, seven villages were selected for in-depth research. The chapter starts with a brief description of the seven research villages, which includes information on village population, village employment patterns, religion and caste, and household ownership of fishing gears. Data for village descriptions have been extracted from both the household village survey (conducted

in 2003) and where available, the State Fisheries Department Marine Fisherfolk Census conducted in 2000 (abbreviated as SFD 2000).

The chapter then discusses perceived coastal management priorities as stated by residents of Pulicat lake fishing villages. First to be discussed are the results of the management priority rating survey, which was distributed through two Pulicat town schools. Secondly, the results of the semi-structured village household survey are presented. Residents in each of the seven research villages were asked to state three top management priorities. The responses given are discussed for each individual village.

The third part of the chapter critiques the effectiveness of using a survey as a tool to assess people's coastal management priorities. Whilst problems of conducting the survey are detailed in chapter three, at the analysis stage, interpretation of survey responses requires substantial input from more qualitative sources of understanding to be given any useful meaning. Primarily a lack of sensitivity to hidden 'insider' issues and a lack of ability to connect related themes in survey responses are key limitations of survey techniques. The chapter argues that interlinking management priorities can show a complex network of problems and consequences which surround a focal problem - a threatened fishing livelihood.

A top coastal management priority for inhabitants of Pulicat fishing villages is the future of their fishery, and many prioritise management which can halt and reverse the current trend of declining fish catches. An additional rating survey conducted with key coastal policy makers in Tamil Nadu, also reveals a common concern over the future of the lake fishery.

The chapter finishes with a closer look at the Pulicat lake fishery. Scientific understanding of the state of the lagoon as a working fishery is fragmentary, and assessment of the lake's natural processes, its fishing capacity and productivity rates are inconclusive. This lack of scientific understanding has led to great contestation between (and within) scientific, policy making and community groups, over if, how and why the fishery may or may not be in decline. It is common for fisheries science to draw upon available data and patch together a 'good as possible' prediction as to

the status and sustainability of a fishery 'pending further research'. This thesis however takes an alternative approach. Instead of trying to base on incomplete data a conclusion over the fate of the fishery, the chapter accepts and lays open the gaps in science and insufficiency in knowledge, and addresses how the uncertainty affects peoples' beliefs of the coastal problem. As Berkes et al (2003) argue, "To be sure, very few ecologists would consider predictive models in ecology as easy to achieve. But there is a fundamental difference between the view that quantitative prediction is difficult and data intensive ('we need more research') and the view that nature is...inherently unpredictable." (Berkes et al 2003:7).

This chapter represents a turning point in the research, which initially devoted many hours to searching for illusive fish catch data to try to substantiate a pattern of change. However, accepting that science of the fishery is uncertain allows us to address the implications of that uncertainty for policy makers; a step forward for a management process which considers policy makers needs.

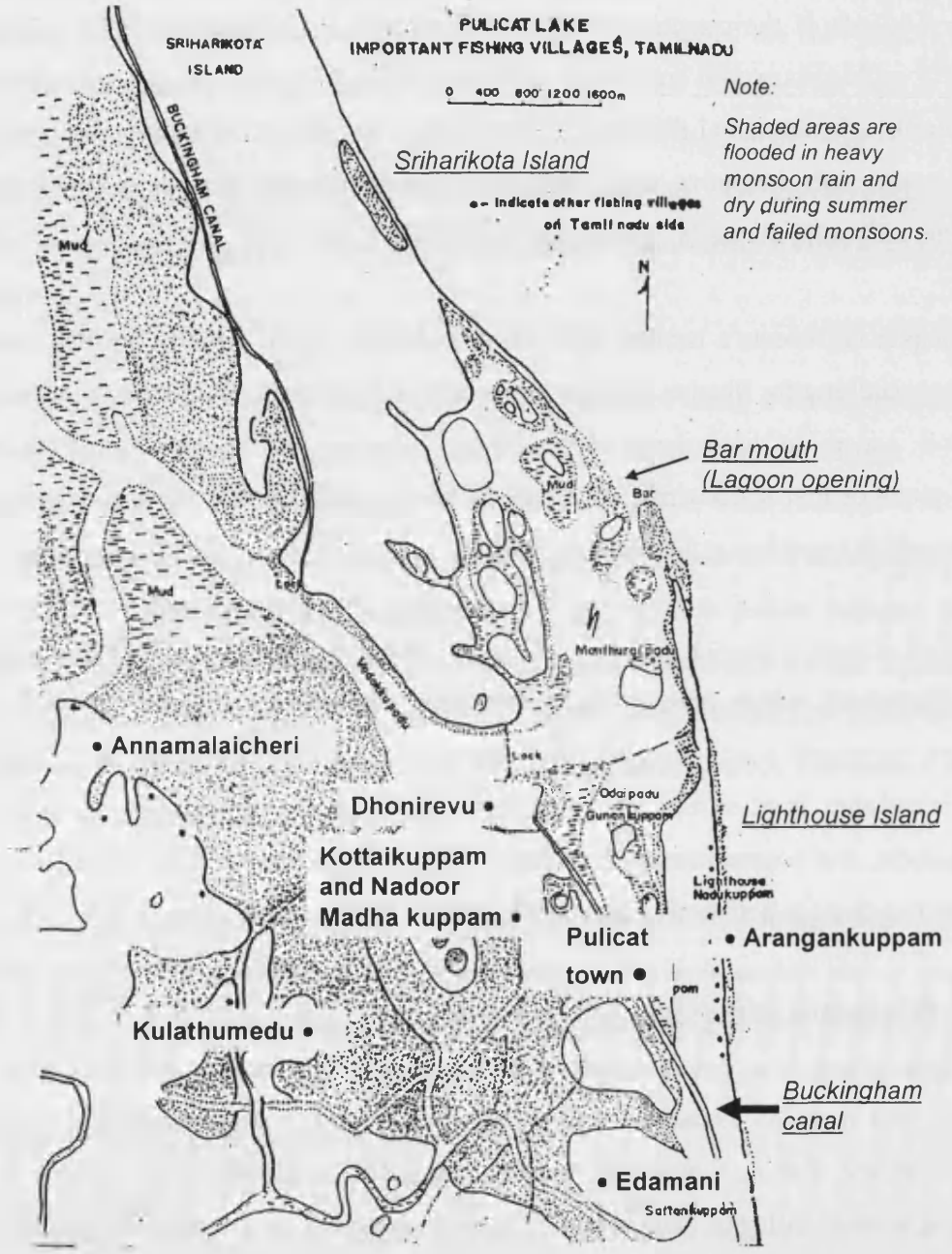
Contestation over potential drivers of the claimed fishery decline is the focus of the next chapter (6), which debates how uncertainty combined with politics can drive people's perceived needs and priorities for management. Uncertainty and politics have important implications for applying participatory approaches in coastal management, and coastal management needs to be better aware of these forces, if it is to have meaning for both policy makers and coastal communities.

1.1 Description of the seven research villages

This section gives brief details on the seven research villages which were the focus of the fieldwork research. Detailed information on each village was collected including: village history; fishing behaviour; general problems faced by each village; and relations between villages, using key person interviews and focus group discussion (as detailed in chapter 3). These data are applied throughout the thesis where relevant to support arguments made. The seven villages are presented according to their status in the Padu system as is discussed in Chapter 4: Traditional Padu fishing villages (Pattinaver caste); a marine fishing village with limited Padu rights; Non traditional Padu fishing villages (Scheduled caste) with limited Padu rights; and a non traditional fishing village (Tribal caste) with no Padu fishing rights.

Map 2: Locations of the seven research villages in the South of Pulicat lake

(Map adapted from Mathew 1991)



1.1.1 Kottaikuppam, Naduvoor Madha kuppam and Annamalaicheri: Traditional Padu fishing villages in Pulicat Lake

The villages of Kottaikuppam, Nadoor Madha kuppam and Annamalaicheri are traditional Pattinaver caste Padu villages operating in Pulicat lake. These villages are (according to local accounts) the 'founders' of the Padu fishing system which exists at Pulicat lake and have much influence over the other villages on the lake. They fish in the highly productive Padu fishing grounds and, as was discussed in the previous chapter, have monopolisation and dominance over a large part of the lake's prawn fishery.

These villages are predominately Pattinaver caste (a subgroup of Most Backward Caste), which is the traditional fishing caste of Tamil Nadu and an important foundation for access into the Padu system (as is detailed in the description of the Padu system, Chapter 4). Naduvoor Madha kuppam (which is also known as Christian kuppam) has a majority of Christian inhabitants, largely due to the presence of a Roman Catholic mission operating in the village. Christians in Nadoor Madha kuppam strongly consider themselves as Pattinaver caste through an association to the traditional Padu fishing rights, despite caste being traditionally linked to the Hindu religion.

Within all traditional Padu fishing villages there is a sense of increasing poverty, which many blame on income losses through declining fish catches (discussed in later chapters). The villagers recall past days of richness from great fishing profits in the 1970s and 1980s and today bitterly tell the misery of their income losses. Traditional Padu villages maintain a strong control over the Padu system operating at Pulicat, and are still dominant over other villages; however, their status as seen by other (non padu) villages is gradually diminishing, and their grip over Padu may eventually slip[46].

[46] The falling status of traditional Padu fishermen is the focus of chapter 7, whilst the future fate of the Padu system is discussed in the concluding chapter of the thesis.

1.1.2 Arangankuppam: A marine fishing village with limited Padu rights

Arangankuppam is a large marine fishing village which was displaced from Sriharikota Island in 1984 from its original location towards the Andhra Pradesh border (approximately 15 miles north of Pulicat town). Arangankuppam is now located on Lighthouse Island to the south of the lake mouth, and its inhabitants fish predominantly in the sea. Arangankuppam is one of the largest marine fishing villages of the area and has a large amount of political sway, for example, the elected Lighthouse Island Gram (state) Panchayat leader is a member of the village. Marine fishing villages around Pulicat are generally well off since they are able to benefit from both sea and lake fishing, another contentious issue for traditional Padu fishing villages (who do not fish in the sea).

Arangankuppam fishermen have won limited access to lake Padu fishing grounds for 6 weeks during the monsoon period (November-December), when rough seas make sea fishing more difficult. Many other marine fishing villages also have limited Padu lake fishing rights. The contention that exists between marine fishermen and lake fishermen, and also between displaced and original marine fishing villages, frequently erupts into conflict over lake fishing rights.

There is a general feeling in Arangankuppam that villagers are better off since displacement, which has primarily been due to a new village location with closer proximity to Pulicat town, and better direct access to fish markets and prawn buyers. This comes at a price however, and a key complaint in this village is the conflicts which have ensued over lake fishing rights. Out of the surveyed households, 48% of household heads stated they fished in the lake at some time during the year[47]. This gives an idea of the scale of lake fishing and indicates that not all marine fishermen utilise their lake fishing allowance during the monsoon months.

[47] Fishing in the lake was asked as a Yes or No question in the household village survey, since villagers were unhappy about disclosing the exact number of months spent fishing in the lake – a highly volatile subject in the area.

1.1.3 Dhonirevu and Edamani: Non traditional (Scheduled caste) fishing villages with limited Padu rights

The meaning of Dhonirevu is 'boat mooring place', a reference to its pre-displacement years when it was combined with the Muslim village of Jamilabad, a primarily boat making village on Sriharikota Island. After the 1984 displacement, the villages separated, the Muslims forming their new village of Jamilabad and the Scheduled caste population remaining in their village of Dhonirevu. Dhonirevu moved only a short distance across the lake from the southern tip of Sriharikota Island and it was able to retain its Padu rights in the lake opening (bar mouth area), which have been established since 1924. Many Dhonirevu inhabitants were also employed in the Casuarina plantations on Sriharikota Island, which are no longer accessible following clearance of the island.

Edamani is a small Scheduled caste village (only 70 households), but it is included here because like Dhonirevu, it is a Scheduled caste village which has won limited Padu fishing rights in the lake. However, whilst Dhonirevu has been fishing padu since 1924, Edamani is at a much more recent stage of acquiring Padu rights, which are still under contestation and, as a result, its situation is significantly different to that of Dhonirevu village. Edamani village is situated to the south of Pulicat town, and its inhabitants fish in the least productive part of the lake (the Odai padu area) in the Buckingham canal. Edamani gained Padu fishing rights (to fish with stake nets) in Odai padu in 1990, following encouragement to seek fishing access by a local NGO during the 1980s. Prior to this time Edamani's Scheduled caste population had non-fishing occupations and caught fish only as a subsidiary income earner using very simple methods such as *Kattu* (digging small traps in the river bank) and fishing by hand[48]. Up until 50 years ago Edamani inhabitants were largely employed in the transportation of goods by boat from Pulicat to Chennai along the Buckingham canal, besides which the village is located. This trade has largely dried up due to

[48] *Kattu* fishing is the building of small traps on the river bank, which relies on the incoming tide to bring small fish and prawns. Village elders report fishing using *Kattu* methods since the 1940s, whilst starting to develop more productive fishing ideas following the intervention of the state fisheries development policies and increased awareness through the local NGO

developments in modern road transport links and this has played a role in livelihood change for Edamani villagers[49].

Currently, Edamani's Padu rights are under tight control by neighbouring traditional Padu fishing villages. Edamani fishers are only permitted to fish in padu sites in the very shallow edges of the lake, the deeper (and more productive) parts being monopolised by Pattinaver caste. In addition, Edamani village is banned from all Padu fishing with stake nets for 3 months during the monsoon period (October to December), which is the most productive and profitable time for the lake fishermen. The village is heavily under the enforcement of neighbouring Pattinaver villages, and Edamani villagers are in a continuous battle with peace committees and Panchayat leaders to try to win better access.

1.1.4 Kulathumedu: a village with no Padu fishing rights

Kulathumedu is almost completely inhabited by people of Scheduled tribe classification, which is the lowest form of social status in India and is considered below the caste system in the Hindu religion. Tribal people are often nomadic and commonly migrate to the lake from inland areas during the productive monsoon when small scale fishing can become quite lucrative. Traditionally, Pulicat lake has been a source of relief during harsh times (such as drought) for many people dependent upon land-based livelihoods. Seasonal and temporary fishing by migrant fishers is common in many small scale fisheries (Mathew 2001, Kramer et al 2002, Curran & Agardy 2002, Bene 2003).

Perhaps driven by lucrative prawn export markets, many once temporary tribal villages have now permanently settled at the lake. Many of these villages have more recently won claims to land ownership through tribal land rights campaigns. Kulathumedu is one such village having won land rights in 2003. Currently, 90% of village households depend upon lake fishing as the main source of income (Household village survey 2003).

[49] Historical livelihood changes from canal based occupations to full time fishing were documented by focus groups held with Edamani village elders.

Tribal fishers are at the bottom of the hierarchy of fishers at Pulicat lake. Men and women are employed in hand fishing for prawn, which is seen by many as the lowest form of fishing technique and an indication of poverty.

1.2 Comparative analysis of key differences between villages using household survey and official census data

A degree of comparative analysis of differences between research villages is useful at this stage for two reasons. Firstly, data from the household village survey and official census[50] data for each village reconfirms the categorisation of different types of fishing village, as was constructed by historical and traditional perspectives in the previous chapter. Secondly, the data provide a more detailed insight into differences between fishing behaviour. Comparing quantitative village data gives an effective illustration of the differences between fishing practices in non-traditional and traditional Padu fishing villages. Analysis at this basic village level sets up future debates in the thesis, which illustrate different fishing village adaptive capacities.

[50] Census data used in this chapter is from the State (Tamil Nadu) Fisheries Department Marine Fisherfolk Village Census (2000), abbreviated from here on as 'SFD'.

Table 3 Research village population size

Village	Padu Status	*Village leader information (2003)*	*State Fisheries Department Census (SFD) 2000 (see box 3)*		*Household surve (2003) (n: survey sample size)*
		No. of families	No. of families	Total population	% of households with fishing as main income source
Nadoor Madha kuppam	Traditional Padu village	635	430	1885	98% (n = 50)
Kottaikuppam	Traditional Padu village	300	142	769	96% (n=95)
Annamalaicheri	Traditional Padu village	600	342	1441	100% (n=20)
Arangankuppam	Non traditional padu rights/ marine fishing village	450	324	1335	92% (n = 75)
Dhonirevu	Non traditional padu rights/ Scheduled caste fishing village	120	129	536	99% (n = 84)
Edamani	Non traditional padu rights/ Scheduled caste fishing village (Buckingham Canal padu)	70	90	366	98 % (n = 58)
Kulathumedu	No Padu rights / Tribal village	80	99	439	90% (n = 73)

Box 3: Data discrepancies between village population size

There is an apparent large increase in population size in the Padu villages Kottaikuppam, Nadoor Madha kuppam and Annamalaicheri between records detailed in the State Fisheries Department Census in 2000 and village leader interviews held in 2003. For example, in Kottaikuppam there is a large difference in population size from the official census (142 families for the year 2000) and population according to village leaders (300 families in 2003). Error on my own part in recording or a misrepresentation of figures by fishing leaders are both unlikely scenarios since several village inhabitants disclosed family numbers within villages on more than one occasion, and village leaders themselves are incredibly aware of who is living within 'their' village jurisdiction. There are several potential problems in defining population changes from cross comparisons of census information which are discussed further in chapter 6. At this stage, the figures are included to give the reader an initial sense of size in comparison to other villages involved in the research.

The most populous traditional Padu fishing villages involved in the research are Annamalaicheri and Nadoor Madha kuppam. Annamalaicheri is located around 6km north of Pulicat town (see map 1) and is the dominant village of the Northern Padu fishing grounds. In the south of the lake, Nadoor Madha kuppam is the dominant Padu fishing village along with two others, Kottaikuppam, and Andikuppam (not included in the research), which both have smaller populations. All types of village, regardless of Padu status, have a high dependency on fishing, with over 90% of households in all villages stating 'fishing' as a main source of household income. All villages, except the marine fishing village of Arangankuppam, fish only in Pulicat lake.

Table 4 Research village employment

Village	**Employment status of men (% adult males employed)** *Source: SFD census 2000*				**Employment status of women (% adult women employed)** *Source: SFD census 2000*			
	No. of adult males	Active fishing	Allied fishing activity	Other than fishing	No. of adult women	Active fishing	Fresh fish trade	Dried fish trade
Nadoor Madha kuppam	681	78%	0	1%	600	0	0	0
Kottaikuppam	263	100%	0	0	249	0	0	0
Annamalaicheri	400	92%	0	0	470	0	36%	0
Arangankuppam	383	98%	5%	1%	406	0	3%	4%
Dhonirevu	183	98%	0	0	182	0	0	0
Edamani	112	86%	0	0	110	0	5%	0
Kulathumedu	147	102%[51]	0	0	126	76%	0	0

Village employment patterns show that almost all males in each research village are employed in full time fishing. Allied fishing activities such as trade, export or boat repair are much more prevalent occupations in Pulicat town[52].

Chapter 4 detailed the role of women in Pulicat fishing villages. Using census data we clearly see that the only village to have women involved in direct fishing is Kulathumedu, a tribal village with poor fishing opportunity and low social status.

[51] In the SFD (2000) census, Kulathumedu has a higher number of adult fishermen than the total number of adult males recorded as living in the village. This may have included some male children fishing, however since there is no description in the SFD census of how people are classified as adult or child, it is difficult to tell where the age limits for Adult fishermen start. Such a high proportion of fishing adult males may indicate a large proportion of the elderly men continuing direct fishing into old age. Retirement from fishing in some villages, such as Dhonirevu, is aided with social welfare from the village catch, but this is not the case in all villages. Age distribution data in the SFD census show that very few village inhabitants (across all villages) reach over the age of 65, however this data is to be treated with caution. For example, the census records for Dhonirevu 2000 state that the village has no inhabitants over the age of 65, while in 2003 I held focus group meetings with at least 8 fishermen who were over the age of 75 (and still very much alive).

[52] Census details for Pulicat town under the marine fisherfolk census 2000 are unavailable since Pulicat town was excluded from the census. Details of the Town and Village Census of India (1991) state that Pulicat town had 71% of its male working population categorised as working in sector III: "Livestock, forestry, fishing, hunting and plantations, orchards and allied activities", whilst 14% were categorised as sector VII "trade and commerce". Working women on the other hand were recorded as having 18% working in sector III and 61% working in sector VII, trade and commerce. However, with such large and indistinctive categorises, working out occupational divisions within a specific fishing sector risks inaccuracy, and therefore these data have been used little in the thesis.

Annamalaicheri village has a large number of its women involved in fresh fish trade because the village is located 6 km from Pulicat town and suffers extremely poor road access. Annamalaicheri inhabitants argue that lack of adequate access to a fish market is a major problem for villagers, who despite having good access to productive fishing sites, are less able to capitalise from their Padu advantage as other Padu fishing villages with closer location to Pulicat town, the main market of the area. Large numbers of women are also involved in transportation and trading of fresh fish from remotely located villages on Lighthouse island (as discussed in chapter 4).

Table 5 Religion and caste in research villages

Village	Religion			Caste		
	Hindu	Muslim	Christian	Most backward (inc. Pattinaver)	Scheduled caste (Scheduled caste)	Scheduled tribe (tribal)
Nadoor Madha kuppam	16%	0	84%	84%	16%	0
Kottaikuppam	100%	0	0	100%	0	0
Annamalaicheri	97%	3%	0	100%	0	0
Arangankuppam	99%	1%	0	99%	1%	0
Dhonirevu	100%	0	0	0	100%	0
Edamani	100%	0	0	32%	68%	0
Kulathumedu	100%	0	0	1%	0	99%

Source: SFD Census 2000

Table 3 illustrates that although fishing villages show a typically high homogeneity in terms of caste and religion, this is not absolute. Nadoor Madha kuppam, for example, has a minority group (16%) of inhabitants who are Hindu and of Scheduled caste. This is a good example that supports ideas that the commonly found homogeneity of caste in South Indian fishing villages (Alexander 1982, Bavinck 2001) is not absolute and may be breaking down due to external change and pressures (Kurien 2001). Scheduled caste inhabitants of Nadoor Madha kuppam have not gained access to Padu

fishing rights, and predominantly fish using small scale traps (illustrated by the fishing gears table below[53])

Table 6 Fishing gear ownership in research villages

FRP: Fibre reinforced plastic – a modern fishing boat

Na: Net ownership data is not available for Kottaikuppam due to survey error

Village	*SFD Census (2000)*		*Household survey 2003*						
			% of households with share in boat		**% of households owning share in n**				
	No. of Country boat	No. of Kattu-maram	Country boat	Kattu-maram	**Padu nets**		**Non Padu nets**		
					Stake Nets *Suthu Valai*	Beach seine *Badi valai*	Cast net	Gill net	No. Trap (200 censu
Nadoor Madha kuppam	58	2	63	0	96	10	0	0	30
Kottaikuppam	36	0	34	0	na	na	na		0
Annamalaicheri	225	0	50	0	95	0	0	0	0
Arangankuppam	81 [54] (FRP)	191	49 (FRP)	9	0	0	0	41/ 54 [55]	0
Dhonirevu	0	194[56]	18	17	98	0	29	7	1880
Edamani	0	19	12	0	61	0	0	28	50
Kulathumedu	0	106	0	79	1	0	0	8	1465

[53] This observation was also discussed in meetings with Nadoor Madha kuppam Pattinaver fishermen, who stated that the marginal population of Scheduled caste fishers are excluded from Padu fishing operations in their village.

[54] In the marine fishing village of Arangankuppam during 2000 and 2003 many households report gaining Fibre Replacement Plastic (FRP) boats and outboard engines through subsidies offered by the State fisheries department. This is the likely cause for such low number of respondents in the household survey owning kattumarams. Most boats in Arangankuppam are today FRP with outboard engine.

[55] Marine fishing gill nets are different to lake fishing gill nets. In Arangankuppam 41% own Prawn gill nets (Yeppa valai) and 54% own Mackerel gill nets (Pannu valai). The marine gill nets are much larger and more expensive than the small scale gill nets used in the lake. The per household average amount of gill net owned in Arangankuppam was 7.46kg at a value of 3000Rs for the Prawn gill net, and 30Kg and 3800Rs average amounts of owned Mackerel gill net (Pannu valai). The smaller gill nets in Edamani village, where 28% of inhabitants owned gill nets on average of 1.2kg with an average value of 500Rs.

[An analysis of variance (ANOVA) found a significantly higher average weight of nets owned by Arangankuppam households in comparison with lake fishing villages. This is further evidence of the larger 'sea worthy' gill nets in use by marine fishermen. Comparisons of the most commonly used net types between lake fishing villages (traditional and non traditional) found no significant differences in average weights owned. For analysis see Appendix 5.4]

[56] A modernisation process of boat ownership can also be seen in Dhonirevu, where in the 2000 census most fishermen owned kattumaram, in 2003 18% of households owned a wooden boat. This is not however indicative of fishing capacity, since in Dhonirevu village fishermen tend to *hire* boats rather than own them, due to poor economic returns from fishing marginal Padu fishing grounds.

A comparative analysis of fishing gears owned in each of the research villages immediately shows stark differences in fishing behaviour. Traditional Pattinaver Padu fishing villages (Nadoor Madha kuppam and Annamalaicheri) have high proportions of households who own Padu fishing nets (Stake nets) and a smaller proportion owning Beach seine (Badi valai). This again illustrates earlier arguments that beach seine fishing, which is not engineered towards catching prawn, is utilised less in comparison to past years (see chapter 4). Kulathumedu households own very few fishing nets, but a large number of fishing traps, an inefficient and 'low status' form of fishing at Pulicat.

Of most relevance to our understanding of differences in fishing behaviour are the differences in diversification of fishing gear. Table 4 clearly shows that non traditional fishing villages (Dhonirevu, Edamani and Arangankuppam) own a wider diversity of fishing gears which include Padu and non padu gears. This generalist approach to fishing, which is not practiced by any of the traditional Padu fishing villages, is vital to understanding different approaches to cope and adapt to change in the fishery, the focus of debate in chapter 7 of this thesis. Nadoor Madha kuppam owns 30 traps, which are likely to be owned by the marginal scheduled caste fishing population, rather than Pattinaver inhabitants.

2. Perceived coastal management priorities according to Pulicat lake inhabitants

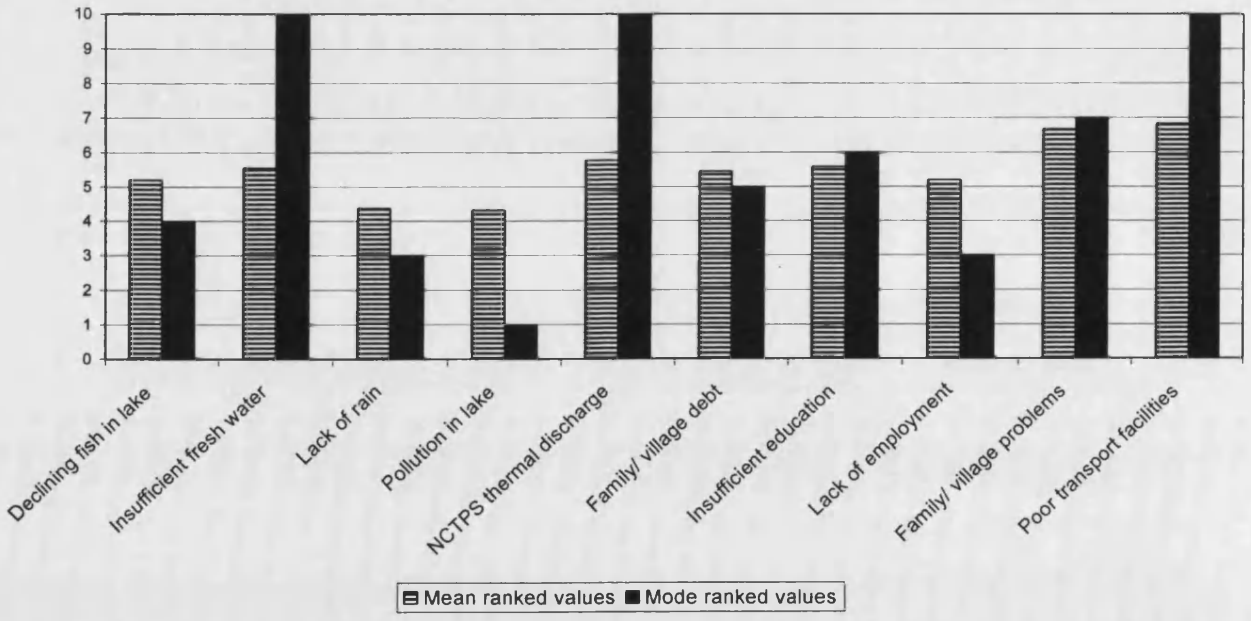
The following section presents a first insight into the perceptions held by the village inhabitants on the priorities for coastal management at Pulicat lake using survey data. The results of the management priority rating survey are discussed first, followed by the results of the semi-structured village household survey. Both surveys provide a foundation from which a wider network of interlinking coastal management problems at Pulicat lake can be formed.

2.1 Interpretation of perceived management needs using the Management priority rating survey

As is detailed in the methodology chapter, a management priority rating survey was distributed through two schools in Pulicat town. Respondents were asked to rate a list of 10 predetermined options in terms of their priorities for management, 1 being the most important problem and 10 being the least important problem.

Graph 1: Average scores and most frequently rated scores given to coastal management priorities by Pulicat lake inhabitants

Sample size: 186 households as sampled through school survey distribution
Rating scale is 1= most important; 10 = least important (the higher the average value, the less prioritised the issue)



* *NCTPS thermal discharge* refers to the release of hot coolant water by the North Chennai Thermal Power Station (abbreviated as NCTPS), located approximately 15km to the south of Pulicat lake in Ennore creek, which is linked to Pulicat waters by the Buckingham Canal waterway.

Coastal management issues rated as a high priority by respondents are:

- Pollution in the lake
- A lack of rain
- A lack of employment
- A decline of fish in the lake.

There are substantial differences between the mean and mode rated values for categories: 'Lack of sufficient drinking water'; 'Poor transport facilities'; and 'NCTPS thermal discharge'. This is because in each of these categories, respondents assigned values that were either very high or very low. The majority of people rated these problems as very low in priority (resulting in a mode value of 10), however, within the sample there are subgroups who assign values other than 10 and generally rated the problems as very high priorities for management (resulting in higher mean values).

Closer analysis on rating data (see appendix 5.1) for the lack of sufficient drinking water revealed that marine fishing villages found access to drinking water less of a problem, with an average management priority rating of 7.25. Lakeside fishing villages considered access to drinking water to be much more important for management rating the issue at an average of 4.9. During the field work period (2002-2003) there was a state-wide water shortage following several years of poor monsoon rains, which in Pulicat meant the loss of functioning water pipe lines. Many of the mainland villages (predominantly lake fishing villages) were wholly reliant upon daily deliveries of drinking water from other regions, and these were rationed in each household. Marine fishing villages, which are almost exclusively located on the Lighthouse Island, suffered less from drinking water shortages since they maintain access to reliable bore wells dug deep into the Island's sand. This situation is reversed if we consider the issue of sufficient transport facilities, since marine fishing villages rate transport as a higher priority (average rating 5.8) than lakeside fishing villages (average rating 7.7). The only mode of transportation from Lighthouse island to the mainland and Pulicat town is by boat, and many of the islanders argue the need to build a bridge. The prioritisation of thermal pollution from the NCTPS also clearly shows a division where people either rate it as a top priority or as a very low priority

for management, with fewer respondents rating it with middle scores. As is discussed in the next chapter, this may be due to village-based political influences and differences in access to information.

2.2 Interpretation of perceived management needs using the Semi-structured village household survey

As is detailed in chapter 3, the head of each surveyed household was asked an open question:

"What are the top 3 problems that you feel people in your village are facing, which coastal managers should be prioritising?" (Stating the most important / prioritised problem first)

Almost all household head interviews were with men, except in the village of Kottaikuppam, where household women were asked their viewpoints in a survey which was navigated by the Kottaikuppam women's self-help group.

Only the first and second problems stated were included in the analysis below[57]. Although people were asked to list the top 3 problems, in many responses a third problem was missing. In my own experience of conducting the survey, many people would often run out of issues after discussing one or two problems and I did not want the survey to 'press' a response out of people. The first stated problem is often a key indicator to people's main perceived management need, being the first thing that comes to mind during the discussion. The opportunity to give a second issue provides more time for thought and reflection of priorities that might not ensure as much passion and feeling as the first.

All survey respondents were also asked to suggest 3 possible solutions to the problems stated. However, solution suggestions were excluded from in-depth analysis since most solutions given were parallel to the problems stated. For example, the stated problem of "industrial lake pollution" would often be accompanied by the

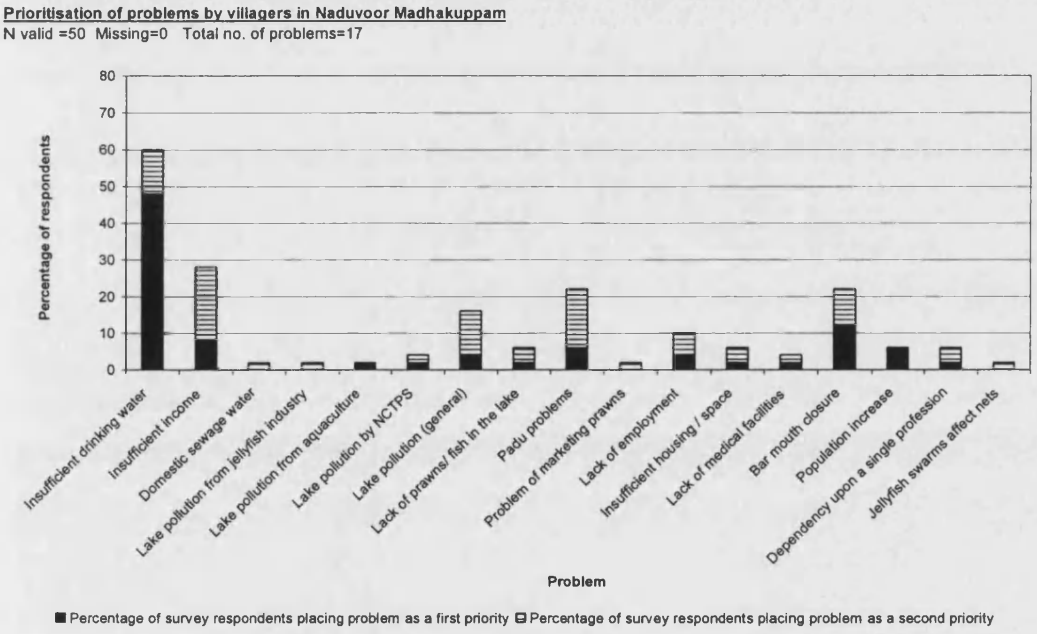
[57] See Appendix 5.5 for the categorisation and coding of perceptions given.

suggested solution "industries should stop polluting the lake". Many solutions also gave a similar response stating the government responsibility to solve coastal problems: "the government should do something". The relevance of this and further discussion on solutions which were suggested in the survey is included in the thesis conclusion.

Analysis was carried out for each village individually. Different village population sizes mean that grouping the data would create overrepresentation for the larger villages.

2.2.1 Survey results for Traditional Padu lake fishing villages

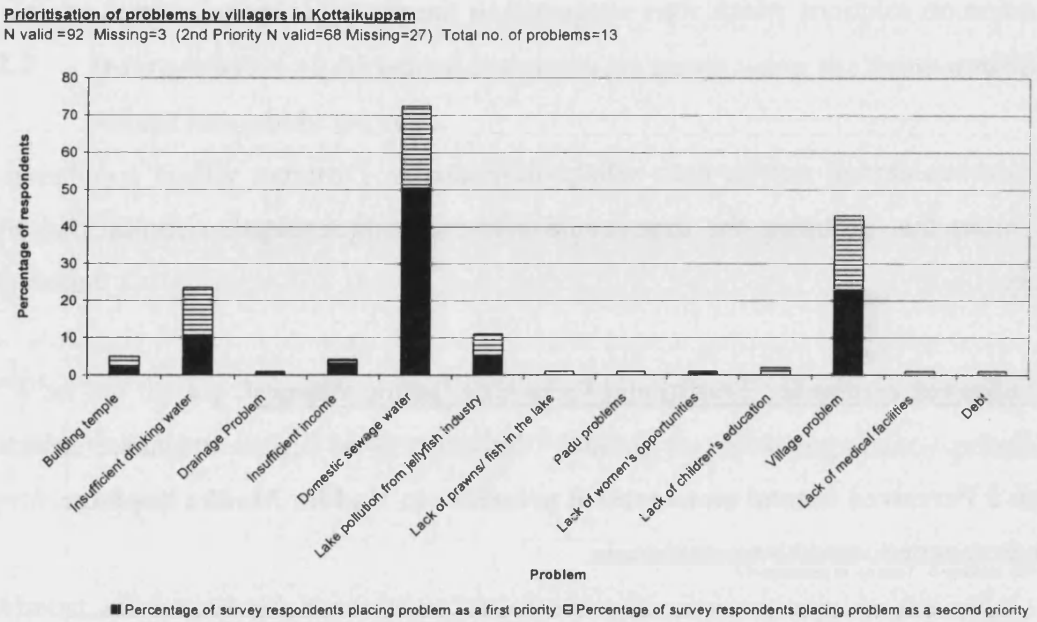
Graph 2 Perceived coastal management priorities in Nadoor Madha kuppam



Almost 50% of Nadoor Madha kuppam residents stated the top management priority facing their village as 'insufficient drinking water', with the second most common priority being 'insufficient income', which was stated more often as a second priority. This interpretation of key problems in the village is supported by the solution suggestions, which are overwhelmingly to solve the drinking water shortages through government intervention, and secondly, to provide jobs or alternative incomes to fishing.

Graph 3 Perceived coastal management priorities in Kottaikuppam

(Note: Survey was completed by women – see methodology chapter)

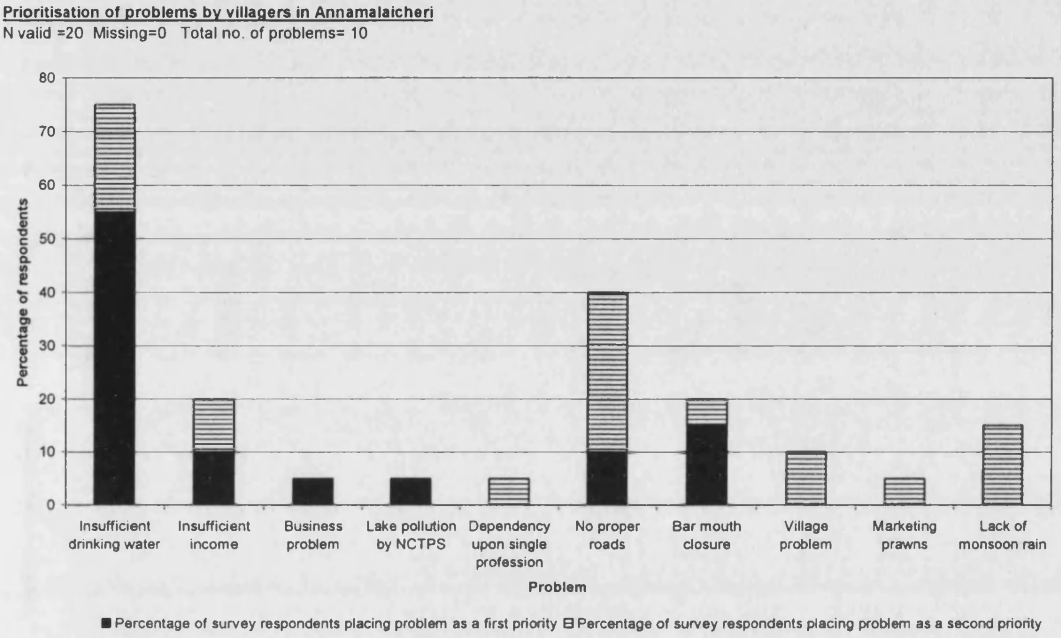


Over 50% of Kottaikuppam respondents stated domestic sewage water as a top priority for management. It is important to note that respondents in this survey were all women, who may experience different problems than male household heads (which were interviewed for the other villages). For example, women often remain at home in the village and daily face the problems with open sewers and poor sewage water management. Men may feel that fishing problems and earning an adequate income are of greater importance to the village. Furthermore, the village of Kottaikuppam is particularly crowded and has many shallow and inadequate open sewers, therefore the survey may be an accurate representation of women's feelings in the village.

Over 20% of women stated 'village problem' as a top priority for management. Kottaikuppam is an influential traditional Padu fishing village and is frequently involved in disputes over fishing rights with other villages. Interestingly, village problems were not cited as a problem in Nadoor Madha kuppam, a neighbouring traditional Padu fishing village also often embroiled in Padu conflict, but where the survey respondents were male and interviewed by an 'unknown' research team. As

discussed in the methodology chapter, surveys can be inadequate tools to highlight sensitive issues such as village conflict. As is discussed in chapter 4, intra-village fighting is also common over non-fishing issues.

Graph 4 Perceived coastal management priorities in Annamalaicheri

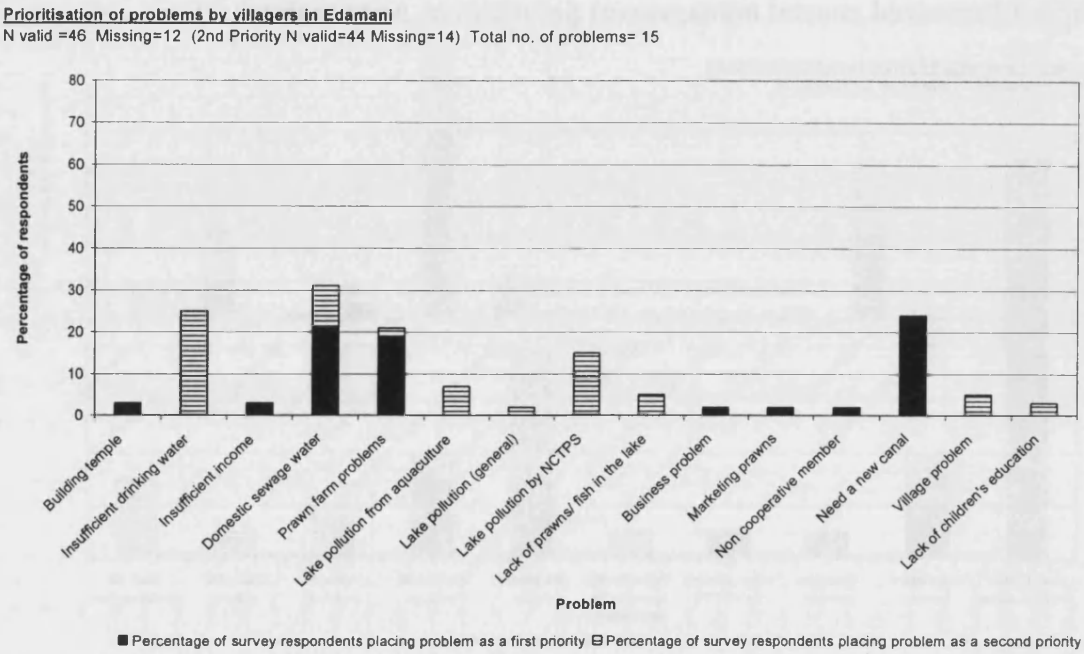


Inhabitants of Annamalaicheri stated insufficient drinking water and a lack of proper road access as key management priorities. This is to be expected since the village is remotely located from Pulicat town (and fish market) and transportation to and from the village is lengthy, infrequent and difficult. A high proportion of respondents also stated 'Bar mouth closure' and 'insufficient income' as first priorities for management. Both of these problems are related to the lake fishery: closure of the bar mouth has a negative impact on the lake's productivity, whilst insufficient income for a village that is almost 100% dependent upon fishing, again links with unpredictable fishing resources.

The linkages between management priorities are the subject of the next section of this chapter; the impact of the barmouth dynamics on the lake fishery is discussed in the next chapter.

2.2.2 Survey results for Non traditional Padu fishing villages with limited Padu rights (scheduled caste fishing villages)[58]

Graph 5 Perceived coastal management priorities in Edamani

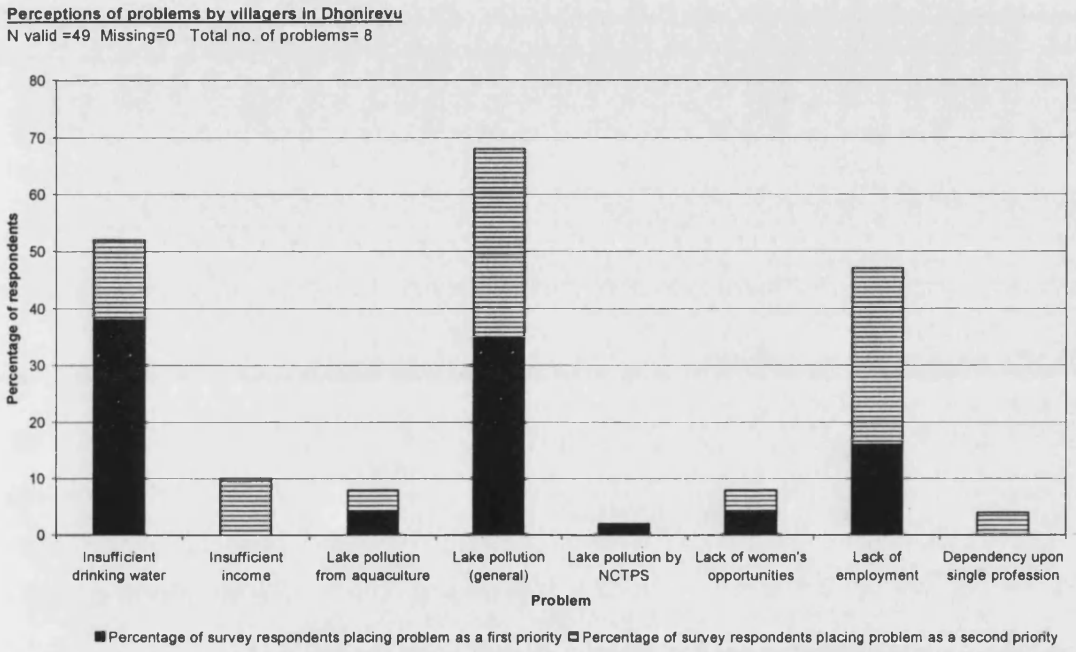


Priority problems in Edamani are the 'need of a new canal' (in reference to the Buckingham canal), 'domestic sewage water' and 'prawn farm problems'. As is discussed earlier in this chapter, in the past, Edamani inhabitants were largely employed in the transportation of goods along the Buckingham canal. The general decline in canal use has meant that many villagers have now turned to full time fishing and are fighting for better Padu fishing rights. Because Edamani village is situated directly by the Buckingham canal, it benefits from passing trading boats, both through direct employment and also through providing supplies to trading boat crews. A revival in canal trade would benefit fishermen and provide alternative income to their current vastly inadequate earnings from lake fishing. The category of 'prawn

[58] The marine fishing village of Arangankuppam is excluded from the analysis of perceived management priorities through survey. Arangankuppam was the first research village and the survey completed in Arangankuppam involved an earlier version, which did not include perceived management needs (a later addition) for other research villages. Arangankuppam fishermen predominantly fish in the sea for most of the year, therefore whilst they have an impact on the lake fishery in terms of interacting with other 'lake' fishing villages, they are not wholly dependent upon the lake for a livelihood. Extensive work through more qualitative methods established that many of the issues facing Arangankuppam villagers were different from those facing lake fishermen, for example: sea-fishing related problems such as conflict with trawler fishermen from Madras; the need for a bridge to be built linking Lighthouse island to the mainland; and the issue of displacement. It was decided that the disadvantages of re-surveying an entire village with an extended version of the original survey, (such as respondent and surveyor fatigue), outweighed the benefits.

farm problems' includes: 'aquaculture affecting the fresh water table'; 'too many prawn farms (no reasons specified as to why it is a problem)'; and 'acquisition of village land for aquaculture development'. Since several prawn farms are located in close proximity to Edamani (the nearest being located only 300m away from the village) it is unsurprising that many of the village problems are related to aquaculture. Insufficient drinking water is also a frequently stated problem, classed by most respondents as a secondary priority for management.

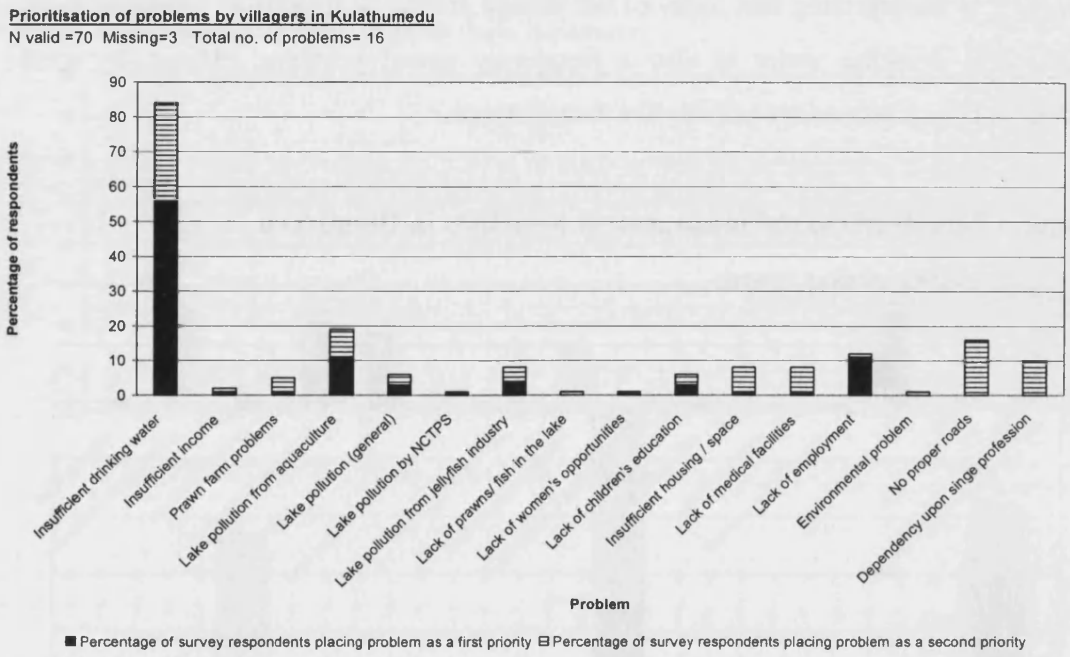
Graph 6 Perceived coastal management priorities in Dhonirevu



The three top priority problems in Dhonirevu are: 'insufficient drinking water'; '(general) lake pollution'; and 'lack of employment' (the latter two are also frequently classed as a second priority problem). Lack of employment and lake pollution are both linked to concerns over productivity in the lake fishery, as is discussed shortly.

2.2.3 Survey results for a Non traditional fishing village with no Padu rights (tribal caste fishing village)

Graph 7 Perceived coastal management priorities in Kulathumedu



The overwhelming problem faced by Kulathumedu villagers is insufficient drinking water (over 80 % of respondents counted this as either a primary or secondary priority for management). Lake pollution from aquaculture is also a notable problem, and again the village location is in close proximity to several prawn farms.

3. Insights and interpretations from assessing coastal management priorities using survey methodology

The following section provides an assessment of using survey methods as a tool to assess people's perceptions of coastal management priorities. The village household survey proved useful in providing a brief overview of village descriptions, for example, types of fishing gear ownership and dependency of villagers on a fishing livelihood. The same household survey also quantified several differences between villages, which strengthened previous interpretations on the divisions in fishing society derived from a historical perspective (see chapter 4). However, there are

several limitations of survey techniques in assessing perceived coastal management priorities which need to be taken into account here.

Firstly, at a practical level, outcomes from the management priority rating survey showed some differences to responses given in the open ended questions of the village household survey. The open ended questions of the household survey were able to highlight the importance assigned by local people to issues of poor amenities such as poor sanitation and insufficient drinking water, options which were not included in the rating survey. Open-ended survey questions are often more effective in eliciting spontaneous responses without influence of the researcher, whilst close-ended questions as those seen in the rating survey, limit the chosen response to the set of questions being offered by the researcher (Foddy 1993, Reja et al 2003). Assigning importance to the need for 'sufficient drinking water' needs to be considered alongside seasonal factors (discussed in the following section); however other high rating management priorities such as poor sanitation are year round problems.

A question which arises here is how much are 'general' and more 'immediate' needs for coastal people, both distinguished and considered as part of coastal management planning? Access to health services, education, drinking water, clean streets and good sanitation are all essential needs for life, and yet one may have difficulty persuading a coastal manager that these problems also from an important part of management planning. Current coastal and fisheries management discourse has acknowledged the problems associated through a lack of participation by local communities in the management processes (Zanetell & Knuth 2004). One might question whether a large part of peoples' reluctance to take part in 'participatory management' of coastal resources is related to the lack of basic human needs which, as shown by the household survey results, come first in many household priorities. Alleviation of poverty through provision of basic services should perhaps be a starting point for a coastal management agenda; how to match the shorter term needs of people with the longer term policy goals of providing a sustainable coast? Open ended questioning in the household survey allowed priorities of people to be highlighted, which are perhaps too easily overlooked in preconceived ideas of coastal community needs. The importance of basic amenities assigned by coastal communities illuminates important questions over what the role of coastal management should include. Whilst

acknowledging the importance of basic amenities, as I argue later in this section, another key concern regards the future of the lake fishery, which is the focus of further debates.

Leading on from the observation of a high prioritisation of basic amenities we can conclude a second limitation, that in this research, survey techniques did not sufficiently account for the impacts of seasonality on given responses, nor the highly variable status of living conditions at Pulicat lake. 'Insufficient drinking water' was a coastal management priority cited by large numbers of respondents in all fishing villages. At the time of survey (summer 2003), the entire state of Tamil Nadu has a water shortage crisis and water was strictly rationed both in rural areas and in the cities. If the survey had been repeated after the monsoon rains, it is quite likely that 'insufficient drinking water' may not have been a priority at all, once the village wells were refilled and the water pipes switched back on.

Seasonality can be built into survey design, and conducting several surveys at different times of the year, may further have illustrated seasonal differences in coastal management priorities. However, conducting numerous village surveys is time consuming. In Participatory Rural Appraisal, several useful methodologies exist, such as calendar planning and seasonal mapping, which could have been more thoroughly employed in this research. However, the important lesson to take from this is that peoples' coastal management priorities can change, with an annual and seasonal dynamism that must be considered in any interpretation of local priorities for coastal management.

A third limitation of using surveys as a tool to investigate coastal management priorities involves the oversight of sensitive management issues. As is discussed in future chapters, the impact of increasing fishing population (see Chapter 6), and the influence of the Padu system (see Chapter 7) on fishing communities is substantial, however neither matter was picked up in either of the two surveys. As is discussed in the methodology chapter (3), many people showed reluctance to discuss sensitive management needs deemed as 'village issues', through the impersonal techniques of a survey. The revelation of 'sensitive' management issues necessitated a more in-depth,

qualitative approach to the research, a development which is further illustrated in subsequent chapters.

Finally, and perhaps most importantly at this stage, surveys, at least in this research, do not account for linkages between problems, which are sometimes hidden and easily overlooked. In the survey results, highly rated priorities for coastal management are often closely linked with one another. For example, (as qualitative interview revealed) "Lack of fresh water into the lake", "a lack of rain during the monsoon season", and "Pollution of the lake" (including thermal pollution), are commonly blamed for a decline in fish and prawn stocks. These factors in turn cause a "lack of employment" and "inadequate income" for a majority people with fishing as their only livelihood. At first sight, however, one might not automatically link these "priorities" with a decline in the fishery. Concern over "pollution of the lake" may initially be ascribed to health fears, however, discussion with fishermen groups reveal that lake pollution is a common source of agitation to the fishermen, who feel the pollution is threatening their fish catches and lowering incomes. Many of the problems and changes that people state in the surveys represent part of a descriptive network of believed causes and consequences of failing fishing livelihoods. Putting people at the centre of coastal management is not as simple as asking them what they need coastal management to do; it requires a more integrated appreciation of the complexity and linkages between coastal changes, drivers of change and consequences of change. This can only come through triangulation with a more qualitative research approach.

During more qualitative research, such as interviews and focus group debate, almost all fishermen described a common concern "*a threat to the fishing livelihood at Pulicat lake*" (evidence for which is detailed later in this chapter). This connects people throughout Pulicat lake, since almost all people involved in the research were heavily dependent upon a fishing livelihood for the main income source of the household[59].

[59] In all seven research villages, over 75% of households were assessed as having 'High fishing dependency' (Household survey 2003). Household dependency on fishing was assessed using three indicators derived from household survey responses: 1) Main income provider; 2) Additional household income other than fishing; 3) Alternative past income sources.

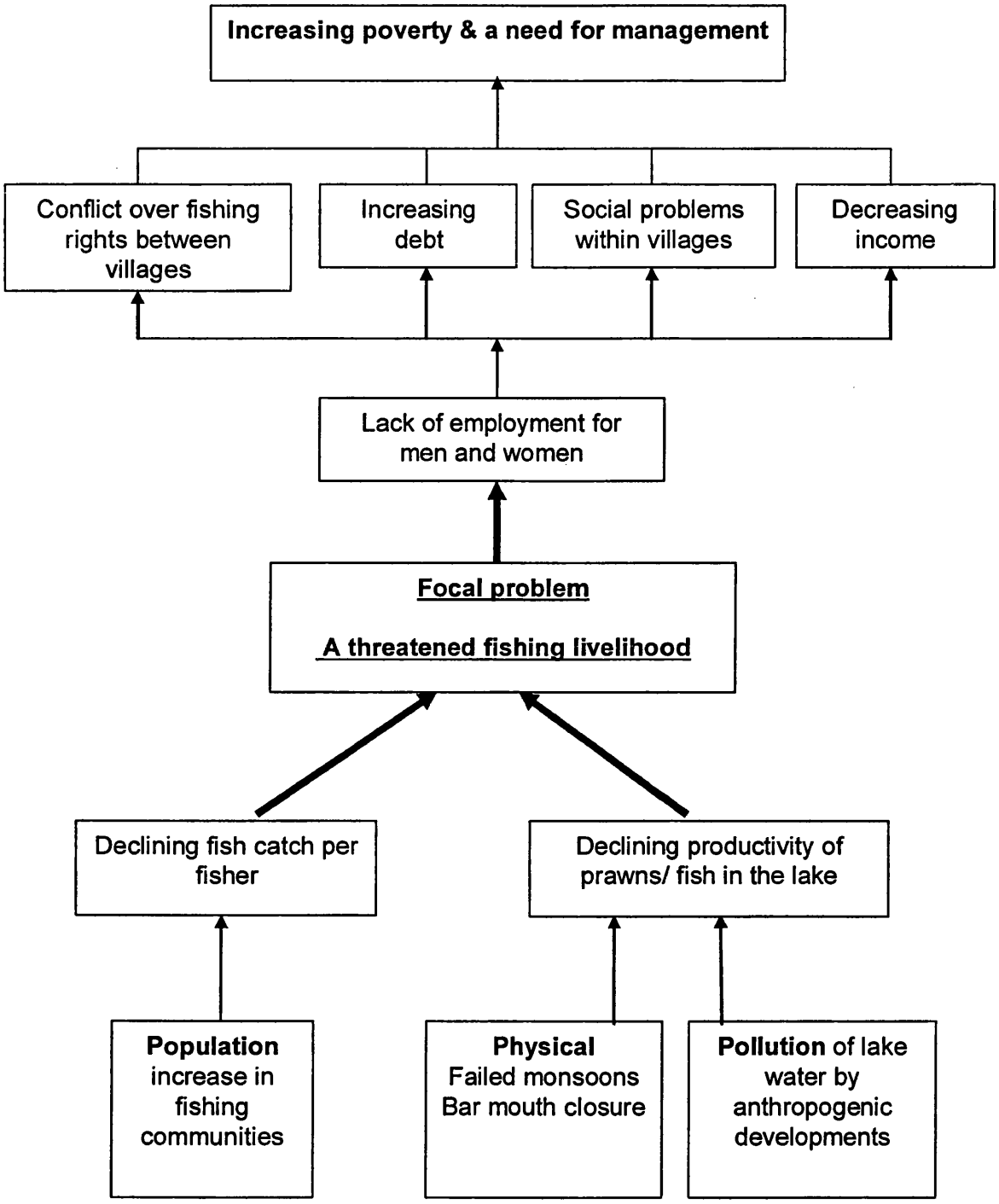
This is not well illustrated by survey results, which is in part due to problems of surveying perceptions with quantitative methods.

A fisherman is unlikely to describe that his main concern for coastal management is to save his fishing livelihood using only 'neat and clear sentences' and words easily associated to 'fishing' by quantitative methods of analysis. The fisherman instead speaks of his troubles using terms which are familiar to his daily life. He speaks of: a lack of income, no job, no opportunities for his sons, nobody with whom to marry his daughter, too many people coming to fish the lake, poor monsoon rains, and continuous pollution of the lake. All of these aspects are perceived causes and consequences of the same fear, a threatened livelihood of fishing. Whether caused by polluted water, lack of fish, or by too many people fishing – essentially the root concern is the same thing, the survival of fishery, and this is common throughout all research villages.

Fig H (below) shows the network of problems and consequences as identified by local Pulicat communities. The network combines evidence from survey, interview and focus group debates. As can be seen by the diagram, each cause and consequence can be clearly linked to an overall concern which is a *threatened fishing livelihood.*

See Appendix 5.7 for details of the analysis and further discussion of 'fishing dependency' indicators in each research village.

Figure H A network of problems and consequences as identified by local communities at Pulicat lake



The threatened fishery is believed by local people to stem from either an overall decline due to external factors (pollution or physical), or a decline of fish catch per person, connected to a rising fishing population. Consequences of a threatened fishing livelihood are a lack of employment, which leads to decreasing incomes, social

problems and conflicts both within and between villages, and increasing debts. These problems eventually lead to increased poverty in fishing communities, unstable fishing societies and a need for coastal management intervention.

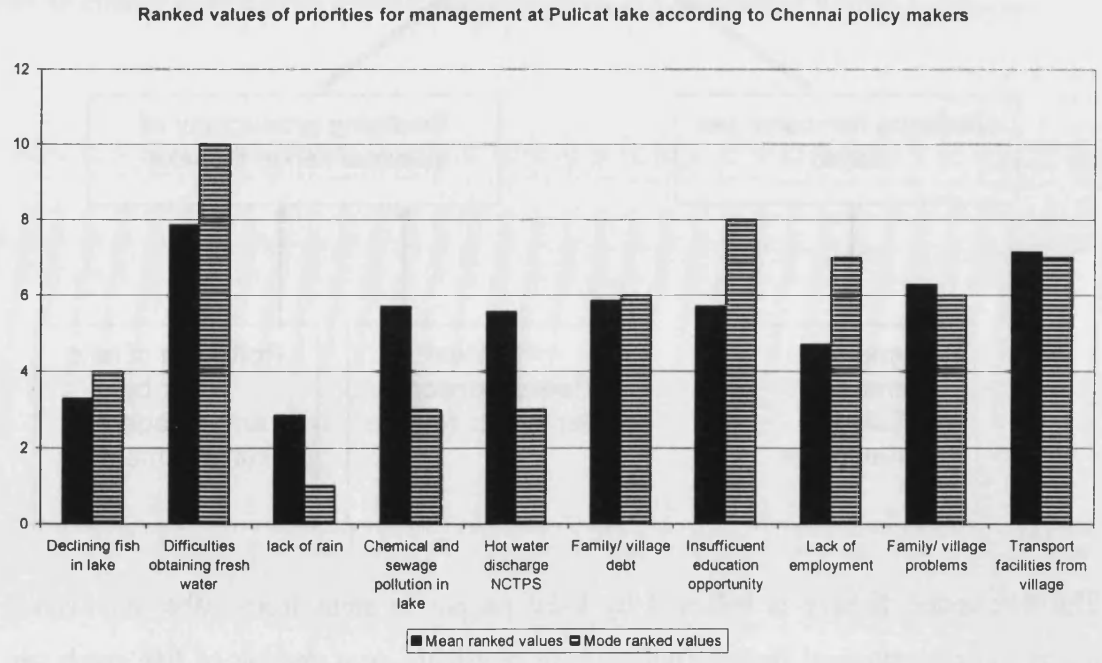
3.1 Perceptions of key policy makers

In addition to the surveys distributed amongst Pulicat research villages, a brief management priority rating survey[60] was given to 7 key policy makers in academic and government positions, who are involved in Pulicat lake management or research. The results show a degree of consensus over causes of problems at Pulicat with high prioritisation given to: "the closure of the bar mouth"; "a lack of rain" (physical causes); "declining fish productivity in the lake"; and "lake pollution". These were the same items which rated highly in the same survey completed by local Pulicat fishing communities.

Graph 8 Rated management priorities given by key policy makers in Chennai

(Sample size: 7 respondents)

10 is the lowest and 1 is the highest priority rating value



[60] The management priority rating survey given to key policy makers offered an identical list of priority options as the survey distributed to Pulicat villages. Key policy makers included 3 academics involved in the design of the ICMAM coastal management plan for Chennai, one official from the Central Marine Fisheries Research Institute (CMFRI), and 3 officials from the State Fisheries Department.

A degree of consensus exists over the occurrence of certain problems at Pulicat, such as the problem of the bar mouth closure, and the acknowledgement that there is a problem with the fishery. However the reasons behind the problems, the real drivers of change at Pulicat are unclear and it is here that we see a lack of clarity from scientists, people or policy makers. Many people feel there are problems at the lake, but there is contestation over what exactly is happening, and how problems are caused and linked. In terms of management this is a barrier: managers do not know what might be manageable and what is not.

The following is a discussion of the Pulicat fishery – *the meta problem* and the main concern for people at the lake, who believe so strongly that their fishery is in decline. I present available evidence and discuss some of the key causes for contested view points over the status of the fishery and its long term sustainability.

4. A closer look at the Pulicat lake fishery – is it threatened?

Almost all fishing communities at Pulicat who were interviewed about the management priorities of the lake complain about a decline in fish catch as a major threat to their survival as fishing people. In the village household survey results, these concerns are illustrated in the form of various causes and consequences which can be directly linked to a decline in fishing employment (as shown in fig 1). There is certainly high variation in fish catches throughout the year and between years due to physical influences and the impact of monsoon rains (see the following section on the impact of the monsoon on fisheries). However, the underlying argument is that beneath these natural fluctuations there is an on-going sustained and longer term decline in fish catch, caused by factors outside the natural lake fisheries cycle.

It is difficult to unpick yearly cyclical variations in lake fishing connected to the monsoon and bar mouth closures from a potential longer term decline in fish catch. Interpretations are largely hindered by a lack of consistently recorded fish catch data for Pulicat lake, which would be necessary to give any degree of certainty to plausible trends. It is largely this lack of data which has resulted in the varied opinions regarding the status and long-term sustainability of the Pulicat lake fishery. Considering that an estimated 30,000 people are dependent upon the lake fishery as a key source of livelihood, the lack of monitoring of the productivity of the fishery is a

serious oversight. Site specific fisheries assessments such as Pulicat lake are commonly overlooked in terms of long term monitoring and research (Silvestre & Pauly 1997). Furthermore, Pulicat lake is situated on a legislative border between marine and inland fisheries governance bodies and, as such, it occupies both a legislative and government research grey area; neither body adequately covers the lake (see chapter 4).

Lack of adequate fish catch data is by no means restricted to the Pulicat fishery; the science of predicting trends of fish yields and future sustainability is in general highly uncertain by nature (Mahon 1997, Richards & Maguire 1998). "Sorting out the causes and effects of fluctuations in fish abundance is complicated by the lack of reliability of fisheries statistics. Discards, dishonesty and the inherent logistic difficulties of collecting statistics all combine to confuse interpretation" (Larkin 1996).

At national and state levels, fish catches in India are monitored primarily by the government institutions of the Central Marine Fisheries Research Institute (CMFRI) and the Marine Products Export Development Agency (MPEDA), formed specifically by the Government of India in 1972 to monitor India's fisheries growth. As is detailed in chapter 4, since the 1960s India has embarked on massive expansion and modernisation of the fisheries sector which led to huge increases in catch, whilst the *Pink gold rush* (1965-1980) (Bavinck 2001:69) fuelled the country's prawn fishery in both inland and marine sectors (MPEDA). In the year 2003-04 frozen shrimp continued to be the largest exportable fish product of India, contributing 31.50% in volume and 65.88% in value of the total export of marine products from India (MPEDA 2005); prawns continue to be the main stay of fishing at Pulicat lake (Bhuvaneswari 2003). However, it is now evident that over the past decade, growth in fisheries production has remained stagnant (Director of fisheries 1999) and "the present state of fisheries in India is considered to be unsustainable" (Vijayakumaran 2001, Haastrecht & Schaap 2003:13).

Whilst a sustained and comprehensive fish catch monitoring programme specific to Pulicat lake is lacking, a great deal of research has been completed at Pulicat over the decades in the form of small and individual research projects. Most have had focus on

recording detailed hydro biological data (Sreenivasan & Pillai 1972); assessing suitability of Pulicat lake for aquaculture (Hornell 1910, Sampson and Srinivasagam 1972, Chalayondeja & Saraya 1982); and sporadic fisheries research (Chacko et al 1953, Krishnan and Sampath 1973, Krishnamoorthy and Rao 1970, Kaliyamurthy 1978). These projects are highly fragmented, their owners being distributed among numerous research institutions, both state and academic. Projects using unrelated methodologies are completed at different times of the year and the majority are unpublished, and therefore, it is almost impossible to extract any meaningful trends from the available data. A lack of coordination in research efforts to date at Pulicat is a major source of the contestation which now exists. Whilst many researchers feel that a great deal of attention has already been lavished upon Pulicat lake, without collaborative efforts comparison and meaning are difficult to ascertain.

Fisheries data recorded during the 1960s and 1970s (Appendix 5.2) showed no substantial increase or decline (Kaliyamurthy 1978 and Jhingran 1991, Bhuvaneswari 2003) and a collation of individual projects by the Central Inland Fisheries Research Institute (now CIBA) between 1965-1981 found few fluctuations in fish catch, except during bad monsoon periods (Pulicat no impact zone study, Anna University 2002). There is also an argument amongst scientists that current fish stocks are far below the carrying capacity of the lake reporting the lake "holds hardly one tenth of its full carrying capacity" (Sanjeevaraj 1993:29), a strong argument for inclusion of intensive aquaculture (Sanjeevaraj 1993). The fishermen contest this vehemently and loss of fishing earnings through a continuous decline in catch is cited by most, as the main concern for coastal management. And yet, this concern, which is at the core of so many other problems and consequences cited by fishing communities, is also up for debate by those deemed responsible for their welfare.

As part of this research, attempts were made to establish whether patterns of decline in the fishery were distinguishable from the data available. The next section presents fish catch data from historical village fishing records, which have been maintained since the 1970s by one Pulicat fishing village, referred to as village X [61]. Fishermen in village X go for fishing in large groups of up to 30 members, therefore maintaining accounts at a group level is part of the village accounting system; those villages who fish using individual fishing units (one boat and 3 fishermen) tend not to keep such long term records.

4.1 "These days we earn one tenth of what we use to earn from fishing": An analysis of fish catch data over a 30 year period at Pulicat lake

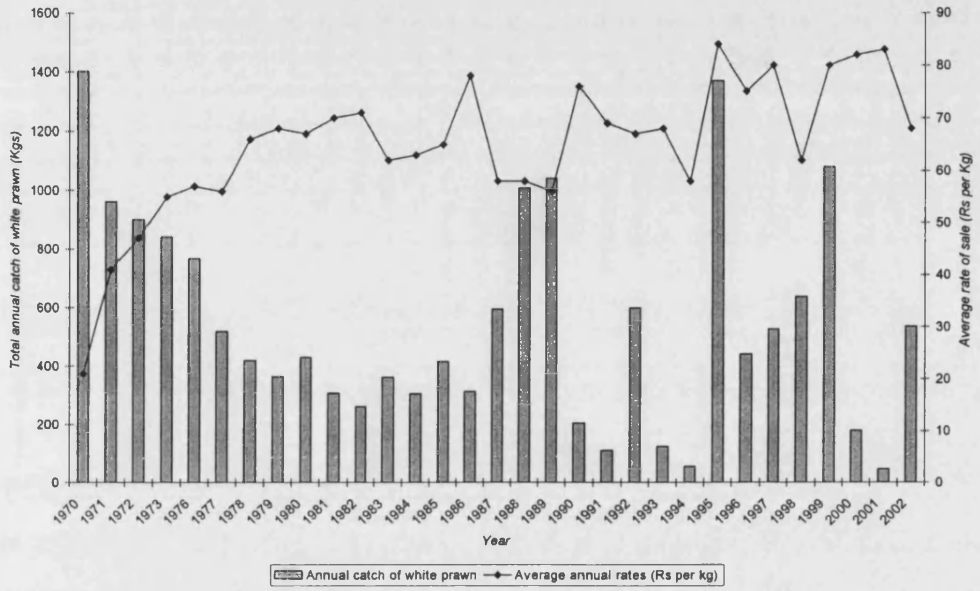
Historical village fishing records dating from 1970 to the present day were made available by a fishing group in one of the villages. Fishing group 'X' is a Padu fishing group consisting of 30 people and approximately 10 fishing boats. The records documented the value, species and weight of each fish catch (as a whole group). According to the Padu rights of the village, boats can only go for Padu fishing twice a month, giving 24 catch values for each year. It is unlikely that fishing trips were missed, as absence from fishing during Padu fishing days can result in permanent withdrawal of fishing rights (see chapter 7). The method of fishing has also remained the same, using the same type of stake net. The number of boats and number of fishermen per boat in this group has also remained constant. Therefore, in terms of Catch Per Unit Effort, we can assume that (as far as we know) fishing effort within the group has remained constant.

The village also depends on fishing for fin fish, crabs and other prawn species: the Indian White prawn *P. indicus,* and the Tiger prawn *P. monodon,* are the most economically valuable commodity in the lake. The below figures show the total

[61] Fish catch data is notoriously difficult to obtain. Fishing villages are highly competitive and tend not to give records to outside researchers, whilst data from prawn exporters at Pulicat is even more difficult to access. Due to the sensitivity of a village's fishing successes and failures, village names and specific sources of fisheries data are kept anonymous (the fishing group is referred to as *Fishing group X).* The village in question however is one of the poorer Padu fishing villages and it is not in high competition with the main Padu fishing villages. Other fishing villages stated they did not keep catch records, or if they did, they were unwilling to reveal their contents.

yearly catches (in KGs) based on two fishing trips a month by a group of 10 boats. The average rate of sale (measured in Rupees per Kg) at Pulicat market for each species is also represented to give an illustration of changes in income earned by the fishing group from these two species of prawn.

Graph 9 Yearly catch trends of White prawn (*P. indicus*) as caught by Group X between 1970 and 2002[62].

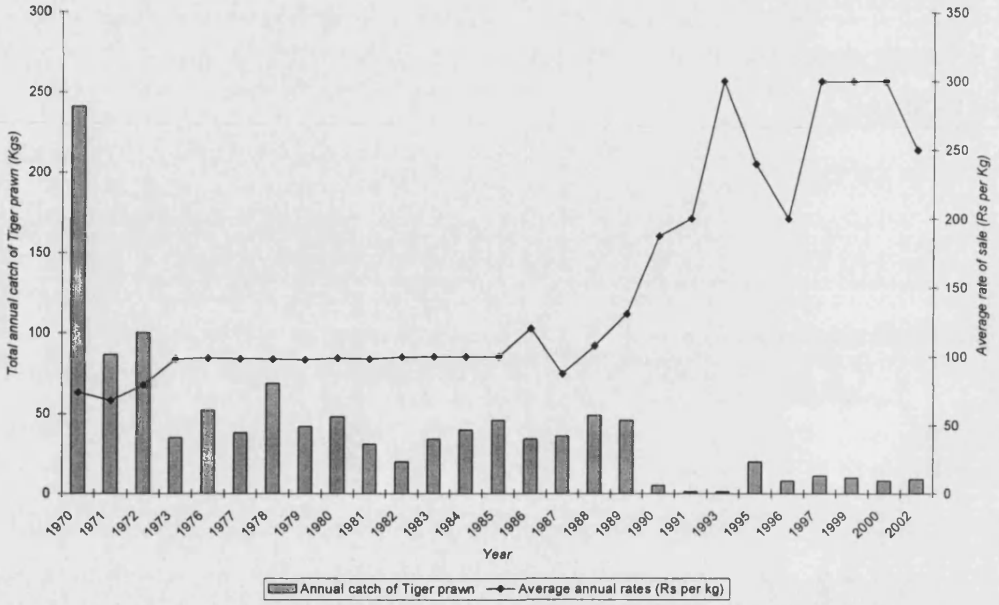


Annual catches seem to be in overall decline, however the trend is highly fluctuating. For example in 1970 the total catch was 1401 kg, whilst in 1995, the catch was almost the same at 1370 kg. This pattern may reflect the typically high variance between good and bad fishing years which can be affected by climatic patterns[63]. The market value of the White prawn according to Pulicat market rates of sale has steadily risen since 1970, which is consistent with the global rise in market value of prawn exports. Following a steep rise from 21 Rs per Kg of prawn in 1970 to 57 Rs per kg in 1976, prawn value has fluctuated between 56 Rs per kg to 84 Rs per kg between 1977 and 2002.

[62] Missing data: For the years 1974, 1975 all data are missing, whilst no Tiger prawn catches (or rates) were recorded in 1992, 1994, 1998 and 2001.

[63] Seasonal influence over fish catches is further discussed in the next chapter in relation to lagoon dynamics according to monsoon and bar mouth functioning.

Graph 10 Yearly catch trends of Tiger prawn (*P. monodon*) as fished by Group X between 1970 and 2002

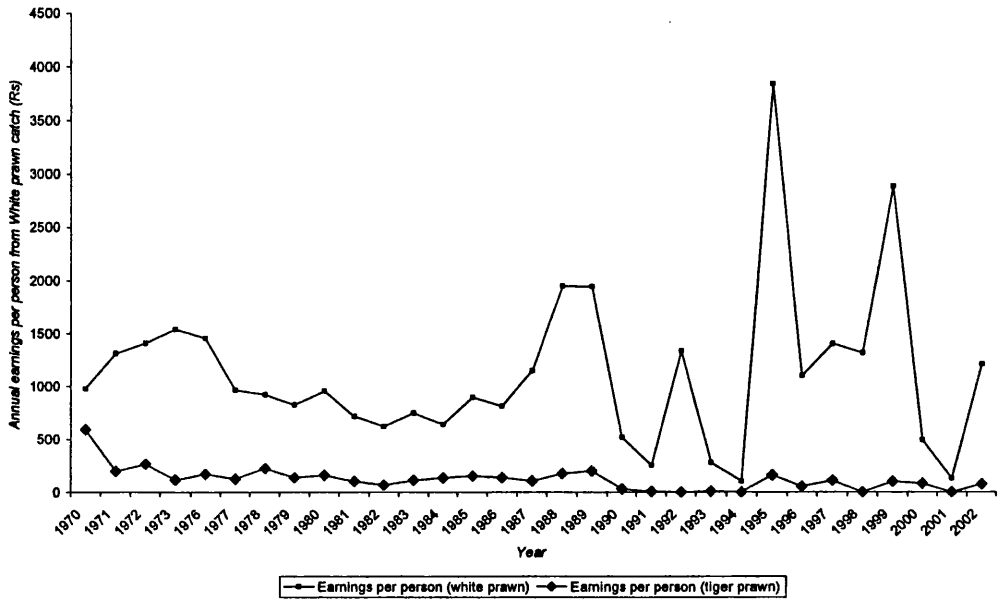


Variation in Tiger prawn catch shows a much clearer decline than that illustrated by White prawn catch levels. Tiger prawns are the most valuable species to be caught at Pulicat lake fetching market rates up to 300 Rs per Kg. The loss of the most valuable proportion of the catch, such as the Tiger prawn, is a possible contributor to a greater overall decline in fishing incomes. Tiger prawn populations throughout the tropics suffer from over fishing not only due to their high export value, but also due to the common collection of juveniles (or prawn seed) which are distributed to aquaculture farms and hatcheries (Bhattacharya & Sarkar 2003). Prawn seed collection is practiced by many non traditional and migrant fishers at Pulicat lake, an occupation which is likely to have increased since the 1960s 'blue revolution' and the development of aquaculture in Tamil Nadu[64].

[64] Appendix 5.3 details further catch data acquired from three export companies operating in Pulicat town since 1979. These data show a much more pronounced decline in almost all species exported from Pulicat town, and in particular all species of Prawn. However, since information on levels of export activity and change in activities of the export companies is not known, the data can not be conclusive of fishing change.

Graph 11, shows changes in earnings from the two species of prawn in fishing group X. Earnings are calculated by multiplying annual catch records with a calculated average rate of sale at Pulicat market. There are 30 members of Fishing group X, and the below graph represents an annual earning from each prawn type per person[65].

Graph 11 Species specific earnings per person from Fishing group X between 1970 – 2002



Earning from Tiger prawn over time correlate by Pearson's coefficient -0.636 significant at P< .01; Earning from White prawn over time correlate by Pearson's coefficient 0.063 P >.05

The graph shows a steady and significant (P<.01) decline in incomes earned from Tiger prawn sales, but a highly fluctuating trend of earning in White prawn sales (statistically insignificant at p>.05). The relative decline in catches of prawn may to a degree have been cushioned by its rising economic value. However, income losses from Tiger prawn catches are substantial and have steadily fallen from almost 600Rs per person per year in 1970 to less than 100Rs per person per year in 2002. In some

[65] Per person representation assumes that catches are divided equally, which is not the case. Fish catch values are divided according to individual ownership of boats, nets and participation in the fishing trip. In the absence of such detail of the fishing group, division in this way at least gives an indication of an average earning by group members from fishing each species. Per person analysis gives more meaning to the fisherman's complaint of loss of income, rather than displaying total annual group catches.

years, Tiger prawns have not been caught at all by the fishing group and, on discussion with fishermen from Group X, this has been attributed to a lack of finding them, rather than any changes in fishing techniques. The earnings analysis again mirrors the unpredictable nature of fishing, where windfall catches one year can be followed by sharp reductions the following year. This highlights the importance of understanding the environmental factors on fisheries which are discussed in the next chapter.

5. Uncertainty and contestation over the Pulicat lake fishery

Historical village catch records provide an important piece of long term monitoring data, which at Pulicat seem to be missing from any other source. Scientists are sometimes accused of overlooking this opportunity to access local knowledge and information on fish catch details (Pauly pers comm 2005), although I would argue that this is not an oversight, rather a matter of practicality. It is not easy to convince fishing communities, who are often in great competition with other fisher groups in the area, to reveal their fishing accounts, which ultimately display village wealth, fishing success, and fishing failures. Fishing communities in South India are extremely jealous and superstitious of each other's gains and fishing successes, and the belief in the evil eye[66] is an integral part of fishing culture. As a result, fishing successes are not openly discussed and information on fishing income is difficult to

[66] The concept of the 'evil eye' can be interpreted as a curse that a magical person (one who possess the evil eye) may bestow on another's person or belongings through envy of success or riches. Throughout Tamil Nadu, large stuffed scarecrows known as *'Thrusti bommai'* are familiar sights on rooftops of houses under construction, to keep away the bad wishes of the envious onlooker. Bavinck (2001) gives a nice description of the Evil eye and the significance of jealously in Tamil fishing communities:
"One morning a motorized kattumaram overturned in the surf. The engine sank and one crew member was wounded. A woman who saw this happen exclaimed that 'this may well be the evil eye, hasn't the crew been coming up in life?'" (Bavinck 2001:118). Furthermore, Bavinck describes how jealously over successful fishing trips can lead to acts of violence and damage of fishing gear and as a result people are secretive over their earnings and 'luck' in fishing:

Bavinck (2001) writes:
"Question: And if a fisherman has good catches, how does he protect them?
Jeevaratnam: He hides the catch
Question: I saw Kalesh running home this morning with his fish basket clutched tightly under his arm...
Jeevaratnam: That's it!" (Bavinck 2001:118).

The power of suspicion, sorcery and jealousy in fisheries is a major factor in the reluctance of fishermen to reveal real data or proof of their fishing earnings. Release of such information can have many repercussions on the village through the jealous of others, which needs to be carefully considered in any attempts to appropriate catch data from village sources.

obtain. The care and discretion with which sensitive village catch data must be treated, in part restricts how much detail we can achieve in describing and explaining trends revealed.

The data on fish catch shows a substantial decline in the Tiger prawn catch, while a decline in catches of White prawn (a more common species) is less apparent. Earnings data, whilst showing a decline from the effect of the fall in Tiger prawn catch are also rather inconclusive in showing a decline in earnings from the White prawn. Furthermore, although White and Tiger prawn earnings represent the main core of fishing earnings (according to the fishing group and historical catch records), fishermen also fish for crab, fin fish and other species of prawn. Some fishing groups in this particular village also fish outside the Padu system, using non padu fishing techniques as small-scale supplementary incomes. These factors also need to be considered in assessing overall changes in income from fishing, although gathering data on the contribution of smaller scale 'informal' fishing is difficult, since fishing outside the Padu group is not recorded.

The data available from the village records give scope to look at a complete data set over 30 years of fish catches and deserve a far more through attention into defining plausible trends and changes than is possible in this thesis. What is of importance to the arguments made in this thesis is recognition that contestation over the health of the fishery exists. Even where longer-term data are available, it is difficult to assign any certainty as to whether the fishery is in decline. The important point to make is that if a majority of 30,000 fisherfolk argue that their fishing stocks are declining and their fishing livelihoods are threatened, whether the scientific proof is there or not, this needs to be dealt with by coastal management and the Indian government.

Amongst those who believe there is a decline in the lake fishery, there is further contestation as to the causes of the decline, the focus of the next chapter. At the core of this contestation is an argument over whether the decline is in the number of fish caught per fisher, resulting from an increased number of fishers and a maximum yield from the lake, or whether an overall decline is underway from external sources (both natural and man-made). As is detailed in the following chapter, numerous claims are made on the causes of fishing decline at Pulicat lake and many arguments exist, some

of which are interlinked. Many of the arguments are political in nature and have been seated at the top of the coastal management agenda for Pulicat. Such arguments lie at the frontline of the media's attention and have thus been squarely placed on the desks of the State government policy makers. The scientific 'evidence' for most claims remains vastly inadequate.

When a decline in the fishery can not be substantiated, management needs to deal with a lack of clarity and lack of certainty in data and scientific reasoning. Whilst efforts can be made to urge improved monitoring of fish catches at Pulicat lake and a more coordinated research effort to establish the nature of the lagoon fishery, coastal management needs to address the contestation that exists. The following chapter illustrates some of the key arguments explaining the *causes* behind the believed fishery decline. Each 'theme of contestation' is broken down to give insight into where the contestation originates, and in some examples, the political nature driving contestation onto the management agenda.

CHAPTER SIX

PRIORITIES FOR MANAGEMENT – A CONTESTED SOUP FOR MANAGERS TO DROWN IN!

Introduction

At this stage of the process, an analysis of perceived problems by villagers at Pulicat lake has produced a complex web of interacting problems which local people feel are priorities for coastal management (see figure 1, previous chapter). As argued in the previous chapter, many of the stated priorities for management can be linked to a focal concern over the state of the lake fishery. Stated management priorities represent either causes or consequences of the threat to Pulicat lake's fishery and fishing livelihood. From this network, several key themes clearly emerge which people believe to be the root cause of the threat to Pulicat lake's fishery:

Theme 1	**Physical causes – failed monsoons (lack of rain) and bar mouth closure (separation of the lagoon from the sea)**
Theme 2	**Pollution of the lake**
Theme 3	**Population increase**

Themes one and two were commonly mentioned coastal management priorities both in the village household survey and also by policy makers and academics. Population increase was not a commonly identified priority in village surveys, however it *was* a commonly cited problem during qualitative interviews (focus groups and key person interviews) as is discussed later in this chapter "Theme 3 Population Increase".

The aim of this chapter is to explore in more detail each of these commonly cited causes of fishery decline. The previous chapter discussed available evidence for substantiating a decline in the lake fishery, the focal problem of concern, and illustrated how the current status of the fishery is perceived differently by fishing groups and academics. Many academics believe fragmentary fish catch data for Pulicat is proof enough that the fishery productivity is not in decline, whereas most fishing communities claim a failing fishery is the cause of many of the problems they face. Where uncertainty exists over whether the fishery is in decline, the perceived *causes* of a potential decline in fish catch at Pulicat lake are even more heavily contested both between and within different stakeholder groups.

This chapter is split into 3 sections based around the three identified themes: *physical causes*, *lake pollution*, and *population growth*. In each section, the discussion relates some of the arguments, inconsistencies and contestations that occur within each of the identified themes, all of which could potentially contribute to a decline in the lake fishery. For each theme, perceptions from a range of stakeholders are combined with existing scientific evidence (quantitative and qualitative) from Pulicat and further a field. I explore each theme to illustrate where the contestation originates, and some of consequences of uncertainty and contestation on coastal management and effective policy making.

Considering these three contested themes is important because they represent the current debates surrounding coastal management needs for Pulicat lake at local, regional, national and international levels. Dividing the key debates of Pulicat lake management needs into themes also allows each theme to be discussed in an integrated way, drawing on scientific evidence which cross disciplinary boundaries, and adding quantitative and qualitative evidence from different sources under one banner.

I do not attempt to state here which themes are valid management priorities and which are not; my aim is to illustrate that the management needs of Pulicat lake are contested and uncertain at all levels of governance and involvement, in order to provoke thought on what implications that this may have for the effectiveness of any future coastal management plans at Pulicat. However, where possible, I draw together existing evidence to discuss each theme and its potential role in the Pulicat fishery. Contestation and confusion surround the lake fishery, both regarding whether the fishery is threatened and the various reasons as to the causes of this threat. The coastal management process needs to be able to utilise scientific based data, theory, and argument, but at the same time be ready to acknowledge that management can not be wholly reliant upon scientific interpretations alone.

Traditionally, coastal management has adopted a top-down approach, focusing on large coastal regions with use of 'expert' and technical driven policies on how people should utilise the coast. This approach has been successful, where there is "broad agreement about the aims of management, clarity about who the coastal users are

whose behaviour is to be managed and well-designed administrative procedures for insuring compliance" (Lowry et al 1999:718). In reality these conditions rarely exist (Lowry et al 1999), and in this chapter I illustrate the wider debates on Pulicat lake to show how disagreement over management priorities, coastal problems and their underlying causes can create a *barrier of contestation* for coastal management. At Pulicat there is little consensus over many of the potential management needs or management aims, let alone agreement over best practice for management procedures.

This *'contested soup'* of plausible problems and consequences is what faces the coastal manager, who can spend decades trying to untangle the debates in an effort to establish some form of 'truth'. The following debates highlight that this 'scientific' truth rarely exists, and clear agreement on coastal problems, their causes, consequences and solutions is rarely achievable. The contestation surrounding each coastal management theme means that there are no simple problems and solutions, only people's beliefs, political agendas, inadequate science and varied interpretations.

Contestation over management objectives and priorities is a very real barrier which coastal management needs to address. Is it possible to resolve management issues in such a way which all people will view as legitimate? Increasingly, coastal management errs on the side of "community owned governance" of resources, in a devolution of power from the state to the community, often through programmes such as Community-based coastal resource management (CBCRM) (Olsen and Christie 2000). Increasing community participation in coastal management is a key part of many coastal management programme directives (Hanna 1995, Wescott 1998). If successful management requires that all people subscribe to a single management process, coastal managers must first ask: is a consensus possible?

This chapter throws some light on understanding the 'contestation barrier' and, in doing so, it is a step towards a coastal management process which firstly can appreciate the existence of contestation and difficulties behind creating consensus, and secondly, address the need to break down and analyse the confusion. The chapter conclusion discusses the relevance of contested management themes to current coastal management discourse and meanings for a people-centred management process. In

the next chapter I offer some insights into how one may climb out of this *soup of contestation* to gain at least a direction for coastal management for Pulicat lake.

1. Theme 1: Physical causes – failed monsoons (lack of rain) and bar mouth closure (separation of the lagoon from the sea)

This section focuses on some of the physical lagoon dynamics as a step towards understanding the behaviour of the Pulicat fishery as influenced by seasonal changes over the year. The previous chapter highlighted the importance of seasonal variation in interpreting peoples' coastal management needs. A failed monsoon can bring misery through water shortages, whilst heavy monsoon rains can bring flooding to fishing villages at Pulicat. However, the fishery itself is also hugely affected by the annual monsoon, and understanding this dynamic is prerequisite to determining any longer-term image of the future of the fishery.

There is a strong consensus between fishermen, academics and government officials that failed monsoon rains and the subsequent isolation of Pulicat lake from the sea, through closure of the 'bar mouth', are correlated to the productivity of the lagoon fishery and the welfare of Pulicat fishermen. As one local academic put it, "when the bar mouth is closed the people starve" (Sanjeevaraj pers comm. 2003). Whilst there is agreement that the natural dynamics of the lake can create serious problems for fishing communities, understanding the natural functions of the lagoon, the influence of seasonality and possible management options are less widely agreed. Coastal problems occurring *by nature* are problematic. Firstly it is difficult to extract natural coastal dynamics from man-made influence when human development of the coast is large scale, complex and ever changing. Natural causes for a declining fishery are also a less favourable culprit to assign blame than the government and coastal development; nature can not be protested against and does not give out compensation. Natural processes at the coast are often more difficult to produce management solutions for and sometimes impossible to stop, whatever the commitment and intention. These issues also need to be considered in debates over the prioritisation of natural lagoon dynamics as a part of coastal management.

Lagoons are highly dynamic and complex coastal environments, quite capable of drastic changes in biological and ecological makeup within a single year, which can be influenced by a large number of factors, both natural and anthropogenic (Angell 1998). Lagoons by definition constitute "a shallow sound, pond or lake generally near but separated from or communicating with the open sea" (Packer 1984); and it is this connection with the sea that is largely responsible for a lagoons rich productivity, diversity and complexity.

As was described in chapter 4, Pulicat lake is joined to the sea by a narrow opening between the Sriharikota Island and Lighthouse Islands. This opening (known as the bar mouth) is closed off by shifting sands from these two islands either partially or completely for a large part of most years. This is common with many lagoons throughout the world (BoBP 1984) and understanding the impacts of closure, either partial or complete, on the lake's productivity is vital to understand the seasonal impacts on fishing communities dependent upon that productivity.

In spite of this, a lack of communication between natural and social science research means that this connectivity is largely ignored. At Pulicat lake, research has been geared towards a micro-level understanding of physio-chemical changes and biological fish production in isolation from each other. Few studies interpret what those processes mean for the lagoon fishery and the lagoon fishermen as a combined entity. This section attempts to fill this gap, by discussing the relevant aspects of current biological understandings of the lake's physical dynamics along side implications for fisheries and fishing communities.

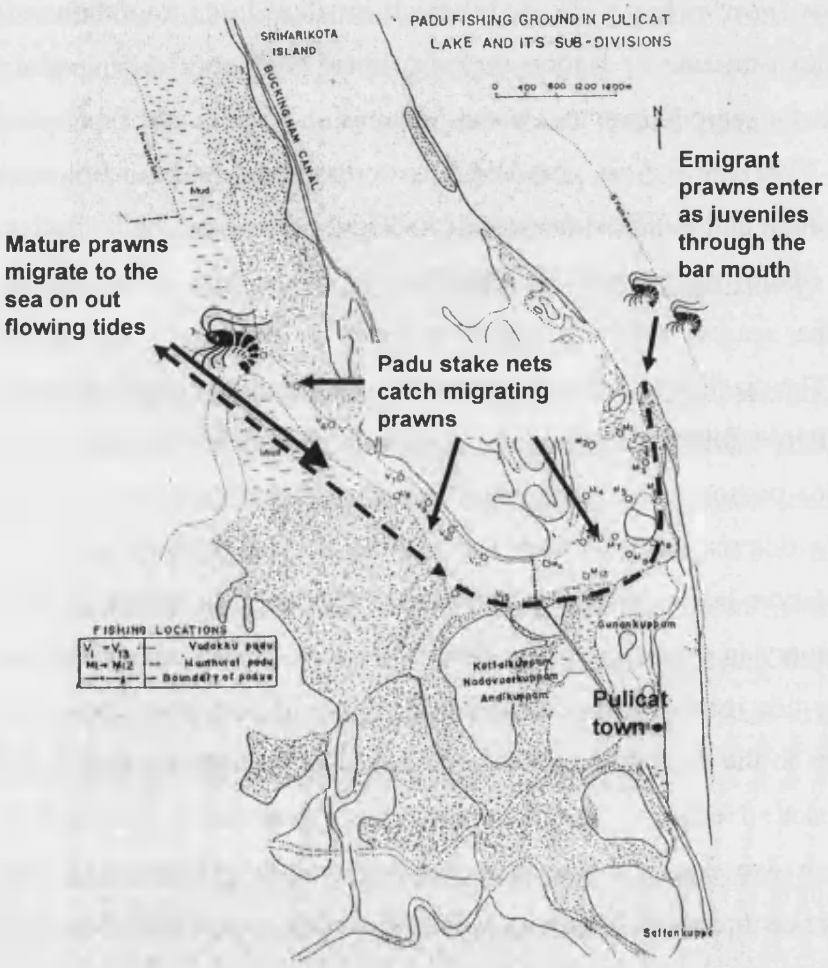
The functioning of Pulicat lake has been described as being similar to that of an inverted bottle (Hornell 1910, Sivasubramanian 1987): the body of the bottle represented by the wide northern sectors in Andhra Pradesh; the neck being the wide channel between Dhonirevu and Annamalaicheri villages in the Tamil Nadu section; and the stopper being the contracted section near to Pulicat town and the Bar mouth in the south (Sivasubramanian 1987). The *bottle body* in the north of the lake is seasonally dried out, partly due to a long distance from the lagoon opening in the south and a lack of tidal flushing. Drying out has potentially been exacerbated by the building of a road across the lake between the SHAR rocket station (located on

Sriharikota Island) and the main land in Andhra Pradesh, which may have restricted water flow between north and south areas. The b*ottle neck* region (in Tamil Nadu), according to fishermen, is the main and most productive fishing ground, fished by the Padu '*Pattinaver caste*' fishing villages. The tidal amplitude of Pulicat lake is 50cm, which extends up to 8km from the lake-mouth inside the lake, where much of the fishing activity is concentrated (Prasadam & Rangaswamy 1998).

Lagoons act as a breeding ground for many species of prawn and fish which enter the calm and shallow lagoon waters as juveniles and return to the sea as adults. The species genus *Penaeus (prawn)* has a life cycle which involves large migrations of post-larval prawns into estuarine or lagoon regions, where they stay as juveniles, returning to the ocean for reproduction and sexual maturation (Garcia and Le Restre 1981, Albertoni et al 1999). At Pulicat, commercially important species are *Penaeus indicus* (the White prawn) and *Penaeus monodon* (the Tiger prawn) and both species migrate up into the central regions (or the Bottle neck) of the lake as juveniles, migrating back to the sea on reaching sexual maturity to spawn (Sampson & Srinivasagam 1972). The mechanisms that drive prawn migration into coastal lagoons and estuaries are still not fully understood by scientists (Calderon-Aguilera et al 2002). Wickins (1976) proposed that post larval prawns penetrate estuaries in the following way "As the tide rises, a salt wedge moves inward along the bottom of the estuary and the post larvae leave the bottom in response to increased salinity. They are carried up the estuary in the saline water (the freshwater flows seaward at the surface) and when the tide reaches its peak and turns to ebb the post larvae settle to the bottom in response to the decreased salinity" (as cited in Calderon-Aguilera et al 2002:118). In Sri Lanka's Negombo lagoon, research has found that *P.indicus* (the White prawn) at the post-larval stages "inhabit the shallow near-shore areas and move progressively to deeper central areas as they grow" (Jayawardane et al 2002:351), and fishermen have learned to exploit this varied size distribution through a diversity of fishing gears, using drag nets in shallow areas and trammel and cast nets in deeper areas to catch the larger prawns (Jayawardane et al 2002). A similar process of prawn emigration in Pulicat lake is likely, although changes in net use are largely restricted to stake net fishing through the Padu system.

Prawns are caught as they migrate back to the sea. Pulicat Padu (stake net) fishermen fish only on the ebb (outgoing) tides stating they 'catch only those that would be lost to the sea'. Restriction of fishing to outgoing tides in order to catch emigrant prawns rather than younger (and smaller) immigrant prawns has also been documented in Sri Lanka (Jayawardane et al 2002) and Kerala (Lobe and Berkes 2004) showing a common understanding by fishermen of lagoon ecology.

Figure I Prawn migration in the Pulicat lake fishery



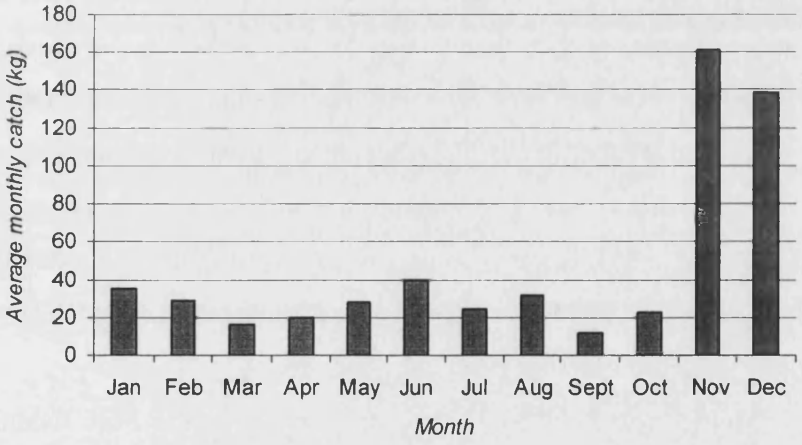
This movement of prawns in and out the lagoon is important since it is this which determines the 'best' or more productive fishing grounds or 'Padus' throughout the lake. Fishermen state the best Padu grounds *(Vadakku Padu)* are those furthest inside the lagoon to the north and around Annamalaicheri village, and it is here according to

fishermen, where the prawns congregate in greatest numbers. This pattern of prawn migration means that any change in fishing behaviour by villages inside the lagoon can potentially affect the catch successes of fishermen downstream towards the bar mouth [67].

1.1 The importance of rain to the lake fishery

During the NW monsoon period (November–December), Pulicat lake receives considerable fresh water input from precipitation and during heavy monsoon rains, through inflow from the Arnaiar, Kalangi and Swarnamukhi rivers. The NW monsoon season is the most productive fishing time of the year, with a slight increase during occasional monsoon rains from the SE monsoon during June-July (see graph 12)

Graph 12 Annual variation of White prawn (*P.indicus*) catches at Pulicat lake



Data source: Average catches were calculated over a 32 year period (1970-2002) using fishing village catch records

Fisherfolk throughout Pulicat state that the rain "is like mother's milk to the prawn" and even a light rainfall out of season can produce mass numbers of prawn and a rapid influx of fishers to the lake within the same day. Whilst it is widely agreed that good

[67] Pulicat fishermen also state that they catch more prawns at spring and neap tides during the new moon period, but scientific explanation of the impact of the lunar cycle on prawn movement is less clear. Some research reports possible influences of the lunar cycle on lagoon prawn catch sizes (Vijayan et al 2000, Mnaya1& Wolanski 2002, Calderon-Aguilera et al 2003) whilst other research notes no influence (Jayawardane 2002).

rainfall at Pulicat yields good prawn catches, the reasons behind this are not fully understood. Various explanations are given by academics and government scientists, such as: "the rain washes off nutrients from the land to the lake which in turn increases the number of prawns attracted to the lake....", or "the rains clean out the lagoon from pollution allowing the prawns to grow better". Whilst these claims may hold some truth, research in other lagoon systems can shed substantial light on the dynamics of Pulicat lake.

Research on prawn movements in Sri Lanka's Negombo lagoon assessed the impact of several environmental variables on both quantity and size of P. *indicus* (White prawn) by recording catch compositions of the different gear types used in highly specified areas of the lagoon (Jayawardane 2002). Research found that salinity and precipitation were key to prawn movement and catch size: "It appears that osmotic stress caused by low salinity waters in the lagoon during the periods of high precipitation may be the strongest influence triggering the onset of emigration" (Jayawardane 2002:351). In other words, the prawns are not attracted to the lake in high rainfall as is commonly understood at Pulicat, they are more likely to be moving *away* from fresh water inputs towards the sea and higher salinity levels. Other research has similarly found low salinity levels (though elevated precipitation) to stimulate emigration of prawns from coastal backwaters towards the sea (Jayakody & Costa 1988, Staples & Vance 1986), linking monsoon rain with a mass exodus of prawn movement (Jayakody & Costa 1988, as cited in Jayawardane et al 2001:362).

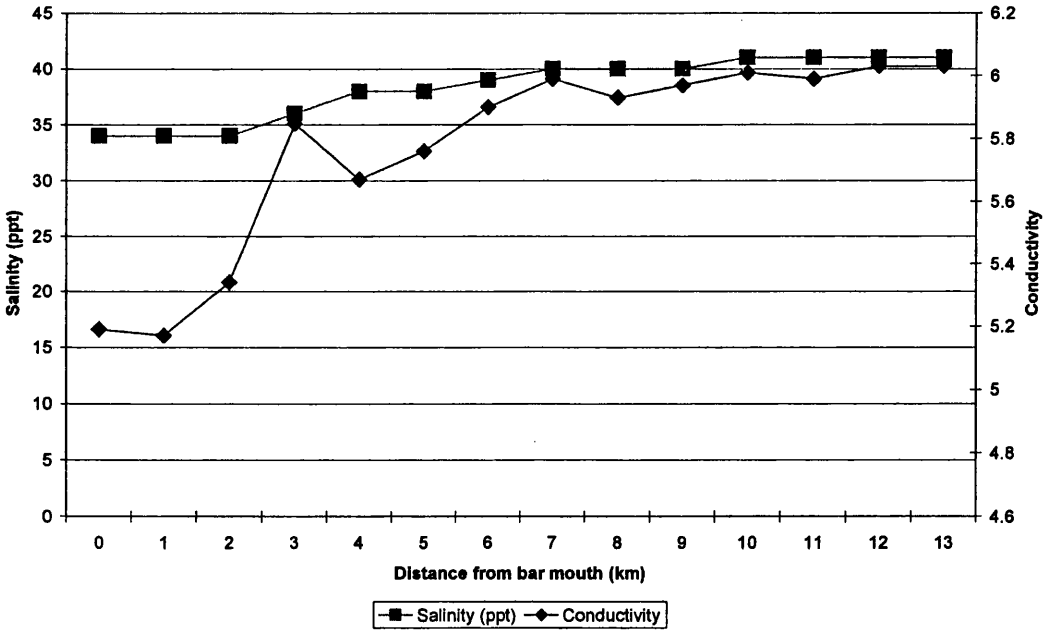
During the monsoon season (November to December), which is the best fishing season of the year for Pulicat lake fishermen, the salinity levels in Pulicat lake can drop drastically and rapidly (Reddy and Reddi 1994). It is this change which spurs a mass migration of prawns to the sea, and prawns on the move are caught by the Padu fishermen nets. During the summer months of the year, the situation is completely reversed as the lake becomes more saline than the sea due to partial closure of the bar mouth and high degrees of evaporation (Rao 1973, Angell 1998). This high salinity can produce a good environment for prawns since P. *indicus* thrive up to a salinity of 50ppt[68] (Angell 1998). In high summer, the narrowing (and sometimes complete

[68] 'ppt' is 'Parts per thousand' the standard unit of measurement for salinity

closure) of the lake bar mouth causes the lake to act as a *negative estuary*, which means that the most saline parts occur furthest inland towards the north, the best padu grounds fished by Padu villages ***(see Graph 13 below[69])***. GIS imagery by Anna University (Chennai) also clearly illustrates that Pulicat lake acts as a negative estuary, becoming more saline inland in the summer months *(see figure J below)*.

Graph 13 Positive correlation between salinity and conductivity of lake water with increasing distance from the bar mouth

The first measurement was taken at the seaward side of the bar mouth and measured 34ppt (the salinity of sea water). As measurements were taken inside the lagoon moving away from the sea, the water becomes more saline than sea water. Salinity levels possibly exceeded 41ppt since this was the maximum range on the probe available. Conductivity, also a measure of salinity shows that salinity increases past the 41ppt mark.



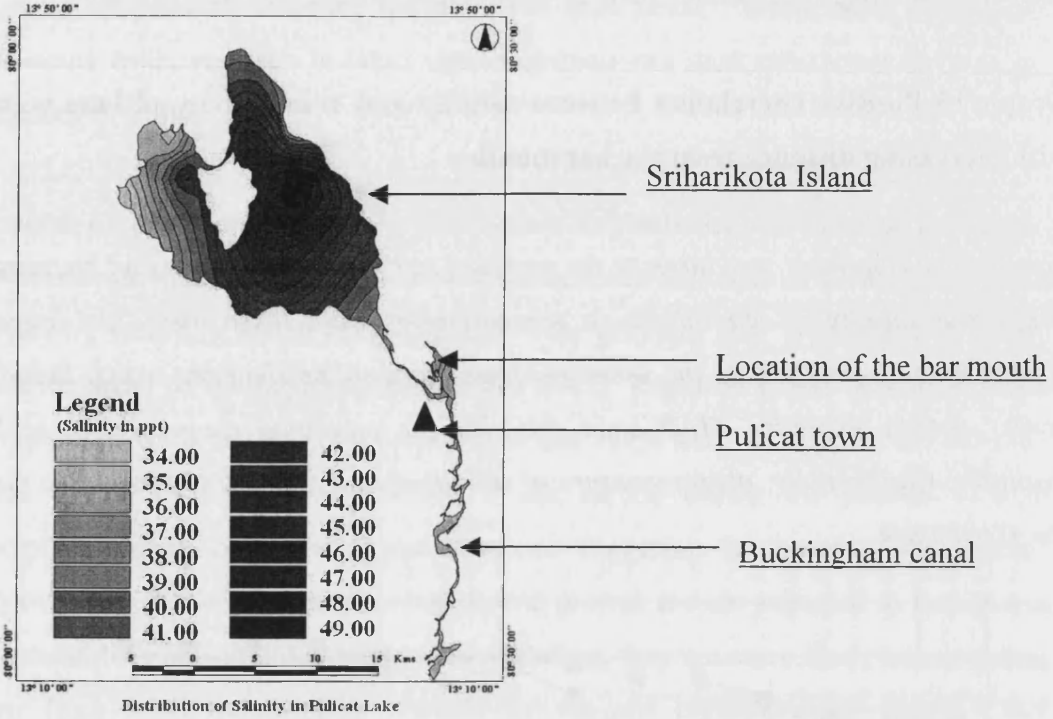
Conductivity and Distance correlate by Pearson's coefficient 8.84 P< .01,
Salinity and distance Pearson's coefficient 0.3 P> .05

[69] Water properties were recorded using an automatic water-probe in June 2003 when the bar mouth was partially closed.

Figure J GIS image showing high salinity concentrations inside Pulicat lake

Courtesy of the Institute of Ocean Management, Anna University, India.

(Copyright, IOM, Anna University)



Seasonal changes from a hyper saline environment in which prawns thrive, to monsoonal fresh water inputs which stimulate prawn emigration present a picture of how the lake functions during a year with a 'normal' monsoon rainfall and partial bar mouth closure. If this is the usual functioning of the lagoon, what goes wrong when the bar mouth closes completely, and why do so many people attribute the closure of the mouth to a disaster in the Pulicat fishery?

1.2 Impacts of the bar mouth closure on the Pulicat lake fishery

There are four possible connections between the bar mouth closure and productivity of the fishery:

1. Whilst *P. indicus* (the White prawn) can thrive up to 50ppt salinity (Angell 1998), the other commercially important species of Pulicat lake *P. monodon* (The Tiger prawn) has a much lower salinity tolerance and beyond 35ppt it does not survive well

(Angell 1998). Hence, the high summer salinities found in Pulicat may be detrimental to Tiger prawn growth and subsequent catch rates. Since Tiger prawn is substantially of more economic value to the fishermen than the White prawn, the economic implications of its loss during hot summer months are likely to have impact on fishing incomes. However, in the previous chapter analysis of village prawn catch data, Tiger prawn catches and earnings showed substantial longer term decline; seasonal decline would be indicated by a more erratic trend. A mix of seasonal variation in Tiger prawn catch and longer term decline from other causes (detailed below) is a possibility.

2. Inconsistent rainfall and a lack of fresh water run off, coupled with a *complete* bar mouth closure, result in extreme salinity and temperature levels (Rao 1973, Angell 1998) which are intolerable to many species of prawn and fish (Cooper 1994, Roy et al 2001). The GIS image produced by Anna University clearly shows salinity deep inside the lake can reach levels of 49ppt, which is far higher than survivable conditions for *P. monodon* and moving towards the outer range of survivable conditions for *P. indicus*. The status of the bar mouth opening was not recorded during these recordings, however during the 2003 survey, the bar mouth was partially closed and salinities reached levels higher than 41ppt. Therefore, we may reasonably assume that, when the lake is fully closed off, both salinity and water temperature rise to levels which neither prawn nor fish can survive, and this is a key factor in why the fishery is demobilised during closed off periods (Sanjeevaraj 1993).

Published research carried on Pulicat lake between 1972-1973 shows that during summer and pre-monsoon months hyper-saline conditions reached almost 50ppt, and temperatures were recorded over 30 degrees, reducing the abundance of many species of bottom dwellers (molluscs and amphipods) which were being monitored (Rao 1973). Krishna (1972) recorded a maximum salinity of 80ppt during the 1972 summer! There seems to be a delicate natural balance in force between the lake ecology and the lake fishery. In salinities up to 50ppt *P. Indicus* can thrive, however, when the bar mouth is fully (or partially) closed, the lake can turn into an evaporating pool of brine in which very little can survive. Extreme salinity caused by monsoon rain variability and closure of the bar mouth may explain the high variations in White prawn catches which were portrayed by the village catch records.

3. As is argued by Sanjeevaraj (1996), a long separation of Pulicat from the sea blocks larvae recruitment and out-migration patterns of the prawn, which also have a significant depletion on fish catch and lagoon productivity (Sanjeevaraj 1996). Albertoni et al (1999) found substantially less prawn larvae both during bar mouth closure and immediately after reopening in coastal lagoons similar to Pulicat in coastal regions of Brazil.

4. Lagoon separation from the sea means a total loss of tidal activity and lagoon flushing[70]. Flushing, the degree to which the coastal water body is flushed by fresh water and/ or ocean water inputs, is an important factor because it relates directly to how sensitive the lagoon is to adverse changes in water quality (Day et al 1989). This factor may leave the lake more vulnerable to pollution, which becomes trapped in the lake sediments at highly concentrated levels due to processes of evaporation.

At Pulicat lake, the physical dynamics between the bar mouth and the sea clearly impact the lake fishery, through influence on prawn survival, migration and risk from pollution. During the dry summer months, closure of the bar mouth can disconnect Pulicat lake from the sea for several months, creating serious consequences for the lake fishery. Relief is brought by the arrival of the N.E monsoon season (October-December), which brings high seas, cyclones and heavy rainfall. Storm events with heavy rainfall are needed to fill the lake until there is enough hydrostatic pressure to breach the barrier and create an ocean inlet (Day et al 1989). From the coastal side, heavy seas may also play a part in breaking through the sand bar and reforming the bar mouth connection (Elango personal communication 2002). Pulicat lake is also connected to three rivers: the Arnaiar, Kalangi and Swarnamukhi, which flow during heavy monsoon years. River inflow, land run off and heavy monsoon precipitation bring vast amounts of fresh water into the system so that in a matter of weeks, the system can change from a hot and hyper saline water body of salinity over 50ppm, to a fresh water / brackish[71] water system over a short time period.

[70] Lagoon flushing is measured by the amount of time it takes the water in a particular area to be totally exchanged with new water –i.e. the turn over time. Time for complete flushing of a water system can range between a single year to infinity (Day et al 1989).

[71] Brackish water is defined as water with a salinity ranging between 5-18 ppt (Day et al 1989).

This vast seasonal change is often overlooked in biological studies confined to data collected in one particular moment within the cycle. The commonly published reference to Pulicat lake being India's second largest *brackish water* lake, for example, is misleading since for most of the year the lagoon exhibits too high salinity levels to be classified as 'brackish'.

1.3 Possible anthropogenic impacts on the bar mouth closures

The partial closure of Pulicat lake with a sandbar is a defining feature of lagoons systems created through natural forces of sediment movements in ocean currents, accretion and long shore drift (Day et al 1989, Jayawardane et al 2002). "Many small estuaries and coastal lagoons in different parts of the world may be classified as temporarily closed/open ecosystems. They are blocked off from the sea for varying lengths of time by a sand bar, which forms at the estuarine mouth. The lengths of the closed and open phases, which are determined primarily by the interaction of river inflow and the sea in the mouth region, affect the structure and functioning of the estuarine biotic community" (Smakhtin 2004: Abs).

Whilst there is good evidence of the disastrous impacts of the bar mouth closure at Pulicat, far less is understood about the drivers of this closure. Of particular debate is whether the sand bar dynamics have been influenced by anthropogenic factors in the name of human coastal development. There are several claims by both fishermen and academics that the bar mouth closure has been exacerbated by coastal developments on the Chennai coast[72], and that the building of small dams in the rivers flowing into Pulicat have caused the bar mouth to close more frequently (due to reduced river inflow)[73].

[72] There is an argument that coastal developments at Chennai, in particular, the construction of the Ennore harbour breakwater has caused erosion and sedimentation problems at the lake. This is believed to be creating a more frequent closure of the Pulicat bar mouth (Government of India 2003-04). Research is currently ongoing by the Department for Ocean Development and Anna University, Chennai to better determine the interplay between manmade coastal developments and the bar mouth dynamics at Pulicat lake; (See the ICMAM Report 2000 for further details).

[73] Closure of lagoon openings to the sea due to upstream damming has been recorded in several coastal areas throughout the world (Fox et al 2001, Grange et al 2000).

It is important to differentiate here that complete closure of the bar mouth is a natural phenomenon, occurring in many lagoons and estuaries throughout the world, and has been documented at Pulicat since the early 1900's (Hornell 1910). The contestation occurs over whether the lagoon is today closing more frequently due to anthropogenic affects, or whether this is a part of natural cycle ongoing for many years as a part of natural lagoon functioning.

The view of several fishermen, and it seems also the Indian government, (see below exert) is that anthropogenic developments along the coast have created changes in lagoon openings, such as those at Pulicat.

Box 4: Exert from a recent India coastal management policy statement

"The tidal inlets like the mouths of creeks, lakes and estuaries play a vital role in exchange of chemical and biological elements that are essential to sustain the productivity of the ecosystem. Due to manmade activities like construction of breakwater, reclamation of land, etc., around these water bodies, there are evidences of severe accretion at their mouths (inlets) resulting in the poor exchange of water between the estuary/lake/creek and the adjoining sea. Formation of sandbars etc., caused by accretion is preventing the outflow of wastewater from these inland water bodies into the sea, increasing the pollution levels in these inland water bodies. Prolonged closure of the mouth also has other impacts like percolation of polluted water into the nearby grounds, affecting the water quality in the household wells".

Government of India
Department of Ocean Development
Annual Report 2003-04 (p.43)

Whilst impacts of coastal engineering constructions on sediment movements are well documented (Hooke et al 1996, Darke & Megonigal 2003, Pruszak 2004), the extent to which coastal developments at Chennai impact the bar mouth at Pulicat remains unclear (Subramanian personal communication 2003). Historical evidence gained from focus group meetings with fishing village elders revealed that the bar mouth has

been closing at Pulicat at least several times a decade since the 1930's[74], which would be contrary to claims that Chennai coastal development causes an increase in bar mouth closure.

Research specific to Pulicat lagoon and long term records on the frequency of bar mouth closure are required to establish possible impacts of recent coastal developments; a great deal of the longer term historical data may not exist.

1.4 Management of the bar mouth – an example of a destroyed tradition

Whatever the causes of bar mouth closure, it is clear that sustained closure creates serious problems for the fishery. In many lagoons and estuaries throughout the world, openings have been artificially maintained for many decades (Oliveria et al 1955 cited in Albertoni 1999). Closer to Pulicat lake, the Ennore river mouth[75] (15km to the south) also has permanent dredgers fixed in place. However, artificial opening of lagoons needs to be informed and specified to local conditions, which will differ in each case. For example, Griffiths (1999) found the abundance of fish unchanged following artificial lagoon openings in Australia, arguing that an offset may exist between the opening of the lagoon and decreasing salinity inside the lagoon, which can cause mass migration of prawns from the lake[76] (Griffiths 1999).

Dredging of the bar mouth at Pulicat has traditionally been done in the past by a consortium of Padu fishing villages, which collectively organised themselves to take shifts and literally dig through the bar mouth when it closed in order to maintain a

[74] Pulicat village elders use the term 'Black year' in reference to a year which witnessed the complete closure of the bar mouth. Elders state: "In some years the bar mouth will be partially closed, but not fully closed. The black year comes when the mouth if fully closed for some time....we receive very poor fishing incomes during these years".
According to village elders who have fished using Padu in the bar mouth for almost 100 years, the bar mouth has closed completely in the years 1932, 1936, 1942, 1943, 1949, 1952, 1963, 1964, 1974. Between 1976 and 1983 the area had consistently good rains and small cycles during monsoon time, leaving the bar mouth open and fish catches high. The 1984 cyclone also produced good catches in the following years (Elder focus group, historical time line using the Tamil calendar).

[75] The Ennore river creek is continuously dredged by fixed mechanical dredgers which maintain an opening to the sea. This is because the North Chennai Thermal Power Station requires access to sea water for use as a coolant in the plant.

[76] This description of losing fish from the lake is perhaps concurrent with some fishermen reports, which state that when the bar mouth is burst open, "all the prawns are lost to the sea".

narrow channel. The problem they faced was a lack of knowledge on the optimal places to dig. The Tamil Nadu Government took over this operation in the 1980s and faced similar challenges. In 1998 the government spent large amounts of money creating an artificial opening with mechanical diggers, only to witness the opening of a natural bar mouth a week later following a storm. The situation today is far worse since nobody now feels any responsibility to open the bar mouth. The government is reluctant to 'waste money' for new openings: "The government can't spend Crores of rupees for a few 100Rs of fish" (the view of a local academic). The fishermen, having had the responsibility removed from them by the state, now feel it is yet another neglected government job.

Attempts to answer the coastal engineering management needs for Pulicat lake are being done in other areas of research (Pandian 2003, ICMAM 2000) and in fact it is within the realm of coastal engineering that the majority of current ideas for coastal management of Pulicat exist. Further discussion of this issue lies outside the scope of this PhD; however, I include it here because it is a highly contested issue. Whilst there is broad agreement that the closure of Pulicat's bar mouth is a problem, how to manage that problem remains contested by scientists and 'experts'. Yet again the scientific understanding of coastal dynamics as specifically applied to Pulicat lake is inadequate.

Understanding Pulicat bar mouth dynamics and impacts on the lake's fishery and fishing communities is vital for management, because ultimately it tells us whether we are looking at a lagoon system which is undergoing continual decline, or a system operating under cyclical change and largely dependent on sufficient monsoon rains. Management requirements for the two scenarios demand completely different approaches; a cyclical fishery may benefit from seasonal assistance to cover fisherfolk in lean fishing periods until the lagoon re-establishes stability; an ever worsening scenario in the fishery would require longer term and permanent livelihood change.

2. Theme 2 Lake pollution

In the previous section I discussed the alleged argument that human developments at the Chennai coast are affecting bar mouth dynamics and, subsequently, the lagoon fishery. The theme of lake pollution follows on well from this idea of a 'development vs. fishing livelihoods' nexus. In many ways, the pollution debate represents a more extreme example of a perceived threat to fisheries, which has been hijacked by wider politics revolving between coastal development, fishing communities and the state government.

Concerns over the impacts of large coastal infrastructure on the bar mouth remain largely restricted to the government, academics and a very small proportion of informed fishermen. The issue of pollution at Pulicat lake is argued by far more people, spanning a much wider network of involved groups. Many NGOs, academics and government representatives cite the pollution of Pulicat lake as a major threat to the fishery. Within Pulicat communities the subject of pollution also ranks highly on people's prioritisation for management. The household survey found that pollution was felt to be a top priority for coastal management in 5 out of the 6 research villages. In the Management priority rating survey, lake pollution scored an average rating of 4.2 on a 1 to 10 scale, where 1 is the most important and 10 is the least important value. Issues of pollution are also the first to be cited in almost all media articles on the lake and occupy a top position on the agenda of many activist movements.

The contestation and politics which surround pollution as a problem at Pulicat lake are complex. Here I attempt to tease out possible political drivers of the pollution 'debate' rather than assign any definite conclusion of the impact of pollution on Pulicat lake. Whilst several causes of pollution are cited by Fisherfolk, such as the outflows from nearby aquaculture farms (particularly mentioned by Edamani and Kulathumedu villages[77]), and the pollution from recently established jellyfish

[77] Edamani and Kulathumedu villages are located particularly close to aquaculture farms in the Buckingham canal, which is a likely reason why complaints about aquaculture were substantially more common in these two villages. The aquaculture farms in operation are illegally positioned, since CRZ legislation states they should be a minimum of 1000m from the High Tide Line of Pulicat lake.

processing units[78], by far the overriding majority of people cite the pollution source of the North Chennai Thermal Power Station (NCTPS) as a key factor in falling fish catches. The contestation over the impacts of the North Chennai Thermal Power Station (referred to from here on as the NCTPS) on Pulicat lake is driven by history, politics and a wider India movement that has for many years lobbied against coastal development. These factors are the focus for the following discussion.

2.1 The problem of the North Chennai Thermal Power Station

"Everyone here will tell you about the NCTPS"

Comment made by a local priest

The NCTPS was built in the 1990s in response to increased electricity demands for the growing population of Chennai city (whose population now stands at 7 million). The NCTPS is located on the coast about 15 km south of Pulicat lake, situated next to Ennore Creek, a backwater which flows into the sea through the Ennore creek bar mouth. Ennore creek is linked to the Buckingham canal waterway, which connects Ennore backwaters to Pulicat lake lying approximately 15 km to the North. Ennore creek is located in the northern industrial belt of Chennai and the region (including the southern section of the Buckingham canal) is seriously affected by pollution from both sewage and industry (Pollution Control Board, ICMAM 2002). Since this region is connected to Pulicat lake via the Buckingham canal, the canal is believed to be a route for the pollution to travel the 15km from Ennore to Pulicat lake.

A major development located on the Ennore creek is the NCTPS, which withdraws water from the bar mouth area of Ennore creek (at the entrance to the sea) and discharges hot coolant water back into the creek. Unlike the bar mouth at Pulicat, the Ennore creek bar mouth is kept open by permanently fixed dredgers and it is argued by some scientists (and the power station itself) that the hot water discharge flows directly out into the sea. This is strongly contested by Pulicat lake fisherfolk and some academics, who believe that the hot release water is capable of travelling 15km up the

[78] See Coulthard (2004) for a detailed explanation of the establishment of the jellyfish industry at Pulicat, the problems of pollution and the consequences for the industry and fishing communities.

Buckingham canal and is largely responsible for killing the lake's fishery (Sanjeevaraj 1993, 1996).

Scientific evidence suggests that it is virtually impossible for the thermal discharge water to reach Pulicat (Pranesh 1996, Veerasamy 2000), whilst water quality tests have found little or no chemical pollution (ICMAM 2002). Research by Anna University specific to the thermal discharge water from the NCTPS found that temperature differences were felt only as far as 500m from the outlet source in Ennore creek, findings which are supported by my own survey of water quality in the Buckingham canal conducted in 2002 (see Appendix 6.1). However, as Majone (1989) so often argues, 'science can never be certain'. Occasional water monitoring in individual projects do not exclude the possibility of sporadic or unexpected pollution 'accidents'; and lagoons are extremely sensitive to pollution (Miller et al 1990), particularly when closed off from the sea (Day et al 1989). As has been discussed previously, bar mouth closure at Pulicat lake is a frequent event with well recognised negative impacts on the Pulicat fishery. In high summer when the bar mouth is closed, extreme levels of salinity and high temperatures in the lake pose serious risk to the lake's ecosystem. High temperatures due to the power of the sun could be misinterpreted as water release from Ennore power station. This connection however has not been linked in the literature as a possible cause of death to fish in the lake and focus tightly remains on the polluting industries. Despite the scientific evidence available concluding otherwise, many fisherfolk at Pulicat lake frequently refer to the experience of pollution from the NCTPS (illustrated below):

"Many fish die due to the NCTPS. The water changes to a brown colour, this is the discharge water, and it comes once a month killing the prawns and fish....We know automatically when they release the thermal water. The bigger fish begin to float, even the crabs in the mud die. There is also some chemical odour in the water. During this time if we are in the water we can feel itching"

Fishermen focus group in Edamani village

"From the time the NCTPS opened, they released water into the lake. We asked them and they said they are not doing so; but they continue to do it. We asked the government officials: they also say they are not releasing hot water. We know they are because the colour of the water changes, it is becoming brown in colour...you can see it now even!"

Comments from Kottaikuppam fishermen

With such a strong and widespread belief it is worth examining in more detail the political nature of the NCTPS, the routes of communication and the source of debate over the pollution. As is illustrated, the wider politics which surround many coastal management priorities, needs and debates can significantly affect the ways in which coastal management can be both shaped and ultimately achieved, and yet conventional coastal management can be ignorant of political implications and relevance to the process.

Anger over the claimed NCTPS pollution reached a peak during the year 2000 following a mass mortality of fish in Pulicat lake, for which the NCTPS was held solely responsible. The below extract is taken from an article written by a local academic and submitted to the Chennai press:

"On the evening of August the 4th (2000), the discharge of this (NCTPS) effluent was greater than usual, extending for a distance of about 20km. The dense colour did not permit anything unusual being noticed but on the morning of the 6th August, mass-mortality of fish and crab was noticed in the Buckingham canal from the NCTPS to the Pulicat lake mouth. Mass mortality of fish is ultimately fishermen's mortality too in a poor country like India...Local fishermen were shocked at this first mass mortality of fish during the lifetime of the oldest fishermen here. ....As a protest, nearly 2000 fishermen laid about 15000 bags of sand across the entire 100m width of the Buckingham canal, just north of the NCTPS. This 3m high barrier prevented the flow of the polluted water from the NCTPS into the Buckingham canal...This was followed with a total hartal in Pulicat town for 3-4 days. From August 5th till the time of writing (Aug 19th) no fishermen went out fishing, either in the sea or the lake. The seafood export business in Pulicat town has come to a standstill"

(Sanjeevaraj 1.09.2000)

Fishermen in Pulicat recalled the same event in focus group discussions:

"At that time people tried to build a dam across the Buckingham canal using sandbags. Every village was employed; everybody took turns to do it. The village accounts paid 100-150Rs per day. These wages remain as a debt for the whole village (in the village account). Further south in the canal more fish died than at Pulicat, since we blocked the water flow...After sometime so that the boats could move along the canal, we opened up the dam"...

"In a single night, fish, snakes and crabs, everything died. So when we thought why this had happened, we found the water temperature was higher. We put some agitations to the NCTPS; we used publishers and political party men. We protested near to the harbour also. So the officials promised us some jobs or to do something but they did nothing"

Comments from Fisherfolk in Edamani village

The fishermen did not work alone in these protests; they were well organised and strongly supported by NGO and environmental activities campaigners, including local politicians and several Chennai academics in the rally against the NCTPS. Such effective organisation links well with a debate on a larger movement of environmental activism in India, which is well established in the fight to protect coastal ecology, and the rights of fishermen. Furthermore, it should perhaps be remembered that many village leaders were instrumental in dealing with the 'blame' of the NCTPS, many spending large amounts of village money travelling to various meetings as part of the pollution campaign. This gives a certain amount of power and status to leaders, upon whom the entire village look towards to change things. As discussed in chapter 4, villager leader influence over the majority is already substantial through the workings of the Village Panchayat system.

The legacy of blame apportioned to the NCTPS for the 2000 mortality of fish has sustained a firm belief that thermal pollution is behind the alleged decline in fish catch at Pulicat. At the Indo-British-Integrated Coastal Zone Management Training Programme (1999-2003), the Coastal Fishermen Association of Pulicat submitted their report stating the coastal management needs as stakeholders of Pulicat lake. It

was entitled "Protect Pulicat lake – Stop destructive industrial activities that affect Pulicat lake and the livelihood of the fishing community". A lobby of NGOs and academics supported this motion and firmly blame the polluting industries at Ennore for the decline in living standards, income, and fishing at Pulicat.

In response to these claims the State Government Electricity Minister released the following statement in the Chennai Press, and it is from this statement that further insight into the creation of the NCTPS debate can be found.

Extract from the New Indian Express 25.4.2000

"The Electricity Minister today said there was no danger to the fish and other marine resources once near the Ennore coast or Pulicat lake due to the water let out by the north Chennai Thermal Power Station (NCTPS). Replying to a special calling attention motion in the Assembly on the problems faced by fishermen in and around Ennore, he said the water taken from the Ennore backwaters for cooling the turbines in the NCTPS was discharged in the Buckingham canal; and even that posed no danger to the marine resources. The water was not drawn from or let out in the Pulicat lake as alleged by some environmentalists. Though the permissible temperature limit in the water discharge was 10 degrees Celsius, the water discharge by the NCTPS was only between 4-5 degree Celsius. Moreover, the place where the water is discharged is at least 25 km away from Pulicat lake. He said there was a lot of false propaganda against the NCTPS. ...Expressing his inability to provide jobs to all the fishermen in the area, the minister said a power plant could at best employ only 1000 persons. But here were 5000 fishermen in the area"

(New Indian Express 2000)

As the above exert indicates, in Pulicat fishing communities there seem to be two accompanying traits to complaints over the NCTPS pollution. The first is a sense of alliance between fishing families at Pulicat lake and those at Ennore creek (who arguably are facing much high risks from pollution (ICMAM 2000)). In many newspaper reports there is often little distinction between pollution at Ennore and pollution at Pulicat despite the large distance of 15km between the two water bodies,

but this alone is not enough to justify the sense of solidarity amongst fishers. There is a degree of cohesiveness amongst fishing communities along the Tamil Nadu coastline (Bavinck 2001), which is particularly strong between villages from Ennore and Pulicat largely due to the high number of marriages and family ties which occur between the two areas. The fishermen of Pulicat automatically feel involved in the problems faced by their relatives at Ennore, and as such, problems are easily transferred and almost hijacked along the coast through local news, family conversations and links between communities. This 'hijacking' is taken to a national level of solidarity by the Indian environmentalist movement, where the NCTPS debate along with the pollution of Ennore creek has become a point of mobilisation; a 'flagship' issue for those who have issues against the government and coastal development.

The second insight taken from the extract is a feeling of injustice dealt to fisher communities by the State government through a broken promise to give local employment in Ennore industries. Several Pulicat fisherfolk feel they have been cheated out of potential jobs as illustrated by the below comment from an interview with a Panchayat president:

"Several (Ennore) fishing villages were displaced when the NCTPS was built. Almost 400 people from those villages got jobs as they were absorbed into the electricity department. Villagers at Pulicat lake feel that their fishing is seriously affected by NCTPS pollution – they have in effect, had their livelihoods displaced and so the NCTPS should provide compensation; the government should give jobs".

Interview with local Gram Panchayat president 2003

There is a feeling throughout Pulicat lake that the government (and in some cases the NCTPS) owe the fishing communities at Pulicat, whether it be a cessation in pollution, alternative employment, or compensation for displaced fishing livelihoods.

Proving the extent of pollution at Pulicat is a research area that needs more methodical attention by the state government and academia, however, the outcomes of such research may in the end become irrelevant. Pollution concerns, regardless of

scientific proof, reach Pulicat in the form of rumour and concern, and the fact that so many fisher folk at Pulicat are convinced it to be a major problem makes it also a problem for any coastal management initiative at the lake. The uptake of the Pulicat pollution argument by larger activist groups is mirrored in a wider campaign of injustice on the poor from Indian economic development. As is discussed in the conclusion (and throughout the thesis), these are powerful and national politics that coastal management can not ignore.

3. Theme 3 Population change

"In olden days there were far less people fishing".

Comment from a Dhonirevu elder 2003

Unlike the previous themes of the bar mouth closure and lake pollution, which are widely cited in the coastal management debate at local, government, and academic levels, the potential problems posed by a growing fishing population are relatively overlooked. Scientific research at Pulicat has traditionally been dominated by the natural sciences with a focus on the ecology and physio-chemical properties of the lake. At the government level, attention on Pulicat has been prioritised to the demanding pollution debate. Analysis of population change at Pulicat lake is seen as the 'social science domain' and, to date, little research has been done to establish the causes of population change, the magnitude of change or the links between population change and an argued decline in fish catch.

Curran et al (2002) argue that coastal management projects in general have an overly strong focus on the institutional, economic, environmental, and resource aspects of the coast, which means, "Population questions themselves get little more than general mention...Demographers and ministries overseeing population policies have had little involvement in the integrated coastal management movement, and consequently their insights are not brought to bear on the questions" (Curran et al 2002:265).

Despite a lack of purposeful research to tease out the influence of population change on the lake fishery, several reports argue that whilst fishing productivity has remained

the same at the lake, it is the increased fisher population, and subsequently reduced amount of catch per fisherman (or reduced Catch per unit effort[79]), which underpins fisher complaints of reduced income (Sivasubramanian 1987, Sanjeevaraj 1993, ICMAM report 2000).

Surveys conducted in this research were ineffective at revealing the problem of change fishing population. An increase in the number of people fishing the lake was not included as a category in the Management priority rating survey[80], and in the semi-structured village household survey less than 3% of respondents (for all villages) stated that they felt growing population was a problem[81].

Plausible reasons for this are two fold. Firstly, as with the decline in fishing, management priorities stated through survey may not automatically be linked to an increase in population. 'Lack of employment' and 'declining fishing incomes' were commonly cited problems that can be closely linked to changes in population, and those few individuals who identified population change as a problem did so arguing that population rise was causing increased unemployment in fishing villages. Secondly, complaints over growing fisher populations can be interpreted by a fisherman as a complaint of over fishing. It is unlikely that any fisherman or woman would be inclined to state this as a problem (particularly as part of a formal recorded survey), in fear of repercussions for his/her own ability to continue fishing the lake. This idea is strengthened by the fact that more qualitative approaches in the research revealed that many fisherfolk feel that growing population is a huge problem; a view especially held by village elders who frequently state that "in olden days there were less people fishing the lake".

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[79] Catch per unit effort or CPUE is used as an measure of fishing efficiency and can be defined as "the quantity of fish caught (in number or in weight) with one standard unit of fishing effort e.g. number of fish taken per 1000 hooks per day or weight of fish, in tons, taken per hour of trawling" (FAO 1998). FAO (1998): Guidelines for the routine collection of capture fishery data. FAO Fish. Tech. Pap, 382: 113 p.

[80] More fishers coming to the lake was an original question in the survey, but it was removed following a request by the local NGO with whom I was staying. The question was considered as too sensitive for a wide-reaching survey, which may invoke feelings of disquiet as to what my research was investigating. Non traditional (non Pattinaver) fishers coming to the lake is a cause for anger amongst many traditional fishing communities.

[81] A growing fishing population was only mentioned as a priority for coastal management in one research village, Nadoor Madha kuppam (which incidentally has the largest Padu fisher population).

Population change and potential impacts of change on the Pulicat fishery are contested at two levels: firstly, whether a population change can be substantiated, and secondly (at a more micro level), where the population growth originates. Is there natural growth or are there processes of in-migration to the lake fishery? These two issues are the subject of the following discussion, a final illustration of the contestation over causes of fishing decline in Pulicat lake.

3.1 Census data – poor evidence for population increase

Proving the extent of population change at Pulicat is difficult, since census data for many of the smaller fishing villages have been missed from official census records. Pulicat lake spans across two states and fringes many districts, whose borders extend deep inland away from the lake. Therefore it is impossible to ascertain any meaning of change specific to Pulicat lake using *district level* census data. The Government of India District State Census provides information on towns and larger villages bordering Pulicat lake and some comparisons can be drawn where the same villages are recorded in more than one census. Tracing fishing villages between census records is difficult; districts merge, split and change names; villages appear and disappear between census years, some becoming towns, others disappearing completely. To an extent this continuous evolution of villages at Pulicat reflects quite accurately the reality on the ground. Villages do appear and disappear within a single decade; villages quarrel and split forming new villages[82], some are swept away by cyclones or displaced from land, whilst other new villages form and win land rights[83].

An analysis of Pulicat village population change, where possible, revealed the highly different nature of individual villages and towns (see Appendix 6.2). In some villages there has been a population decrease following a boom in the 1981 census; in other villages there has been a steady fall in population. There is no historical census data for the research villages involved in this thesis (their first inclusion in a census was

[82] An example of a village split would be the 1986 split of Dhonirevu village, when the Muslim portion of the population formed their own separate village, Jamilabad. Village splits are very common in fishing villages throughout the Tamil Nadu coastline, and can often be identified through names such as 'New x kuppam', a sign of a split from the original 'x kuppam'.

[83] During the field work, a new village, 'Israel kuppam', appeared bordering Pulicat town, whilst the tribal village of Kulathumedu village had won land rights for their recently established permanent settlement.

the State Fisheries Department Marine fisherfolk census of 2000). Analysis using census data on changes in the number of people employed in the fisheries sector is also difficult, since the census categorisation of 'fishing' is inclusive of many other livelihoods: "livestock, forestry, fishing, hunting and plantations, orchards and allied activities, and mining and quarrying".

Since many of the suspected changes of people's livelihoods entering into the fisheries sector come from the plantation, livestock and hunting sectors, analysis of this data does not reveal a great deal.

3.2 Evidence of population change from qualitative sources

More substantial evidence for a fishing population increase in Pulicat fishing villages is drawn from qualitative interviews with fishing village leaders. In the research fishing villages of this thesis, there are several pieces of evidence that point towards a natural population increase over the years. A good example is the changes which have been made to the Padu system within all researched Padu practicing villages. Each Padu village leader describes how they have had to increase the number of fishermen per boat and in some cases, split villages into smaller fishing groups to cope with rising fisher population, whilst maintaining the Padu system of access and rotation.

In addition to evidence for natural population growth given by Padu village leaders, focus group discussions with Pulicat fishing communities clearly illustrated that *migration* to the fishery was commonly perceived as a threat to the fishing livelihood. Seasonal migration to Pulicat lake by agricultural labourers and people of other non-fishing occupations has been ongoing for many decades. Hornell (1924) wrote: "the accessibility of backwaters and the ease with which fishing can be carried on there often induce men of other occupations to try their hand at fishing in the slack season of their own calling, or after their ordinary day's work" (Hornell 1924:79).

Chapter 4 detailed the historical events and changes in state fisheries policy which created a pull-and push factor of more permanent changes in livelihood, towards the lake fishery. Chapter 4 also details the opening up of the Padu system to accommodate 'non-traditional' or (non–Pattinaver) fishermen into the Padu system of

fishing prawn with stake net, leading to the establishment of 'non-traditional fishing villages' with limited Padu fishing rights. The gaining of Padu fishing rights by villages, such as Dhonirevu[84] and Edamani (discussed in chapter 5), has created a degree of division in 'traditional' fishing society at Pulicat, and tensions over identity between 'traditional' and 'non traditional' fishermen.

Outside of the Padu system, many other Pulicat residents have also changed from a non-fishing occupation to become full time fishers due to a loss of their own occupations, fishing with small scale non-padu fishing gears (*Sirutholil).* These include ex- shell miners, plantation labourers and boat workers for the transportation of shells and firewood to Chennai (Mathew 1991, Krishnan and Sampath 1973). Chapter 4 (and 5) also details how once migrant seasonal fishing villages have set up permanent settlements, such as Kulathumedu tribal village, and are involved in small scale fishing at Pulicat lake.

These forms of permanent and seasonal migration into the Pulicat lake fishery have taken their toll on 'traditional' fishermen at the lake, as is illustrated by the following statement:

"People who are doing agriculture are also coming to the lake for fishing...if fishermen only fished – there would not be such a big problem in the lake, but it is the people other than traditional fishermen who also put their nets in the lake that cause the problem"

Comments from Nadoor Madha kuppam 2003

Whilst 'traditional' Pattinaver fishermen have historically fought fiercely to defend Padu fishing rights (prawn fishing with stake nets), many were less interested by the activities of those fishing groups operating outside of the Padu system, small scale fishing or 'Sirutholil'. However, as the fishery further declines, blame is increasingly

[84] For example, in Dhonirevu village 26% of household survey respondents stated that prior to full time fishing, they had worked on Casuarina plantations on Sriharikota Island until they were displaced in 1984 (household survey 2003).

apportioned to non-padu fishers; the tolerance of Pattinaver who see their traditional 'birth rights' slowly eroding away seems to be decreasing.

An illustration of a degree of understanding of the needs of lower status (non padu) fishermen in the fishery was illustrated by the comments made by a Padu village leader:

"So many people are fishing the lake. But what can we do, they are poor, they also must eat something"

Comment from Padu village leader in reference to non padu fishers

Such statements seem to be increasingly accompanied by other feelings of intolerance, as Pattinaver incomes are continuously eroded:

"Last year we had a drought so that the bar mouth was not running properly. At that time, crops in the near by agricultural villages failed. People came to catch prawns by hand. Regular Padu fishermen did not get many prawns, but the people who catch prawns by hand are able to earn a regular income of 100Rs a day. Once the rains came again they returned to their villages. Some still remain at the lake, but not in large numbers like last year. They spent their money on their family and saved because they were able to get daily income. In 20 days they were buying jewels for themselves"

Pattinaver focus group, Kottaikuppam

Prawn fishing by hand is seen throughout Pulicat as the most demeaning and low status form of fishing. It is unlikely that migrant fishers were able to buy jewels on 20 days wages using such a method, but the implication that earning more fishing the 'poor mans way' over the Pattinaver way is an important concept. The potential benefits of small scale 'sirutholil' fishing, such as a regular income external to the Padu system are further discussed in the next chapter, which looks in more detail at the Padu system and implications for adaptive capacity to cope with change in the fishery.

Migration is often argued to be the largest contributor to population growth in coastal areas (Cohen and Small 1998, Curran and Agardy 2002) and migration into coastal fisheries is equally argued to create a risk of over fishing (Panayatou 2000, Kramer et al 2002). However, the definition and magnitude of that risk is often difficult to verify (Curran et al 2002). For example, Kramer et al (2002) estimated that migration to fishing villages in Sulawesi, Indonesia, accounted for at least 1/4 of fishing village population growth over the past decade. Their research found some indications of a correlation between a decline in fishing catch and increased migration to the fishery, although they admit that "If catches have in fact declined, some of this may be due to natural forces such as changing weather patterns" (Kramer et al 2002:372). Indeed, this mixture bears resemblance to the situation at Pulicat, where cause and effect of multiple factors are difficult to extract and define. Literature on Common Property Resource management argues that many traditional management institutions, when in the hands of local people, can counter the Malthusian effects of population growth and act as a barrier to overexploitation through the exclusion of non-traditional fishing groups (MaCay and Acheson 1987, Ostrom et al 1999, Curran and Agardy 2002). The Padu system in place at Pulicat is one such institution and its effectiveness at restraining fishing effort under increasing fishing pressure is discussed in more detail in the next chapter.

Within the vast literature on migration, traditional push-pull models of migration are sometimes cited as lacking in appreciation of the complex cultural, societal and community links which influence people's graphical mobility (Jones 1999, Corbett 2005). In the case at Pulicat, a cause of population growth, according to local people, is the entrance to the fishery by non-traditional (non Pattinaver caste) fishers, who enter *physically* from inland regions, and *occupationally* from other livelihoods. "Existing social networks and embedded social relations in coastal communities are often upset by influxes of non-indigenous peoples with differing customs, technologies, and levels of investment in resource management" (Curran & Agardy 2004:205). Whilst this is certainly true in many cases, the institution of Padu at Pulicat has historically restricted the type of fishing available to incoming migrants and thus reduced (not eliminated) potential conflicts over fishing space.

Population change and the numerous explanations behind it are under researched and overlooked in the management of Pulicat lake. Contestation exists at a local level, as people dispute who are to blame for a decline in fishing; non-traditional Padu fishers often blame the new migrants for the decline, whilst traditional Pattinaver fishers blame both occupational and seasonal migration into the fishery for falling fish catches.

4. Implications of the barriers of contestation for coastal management

Original aims of this thesis were to develop insight into potential coastal management solutions for Pulicat lake. However, the situation at Pulicat has not yet reached the stage where managers can start implementing coastal management because managers, academics, communities and the government are still arguing over what it is that needs to be managed.

This chapter has shed light on some of the debates within the coastal management community of Pulicat, as represented by academics, government officials and Pulicat lake inhabitants. Key themes of common concern have been drawn upon as examples of the lack of certainty and contestation which can exist over both the drivers and consequences of change at Pulicat lake.

It is outside the scope of this thesis to draw together the various data to conclude which are valid priorities and which are not; indeed adequate data to conclude either way is lacking. Furthermore, should perfect data even exist, this may still not lead to dissolution of the contestation that surrounds each theme. The prevalence of politics and personal agenda may run so strong that scientific explanation and justification, to an extent, almost become redundant. The importance to coastal management at this stage is to acknowledge this contestation exists and to work out how to deal with it; in essence, how to move on through the soup of contestation which is presented to the coastal manager.

"People involved in the practice of resource management are all linked by the need for understanding. Yet in these complex resource issues, uncertainty is pervasive. Partitioning that uncertainty is an initial step for an approach that involves confronting

and the hope of winnowing" (Gunderson 2003:39). The network of coastal management priorities and problems identified in this and the previous chapter is highly complex. Whilst a common claim of 'integrated coastal management' is to offer tools to manage the complexity of the coast (Olsen and Tobey 1997), what coastal management frequently fails to do is acknowledge the relevance of contested management needs on the efficiency of coastal management policy outcomes.

The policy process can be considered as heavily reliant upon identification of problems, prioritisation of problems and formulation of policies to be implemented (Campbell et al 2003). "While all policy processes are complex, the policy process in coastal areas can be even more complex. The situation in the coastal zone is complicated by the interaction of structures and processes required to deal with the complex ecosystem and the resulting diversity of livelihoods of the people who depend upon those ecosystems" (Campbell et al 2003:15).

At Pulicat lake, the lack of clarity over problems and the connectivity between problems mean that policy makers face a brick wall and management can not move forward. As is illustrated by comments from a key coastal policy maker:

"The problem at Pulicat lake is a decline in fishing resources, the lake is shrinking and the threat of erosion due to developments at Chennai....This is the expert opinion, simply we don't have the data to prove it"

ICMAM project, Chennai,
Personal communication

In a review of coastal management policy, Burrill et al (2000) claimed the origin of coastal problems was attributable in part to a lack of vision and lack of coordinated approaches to understanding the coastal complexities. "Management of the coast has lacked vision and is based on a limited understanding of coastal processes...Scientific research and data collection have been isolated from the end-users" (Burrill et al 2000 as cited in Campbell et al 2003:17). The fragmentary approaches to research and governance of the coast in Tamil Nadu inherently lack any appreciation of the complexity of the coast, and the approach is unlikely to provide effective management suited to people's needs.

5. Can coastal management deal with management contestation?

The conundrum that faces the coastal manager and policy makers is that whilst integration of participation can reveal great insights into the complexity of problems at the coast, this *does not remove* the contestation and confusion that exist within each problem. The question becomes how to create management that is both appropriate to people's needs, whilst acknowledging that people's needs at the coast are different. At the same time, management has to have meaningful input for policy makers, who are currently faced with the contested network of different perspectives and arguments, a network that is repeated and replicated through continuing debates.

There are three challenges which emerge from these contested themes, which coastal management needs to better consider if it is to become an effective and informed management ideology.

1. Where can better science make a difference

A lack of coordinated and long term monitoring and scientific research is prevalent in all of the discussed coastal management priority themes. Walters (1997) argues that many case studies of the coast, management have failed to produce effective models for policy users to follow because of an inability to resolve key uncertainties, citing "lack of data on key processes that are difficult to study" as a major driver of uncertainty. An established monitoring programme for the lake fishery may help to solve by what magnitude the fishery is changing, a vital starting point to understand and explain potential causes. More coherent and systematic water quality monitoring in Pulicat lake may also assist in our understanding of the dynamics behind the bar mouth closure, and the possible impacts of pollution upon changes in the lake fishery.

A domination of the natural sciences in Pulicat lake research has meant an almost complete oversight of the importance of population dynamics and migration on the lake fishery, which are well researched areas in the social sciences. However, whilst improvements to scientific research and better collaboration between scientific disciplines may make some headway in producing management solutions for Pulicat lake, coastal management has to be able to deal with this lack of evidence, both in

terms of a gap in scientific knowledge, but also through appreciating the impact of such a gap on the actions and beliefs of others. Where there is uncertainty in science, there is room for politics (Majone 1989); since the science at Pulicat is almost never certain, how can the lakes policy makers better cope with those politics?

2. Engaging with the wider politics

Coastal management needs to better engage with the political drivers of debates over management needs and priorities, to be able to place those debates within the country-wide context and find a way to include them. Whereas science uses uncertainty as the basis of inquiry, vested interest groups use and foster that uncertainty to maintain a status quo policy (Berkes et al 2003).

A good example from Pulicat is the need to understand the 'pollution' debate in Pulicat as a wider 'people vs. development' debate, where coastal development has been seen by many as operating against the rights of the coastal population. Coastal campaigns by popular and highly influential figures such as, Shri Janannathan (in Tamil Nadu) and Sri Das of Orissa[85], have heavily influenced coastal policy outcomes, for example the restrictions on Aquaculture development (detailed in chapter 4).

An over dominance by natural sciences in coastal resource management means that finding solutions to 'technical uncertainties' of resource issues has remained the domain of a technical and expert community (Gunderson 2003). However, "Those uncertainties have technical components, political components and stakeholder-citizen components. Few arenas exist that seem to successfully embrace these different types of uncertainties" (Gunderson 2003:48). Coastal Management needs to appreciate that considering the wider political objectives and agendas of the 'environmental debate' may often mean a consensus through participation is not possible. There are large politics to which coastal management should not be blind.

[85] Sri Das, a former state minister, has been behind several community coastal protection movements, such as the Save The Coast Movement used to block tourism development in Orissa and the powerful Chilka Bachao Andolan (Save Chilka Lake Movement) (Ahmed 1997).

Political ecology is a useful discipline with which to explore the wider drivers of contestation, because the different view points of management needs stem not only from political drivers, but also from a lack of understanding of social elements and their relation to the changes witnessed in the lake environment. It is the acknowledgement of the contestation which is required to derive more meaningful management. "The Political ecology perspective compels the analyst to consider that there exist different actors who define knowledge, ecological relations, and resources in different ways and at different geographic scales. Actors will bring different cultural perspectives and experience, and may use different definitions in pursuit of their own political agendas" (Blaikie 1985, Llaikie and Jeanrenaud 1996 as cited in Berkes et al 2003:10).

3. Understanding the limits of local participation in management

As is discussed in the literature review, participation of local communities in coastal management is often seen as the missing link in effective coastal management (Moffat et al 1998, White & Deguit 2000, Pollnac and Crawford 2000). A high level of local participation in this research has certainly revealed a greater detail of understanding of the variety of problems people face, and the interconnectivity between management issues than that extractable through academic or government publications. However, the case at Pulicat clearly shows a shortcoming of the participation ideals in practice.

Prioritisation of problems by Pulicat communities faced substantial contestation within fishing communities in attributing a cause for fishing decline. A gap in scientific understanding, combined with heavy political influences and opposing agendas means it is unlikely that any degree of 'education' on coastal issues (as is often advocated) would create a consensus for management action and compromise. As is debated in the literature review, the shortfall of participation in current coastal management discourse is that it assumes that a consensus over management goals can be agreed: "Participatory approaches stress solidarity within communities; processes of conflict, and negotiation, inclusion and exclusion are occasionally acknowledged but little investigated" (Cleaver 2001:44).

The local fishing community at Pulicat includes many different social groups, spanning different levels of hierarchy based upon caste, tradition and history. The groups suffer different problems, perceive different management needs and have vastly different priorities which are affected by issues of status, power, and as was seen in the case of NCTPS pollution, even national politics. The banner of 'local fisher representative' as a single stakeholder excludes the significant heterogeneity that exists at the local level.

With such strong feeling and contestation over priorities and problems, initiating and maintaining participation in coastal management at Pulicat is extremely difficult. For example, a meeting between 'stakeholders' of Pulicat lake as part of a coastal management training initiative in Chennai, erupted into disarray when local fishing representatives walked out in protest. As part of participation process, several industrialists from Ennore (North Chennai) had been invited and introduced to the session as a 'stakeholder of the coast'. The fishermen representatives left in protest arguing that, "industrialists have no stake in our lake; they are just the abusers of it" (Rajaseker personal communication 2003).

As Campbell et al (2003) point out, "Participation is not as easy as many believe it to be, it is important to recognise and integrate the forces of politics and patronage and power relations that exist in coastal areas and that can make participation very difficult" (Campbell et al 2003:20). As discussed in chapter 4, fishing villages in Pulicat often have influential leaders (Chettiyar), who, with the strength of the village Panchayat behind them, are powerful and persuasive forces in the village. As one man put it, "the main problem these villagers face is that they will never stand up to these Chettiyar". The powerful combination of NGOs and strong fishing community leaders who frequently lobby the NCTPS pollution issue are a good example of where those with the loudest voice may not automatically represent the majority of people.

Contestation over some problems may detract attention from under researched and misunderstood problems elsewhere. The pollution issue is a top 'political' concern at Pulicat, despite lacking supporting scientific evidence, whereas the threats from migration and an expanding fishing population to the lake fishery are rarely mentioned. On the other hand, the lack of local participation in State government

policy to date means that the majority of fishers are wholly dependent upon those parts of the community which are able to speak loudly and be heard.

Whilst inclusion of 'people' in coastal management has at best meant 'better 'participation', there is a growing voice in the discourses of coastal management and natural resource management in general that that inclusion of people is not enough on its own (Campbell 2003). As Berkes, Colding & Folke (2003) argue, "The failures of the past have not been complete: there have been partial successes. This mixed picture comes because theories, trials and projects were not wrong, just too partial". The recent fad for community-based development alone is another such correct, partial solution that will fail" (Holling 2003:xx). At Pulicat, participation in assigning priority to coastal problems and needs was missing in the realisations of the complexity of those needs, and the limits of using only participation to address them.

6. Conclusion

This chapter has explained the main current coastal management issues at Pulicat lake and given some insight into the contestation surrounding each management theme. These are the current debates surrounding coastal management needs for Pulicat lake at local, regional, national and international levels. This is what a 'participatory' Coastal Management process has produced and this is what coastal policy makers are faced with around the world – a contested, unsupported, lacking in data, agenda driven, personalised and uninformed, passionately believed group of impossible problems with which to unravel and establish, substantiate, prove and solve. It is no wonder so many of our coasts are in disarray.

It is through an interdisciplinary approach that coastal managers may gain a direction in which to follow, and that approach needs to have a much larger focus on the social and political sciences in order to better understand the contestation described.

Coastal management at Pulicat lake to date has been heavily focused on natural sciences and coastal engineering, and whilst these are useful in terms of attempting to manage the physical processes of the coast, they have overlooked other equally important management needs, such as those presented by migration and population

change. Usually, most ICM projects are still rooted on coastal management decisions taken by natural science based 'experts' in the academic field, heavily reliant upon generalised coastal processes and dynamics, and missing aspects of the local and the specific. In doing so, coastal management remains top-down in its approach, blind to the contestation which exists in identifying and prioritising management options and, therefore, produces inappropriate and uniformed advice to policy makers.

In order to meet the numerous challenges presented to coastal managers – coping with a lack of consensus over management problems; gaps in scientific understanding; engaging with the wider politics of management prioritisation; and the limits of people participation - coastal management needs to engage with social science disciplines. Better integration with the social sciences gives a path to understand people and society as a part of coastal management in ways other than just a peripheral inclusion of them through a largely over-rated 'participation'.

Berkes et al (2003) argue that natural resource management has not learned from its failures, and that a lack of an integrated understanding of contested issues and different perspectives on management are key drivers of policy failure. "Each spasm of policy change builds on theory, though many would deny anything but the most pragmatic and non-theoretical foundations to their proposed actions. The conservationists depend on theories of ecology and evolution, the developers on variants of free market models, the community activists on theories of community and social organisation. All of these theories are correct. Correct in the sense of being partially tested and credible representations of one, but only one, part of reality. The problem is that they are partial. Each misses a crucial dimension. Economic theory deals poorly with slow variables that form cultural and ecological foundations for sustainability. Ecological theory ignores the richness of people's needs and inventiveness. Social theory is fragmented and static" (Holling 2003:xix).

At Pulicat, all the theories of the problems of the lake may be correct, but they are partial and therefore can not create a complete management strategy that is accepted or approved by all the different viewpoints.

6.1 People's responses to coastal change - a way through the contestation barrier?

In coastal and natural resource management there are developing ideas which focus on people, not as participants in coastal management, but as actors within the coast. To understand how people of the coast can react and respond to the challenges they face at the coast are directions which management can follow (Bene 2003, Campbell 2003).

"As Thompson (1983) states, we have no escape from having to 'manage the unmanageable'. Given that humans will continue to cope with systems that are partly knowable and partly unknowable, the ways in which people begin to make sense and develop dynamic responses are linked to the types of surprises and crises. The relationship between different types of uncertainty is key: how people chose to deal with uncertainty appears to either increase or decrease the resilience of an ecosystem. It is the ecological resilience that allows managers a margin of failure"

(Gunderson 2003:38)

Theories of eco-system resilience discussed in the beginning of this thesis, and attention to how people are reacting and responding to the changes and problems at Pulicat lake are a possible route through the barrier of contestation currently facing coastal managers. In the next chapter, as advocated by authors such as Berkes, Colding and Folke (2003), Campbell (2003) and Bene (2003), I investigate how people at Pulicat are reacting and adapting to the changes and problems discussed in this chapter. I argue that some people are more able to adapt and cope to change than others, and through considering this manoeuvrability from an ethnographic and cultural perspective, it is possible to gauge a more meaningful response for coastal management. Furthermore, it offers a path to Policy makers through the stagnant contestation barrier described in this chapter.

CHAPTER SEVEN

PEOPLE'S RESPONSES TO COASTAL CHANGE – A DIRECTION FOR COASTAL MANAGEMENT

Introduction

As discussed in the previous chapter, the continuous contestation over the needs and priorities for coastal management at Pulicat lake increasingly presents a barrier to effecting ideas on management solutions. It is difficult to move forward with a complex network of unclear management needs, which are prioritised and perceived differently by the various stakeholder and scientist groups. An example of how this blockade can inhibit effective policy making is illustrated by the discussion that follows, which was held between myself and a group of Chennai-based policy makers made up of government officials and senior academics.

I was asked...

"what is the main problem at Pulicat lake"... and in response I had to state three things:

First, that there was not one priority for management, but actually a quite complex network of many problems. Furthermore, those problems were not static but changed and varied in magnitude over the year and between different years.

Second, I argued there is still a lack of sufficient data on many of these problems to 'prove' the implications either way, a comment which exasperated academics who feel Pulicat has already been the subject of intensive 'natural science' based research.

Thirdly, I concluded that the problem of Pulicat lake very much depended upon whom one asked; everybody had an opinion on priorities, and whilst there was a degree of consensus over some factors, points of view were frequently varied both between and within designated 'stakeholder groups'.

These comments were regarded as unhelpful for the policy makers, who wanted a clear direction and set objectives to follow, objectives which I felt were becoming increasingly illusive.

There is increasing recognition in the field of natural resource management that inadequate science and contestation over management needs and priorities pose a problem to policy makers (Caddy & Cochrane 2001, Bene 2003, Campbell 2003, Berkes et al 2003). "Recent fisheries agreements now recognise that there is a high risk of wrong management decisions based on uncertain data" (Francis 1991 as cited in Caddy & Cochrane2001:665). Furthermore, "a key problem in achieving effective fisheries management remains in the problem of dealing with conflicting objectives" (Caddy & Cochrane2001:667). Cochrane (2000) concluded from research into several natural resource management case studies that primary reasons for the failure of management in fisheries were: "high biological and ecological uncertainty as to resource dynamics"; the "conflict between social and economic priorities"; and "poorly defined objectives and institutional weakness, particularly relating to decision-making and co-responsibility" (Cochrane 2000 as cited in Caddy & Cochrane 2001:654). These failings summate the experience of coastal management at Pulicat well, where inadequate science and conflicting priorities give unclear messages to policy makers. A way for management to move forward from this blockade of uncertainty and contestation is urgently required, since without a direction, management is stagnant.

The previous chapter concluded with suggestions that analysis of the way in which coastal people are responding to change may offer a way past the barrier of contestation facing coastal policy makers. This chapter addresses the potential of adaptive capacity as a means to better informed management by analysing how Pulicat lake fishing communities are responding to change. The chapter illustrates how adaptive capacities in fishing communities can be both fostered, and inhibited, by current traditional, cultural and community forces.

The chapter starts with a re-briefing on the ideals of resilience and adaptive capacity (further detailed in the literature review), and their applicability to coastal management at Pulicat lake. A key part of investigating people's adaptive capacity lies in understanding, in greater depth, the implications of the Padu system on fisher behaviour. The second part of the chapter describes how a closer analysis of the Padu system became central to understanding people's responses to changes in the fishery. The Padu system is described in basic technical and operative terms in Chapter 5.

This chapter provides a more in-depth interpretation by discussing, what Padu means for those communities operating within it, the status which is attached to Padu membership, and meanings for people's capacity to adapt to change. This entails a closer look at the benefits and costs of Padu for Pattinaver fishermen, during which I develop an argument that Padu, whilst limiting access for non-Padu and non-traditional Padu fishers, also has detrimental impacts on Pattinaver Padu fishers through creating over-dependency on a highly specialised prawn fishery.

The ability or inability of societies to cope with coastal change at Pulicat lake is illustrated in the third part of this chapter using evidence from two research villages: Nadoor Madha kuppam, a traditional Pattinaver caste Padu fishing village, and Dhonirevu, a non-traditional Scheduled caste Padu fishing village. McGoodwin's (1990) use of the term 'Economic and Occupational Pluralism' - the ability of a fisher to diversify from fishing - provides a good setting in which to discuss the importance of livelihood diversification for fishermen operating within the Padu system. The chapter argues that Scheduled caste fishermen can be seen to optimise 'occupational pluralism' more than Pattinaver fishermen, who despite having monopolisation over the best fishing grounds, face many barriers in coping with change. The cultural and caste-related nature of these social boundaries is discussed alongside recognition of the social status that Pattinaver fishermen receive under the Padu system; there is more to the Padu system than merely access to good fishing.

The chapter concludes by discussing the relevance of these deeper insights on the Padu system to the fostering of resilience in coastal management at Pulicat lake. Management options for Pulicat lake are a main focus for the thesis conclusion, the next chapter (8).

1. Understanding community responses to change as a way forward for coastal management

Understanding people's responses to change as a route for management is not a recent idea in natural resource management. For example Kurien and Achari (1994) state, in their study of fisher reactions to over fishing in Kerala that "Understanding the nature of their reactions and the logic behind them is crucial to any attempt to resolve the

crisis" (Kurien & Achari 1994:232). However, applications of studying community responses to changes in the coast have been largely overlooked by conventional coastal and natural resource management, still largely dominated by a natural science point of view.

As was discussed in the literature review, the social sciences are far ahead in applying understandings about how and why people respond to both social and environmental change, particularly through the discourse of poverty research and livelihood strategies of the poor. "This involvement needs to ***build on the strengths*** of the poor rather than viewing them as helpless people who need safety nets. The poor demonstrate an incredible capacity to survive and that capacity needs to be harnessed and worked with. This requires understanding the coping and adaptive strategies of the poor, their capacity to change, how they have dealt with change in the past, and what their perceptions of future change are" (Campbell 2003:25).

Berkes, Colding and Folke (2003) offer perhaps the most recent interdisciplinary theory in their work on social-ecological system resilience and adaptive capacity (see literature review), which is rooted in understanding how both ecological systems and the societies living within them respond and adapt to change. Through an integrated and interdisciplinary approach, they explore the *responses* of complete systems to crisis and change. Their argument is that a 'focus on forces of evolution from biology, ecology, society and culture' may procure a more encompassing and successful form of management (Berkes et al 2003). This focus is grounded in understanding how people evolve in their societal structures and on an individual basis to cope with change (Holling 2003).

It is a direction which can be followed by coastal managers. Examining adaptive capacities of coastal people allows management to move past the stagnant and partial attempts to explain and substantiate change, to engage with the ways in which the system and societies are already managing themselves. This alternative approach "shifts the focus of management action from the exacting and difficult question 'where do we want to be?' to the simpler and more manageable 'how do we move from here towards the desired direction?' (Berkes et al 2001:131)" (Berkes et al

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It is a direction which can be followed by coastal managers. Examining adaptive capacities of coastal people allows management to move past the stagnant and partial attempts to explain and substantiate change, to engage with the ways in which the system and societies are already managing themselves. This alternative approach "shifts the focus of management action from the exacting and difficult question 'where do we want to be?' to the simpler and more manageable 'how do we move from here towards the desired direction?' (Berkes et al 2001:131)" (Berkes et al

2003:8). Managers can become active towards an evolving goal which is centred on people, without first requiring consensus and exact objectives for the end result.

Berkes et al (2003) draw heavily on the theories of system *resilience,* the ways in which a system "absorbs change and provides the capacity to adapt to change" (Berkes et al 2003:6). According to Berkes et al (2003), "The concept of resilience is a promising tool for analyzing adaptive change towards sustainability because it provides a way for analyzing how to maintain stability in the face of change. A resilient social-ecological system, which can buffer a great deal of change or disturbance, is synonymous with ecological, economic, and social sustainability" (Berkes et al 2003:15). It follows that analysing the ways in which people at Pulicat can foster resilience, how they cope in times of need, could provide a direction for a more sustainability focused and effective form of coastal management.

However, understanding the mechanisms of adaptation and their role in fostering system resilience is often illusive (Berkes et al 2003) and needs to be coupled with an appreciation of resistance and barriers to adaptation and resilience. In the fisheries literature, it is increasingly argued that the tradition, culture and behaviour of fishing communities are key to understanding both the dynamics of and management needs within a fishery (McGoodwin 1990, Bene and Tewfik 2000 and Kurien & Paul 2001). Coupling an understanding of the forces of culture and tradition in people's adaptation to change and the building of system resilience is an important focus in this chapter.

1.2 Resilience as an emergent process – the relevance of the Padu system comes to light

The resilience concept, as described in earlier chapters, is: "an emergent property of a system, one that can not be predicted or understood simply by examining the system's parts" (Berkes et al 2003:5). Within this PhD thesis, identifying and understanding people's adaptations to change in the Pulicat lake system has been a lengthy process, which has required a qualitative approach, sensitive to people's 'insider' domains. As is detailed in the methodology chapter, insights into people's ability to cope, adapt and manoeuvre within their fishing livelihoods at Pulicat began to emerge quite late on in the fieldwork. Equally emergent was a change in focus, from participation and the collection of people's perceptions of change, which ultimately led to a barrier of

contested themes, to a focus on responses to change, as increasing evidence materialised. Addressing the ability to cope with change required a shift from data intensive survey methods, to a deeper analysis supported by focus group debate, individual interview and informal conversation.

Throughout this thesis, reference has been made to the different fishing groups operating at Pulicat lake and the divisions which are largely based on caste, traditional fishing status and the Padu system. With increasing time spent in the field, fieldwork observations of *Pattinaver* (the traditional fishing caste of the lake) and *Non-Pattinaver* (non-traditional fishing groups) started to reveal differences in the ways in which fishers were able to cope with changes in the fishery. Contrasting adaptation skills were most evident between traditional and non traditional fishing groups operating within the Padu system.

As time passed in each research village, I increasingly felt an underlying difference between traditional (Pattinaver) and non traditional fishers in the degree of satisfaction with which people spoke about their lives. I felt that this difference was displayed less in the responses people gave to questions in the survey; generally, the same fears surrounding a loss of fishing livelihood earnings were described in all villages. Rather, differences became evident in the ways in which people spoke about management needs of the lake: the degrees of anger with which many spoke of the changes to the fishery; the desperation with which people wanted change for the better; and especially, in the way that traditional and non-traditional fishers regarded each other. These observations were frequently the product of more qualitative approaches to research: focus groups, interviews and conversation rather than direct questioning through survey. It was during these conversations that the issue of the Padu system started to emerge, which up until that point had been largely hidden in previous household surveys and certainly held back from early conversations.

This movement from a data intensive to a greater depth intensive angle of research is detailed in the methodology chapter, where I refer to Erving Goffman's concepts of 'outsider', 'front stage', and 'back stage' visions of community life. As a clear outsider at Pulicat, it took a lot of time in field work to progress through these different stages. However, as Goffman pointed out, "The wall that cuts the front and

back regions off from the outside obviously has a function to play in the performance staged and presented in these regions, but the outside decorations of the building must in part be seen as an aspect of another show; and sometimes the latter contribution may be the more important one" (Goffman 1959:117-118). The fact that it took so long for me to hear conversations about the Padu system may actually tell me something of its influence and significance at Pulicat.

Whilst my observations of differences between traditional and non traditional fishers were ongoing, the operations of the Padu system were linked to people's expressions of bitterness and discussions over their particular Padu fate, whether it be inclusion or exclusion from the system. Furthermore, what separates traditional Pattinaver and non traditional fishers (either with or without Padu rights) is a distinct allegiance to Padu, a dedication felt by some fishers to ensure the system's future survival and anger at current pressures and threats facing the system. It became increasingly clear that I needed to pay closer attention to the Padu system and follow these first indications of its importance and relevance to a people-centred coastal management.

It was this contrast between ability and inability to cope which first directed the focus of research onto 'adaptive capacity' of fishing communities as a potential route for management. The research evolved to address not only what people think about priorities for management and change at Pulicat, but to also look at how people are reacting and responding to those changes, whilst gaining some insight into the social constraints and barriers to adaptation and surviving change. This approach fits well in the current literature on adaptive capacity and systems resilience and may provide a route for developing coastal management that has a greater utility to policy makers and is better suited to people's needs.

Coastal communities, through experience, trial and error, communal learning and 'social memory', are perhaps more adept at coping with coastal change and increasing societal forms of resilience than coastal managers appreciate. Furthermore, communities are potentially more likely to develop coping strategies which are suited to their own needs and in tune with cultural and traditional boundaries than top down uniformed and undiscriminating management; coastal mangers need to learn from people's adaptive responses. Institutions such as the Padu system are a useful tool to

observe adaptation (Gunderson 2003): "...institutions, traditional knowledge, common property systems, are the mechanisms by which people link to their environment. It is such linkages and connectivity across time and among people that help navigate transitions through periods of uncertainty to provide social resilience", a knowledge source which Gunderson refers to as 'Cultural capital' (Gunderson 2003:47).

2. A closer look at the Padu system – a key to understanding adaptive capacity in Pulicat fishing communities

The significance of Padu to coastal management is that it represents the key to adaptation and coping with change at Pulicat

The Padu system is an informal CPR institution and, as with many locally formed institutions, Padu has strict access conditions (explained in chapter 4). Access to fishing in many artisanal fisheries is restricted by formal state intervention, such as licensing (Pomeroy 1994, Lobe and Berkes 2004), and as Ostrom (1990) argues, a degree of legal recognition of local access boundaries and clear membership rules are often vital parts of effective collective action. Many traditional fisheries also operate without state formalisation, functioning within their own culture and tradition based access laws (McClanahan et al 1997, Pomeroy 1999 and Cooke et al 2000).

At Pulicat lake, caste status, historical background and, in some cases, political persuasion are the main determinants to access rights to fish in the best fishing grounds with stake nets. For many months at Pulicat, I felt that the traditional fishing caste, or 'Pattinaver', villages were the superior group; they had the dominance of the lake through access to the best fishing grounds and optimal fishing gears, and it was the Pattinaver who enforced non-Pattinaver villages to fish with inferior nets in poor fishing places, punishing those who did not comply. This dominance was evident in several of the non-Pattinaver research villages, such as Kulathumedu (a tribal village with no fishing rights) and Edamani, a Scheduled village striving for better Padu rights, whose inhabitants frequently speak of domination by Pattinaver fishers (*see boxes 5 and 6*).

Box 5 Villages excluded from Padu / battling for Padu inclusion

As is detailed in chapter 4 there are three groups of non traditional lake fishers: marine fishermen, scheduled caste villages and tribal caste villages. Below are some implications of Padu exclusion for the latter two types of village. Marine fishers feel Padu exclusion less; despite many villages having Padu fishing rights during the monsoon months, marine fishermen still gain most of their income from the sea.

Scheduled caste villages – non traditional 'limited' Padu fishers

Two research villages at Pulicat fall under this category, the village of Dhonirevu and Edamani, both of which represent scheduled caste fishing villages (a non traditional fishing caste) and both have limited Padu fishing rights. As described in Chapter 5, Dhonirevu's Padu access is far older, better established and relatively uncontested by Pattinaver villages (Sivasubramanian 1987). However, Edamani is in a far more recent stage of fighting for better Padu rights, which are heavily dominated by the Padu village Sathankuppam operating in the Buckingham canal (the least productive Padu fishing ground). Focus group discussions in Edamani revealed that Padu fishing activities are heavily restricted by the neighbouring Traditional Padu village *Sathankuppam*. During the NW monsoon period (October to December), Edamani is banned from Padu fishing for three months, which also happens to be the most productive time of the fishery. Village leaders argue that during these months the village suffers terribly:

"We can not go to the lake for fishing between October to December. This is the best fishing time when people earn most income, but they (Sathankuppam) don't allow us to fish then. At this time we have much rain, we can't go outside, we have no livelihood. During those 3 months there is no limit to our sufferings".

(Edamani focus group 2003)

One way of coping is to go for non Padu small scale fishing (Sirutholil) with gill nets and by hand in the shallow areas of the lake. Whilst this does not yield high income, it is considered as at least something to see them through the fishing ban period.

"During the monsoon time we are prevented from fishing with nets, so we will use our hands. Mostly the women will fish by hand, but at this time there is no profession for men so they will also go hand fishing. Hand fishing catches mostly the smaller prawns which are sold at the market. If we catch a female with eggs we can take it to the prawn hatchery. Any body can fish for prawns using their hands".

(Edamani focus group 2003)

Edamani has been involved in several village fights over Padu fishing rights in recent years and there are even complaints that government officials have been bribed with money from traditional Padu villages to stop Edamani gaining better fishing rights.

Box 6 Villages excluded from Padu / battling for Padu inclusion

Kulathumedu – a tribal village fighting for fishing nets

Kulathumedu villagers are not fighting for Padu rights, at least not yet. They are in the process of acquiring fishing gear to improve their means of making a livelihood from fishing. As long as they catch fish and prawns using non Padu gears, the Pattinaver Padu villages largely leave them alone. The village is very poor and most of the inhabitants own no fishing gear and catch prawns using hands.

However within this village there is an increasing divide between those that have nets and those who don't. People make alliances, some work for Padu fishermen through the operation of Beach seine (Badi valai) and acquire access to fishing gears also through NGO work. Kulathumedu is the only researched village where women are actively engaged in fishing, which is a good measure of their poverty, since direct fishing by women is seen as a low status activity and is looked down upon by the male dominated fishing communities. Women often join their husbands in a kattumaram if one is owned, or else they collect juvenile prawns (prawn seed) which they sell to nearby aquaculture farms.

In Edamani and Kulathumedu villages, people feel that the Pattinaver Padu fishers have a good life, and they would very much like to participate in Padu fishing but know too well their fate if they should try:

"If we tried to fish using Suthuvalai [stake nets], the Pattinaver fishermen would come and beat us and steal our nets"

Edamani focus group 2003

These villages are both struggling to maintain an existence in fishing at the lake, and are undoubted some of the poorest inhabitants of Pulicat. The passion over fishing that is often witnessed in Pattinaver fishing villages is less common here; people are merely trying to make a living, some because of the disappearance of a traditional occupation, others because there is good money to be made from prawns.

Pattinaver is the superior fishing caste at Pulicat with substantial monopoly over the lake's resources, which is seen by most as the traditional birth right of the Pattinaver fisherman. This interpretation of dominance is echoed in other writings on Pulicat (Sivasubramanian 1987 and Mathew 1991).

Sivasubramanian (1987) writes: "...the overbearing Pattinaver people permitted other community people to fish in the same area, but with some restriction. The other community people are not allowed to operate the boats and nets used by Pattinavers for prawn catching....the communities other than Pattinavers have to be satisfied with

less catch and low income. They are not experienced enough to go for fishing in the sea. Obviously the investments on crafts and nets by the Pattinaver are larger, and their earnings more than that of the rest of the fishing communities.
The upper caste dominate socially and economically over the lower caste people who are poor" (Sivasubramanian 1987:24).

There is however more to the Padu system at Pulicat than stories of domination and unequal fishing access. The following discussion re-visits the Padu system and addresses its significance for the people operating within it.

2.1 Observing the dominant Padu fishermen in a vulnerable light

Despite having economic and social superiority of the lake fishery, Padu Pattinaver fishers are also heavily dependent upon it, and when the fishery fails to produce, the Pattinaver fishers seem to feel the loss more so than in other villages. During interviews, Padu fishermen often spoke of their great suffering due to falling fish catches. The air of desperation to their situation was accompanied by a resistant pride and anger in that the difficulties they faced were somebody else's fault, and the situation was unjust. Pattinaver rights to fish the lake are sacred and should be respected by all; a sense of having to live as poor 'lower caste' fishermen infuriates Pattinaver fishers.

At the same time, many non Pattinaver villages who operate with relatively poor Padu fishing rights seem less dependent on fishing, often relying on relatives employed *outside fishing* or other trades during lean fishing seasons. Furthermore, non Pattinaver groups on several occasions criticised the Pattinaver fishing villages for their lack of 'thrift', indulgent spending, and inability to save. There seemed to be a growing picture that Pattinaver fishers were less able to cope with changes in the fishery than non Pattinaver, and this observation presented an opening to develop an 'adaptive capacity' way of thinking about coastal management at Pulicat to which the significance of Padu is heavily associated.

2.2 Padu – why people fight to keep it

2.2.1 Benefits for Padu fishermen

The main benefit of the Padu system to traditional Padu 'Pattinaver' is that their 'Padu' fishing grounds are the most productive grounds in the lake and the gears used for fishing are the most effective for maximising catch of prawn. If the lake receives plentiful rains, which yield a good prawn catch, Padu villages can earn 10 times more than other villages because they have access to the best fishing areas. This is a major reason why those that have Padu rights so vehemently defend them, and it is also why those without Padu rights fight to gain them. The Padu system also brings a form of community welfare: a village widow can receive a half value share in the catch of the Padu fishing group of her deceased husband until her son is old enough to receive Talekettu (Padu fishing membership) status and go fishing himself in his father's place.

2.2.2. The benefit of sustainable fishing – The Padu regulation of fishing effort

The Padu system was originally created by a need for equal sharing of fishing grounds to avoid conflict between fishing villages, rather than any explicit intention towards sustainable fishing (Mathew 1991). The sustainable fishing of the lake through the Padu system is however a definite consequence of the system (Mathew 1991). Whilst the Padu system has been extended to include several new villages who now fish with Stake nets for prawns, *within* Padu villages fishing effort remains *constant*, and this contributes to the overall sustainability of the fishery. Constant fishing pressure within villages occurs because neither the number of fishing days allotted to a village, nor the size of fishing spaces utilised by Padu villages can be changed once they are established due to the rotation of grounds with other villages.

A good example of this is found in Nadoor Madha Kuppam, the largest of the traditional Padu fishing villages. In the 1980s, Nadoor Madha Kuppam consisted of 2 groups of fishermen, therefore, due to the Padu rules of rotational access, each of

these groups went for fishing once every 6 days[86]. In more recent years, due to increasing village population, the fishing groups have been further divided into four fishing groups. As a result, each fisherman in the village can only go for fishing once every 12 days[87]. Changing the system to fish for more Padu grounds would interfere with the other villages also in the system and create conflict.

Another way to cope with population increase in Padu fishing villages has been to increase the number of fishermen per boat. In most Padu fishing villages there has been an increase from two to three fishermen per boat, further reducing individual income through smaller shares of the fish catch. What is important to note, however, is that whilst fishing pressure remains constant within the Padu system, outside the Padu system fishing pressure may have increased through non Padu fishing. Furthermore, the Padu system itself utilises the lake to its maximum – each Padu area is fished every day of the year.

2.3 Padu as 'Disguised unemployment' – a negative consequence for Padu fishermen

The Padu system at Pulicat lake has enjoyed legitimacy amongst lagoon fishermen for many decades, and has at the same time, restrained fishing pressure on the lake's prawn fishery. However, the Padu system grows increasingly unstable as the population of 'legitimate' Pattinaver fishermen continues to rise. As described above, the Padu system is upheld despite growing village populations and increasing numbers of fishermen; instead of increasing fishing plots, under the Padu system, fishermen decrease the amount of fishing per fisherman.

[86] Nadoor Madha Kuppam shares its Padu grounds with 2 other villages. Each village in this rotation goes for fishing once in three days. Because there are two fishing groups in Nadoor Madha Kuppam (due to large population size) each village group goes for fishing once every 6 days. Each village within the rotation will only fish on their specific allocated 'Padu' day.

[87] Once a year in each Padu fishing village, the Talekettu (Padu membership) list is renewed. This involves deleting deceased fishermen and adding newly 'qualified' fishermen to the distribution system of Padu fishing grounds. The Talekettu membership list maintains the same utilisation of the same Padu grounds each year.

It is a classic fishing conundrum where an annual yield of fish remains the same, but catch per unit effort is reduced when more fishers enter the system (Hardin 1968). The Padu system at Pulicat lake is a Common Property Resource institution which has avoided over fishing through the 'tragedy of the commons' (Hardin 1968). Fishing returns per unit effort are reduced systematically by the institution of Padu to the benefit of the lake fish resource but to the detriment of the individual fisher. This problem has been termed by Sivasubramanian (1987) as *'disguised unemployment'* and it throws into doubt the long term sustainability of the Padu system in its current form.

Sivasubramanian (1987) states:

"The Pattinaver community being traditional fishermen, by virtue of their early settlement in Pulicat area and by virtue of possessing key strategic fishing areas in the lake, and because of their larger population, claim supremacy over other communities in the matter of fishing in Pulicat lake. Unlike their marine counter-folk on the marine side, the area of operation for fishing is limited. Accommodating new entrants into the small field is a problem. So they have formed into unions of village to regulate the fishing operation. Hence the Padu system of fishing was evolved. Within villages, as the number of eligible fishermen in the villages increase, they have to share the fishing area allocated to them. With the result more men operate in a smaller area and the under employment (or *disguised unemployment*) is aggravating"

(Sivasubramanian 1987:23)

Mathew (1991) also recognises this flaw in the Padu system stating: "The increase in demographic pressure without commensurate increase in the frequency of access to the fishing grounds has further led to an enhanced pressure on the already fragile resource-base" (Mathew 1991:17).

This increasing *disguised unemployment* is a key driver of the increased suffering and lack of fishing income in traditional Padu fishing villages, as highlighted by the below discussions:

"How can we manage? Where can we go? If we go outside we can not have a peaceful life. We decided to stay in our village. Earlier we had 3 meals a day, but nowadays for a single meal it is very hard. We go to join our children in the school but we can not pay the school fees. We can't educate our children. We want to, but because of our low income, we can not. We can not even afford the school uniform[88]. We are going for Badi valai fishing as labourers[89], labourers can you believe! Because at least we can earn 100Rs. With that we have to manage for 3 days".

"We can dress well but don't be fooled – we earn less. People fishing in the sea are earning more than us. The three (traditional Padu) villages are very backward in income but we are in front in facilities and lifestyle. Because of the growing fishing population, we can not stay here".

Comments from Kottaikuppam fishermen

This notion of earning less but still being 'forward in their lifestyle and facilities' hints on the status and prestige with which traditional Padu villages have been regarded at Pulicat lake. During one informal visit, a friend was surprised to see their impoverishment, since the Padu villagers are usual the envy of the lake.

He observed:

"Still they look and dress well, but when we go into their houses we can see the difference. For example, some have not been painted for a good 15 years. Normally it is the custom in the annual Pongal[90] festival that all will paint their houses. In some houses only the cement remains – they must not have been repainted for 10-12 years! It is a sign of their increasing impoverishment".

[88] School fees for a government run school are around 200Rs per year
[89] There is at least one Badi valai (beach seine) trip once every 3 days since only 1 person can use a badi valai on a particular Padu fishing day. Traditionally beach seining employed non Pattinaver caste people from other villagers as labourers. However in hard times and lean fishing periods, Badi valai owners will give the jobs to their own village men, who earn 100Rs for the day long operating work.
[90] Pongal is a four day harvest festival in India, celebrated each year on the 13-16th January

2.4 Some consequences of Padu system impoverishment

Many Padu fisherfolk blame the contested network of problems discussed in chapter 6: 'lack of rain'; 'pollution'; and 'coastal development' for their demise in fishing. The 'disguised unemployment' through Padu is either not recognised or not revealed to the researcher for reasons of sensitivity over its debate. People are reluctant to discuss 'insider issues', such as Padu, and may equally overlook themselves the relevance of Padu as a form of 'disguised unemployment' in their lives.

The discouragement of discussing the Padu system with outsiders, combined with an inherent ignorance from the state on local forms of traditional governance, means that the Padu system is also overlooked by researchers and policy makers external to Pulicat communities. At best it is acknowledged as a system which exists at the lake, the consequences of that existence are rarely debated in academic or government circles.

The State Government authorities do not formally recognize the control of access rights to the waters through local institutions and the Padu system is perceived as:

"an exploitative arrangement by a limited number of fishermen for their own benefit... The government does not legitimize territorial use rights in fisheries and is of the view that conflicts can be resolved only with the strengthening of the government machinery in Pulicat" (Rajagopalan & Lakshmi 2003:45).

Within local academic circles, a large neglect of social science based studies at Pulicat has meant that the importance of the Padu system to Pulicat lake society has been suppressed, and at best, it is a misunderstood phenomenon that operates without much scientific reason. I recall one visit to Pulicat by a local academic who convened a meeting with traditional Padu fishing villages. The professor enquired "why the fishermen 'bothered' to hold on to the Padu system", which by his understanding was detrimental to their own fishing earnings. The shock and anger of the fishermen over such a question was evident as my neighbour leant over and whispered to me:

"What! He might as well ask us why we bother to eat"

Indeed it did seem ridiculous that after the Padu fishermen spend day and night defending their Padu status, preventing others from fishing the lake 'illegally', and killing each other in warfare over the defence of their historical right to fish the Padu, that here stood an intelligent man from Chennai asking why they "bothered".

Whilst many Pattinaver fishers who are suffering under the Padu system's 'disguised unemployment' may blame other forms of change at Pulicat for their diminishing fishing livelihood, the changes within the Padu system are also impacting Pulicat fishing society. Chapter 4 detailed the existing divisions between traditional 'Pattinaver' fishers and non traditional 'non Pattinaver' fishers at Pulicat. With increasing levels of 'disguised unemployment', these divisions seem to be deepening.

Firstly, many Pattinaver fishers display a growing anger over the survival of non traditional fishers at Pulicat which until recently had been largely tolerated by Pattinaver fishermen. We can recall in the previous chapter, the tinge of jealously, as Pattinaver fishermen described how migrant fishers at Pulicat were able to buy jewels with a daily wage. Secondly, there is a growing frustration of Pattinaver Padu fishers over an inability to improve their situation, an inability to cope or adapt.

These frustrations are depicted by the following conversations:

"We traditional (padu) fishing villages are all fishing in the same area. We make turns with each other so there will not be any problem between villages. We will only fish on our allotted fishing day. It is an agreement followed by us. When people from outside come into the lake, they don't follow these restrictions. They fish daily and we can not control them because they are not in our villages. They fish daily. We only fish once in 6 days".

"People have always come to the edges of the lake to do small fishing (Sirutholil)...they can fish everyday.... They do not suffer as we. Their incomes have dropped less"

Comments from fishermen in Nadoor Madha kuppam

Interview with Kottaikuppam Pattinaver fishermen:

Qu: "Do you go for small fishing (*Sirutholil*) on non Padu days?"

Reply: "No, we can not go. That day is for other villages for their fishing turn, so we can not go for fishing"

Qu: "What will you do on non fishing days?"

Reply: "We will stay in our houses, or maybe hang around Pulicat town...sometimes people create problems if they are drinking (alcohol), which happens a lot..."

Reply: "If one man goes fishing on non Padu days – then all in the village will follow him, so we don't, because this would break the Padu system. This is why we are always fighting with other villagers. We are trying to uphold the Padu system but in doing so we are suffering more than other villages. During the lean season our income decreases, but if catches are good our incomes are 10 times more than the other people because we have good fishing areas"

Comments from Kottaikuppam interview

These comments suggest that the traditional disinterest that is showed by Pattinaver fishers over the poorer non padu fishing (Sirutholil) is slowly changing. As Pattinaver incomes decrease they become frustrated by people earning smaller, but more regular wages. Pattinaver fishermen can increasingly be seen in a vulnerable light compared to lower status types of fishing.

This produces two key questions:

1. What are non traditional (non-Pattinaver) fishers doing to make sure they do not suffer as Pattinaver fishers – how have their incomes dropped less, as is reported by Padu fishermen?
2. What is stopping the Pattinaver fishermen from following non-traditional fishermen and adapting in the same way?

3. Adapting and coping with Padu – Evidence from two case study villages

Within fisheries science, a focus on reactions of fishers to a changing fish resource were core to McGoodwin's (1990:116-118) arguments on the importance of 'Economic and occupational pluralism' – the ability of a fisher to diversify from fishing - as a vital means of coping in inherently unpredictable fisheries. As is discussed in this section, the ability to adapt and cope with changes in the Pulicat fishery is firmly rooted to the ability to diversify and acquire 'occupational pluralism'.

This section details a case study example of two villages, both with Padu fishing rights but both with very different backgrounds. As detailed in Chapter 5, Nadoor Madha Kuppam is a traditional Pattinaver fishing village and Dhonirevu is a Scheduled caste village, also operating limited Padu fishing rights in less productive Padu grounds. The two villages offer a good comparative study where both live under the restrictions of Padu; due to forced adaptation to rising village population, both villages go for fishing only once in 12 days (albeit in different fishing grounds). Each village has a different background, history and Caste – which to a large extent depicts occupation and traditional livelihood[91].

The following evidence suggests that fishermen in each village are coping differently with change. Poor households may often adopt 'survival strategies' (McGregor 2000). Both *Traditional Pattinaver* and *Non traditional (non-Pattinaver) Padu* fishing villages are increasingly poor due to falling fishing income under the Padu restrictions of access, and yet there seem to be differences in the strategies adopted by each village. Despite both village types being under the *same restrictions* of Padu, the latter is seemingly more able to cope than the former.

[91] Caste is intrinsically linked to occupation. For a good example of the importance of caste in setting social boundaries within fishing livelihoods see Ehsan (1994) and Campbell (2003).

Village 1 **Traditional Padu village - Nadoor Madha kuppam** is a large predominantly Christian village of *Pattinaver* caste and is the largest *'traditional'* Padu fishing village in the southern region of the lake. As a traditional Padu village, it has access to the best Padu fishing grounds of the lake.

Village 2 **New Padu fishing village - Dhonirevu** is a 100% *Scheduled caste* village which won limited Padu fishing rights in the 1920's after negotiations with local political leaders, and is classed as a *Non Traditional Padu village.* As such, it has fishing access in the less productive areas of the lake.

The following evidence highlights two important differences between the villages which, as is discussed, have a direct impact on a fishermen's ability to adapt to a declining fishing income

Evidence 1 As illustrated by Table 7, each village shows different patterns of fishing gear ownership. Different approaches to fishing the lake result in different dependencies on Padu prawn fishing.

Evidence 2 As illustrated by Table 8, each village has a high dependency on fishing for an income, but a higher percentage of Dhonirevu fishermen have alternative trades which are not related to fishing.

Table 7: Fishing assets in the case study villages

Village	Household survey 2003 % of households owning share in net[92]				
	Padu nets		Non Padu nets		
	Stake Nets *Suthu Valai / Adaipu valai*	Beach seine *Badi valai*	Cast net	Gill net	No. of Traps (SFD census 2000)
Nadoor Madha kuppam	**96**	10	**0**	**0**	**30**
Dhonirevu	**98**	0	**29**	**7**	**1880**

Source: Household village survey (2003) and SFD Tamil Nadu State Fisheries Department Census (2000)

Table 8: Household dependency on fishing as a source of income

Village	No. of Padu fishing days per year	% of household heads with an additional trade to fishing	% of households with fishing as only source of income
Nadoor Madha kuppam	32	0%	84%[93]
Dhonirevu	32	33%	83%

Source: Household village survey (2003)

3.1 Evidence 1 Different approaches to fishing in each village

Although fishing gears of research villages are detailed in chapter 5, with an improved understanding of the relevance of Padu and non-padu types of fishing, new meaning can be assigned to gear ownership patters of each village. A major difference of fishing gears owned by the traditional Padu fishing village and the non-Pattinaver Padu fishing village becomes obvious if we look at nets in terms of *Padu fishing nets*

[92] The State Fisheries Department 2000 Census does not detail differences in lake fishing nets, categorising them only as 'other'. Therefore, the only information available on lake net ownership was that collected during the PhD fieldwork research in the Household survey 2003.

[93] Those households with 'other' income sources (where stated), included income earned from sons involved in fish trade (in Nadoor Madha kuppam) or working as labourers (in Dhonirevu) (see Appendix 5.7 for further details of dependency calculations).

and *non Padu fishing nets* - those small scale fishing nets which escape Padu regulation due to their low yields (see table 7).

Both villages have access to Padu grounds and so ownership of Padu stake nets is high. However, almost 30% of Dhonirevu inhabitants own non Padu fishing gears. This is because Dhonirevu fishermen fish using *Sirutholil,* small scale fishing using non Padu fishing gears (cast nets, gill nets and crab traps) on non Padu fishing days. This diversity of fishing gear and utilisation of fishing opportunities on Non Padu fishing days (11 out of 12 days) is essential for providing additional albeit small income between Padu fishing trips.

Dhonirevu fishermen state:

"How we will manage with fishing once in 12 days. We also use our cast nets and we can get less but at least some prawns for some small income"

The village of Dhonirevu clearly shows signs of diversification in their fishing behaviour by fishing on non-Padu fishing days with non-Padu fishing gears, behaviour largely utilised by non-Pattinaver fishing groups. Fishing with Sirutholil was also evident in Edamani village (detailed earlier), however since this village is still struggling with very limited Padu rights, it is a less good comparison with Pattinaver fishing behaviour.

The village of Nadoor Madha kuppam in comparison to Dhonirevu shows little evidence of fishing diversification. There is no evidence of ownership of small nets - only 30 traps, which are likely to be used by the minority Scheduled caste population in the village. Dhonirevu is a village which has adapted to benefit both from Padu fishing once in 12 days and supplementation of their income through small scale *Sirutholil* on non fishing days. *Sirutholil* is a coping mechanism employed by Dhonirevu fishermen, who find it difficult to cope with incomes from only 32 fishing days per year. "Diversity is the hallmark of artisanal fishing craft and gear technologies" (Kurien 2000:5.1) and yet, it seems that the traditional Padu villages of

Pulicat have lost their ability to diversify, in comparison to the Scheduled caste fishermen of Dhonirevu, who may catch less prawns but who fish more regularly[94]

An important question emerges at this point: why in lean fishing periods do the traditional Padu villages also not go for small scale fishing using cast nets?

There seems to be a consensus from Traditional Padu fishermen that, firstly, it is beneath their status to fish with such small nets so commonly used by non Pattinaver caste fisherfolk; and secondly, whilst some fishermen would like to go for small scale fishing during 'low income' years as are presently being suffered, they are unable to because they must uphold the Padu system, a part of *'Padu restriction'*.

As one fisherman put it:

"If one goes we would all go"

Spoken in reference to non Padu 'sirutholil' fishing, Nadoor Madha kuppam 2003

Nadoor Madha kuppam is the largest traditional Padu village in the Southern part of the lake. If all fishermen start to fish on non Padu days, even only using small fishing gears, they risk jeopardising the entire system and this fear that "the lake would become a free for all", is rife amongst most traditional Padu fishermen. Dhonirevu fishermen are also bound to these Padu rules, although their commitment to maintaining the Padu system is considerably less passionate in comparison to Pattinaver fishers, largely because Dhonirevu does not have to protect the better fishing grounds. In addition to this, whilst there is an increasing number of people in Nadoor Madha kuppam who might consider using small scale fishing were it not for the Padu system, there is another group within the village, mainly the village leadership and elite who literally would not be seen dead fishing with a cast net, a net traditionally used by poorer people of non fishing caste status.

[94] The described situation set up a trade off between a lower but more stable income from fishing with non Padu techniques versus a substantially higher but more fluctuating and increasingly irregular income earned by traditional Padu fishing villages. In the social sciences, there is extensive current literature and theory on income distribution, income risk and coping strategies of the poor: Analysis of 'Risk' and 'Uncertainty' in rural livelihoods (Devereux 2001) and relative loss; the relatively of incomes earned playing a major factor in people's wellbeing (Graham and Pettinato 2002).

My suggestion of the benefits of *Sirutholil* fishing during one focus group in Kottaikuppam village received angry replies from fishermen, who felt it is their right to have a productive lake and a sustainable Padu system; rights which should not be compromised by adapting mechanisms used by lower status fishermen, who should not even be fishing.

Kottaikuppam meeting Feb 2003

3.2 Evidence 2 Dependency on fishing

Evidence presented in table 2 shows that both villages have a high dependency on fishing for an income. If we look at diversity in livelihoods *external to fishing,* or 'occupational pluralism', the scheduled caste population of Dhonirevu again show an ability to diversify: a higher percentage of Dhonirevu fishermen have alternative trades which are not related to fishing. The below discussion illustrates how Dhonirevu fishermen are able to adapt and seek external income support during lean fishing periods from non fishing sources. Of all Nadoor Madha kuppam household heads who were interviewed, none had experienced any occupation other than fishing. Pattinaver caste villagers are by tradition fishermen and their experience or knowledge of other occupations or trades is extremely limited.

3.2.1 Occupational pluralism as a form of adaptation

McGoodwin (1990) states that,

"Economic pluralism marks fishing communities all over the world. ....Retaining the diverse sources of livelihood that are the substance of a pluralistic economic system makes good sense in fishing communities, in view of the sporadic nature of production and other risks associated with most types of fishing activity. Surely one of the main reasons the human species has been so successful has been its ability to exploit a variety of ecological niches, avoiding specialisation. Indeed, Paul Jorion (1988:152-53) goes so far as to argue that it is a universal "sociological law" that,

"no one ever becomes a full-time maritime fisherman other than under duress"...

...It is not the continuous dangerous nature of the occupation which makes full-time fishing so unattractive, it is too risky in economic terms" (McGoodwin 1990:118).

Diversifying incomes within the fishery reduces the dependency upon a single means of earning an income. Should the main livelihood change, there are others upon which to depend; a form of community and societal resilience to disturbances or shocks.

The case study of Dhonirevu village provides a good example of 'Occupational pluralism', which has formed as an adaptive response to change in several scheduled caste villages, but has been restricted in its use by others. As this following section debates, these barriers to accessing occupational pluralism as a means of coping with change are both cultural and traditional in nature.

An example of livelihood diversification came from the following focus group held in Dhonirevu village 2003:

"When we were earning good income from the lake (during more productive times) my family bought some agricultural land in the nearby village. We automatically get rice grains from this, and we use this for cooking or sell any surplus. The people who don't have lands in their family go hungry"

Dhonirevu fishermen focus group 2003

"These days everyone does a little of everything. In the past we would only do one thing for earning a living...now everybody and anybody '*Owerutthan*' is doing some other work ....Where income comes, we must follow it there. We have to change our professions because we don't get enough fishing here these days".

Village elder focus group Dhonirevu village 2003

An explanation into this ability to diversify stems from the background of Scheduled caste fishermen. Scheduled caste populations work by trade in a variety of livelihoods, and as a result, they have a range of skills applicable to adaptability.

Pattinaver fishermen, on the other hand, are skilled in fishing and may struggle to take on other work.

3.2.2 Historical evidence & social memory– external access to resources

In addition to occupational pluralism displayed by Dhonirevu fishermen, Focus group interviews with village elders from Dhonirevu revealed that historically, the village has depended upon a wider network of non-fishing occupational support. Village elders described that during lean fishing periods at the lake, fishermen from Dhonirevu often fled the village to move inland, stay with relatives and depend upon support from relatives involved in non-fishing activities, such as agriculture or Chennai based labour. In the present day, non-fishing income and family connections outside the village were cited as a key source of funds or loans during lean fishing seasons:

Qu: How do people manage for income in lean fishing seasons?
Reply: Some people are married with persons from outside 'agricultural' villages. If anybody's wife's house is richer or better off, they will help. When the fishing family gets income they may repay the debt but sometimes the family doesn't ask for the repayment - it is in the family".

Focus group meeting Village elders, Dhonirevu 2003

Due to the caste tradition, most of the Pattinaver caste fisherfolk marry within their own fishing caste and it seems rare for a fishing family to have relatives not involved in fishing. In Tamil Nadu fishing communities "The unity of caste has led to extensive marriage networks along the coast" (Bavinck 2001b:1). In Dhonirevu, scheduled caste is by tradition a non-fishing culture, and so in theory, marriage into a family of non-fishing background (or dependency) may be more likely.

In development studies, social networks within societies are categorised as 'social capital' defined by Putnam (1993) as: "the features of social organisations, such as networks, norms and trust that facilitate actions and cooperation for mutual benefits" (Putnam 1993:35). *Social capital* is increasingly considered as a central concept in development strategies and intervention (Fukuyama 2001, Bowles & Gintis 2002)

where it is understood as a "by-product of religion, tradition, shared historical experience and other types of cultural norms...and often critical for understanding development" (Fukuyama 2001:Abs). In Pulicat villages, family connections to land based occupations displayed in Dhonirevu village certainly seem to form a route to reduced vulnerability to changes in the fishery resource.

This evidence of differing degrees of 'ability to diversify' as displayed by the two fishing villages suggests that deeper influences than the restriction of the Padu system alone are contributing to the lack of adaptive capacity. Living under a stricter sense of Padu system ruling 'entraps' many Pattinaver fishermen in traditional Padu villages, which is fuelled by an inherent fear of Padu breakdown, and the loss of the most productive fishing grounds of the lake. Lack of diversification in both fishing behaviour and occupation is also related to issues of caste, for example, the illustration that using small scale 'Sirutholil' fishing gear is often considered beneath the status of a Pattinaver fisherman.

In summary:

Within the Padu system at Pulicat, non-traditional Padu fishers (illustrated by the Scheduled caste fishermen) adapt to lean fishing periods through diversifying into small 'sirutholil' fishing gears which are not restricted by Padu law. Scheduled caste fishers rely on external family support 'social capital' from non-fishing dependent relatives and are able to utilise occupational pluralism through a history of non-fishing skills and trade.

Therefore, scheduled caste fishermen seem to be in a stronger position than Pattinaver fishers who, despite having the monopoly over the prawn fishery at Pulicat, show little ability to diversify, either within fisheries or external to fisheries. In other words, Pattinaver are less able to adapt to change and are therefore less resilient to changes in the fishery resource.

4. What stops Pattinaver fishers from following suit? - Barriers to adaptation are fostered in mechanisms of the Padu system and the status which Padu membership (Talekettu) brings to Pattinaver fishers.

The acquisition of many of these coping mechanisms as shown by scheduled caste fishers is a result of a long history of non-fishing livelihoods. As discussed, many of the scheduled caste fishers are relatively new fishers, with a background in other trades, which they can depend upon in lean fishing times. Another aspect is that, because Scheduled caste villages (including Edamani) in general have access to poorer Padu fishing grounds in comparison to the Pattinaver fishermen, adapting to diversify fishing technique and income sources have become a necessity for survival. The importance of 'social memory' in facilitating resilience to change is perhaps best illustrated by these mechanisms. However, the traditional fishing caste of Pattinaver does not have access to the same historical adaptation routes.

At this stage, it may be a simple option to build coastal management upon the Scheduled caste resilience strategies and advise Pattinaver fishers to diversify their fishing techniques and seek non-fishing trades as a subsidiary to fishing incomes, a form of income security in an unpredictable lagoon fishery. However, what has emerged from the discussions with Pattinaver fishers is their unwillingness to use small scale fishing gears, such as the lower status '*sirutholil*' nets. This leads to recognition of the role of cultural and social values in the ability to adapt to change. There are good reasons why Pattinaver fishers have not followed suit and diversified to change their fishing ways, and these barriers to adaptation are the focus of the following discussion.

4.1 Padu livelihood lock in – a membership for life

The Padu system is inherently flawed as the population of eligible Padu Pattinaver fishers increases, and yet, loyalty to Padu has been shown to restrict occupational pluralism as a means of surviving change. To understand the deeper implications of belonging to the Padu institution, we have to revisit the village membership system of Talekettu (discussed in Chapter 4). Talekettu status, which in English translates as 'privileged' (Mathew 1991), is required in order to gain access to Padu fishing rights.

The influence of Talekettu status on obtaining occupational pluralism is two fold: firstly, by the restrictions imposed through fishing under the Padu system, and secondly, through the high social status that accompanies being a Talekettu member; each of these influences is discussed in turn.

Once Talekettu status is bestowed on a village member, he obtains full Padu fishing rights; his name is added to the village Padu list and he joins the rotational system of fishing in the most productive parts of the lake with the lucrative stake net. However, in joining the Padu system, a fisher reduces his ability to earn a living from other means; as it stands today, the Padu system assumes complete dependency on the lake's prawn fishery. "Padu rights are inalienable, cannot be leased out or sold. If a particular group is unable to fish on its allotted day, the Talekettu of its village have the right to operate in that fishing group on that particular day" (Mathew 1991:8)...in other words, if you do not use your Padu turn it is lost to another group. If a Padu turn is missed regularly, the fishing unit in question can lose their rights permanently; left or underutilised Padu grounds are reabsorbed and re-shared into the active Padu system. This means that it is not possible for a fisherman to leave the area to find other work, either on a seasonal or part time basis, since a fisherman must be back in the village to fish on his Padu day, or else forfeit his right with a risk to losing it completely (Rajaseker personal communication 2003).

Bavinck (2001b) describes a similar notion of village membership in Tamil marine fishing villages called 'varikkaarar', which, like 'Talekettu', is a formal and achieved village membership, strongly linked to the fishing profession and 'territorial rights' (to be distinguished from a simple residency in a village community). The system of Varikkaarars clearly exhibits the same restrictions to adapt to change as Talekettu and the Padu system, through limiting manoeuvrability within the fishing livelihood. As in Padu fishing villages at Pulicat, the marine fishing villages along the Coromandel coast lose their varikkaarar status on leaving the village.

Bavinck (2001b) describes the system:

"Although a formal nomination remains obligatory, fishermen who grow up and live in the village gain membership almost automatically. It can be retracted however, if they leave the village for a long time. Outside fishermen who settle in the

village, many of whom come to join their wives, can and often do have their membership rights signed over from their old place of residence. The Panchayat poses conditions on such a transfer however. These follow partly from the general conditions of membership. Basically, the person seeking membership must be a male engaged in the fishing profession and living in the village for some years already, with the intention of staying. On the formal side, an outside applicant must provide a letter from his original Panchayat that attests to his desire to transfer membership. In addition, he must be willing to pay the Panchayat an admission fee. This fee is substantial, and the fishermen I overhear frequently used the English words 'fine' or even 'punishment' to describe it ... (the fee can be up to 5000Rs)...The sum to be paid relates to the rights which derive form membership and to the fact that other members have been paying for some of the privileges the new member will enjoy in the future"

(Bavinck 2001b:4)

Bavinck's reference to paying a 'fine' illustrates the extent to which remaining within one village is weighted by the fishing society. Once a fisherman has left the village, it is difficult to return; the admission fee of 5000Rs is an indication that socially, it is unacceptable to leave the system. Therefore there must be a large social pressure on a fishermen and his family to remain fishing in their village of birth.

At Pulicat these customs of Talekettu status explain a well known Tamil phrase spoken regularly by Pattinaver fishermen:

"A man will leave his wife, but he will never leave his Padu"

This problem is particularly harsh for those fishermen in Nadoor Madha kuppam who are only able to fish once in 12 days due to the Padu system and their village population size. Furthermore, since fishermen can not realistically look outside of their village for work, there is a great deal of boredom on non fishing days. During a non fishing day, fishermen usually can be found mending their nets, or playing cards under the tree. Very few have alternative occupations to fill the time which has lead to several other social problems such as alcohol abuse.

4.2 The status of Talekettu membership

Overall, Talekettu invokes great immobility in the villages and a heavy livelihood dependency upon the Padu fishing system. It is not only the laws surrounding the use of Padu rights that 'trap' fishermen within the system, issues of caste, status and social expectations of Talekettu prestige also contribute to a reduced ability to diversity livelihoods.

The institution of Talekettu at Pulicat not only provides access to Padu fishing rights, it entails far more status and social power within the community, which are embedded in larger cross-village institutions, as well as a the individual level. The 'Association of Traditional Lake Fishermen of Pulicat' (*Pazhavercaud Yeri Meenavar Nattu Padagu Aikya Sangam)* is a consortium involving 24 lake-side villages, which was formed after the 1978 conflicts in response to pressures from 'Outsider' fishing (Mathew 1991), an association which encompasses 'all Talekettu who honour the Padu system' (Mathew 1991).

Similarly, Bavinck (2001b) describes the high social status which is assumed under varikkaarar membership:

"The varikkaarar is the everyday custodian of village well-being, its foot soldier. Along with the title come economic as well as religious and political tasks. As a village member he is responsible for performing ritual duties for the tutelary deity. Village members may also become warriors who defend the village and its honour against adversaries from other villages. Furthermore, because of their pivotal role in everyday life, varikkaarars have a pre-eminent political position" (Bavinck 2001b:3).

4.3 Upward social mobility for lower castes – why fight for Padu status.

So far we have discussed why Pattinavers are unwilling and unable to leave the Padu system of fishing; factors of social status, prestige as well as access to the best fishing grounds all play important roles. On the other hand, it is interesting to ask why those without Padu status battle so hard to obtain it. The gains from better fishing access are obvious, but as has been shown, there is more to Padu than money and fishing

opportunity. Edamani village for example is fiercely fighting for better Padu rights in the Buckingham canal, a very unproductive fishing area and I often pondered as to why they bothered fighting so hard for rights to fish in such a poor fishing place. What I was missing is that Padu rights do not just come with fishing access, they also accompany a rise in social status. Pattinaver is a high fishing caste and the dominant fishing caste in Tamil Nadu. Gaining Padu rights or 'Padu status' may mean a degree of upward social transition.

"Caste is experienced not so much as something which you 'do', as something which is 'done to you' by other (high caste) people"

(Searle-Chetterjee & Sharma 1995:11 as cited in Jaya 2003:4)

At Pulicat, the higher Pattinaver Fishing caste dominates and legislates fishing access amongst themselves, and, to a large extent, for non-traditional (sometimes but not exclusively) lower caste fishing groups.

In India, "strength of caste as a way of social acceptance and political identification continues"...and "one manifestation is the intertwining of the caste system with the political and economic life of Indian society"

(Jaya 2003:4)

We have already witnessed both the presence and the strength of political power in Pulicat over the pollution debate in the previous chapter, where the power of fishers to protest is strongly linked with access to local political movements and environmental activist groups. The caste system in India is in a process of transition, a process which can be broadly viewed along two dimensions: one, a detachment from a religious-status hierarchy ('de-ritualisation'), and, the other, an evolution of 'politicisation' (Sheth 2000).

"These changes have (a) pushed caste out of the traditional stratification system; (b) linked it to the new structure of representational power; and (c) made it possible, in their cumulative impact, for individual members of a caste to claim and achieve new economic interest and a class-like identity"[95]

(Sheth 2000:243)

Sheth (2000) argues that the caste system has lost much of its support by a de-ritualisation of caste, "the de-linking of caste from various forms of rituality which bounded it to a fixed status, an occupation, and specific rules of commensality and endogamy" (Sheth 2000:244). This has made way for processes by which people can not only make political allegiances through caste, but can become upwardly mobile within the caste system.

"The concept of *Sanskritisation* delineates a mode by which a lower caste moves up in the hierarchy by adopting some of the practices of their upper castes" (Jaya 2003:3). By winning Padu fishing rights, lower caste non-traditional fishers gain a form of recognition within a higher caste fishing group. Economic gains by fishing with stake nets for the high value prawn, alongside the prestige which is associated with Padu fishers, could be viewed as a form of Sanskritisation. It is most likely no coincidence that those non-traditional villages which are fishing and have won Padu rights are scheduled caste villages (Dhonirevu and Edamani); the political movements to raise the dalit status through positive discrimination is at the front of caste mobility trends (Jaya 2003). Padu may not only be a route to higher caste and social status at Pulicat, but it is also a likely route to politics and power in the region. As one Padu village leader once said during a quieter moment:

"Money is power, and without power, here you are nobody"

Pattinaver fishermen control the Padu system and whoever controls Padu has status and control in the lake; whoever controls the lake has power.

[95] Discourse on post-colonial caste is focussed on a debate of 'traditional vs. modernity' and 'caste vs. class' (Sheth 2000). Sheth argues that the caste system now survives as a kinship-based cultural community, and operates in a different, newly emergent system of social stratification" (Sheth 2000:244).

This 'power', which is embedded in Padu fishing rights, is perhaps amassed in Padu village leaders; Padu Panchayats are perhaps the pinnacle of power over the lake[96]

People make alliances with Pattinaver fishermen and in Pulicat political and economic alliances are vital. When one elite group has control over almost every part of village life, there is little one can argue against such a powerful force. It is perhaps more tempting to push for the opportunity to become part of that elite force. As Paz (1997) writes, "Besides their religious aspects, castes are groups ruled by councils that serve a political function in self-government. Alongside this political autonomy in internal matters, one must add an economic function. Castes are mutual aid societies. They are not only cooperatives, such as ours, but also solidarity groups, genuine fraternities. Each individual is nearly always guaranteed help from other caste members" (Paz 1997:58-59). Gaining Padu fishing rights assumes lower status fishermen into the care of an elite group, where they become part of the 'traditional' fishers of the lake, and can oppose the increasingly threatened 'non traditional' fishing sectors.

5. Conclusion - Meanings for adaptation and fostering of resilience in coastal management

The Padu system may lock people out of the most lucrative parts of the lake's fishery, but it also keeps those operating within it firmly locked in. All Padu fishermen uphold the Padu system, but in doing so, their income is vastly reduced during lean seasons, potentially more than other villages (fishing villages who are not involved in Padu fishing, and those which are, but who go for small scale sirutholil fishing outside the Padu system). We might ask ourselves why Padu fishermen remain true to the Padu system when it so severely restricts their flexibility to earn an income. Padu is not adhered to through a heroic act of conservationism on behalf of the lagoon, but because of tradition, fear, culture, caste, social status, lack of options, inability to adapt and over dependency on Padu prawn fishing, exacerbated by a state driven investment in the prawn fishery[97].

[96] Chapter 4 details the running of village (non state) Panchayat (village councils) separately from state management gram Panchayat. Within the village Panchayat, leadership is maintained by an elite group, usually through kinship.

[97] As is discussed in chapter 4, there is evidence of gear overspecialisation towards the prawn (i.e. heavily dependency upon stake nets) since the State's 1970s rapid development of prawn fishing.

One must not forget that when fishing times are good Padu fishermen become very wealthy – a good reason to keep within the Padu system. Another key reason as to why the Padu system upholds through the poorer fishing times is a fear that once broken, the lack of Padu would allow the lake fishery to become an open access resource for all. This would worsen the already serious village feuding in the area and the rotational system of sharing would be destroyed, upsetting the balance of fishing days and fishing areas utilised by neighbouring villages, as well as posing a likely risk of rapid over fishing.

Berkes et al (2003) argue that the adaptive capacity of all levels of society is constrained by the resilience of their institutions and the natural systems on which they depend. The greater their resilience, the greater is their ability to absorb shocks and perturbations and adapt to change. Conversely, the less resilient the system, the greater is the vulnerability of institutions and societies to cope and adapt to change (Adger 2000, Berkes et al 2003:14). The restrictions of Padu and the associated caste, cultural and status implications seem to restrict the capacity for fishing society resilience at Pulicat. As is discussed in the preliminarily chapters of this thesis, a desired form of management through a resilience approach is one which 'manages for sustainability'. "In operationalizing this view of resilience, managing for sustainability in socio-economic systems means not pushing the system to its limits but maintaining diversity and variability, leaving some slack and flexibility...It also mean us learning how to maintain and enhance adaptability, and understanding when and where it is possible to intervene in management" (Berkes et al 2003:15).

The Padu system in this sense seems to work against management ideals of building capacity for resilience, being restrictive of occupational pluralism and cemented in issues of caste and status, which are, by tradition, inflexible parts of Indian society. The capacity of the Padu system to adapt to current and future changes at Pulicat lake may well be the deciding chapter in the survival of the fishery.

McGoodwin (1990) argues, that "an eligibility requirement for entry or access to a fishery, may ultimately bring about or hasten the fragmentation and demise of an otherwise well-integrated plural economic system....Often, as A.K Craig (1966)

observes, this policy arises from a desire to develop an export trade and generate foreign exchange, with no regard for the impact on local traditional communities" (McGoodwin 1990:118). At Pulicat lake, specialisation in prawn fishing with stake nets may have been accelerated or even instigated by the state, as Padu fishers focused more and eventually all of their attention on the prawn fishers (for example, the decline in Beach seine fishing is noted by Mathew 1991).

However, the foundations of the Padu system are traditional and cultural, and heavily embroiled in Pattinaver caste social status. The state may have encouraged more people to fish prawn, but the restrictions that determine that a participant must be a full-time fisher for prawn is a law from the Padu system, which has been operating since time immemorial, according to local fishers.

The costs and benefits of Padu are well summarised by Sivasubramanian (1987), who writes:

"They (the Padu fishermen) have been depending on the fishing wealth of the Pulicat lake for several decades. The Padu system of fishing has made them immobile and they do not go in search of employment elsewhere for the fear of losing the Padu....(however) It is this attachment to the fishing occupation that enabled the community to unite together, to settle their fishing dispute amicably and to evolve a system to regulate the fishing operation" (Sivasubramanian 1987:13).

Whilst Padu may act as a limiting force in the development of coping strategies of traditional Padu fishermen, it is nevertheless tightly engrained in fishing society at Pulicat lake. Fishermen at Pulicat kill each other over Padu rights and it would be imprudent to attempt to abolish the system.

A question arises which asks how does management cope with a failing fishing institution which is so embedded in people's culture? As discussed in the previous chapter, management ideas for Pulicat have reached a standstill and academic viewpoints as to the problems of the lake remain inconsistent and largely focussed upon natural science perspectives. In light of the implications of the Padu system for

Pulicat fisherfolk, natural science based solutions seem even less appropriate for a very society-oriented problem.

Whilst a way forward in management may be discovered through the adaptive capacity of society in an attempt to foster system resilience, the barriers to building those adaptive capacities must also be addressed and incorporated in management. The final chapter of the thesis begins with a discussion on how resilience theory can be applied to Pulicat lake. Management is required which works alongside the power of the Padu system through a better inclusion of cultural and traditional aspects of people's lives. This is accompanied by contributions from Pulicat communities on appropriate 'solutions' and a discussion of the future 'management' and fate of the Padu system.

CHAPTER EIGHT

CONCLUSION

The aims of this concluding chapter are two fold: first, to discuss the 'people-centred' approach to coastal management, which has been developed in this thesis, and the main findings that have emerged from it, and secondly, to draw on these findings to ascertain a direction for management for Pulicat lake.

The chapter is split into five parts, starting with an overview of the thesis and a summary of the key findings and lessons that can be applied to a people-centred coastal management process. The chapter then consolidates the people-centred coastal management process for Pulicat lake, discussing the process in the context of resilience theory and adaptive capacity, as debated by Berkes et al (2003). As has been argued throughout this thesis, a focus on the adaptive capacity of coastal communities can provide a management direction which is more in tune with the needs of policy makers and coastal communities.

A key finding of the thesis has been the relevance of the Padu system to fishing communities at Pulicat lake. The third part of this chapter debates the future of the Padu system as a part of coastal management for Pulicat lake. Should coastal management encompass a traditional system which works against the ideals of resilience and restricts adaptive capacity to cope with change? The fourth part of the chapter discusses future management suggestions for Pulicat lake, combining local suggestions on appropriate solutions with wider arguments which are prominent in current fisheries management thinking. This section applies arguments developed from the thesis to the idea of creating alternative fishing livelihoods, a commonly advocated management solution for fisheries world wide.

The chapter concludes with a short discussion of the current (2005) status of Pulicat lake, in particular focussing on events that have followed the 2004 South Asian tsunami disaster. This section illustrates how the Pulicat system has shifted according to the huge impacts of the tsunami aid money, and how lessons from existing traditional local knowledge capacities have been disastrously overlooked in rebuilding efforts of South Indian fisheries.

1. Key lessons for a people-centred coastal management approach

The challenge set out at the beginning of this thesis was to develop a 'people centred' coastal management process, which can be defined as management which is more usable to policy makers and, at the same time, more in tune with coastal community needs. This was in recognition of the inadequacies of coastal resource management to date (Tobey and Volk 2002, Campbell 2003) and the paradigmatic shift underway in natural resource management in general (Cortner and Moote 1994, Imperial 1999). This paradigmatic shift has moved away from managing the individual aspects of natural resources in isolation of each other, towards a more integrated 'ecosystem approach', which has encompassed greater participation of coastal resource users and collaborative decision making (Imperial 1999). The literature review discussed some of the various tools available for a more 'integrated' form of coastal resource management, such as Integrated Coastal Management (ICM) (Cicin-Sain 1993, Cicin-Sain & Knecht 1998), Adaptive management (Gunderson et al 1995, Berkes et al 2003) and Ecosystem management based around theories of resilience (Berkes et al 2003).

This thesis, argues from an early stage, that despite these emerging holistic opportunities, there is still an over-dominance of the natural sciences and 'technical' expert driven solutions in coastal resource management. This has proved ineffective for a complex coastal environment, which is heavily integrated with high human utility, community dependency, culture, tradition and social need. The ideologies which the process in this thesis have been based upon are interdisciplinary in nature, bringing social science theory and methodology into a more central position in the coastal management process. This has readdressed the balance of disciplines in coastal management through enabling use of *appropriate* methodology and theory to understand the varied management issues, as well as the connections between them. As has been argued throughout this thesis, at Pulicat lake many of the challenges for coastal management are of a social nature. This has necessitated a definite shift towards an improved understanding of Pulicat society, an understanding which has been largely neglected by current coastal policy makers in Tamil Nadu.

A substantial part of this neglect stems from an over-reliance on incomplete quantitative 'data sets' to form management decisions and a strong natural science research tradition, which have failed to give adequate understanding for informed policy making. As a result, Pulicat has received little attention from coastal managers to date; there is no agreement on what needs to be managed, let alone on how to best manage it.

Chapter 4 established the foundation for understanding change at Pulicat lake in an integrated and holistic form, through assessing change in terms of state-wide policy, global market, and local community forces. This combined approach clearly shows the connections between the three forces of change; how a history of state fisheries policy change, driven by the global prawn export market, has in turn driven change within, and division between, Pulicat fishing communities. Chapter 4 also introduced the importance of the Padu system, which has a central role in determining how fishing communities are affected by state policy and market forces. Establishing this integrated background of change was an important step in creating an informed context in which to discuss people's perceptions of change, management priorities and different coping ability.

A powerful argument in coastal management and natural resource management discourse is that better inclusion of 'people' in management requires more effective means of 'local participation' (White & Samarakoon 1994, Christie & White 1997, Pollnac and Crawford 2000). As is detailed in the literature review, improved local participation, "increasing reliance on local participation and using participation oriented research approaches" (Christie & White 1997:155), is heralded by many as a solution to ineffective coastal management. The current challenge to 'participatory' coastal management, as posed in the academic literature, is to improve communication between all stakeholders concerned with the environmental, economic and social factors of the coastal and marine area (Burbridge 1997, Clark 1996, Gupta & Fletcher 2001). This in theory would instil a 'bottom-up' process of management:

"the involvement of all significant stakeholders in an ICM programme is seen as essential in order to engender enhanced stakeholder 'ownership' of, commitment to, and belief in, the management process...Through this type of approach, the

readiness of stakeholders to address actual and perceived conflicts is likely to be enhanced (Gupta & Fletcher 2001:762).

The research in this thesis has at its core a participatory approach, which has integrated perceptions of scientists, policy makers and local communities on the coastal management needs at Pulicat lake. Quantitative surveys were carried out alongside qualitative approaches, such as key person interviews and focus group debates. Interviews were also carried out with relevant academics, government policy makers and NGO representatives to engage with the wider debates on coastal management needs for Pulicat lake.

Chapter 5 identified that people's perceptions of change and management needs are largely based around a fear for the future of the fishing livelihood at Pulicat lake and declining fishing catches representing a key concern[98]. Whilst there is a degree of consensus over concern for the sustainability of the Pulicat fishery, the drivers of change and threats to the fishery are largely contested and unclear, argued differently by people, both between and within stakeholder groups. The process used to identify coastal management issues, which is rooted in social science methodology and participatory techniques, has produced important insight into why the contestation exists between and within stakeholder groups. Visser (1999) argues that "there is a need to facilitate universal logic or 'reason' in decision-making by government officials, scientific experts and the community" (Visser 1999, as cited in Gupta and Fletcher 2001:762). Chapter 6 argues that contestation over management priorities, a lack of clear scientific understanding, and politically and socially driven agendas mean that in reality, the participatory process creates neither consensus nor 'reasoned' management objectives.

The recognition of the largely insolvable contestation that exists between different coastal stakeholders is a key stage of the people-centred coastal management process, because it recognises that contestation contributes to ineffective coastal policy. Policy

[98] In addition, research revealed that survey methodologies failed to take into account the impacts of seasonality, illustrated by the large number of people who prioritised management needs to establish reliable drinking water sources. Whilst this in part was due to the severe drought and water shortages experienced during the year of fieldwork, the importance of basic amenities to local people should not be overlooked by coastal management and necessitates a better combination of management alongside overall improvement of amenities.

makers are unequipped to deal with complexity, as Majone (1989) points out: "When the policy maker's problem involves more than a selection of the most appropriate means to achieve a given end, for example, the policy maker may be uncertain about the nature of the problem to be solved; he feels that things are not as they should be, but has no clear idea about what should be done" (Majone 1989:38). And yet, coastal systems are complex and perceived management needs are diverse and incomplete.

Furthermore, the complexities of the coast are likely to grow with increasingly integrated and interdisciplinary approaches to coastal management. Informed coastal management necessitates a much deeper understanding of the coast as a social-natural system, analysed in context with the dynamic changes it is experiencing. A consensus amongst the varied stakeholders of the coast is unlikely and a change in the focus of policy making is required. Policy makers need to learn how to accept the complexities of the coast, and how to create policy which is informed of the contestation and its implications. Again, a shift of management focus from asking "where do we want to be?" to asking "how do we move from here towards the desired direction?" (Berkes et al 2001:131, as cited in Berkes et al 2003:8) holds useful relevance for the coastal management situation at Pulicat lake.

In addition to contrasting agendas of coastal resource users, Chapter 6 described how a lack of scientific evidence on the changes or impacts of change at Pulicat lake have further fuelled contestation over management needs. This has, in part, originated from a lack of coordinated scientific research and fragmentary data collection. However, a lack of evidence is also due to an oversight of the different forms of evidence which can and should be used in an informed coastal policy making process. Over-emphasis on traditional 'natural' science data in coastal management has meant a neglect of other forms of evidence formed through a greater utility of social science methodologies. This thesis has illustrated how using qualitative methodologies, such as focus groups, interviews, and a greater dedication to time spent in the field, has provided substantial evidence on overlooked management needs, such as the impact of the Padu system on coastal management needs at Pulicat.

"It is an important question how we deal with scientific uncertainty in exploited, complex natural systems such as fisheries...A large part of the problem

arises from scientific uncertainty, and our understanding of that uncertainty. The difficulty of the scientific problem in a complex, quickly changing, and highly adaptive environment such as the ocean should not be underestimated. It has created pervasive uncertainty that has been magnified by the strategic behaviour of the various human interests who play in the game of fisheries management" (Wilson 2002:327).

As Wilson (2002) points out, understanding the nature and impacts of scientific uncertainty is a key part of dealing with it, and even more so, such awareness enables policy makers to better cope with the contestation which arises out of uncertainty.

Chapter 6 sought to clarify some of the macro political drivers of contested management themes. Powerful anti-development groups involving fishermen, NGOs and academics have a strong voice for coastal campaigns in both the Indian press and the Indian government. NGOs and fishermen activists are a potent mixture, facilitating national headlines, such as 'Pulicat in Peril' (Frontline 2000), an entire article which argues that pollution of Pulicat lake is the sole cause of fishing decline.

The case of the suspected thermal pollution from the North Chennai Thermal Power Station is a good example of where the role of activists and the press have created substantial pressure on state government and coastal policy makers. As a result, the issues of thermal pollution and other Chennai coastal developments as threats to fisher livelihoods are the focus of the current management debate. Despite a lack of 'scientific' data to support arguments, the strength and dominance of the pollution argument in the management agenda for Pulicat dwarfs other potentially equal, if not greater, problems. As a result, problems such as increasing population pressure and the impacts of the traditional institution of Padu are excluded from the management agenda, largely because they are not part of a political cause.

All arguments may be correct or 'rationalised', however, in the case of Pulicat coastal management, the processes of argument and persuasion seem to out play the need for evidence. The result is a bias impetus to certain causes over others. This lack of clarity and numerous alleged claims also risk creating a sense of apathy in policy makers. For example, a fisheries department official once remarked:

"The fishermen will always say what is beneficial for them. All over the Tamil Nadu coast they want everything for free. They will blame the government for all. If it doesn't rain they will blame the government, if it does rain they will blame the government".

In his analysis of the political ecology of aquaculture in Asia, Bene (2005) notes:

"One striking element of this controversial debate is that it does not simply oppose NGOs and environmental activism on one side and industrial entrepreneurs and aquaculture supporters on the other. The debate runs across organisations and institutions, creating discord and tension between practitioners with the same backgrounds or staff of the same agency" (Bene 2005:586).

A similar scenario was described in chapter 6 for Pulicat lake, where academics, NGOs, local fishermen, and policy makers show varying opinions on the needs for management, unable to give policy makers a direction. Amongst Pulicat communities, a top priority for many people was a lack of basic amenities, such as sufficient drinking water, whilst more in-depth research highlighted the significance of the Padu system on people's lives. These issues, however, rarely make the news headlines, nor do they seem to reach the minds of policy makers.

A people-centred coastal management, which is built on increased 'participation' alone, is naive if such processes are ignorant of the larger politics in force and the inherent difficulties of reaching a consensus in policy making. This is increasingly recognised by the academic community; Holling (2003) goes as far as stating:

"The failures of the past have not been complete: there have been partial successes. This mixed picture comes because theories, trials and projects were not wrong, just too partial. The recent fad for community-based development alone is another such correct, partial solution that will fail" (Holling 2003:xix).

As is argued in the literature review, participation in coastal management also needs to be more aware of local politics in force in the participation process by questioning 'who is the active participant?' Stakeholder approaches are already increasingly criticised for their inefficiency at encompassing equal participation (Cooke & Kothari 2001). Guijt and Shah (1998), for example, argue that, "simplistic understandings of

'communities' see them as homogeneous static and harmonious units within which people share common interests and needs. This articulation of the notion of 'community' conceals power relations within communities and further masks biases in interests and need based on, for example, age, class, caste, ethnicity, religion and gender" (Guijt and Shah (1998) as cited in Cooke and Kothari 2001:6).
Within fishing communities at Pulicat, the lack of consensus over management priorities is accompanied by large divisions between fishing groups, such as traditional and non-traditional fishers. Both groups are subsumed under the umbrella of 'local community participants', and yet, as is discussed in Chapter 7, their management needs and social status, as defined by the padu system at Pulicat, are quite different. These are the would-be managers of a more participatory coastal management, and yet an equal participation in managing the lake as 'one combined manager' is unlikely considering the issues of tradition, status and caste.

As is detailed in Chapter 4, powerful village leadership groups have strong influence and voice in the village, but they are also a link between the village and the external world. Village Chettiyar attend inter-village meetings, interact with the state-led Gram Panchayat councils and are the first point of connection with groups external to the village. As Bavinck (2001) states, "External relations are the prerogative of the Chettiyar and the new-style leaders, each operating on their own terrain. As village opinion-makers, however, these men all play important roles in decision making. Together they form the village's political elite" (Bavinck 2001b:6). The reference here to the Chettiyar as 'village opinion-makers' is insightful over the sway this powerful elite group can have over forming the perceptions of the majority. Such political levy of a few individuals over the majority questions the ability of effective participatory approaches, as was frequently illustrated by the common reference of fishermen to the problems of the NCTPS pollution. It is difficult to tease out politically influenced perceptions from perceptions built on 'traditional knowledge' and experience, and yet these micro-politics are also neglected in participatory coastal management discourse.

Whilst it is important to acknowledge the limits to participation and its inability to provide an ultimate 'consensus' or agreement in management, it is equally important to acknowledge its significance to the coastal management process. As is discussed in

chapter 6, using a participatory approach in this thesis has highlighted the aspects of change at Pulicat which are important to people affected by those changes, and it has also enlightened us as to the contestation that exists.

Understanding local perceptions, how they are shaped and the barriers that contested viewpoints can create for policy making are vital parts of informed coastal management. Felt (1994), for example, argues that "lack of consensus, and even contradictions, among fishers need not negate the relevance and utility of their knowledge for resource management....Fisher knowledge, in other words, must be primarily understood as a social construction in which particular experiences are given meaning within a specific cultural context" (Felt 1994:253). Participation may not be the solution envisaged by many coastal management academic and practitioners, but this does not mean that those perceptions, or the local knowledge from which they may be derived, are un-useful. As Felt (1994) points out, "failure to understand this complex process of knowledge construction may lead to the unfortunate decision to simply discount fishers' assessments that differ from scientific ones as misguided, ignorant, or worse. Such a conclusion undermines the general claim to legitimacy for indigenous knowledge, as well as precludes potentially insightful understandings about a resource, simply because the general conclusion appears at odds with other dominant views" (Felt 1994:253).

At this stage it is useful to summarise the findings of the coastal management process so far, which up until this point focussed on stakeholder participation from academic, policy making and local community perceptions (see box 7).

Box 7 Key lessons for a people-centred coastal management process

1. An appreciation that science is sometimes incomplete and that the route from science into policy is not always a rational and smooth process.
2. Coastal management priorities are contested both within and between different stakeholder groups. Greater participation in coastal management does not necessarily solve the contestation over perceived coastal management priorities, needs and agendas.
3. The barrier produced by contested management priorities is un-useful for coastal policy makers, who need clear cut advice and objectives to follow.
4. Current 'participation' in coastal management neglects the macro political drivers which can design perceived management needs. Participation without consideration of the social and cultural context in which it is sought can easily overlook the micro politics of traditional belief, personal agenda and village heterogeneity. Participatory approaches need to acknowledge that there is heterogeneity of needs both between and within user groups of the coast, redefining 'local community' to account for the variation in need and opinion.

2. Building a people-centred coastal management approach in the context of community adaptive capacity

Chapter 7 introduces an alternative approach to management which considers people not just as participants in coastal management, but as actors in the coast. People have the capability to determine parts of their own lives, and it is the observation of how people manoeuvre within their livelihoods – how they adapt and cope with change– which gives a direction for policy and management to follow.

This thesis has drawn on concepts of 'Adaptive capacity' (Berkes et al 2003) based on 'system resilience' (McCay and Vayda 1975, Berkes et al 2003) which "stresses the

ability of individuals, households or groups to adapt to disturbances and survive (McCay 1981, Lamson 1986)" (as cited in Davidson-Hunt & Berkes 2000:8). As Walters (2002) argues, "Uninformed management on incomplete resource knowledge is risky, we are more likely to find ways to align individual incentives with ecosystem sustainability if we begin to view these systems as complex adaptive systems" Walters 2002:328).

At Pulicat lake, the Padu system has proved a key source of understanding how people within the system are able or unable to adapt to changes. This finding contributes to increasing arguments over the importance of institutions as a means to integrate better with the 'community' (in the context of community-based management of natural resources) (Agrawal & Gibson 1999) and as a route to understanding social behaviour within a society-environment context (Leach, Mearns and Scoones 1999).

In this research, the institution of Padu is used to illustrate 'resilience for sustainability' by providing an explanation of different adaptive capacities displayed by different Pulicat fishing communities.

"In operationalizing this view of resilience, managing for sustainability in socio-economic systems means not pushing the system to its limits but maintaining diversity and variability, leaving some slack and flexibility...It also means learning how to maintain and enhance adaptability, and understanding when and where it is possible to intervene in management" (Berkes et al 2003:15).

At Pulicat lake we see the adaptive capacities of certain social groups are greater than those of others. The influences of Padu on people's ability to cope with change and manoeuvre within their own livelihoods and life style send a clear message that caste, status and traditional institutions are vital parts of an informed management system; understanding these factors informs management of how society is already reacting to change, and offers a route for coastal policy makers to build upon.

As is detailed in the methodology chapter, understanding the role of Padu in defining people's ability to adapt to change, or in other words, society's ability to increase resilience towards sustainability (Berkes et al 2003), has relied upon qualitative social science research techniques. Berkes et al (2003) define qualitative analysis as

"the understanding of the system's behaviour to help guide management directions" (Berkes et al 2003:7). Recognising the importance of qualitative analysis is one step towards acknowledging that complexity exists (Berkes et al 2003) and accepting complexity into the management process.

The case study of Pulicat clearly shows the requirement for qualitative approaches in the social sciences to uncover the social adaptation to changes which were largely obscured from more quantitative research methodologies. Chapters 3 and 5 illustrated the inadequacy of the village household survey in extracting 'sensitive' issues such as population increase as a priority for coastal management, and the relevance of the padu system to people's lives. The padu system, in particular, represents a highly sensitive management issue, which is seen by many at Pulicat as an insider 'village issue', rarely debated with strangers through impersonal and inappropriate survey techniques. McGoodwin (2001) warns on the difficulties which can be experienced in researching the informal side of fisheries management:

"In many small-scale fishing communities there is often a dual system of fisheries management, consisting of an informal system which is devised and implemented by the community itself, and which coexists alongside a more formal, government-instituted management system. Outsiders are often unaware of the informal system as it is not always easily observed or understood, and problems can arise when new formal management systems are imposed on top of a community's informal management system" (McGoodwin 2001:5).

McIntosh's (2000) description of 'social memory' states "the arena in which captured experience with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision-making processes into appropriate strategies for dealing with ongoing change (McIntosh 2000)" (Berkes et al 2003:21). Chapter 7 illustrates a movement from data intensive survey analysis to a deeper exploration of people's perception of change and ability to cope with change, drawing on social memory of past responses to crises in the fishery. It is this deeper understanding which enables management to move towards an adaptive response to better inform policy makers

Chapter 7 discuses the application of 'adaptation' to change as a form of 'resilience towards sustainability' (Berkes et al 2003) through illustration of adaptive capacities in Pulicat lake fishing communities. The chapter focussed on two villages in particular, who, despite having similar fishing access under the Padu system, display different approaches to fishing, and varying degrees of dependency on fishing as a livelihood.

Firstly, Scheduled caste fishermen in Dhonirevu villages were shown to diversify their use of fishing gears using non padu nets on non padu fishing days (*Sirutholil fishing*), and as a result, they are less dependent upon the highly species specific Padu fishery, which is focussed on catching prawns with stake nets. Secondly, Scheduled caste fishermen seem less dependent upon the livelihood of fishing as a whole, due to knowledge of other trades through their history and their practiced caste customs. Diversification into non padu fishing and dependency on non-fishing livelihoods are coping strategies of Scheduled caste fishing households. These strategies are driven by a combination of different historical occupations, caste and also through necessity. Other incomes are needed to supplement scheduled caste fishing in the least productive Padu places. The ability to adopt coping mechanisms through diversification in both fishing and external livelihoods seems to be largely attributable to factors of caste, culture and tradition. Pattinaver fishermen were less able to diversify their occupation due to a mix of influences: Padu law; a feeling of responsibility as the traditional 'keepers' of the Padu system; and the influence of caste and social norms that affected both the opportunity and willingness to adapt. It is this combination which, at least in these two villages, shows strong influence over the development of coping strategies and, ultimately, the ability to adapt and diversify during lean fishing seasons.

Chapter one described the overall thesis aim: to develop a coastal management process which is able to better engage with coastal communities and what they can teach us about surviving the coast, and at the same time, be considerate of the needs of policy makers. Building on Berkes et al (2003) arguments for building natural resource management upon existing structures of resilience shown by local communities, this research has argued that at the foundation of community resilience, are institutional traditions and cultural structures, which can act as a facilitator, or

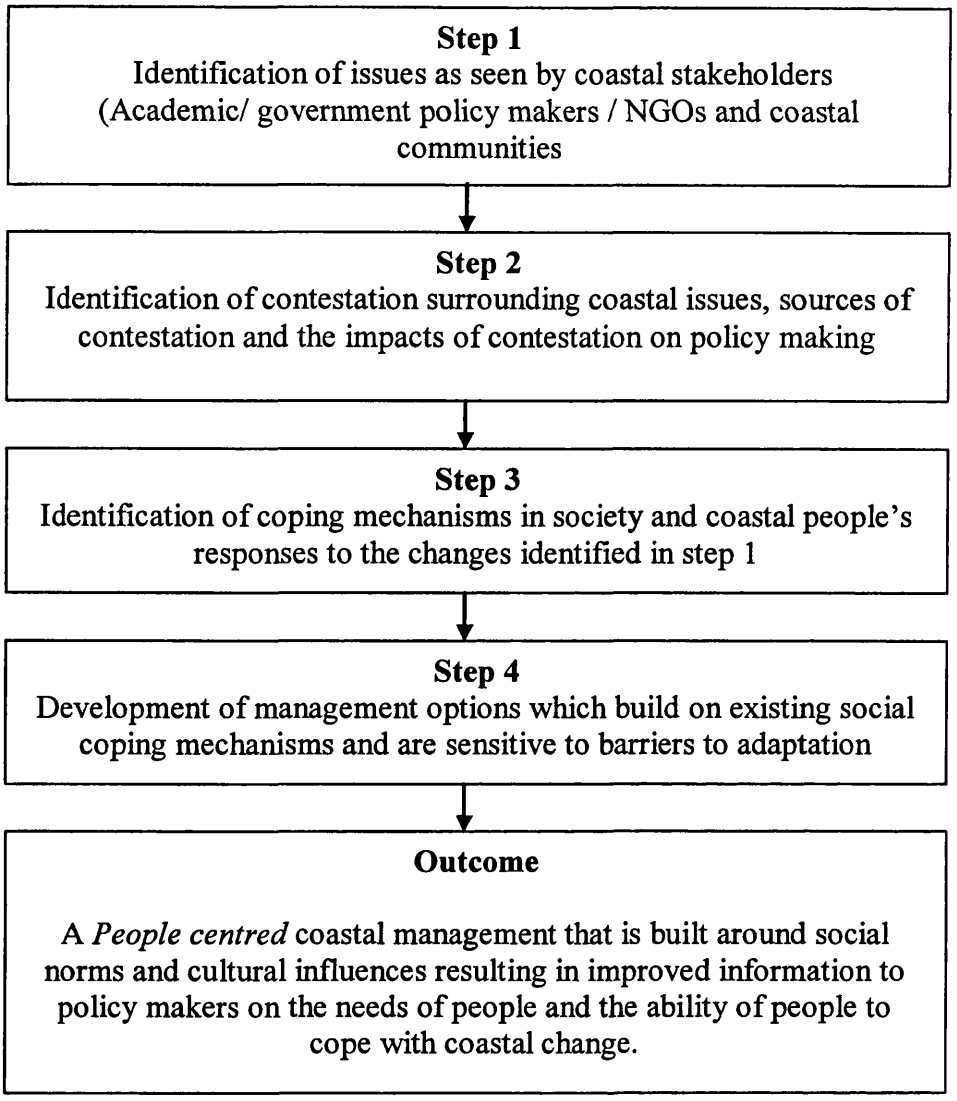
barrier, to adaptive capacity. Understanding the opportunities and restrictions which shape how different groups are able to adapt to cope with change is a core part of forming appropriate management suggestions, which are sensitive to people's cultural, traditional, and social norms. Without understanding these norms and the impacts of the ways in which societies already function, coastal management intervention is likely to have little effect.

The theoretical framework developed in Chapter one was based around three sub questions:

1. What is the interaction between and driving force behind the environmental and social changes at Pulicat lake using the fisheries sector as an example?
2. How do stakeholders perceive these changes?
3. How are people reacting to change, and coping with change?

The theoretical framework advocated a combination of quantitative and qualitative analysis of change, with micro interpretations of adaptations to change. This was in order to understand the social-environmental nexus alongside knowledge of how people are responding to change in order to help themselves. Figure 1, is a diagrammatic representation of the people-centred coastal management process developed in this thesis.

Figure K A People-centred approach to coastal management



The first step of the process identifies all coastal stakeholders and their perceived management needs and priorities. Differences in perceptions are then laid open in Step 2 and discussed in terms of: 1) drivers of contestation and disagreement and 2) impacts of the contestation on effective coastal policy making. Contested management needs and priorities present a barrier to policy makers, which may not easily be solvable. Therefore, the process recognises that different view points exist and assesses the wider realm within which perceptions are constructed. This enables policy makers to be better informed, and therefore better equipped, to deal with the complexity that contestation can generate.

In full recognition of the complexity which surrounds management priorities, the management process can then move to Step 3: identifying how people at the coast are already responding and coping with change. In this research, identification of people's responses to change was achieved through combining quantitative and qualitative research techniques. An in-depth analysis of the Padu system provided a route to understanding how and why people were able (and unable) to adapt to change within existing social and cultural boundaries. Traditional management institutions can be instrumental in shaping adaptive capacity and better recognition of such institutions within the coastal management process is necessary. In Step 4, the informed coastal management process is in a position to build upon the adaptive capacity within fishing communities. Management suggestions (the Outcome), should be in tune with social and cultural sensitivities since they are built upon mechanisms devised by the communities themselves.

2.1 Considering Pulicat lake in terms of resilience

"Resilience thinking helps the researcher to look beyond the static analysis of social systems and ecological systems, and to ask instead questions regarding the adaptive capacity of societies and their institutions. One way is to look for co-existing property rights systems, and to analyse their performance and adaptation. Another way may be to investigate a given social – ecological system holistically, and to tease out the details of different kinds of adaptations that confer resilience to the system as a whole. A third way is to search out cases in which there is periodic perturbation in the system (e.g. annual flood), and look specifically at how societies build resilience to enable them to live with disturbance" (Berkes et al 2003:115).

The coastal management process developed in this thesis applies all three of these options to understanding community responses to change at Pulicat lake. Firstly, understanding implications of the Padu system (a common property resource institution) highlights several social barriers to develop adaptive capacity. Secondly, a holistic analysis of change at Pulicat from market, state, and community factors gives an integrated view of change within which to consider responses to change. Finally, the dynamic variation of the lagoon productivity according to natural events (such as cyclone and rainfall – see chapter 6) gives opportunity to analyse responses to those

changes using tools such as social memory. For example, the Scheduled caste fishermen's reference to moving away from the lake and depending upon agricultural family ties during poor fishing seasons. "It is such linkages and connectivity across time and among people that help navigate transitions through periods of uncertainty to provide social resilience" (Berkes et al 2003:47).

Whilst the Padu system has provided a route to understanding adaptive capacity of fishing communities and the variations between different fishing villages, the Padu system is also rigid and inflexible to change. The future of the Padu system is the focus of the following discussion, as an introduction to management possibilities at Pulicat lake.

3. Meanings for management – building a direction for coastal management in the context of cultural and traditional social settings

3.1 What future for the Padu system in a resilient coastal management process?

At Pulicat lake, the link between management, policy and the institution of Padu is that understanding Padu gives the manager information on adaptive capacity of people, and where these capacities can be built upon. As has been discussed, Berkes et al (2003) argue that to build management for sustainability in social-ecological systems, management must encompass flexibility through resilience and adaptation. At Pulicat lake, we have seen how the traditional Padu system is rigid by nature. Whilst Scheduled caste fishing behaviour shows clear adaptive capacity which can offer direction for management, Pattinaver caste fishermen remain stuck within a rigid and inflexible system.

As discussed in Chapter 7, there are costs and benefits of the Padu system, and the importance of Padu to Pattinaver societies is vital to consider in any management of Pulicat lake. In terms of sustaining the lagoon fishery as a natural resource, Padu is extremely effective, but only in the short term, as the adverse effects on fishing societies become increasingly serious. On the other hand, legitimisation of rights for an already mono-occupational and high dependent social group drives Pattinaver Padu

fishermen further into risk and vulnerability. "Relatively few small-scale fishers rely exclusively on fishing for their livelihood. Not only does having economic means other than fishing increase their security, it also effectively reduces their fishing effort....From this perspective we see how unwise are the management policies that permit only full-time fishers access to fisheries" (McGoodwin 1990:117). Whilst understanding the Padu system highlights people's ability to adapt and cope with change, in many ways, the Padu system itself works against the ideals of resilience.

Alcorn et al (2003) argue that "Safeguarding resilience requires appropriate management decisions by people using their society's cultural norms and institutions at different (small and large) scales. Conflict between these scales sometimes leads to clashing management decisions, and subsequently an erosion of resilience. Over time, changes in social and political conditions as well as population sizes, technologies, incentive, and values can also result in this erosion unless societies recognize and respond to negative ecological feedback by modifying their management institutions" (Alcorn et al 2003:299)

The Padu system at Pulicat is certainly suffering from internal pressure from population growth, and external pressure from demands on fishing space; however, the pathways to respond to these pressures and 'modify' the institution are restricted to a Pattinaver elite. Alcorn et al (2003) state: "if the political system is closed to participants who want to modify institutions in response to negative ecological feedback, then, during crises, ecological resilience will diminish until the system flips. Resilience depends on a vibrant political life in which multiple interests participate" (Alcorn et al 2003:300). The role of a Pattinaver elite and the influence of traditional Padu village leaders at Pulicat do not provide the foundations for a democratic political assessment of the functioning of the Padu system within Padu fishing society. The Padu system grows increasingly fragile, and yet should coastal management support a traditional institution so rooted in an undemocratic and rigid caste system?

Management solutions for the Padu system suggested by the Tamil Nadu state fisheries department include licensing of Padu rights: "A participatory approach in the implementation of a suitable, modified and scientific 'Padu' system, in the place of

the traditional one, to restore the conflicting fishing groups to sustain fish production and protect the lake's ecosystem" (Krishnamurthy & Ramakrishna 2002). Mathew (1991) advises: "Instead of dismantling the Padu system and replacing it with licensing, it would be preferable to strengthen the weaker links in the traditional system with constructive interventions, as in the case of Kattudel fishery in Sri Lanka where the traditional rights to the fishing ground are formally recognised by the state (Atapattu 1987)" (Mathew 1991:17). Ostrom (1990) argues that the breakdown of traditional management responsibilities at the local village level undermines the viability of common-property arrangements (Ostrom 1990:157, Agrawal and Yadama 1997, Agrawal 2002).

A useful example of the risks posed by undermining the Padu system with state intervention has been documented by Lobe and Berkes (2004), who studied the Padu system in the state of Kerala. The Keralan Padu system received formal recognition by state-wide legislation in 1974, which demanded all fishing to require a state-sanctioned license. This has resulted in the Padu system being divided between two groups – those with official licences gained from the fisheries department and another group, who operate in separate padu areas with no licence. The latter have won rights to 'illicitly' fish Padu areas through several decades of arguing their 'caste-based occupational rights' as fishers through the municipal courts of Kerala during the 1970s and 1980s (Lobe and Berkes 2004). Interestingly, the authors note that "Interviews with members of these groups confirm that they did so in order to cash in on profits from the lucrative shrimp fishery" (Lobe and Berkes 2004:275). This legislation has effectively reverted the Padu region to an open access resource and, due to a poorly equipped fisheries department to enforce the licensing legislation, there has been a continuous conflict over access to fishing and licence use (Lobe and Berkes 2004). "This in turn has resulted in the current situation of separate licensed and non licensed padu grounds, which the authors argue may eventually lead to an unsustainable fishery" (Lobe and Berkes 2004:279).

Licensing efforts of the Tamil Nadu Fisheries Department at Pulicat lake have already been attempted and failed in the 1970s, and the current state government seems at a loss to explain why the fishermen remain within the system (Sanjeevaraj personal communication 2002). Improved understanding of the Padu system, in terms of the

status and caste that Padu membership can bestow and the strength of will with which people desire it, places coastal managers in a more informed position.

Rather than overriding the institution with a state-led system, as was done with the bar mouth dredging, power needs to remain with the people of Pulicat. Mathew (1991) suggests that management needs to build on the existing structures in place: Padu fishermen should keep to their traditional fishing grounds, marine fishermen should be kept to the sea, and schemes should be devised which rehabilitate 'displaced peasants' and Tribal people to land-based occupations (Mathew 1991).

Engaging policy makers with Padu would mean that adaptive mechanisms in the community have potential to become a part of management. This can be used to encourage alternative livelihoods, in an informed way of where this is likely to be successful, and where it may not be so useful. Management mechanisms, such as seasonal assistance through either alternative livelihoods, or financial assistance[99] in lean fishing seasons with a focus on planning and saving money during more productive seasons, would certainly be useful at Pulicat. Building on Mathew's (1991) ideas, learning from the ability of non-traditional fishers to diversify into non-fishing livelihoods may point managers to direct alternative livelihood options to those better able to cope with change, rather than the Pattinaver fishing caste – who largely want only to be left alone to fish a productive lake.

4. Suggested solutions for the management of Pulicat lake

The aim of this section is to illustrate how a deeper understanding of the Padu system, as a route to engaging with people's adaptive capacities to cope with change, is able to produce a direction for coastal management. It focuses on a commonly suggested management solution suggested by local Pulicat people, and advocated by fisheries managers worldwide: establishing alternative livelihoods to fishing. This is discussed within the context of Padu and adaptation to change, and illustrates the utility of our

[99] Currently, the State Fisheries Department operates a Savings-cum-relief scheme intended to provide fishermen with income relief during lean fishing periods. Although this scheme was primarily aimed at marine fishermen to cover the gap in earning income during the monsoon season (Bavinck 2001) when many marine fishermen do not go for fishing do to high seas, lake fishermen utilise the fund as a support during the summer months when the lake productivity is low.

understanding of the Padu system for the viability of introducing alternative livelihood intervention.

4.1 Local suggestions for a management solution to Pulicat Lake

Research was conducted with Pulicat communities to establish their own proposals for management solutions. In keeping with the tendency for contestation over management needs and priorities, the solutions offered were also varied and sometimes contrasting. However, three trends could be distinguished: 1) The government is solely responsible to produce a solution, 2) Alternative jobs to fishing are necessary and 3) Traditional fishers should be left to fish the lake and the threats to the fishery removed[100].

The first suggested solution was a common belief of the responsibility of the government to solve the problems faced by fishing communities. The household village survey found that 43% of respondents[101] stated it was up to the government to provide a solution to the management needs at Pulicat lake. As is discussed in chapter 6, the community-based management endeavours, such as the dredging of the bar mouth, were lost following partial and inadequate take over from the government. This policy may have encouraged dependency on the government for help, rather than a reliance on community-based traditional systems.

The second trend of solution suggestions was the common request for alternative jobs, which were not reliant on fishing. This suggestion was, however, varied amongst villages[102]. Those respondents who did talk about alternative jobs, often made reference to the importance of employing village youth. Complaints that a lack of fishing opportunity instilled a sense of idleness amongst the village youth, frequently led to requests for alternative work or opportunities for self-employment.

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[100] See Appendix 5.5 for categorisation and coding of solutions given in response to the village household survey

[101] Sample size was cumulated for all villages resulting in 318 survey respondents

[102] For example, the household survey in Nadoor Madha kuppam, found 14% of respondents stated alternative jobs as a top solution priority; second behind the 40% who wanted solutions to the drinking water shortages. In the tribal village of Kulathumedu, most fishers could not think of a solution, rather they stated that this was the job of the government.

In contrast to these requests, a third trend was voiced, particularly amongst traditional Pattinaver fishermen, that management solutions should tackle the many threats to the lake fishery, as is illustrated by the comments below:

"Traditional fishermen want dignity, and feel they want their fishing back. Give the other livelihoods to the non-traditional fishing villages, as they will be more accepting of them"

Comments made at a local meeting between fishermen and NGO officials

These fishers often argue that the only solution to the lake's fishery decline is a cessation of the development activities affecting the lake, such as NCTPS pollution; they demand simply to be left with the dignity of fishing in clean waters.

This divide between 'wanting alternative jobs' and 'wanting to fish' is aptly illustrated by a published article on the impacts of coastal development on Pulicat lake (Frontline magazine 2000), which reports one villager as saying:

"Each affected family should be given a job at the port, the NCTPS or the petro-chemical park and also alternative accommodation"

Whilst another stated:

"There is no one to represent our cause. Perhaps we need an Arundharti Roy to take our case of blatant human rights violation, or else we are doomed"

(Front line 2000:71)

The coastal community is divided in its reaction to coastal development. In fishing villages closer to Chennai's industrial belt at Ennore, for example, village elders have banned their youth from obtaining jobs in polluting factories as a protest to their suffering in a polluted environment. The youth are often in disagreement with this, and the resulting conflict aptly illustrates the division of opinions which can exist within a community.

It is this divide between wanting the right to fish, and wanting an alternative job to fishing that leads us to the relevance of traditional vs. non traditional fishers operating around the institution of the Padu system. In the following section, this divide in Pulicat fishing communities is applied to current academic fisheries management calls for alternative livelihoods as a solution to threatened fisheries.

4.2 Are alternative livelihoods a potential solution for the Pulicat fishery?

As has been detailed in Chapter 7, the social status which accompanies membership of the Padu system has powerful influence over the ways in which traditional fishers behave. The Padu system restricts traditional Padu fishers from using a more diverse range of (non padu) fishing gears, and it restricts their ability to diversify into non-fishing livelihoods. This is particularly relevant to current fisheries management approaches which promote alternative livelihoods as a solution to fisheries pressure and inadequate fishing incomes.

In a recent letter to the journal Nature, Daniel Pauly argued that, in response to the tragic tsunami in South Asia (Boxing day 2004), fisheries managers should re-emphasise the need to develop alternative livelihood strategies outside the fishing sector in affected fishing communities.

"The challenge is to rebuild fisheries while directing as much money and energy as possible to generating land-based job opportunities for young fishers. Emphasis should be given to basic education and technical skills: many fishers in south and southeast Asia are illiterate, and this limits their social mobility...
Amending the old adage that teaching people to fish is better than giving them a fish to eat, we should instead be teaching them to repair bikes, sewing machines and water pumps".

(Pauly 2005:457)

In small-scale fisheries research, a lack of alternative employment to fishing has often been cited as an explanation to the persistence of poverty in many fishing communities (Smith 1979, Panayotou 1982, as cited in Bene 2003). This, combined with the urgency amongst managers to reduce global fishing pressure on over fished

stocks, makes alternatives to fishing a popular idea. As a result, developing alternative livelihoods to fishing, as a means of improving fisheries sustainability, is a commonly recommended management concept (Pomeroy et al 1997, McManus 1997, Kühlmann 2002, Campbell 2003, Dankwa et al 2004, Pauly 2005).

However, understanding the adaptive capacity of different groups of Pulicat fishers in the context of the Padu system's influence immediately highlights potential barriers to introducing alternative livelihoods so liberally. I can not imagine for a minute, that a traditional Padu fisherman would be impressed by efforts to re-educate him to mend bicycles. At the same time I also know a non-traditional fisherman at Pulicat who already mends clothes as an additional income to fishing. Recognising this diversity and heterogeneity amongst the fishing community is instrumental in efforts to introduce alternative employment opportunities as a form of management. Fishing villages are separated by caste, social status and traditional fishing access rights, and accompanying these differences are issues of dominance, influence and political power, which can also vary between individual fishermen of the same village.

Bene & Mindjimba (2003) discuss the need to better recognise heterogeneity of fishing societies in management, drawing largely on the development discourse in the social sciences: "One of the key conclusions that emerges from recent socio-economic research in rural development is the need to recognise the heterogeneity of rural societies and the diversity of their livelihood strategies. Even small communities are made up of diverse assemblages of different socio-economic strata characterised by different livelihood strategies and economic portfolios (Ashley and Carney 1999; Ellis 1999; Toulmin et al. 2000; Vosti and Reardon 1997). Depending on where they stand within these socio-economic strata, households and individuals have highly differentiated access to resources and opportunities, much of which is systematically linked to ethnicity, gender and ownership of assets, as well as knowledge, network and experience acquired over time" (Bene & Mindjimba 2003:187).

Within the Padu system, divisions between non-traditional and traditional fishing communities clearly illustrate varied abilities to adopt different livelihood strategies. Despite both operating under the Padu system, Scheduled caste fishers are able to spread their livelihoods across non-padu fishing techniques and non fishing

livelihoods. Traditional Padu fishers on the other hand, are more restricted to fishing only with Padu nets; restrictions which are considerably status orientated. Padu fishers seem to have adapted well to earning substantial incomes through Prawns, and the accompanying social status that wealth can bring. As populations grow, and Padu access diminishes, traditional Padu fishers are less adapted to cope with poorer incomes.

This also fits well with Bene's (2003) arguments on the capacities of poorer fishing households to show diverse adaptations: "While the poorest households in the community will depend heavily upon a given combination of crops and/or natural resources (usually common pool resources) for their food security and income generation, the better-off, because they face different socio-economic and institutional constraints and opportunities, will develop (sometimes radically) different activity portfolios. In this context, understanding the exact contribution of each rural activity to the local and households' economy and identifying their respective potential (positive or negative) effects on poverty reduction and wealth differentiation for the local population appear as a key-element for the design of appropriate rural development policies" (Bene et al 2003:187). As Bene (2003) concludes, recognising the heterogeneity in adaptive capacity of fisher households, and the social and cultural factors which drive them, is vital to make informed policy. In the example of alternative livelihood encouragement as a potential management option, understanding the existing ability and barriers in the community to enable acceptance of an alternative livelihood is an important foundation.

Pomeroy et al (1997) recognised that introducing alternative approaches to a fishing livelihood may not be suitable for all fishers. They posed the question:

'Do fishers like their occupation?'

Pomeroy et al (1997:116-7)

Pomeroy et al (1997) build on the commonly held premise that fishing is a last resort for job seekers; and an occupation of the very poor (Bailey 1988, Bene 2003), which brings with it an assumption that all 'poor' fishers may be welcoming of an alternative occupation (Pomeroy et al 1997). However, "Worldwide observation of fishers

indicates that there are aspects of the occupation which are attractive to certain types of people. Many state that they prefer fishing to any other available occupation (Pollnac et al 1988) hence, despite beliefs to the contrary among development workers, we were not surprised to find that (in the Philippines) 83% of the fishers interviewed said that they would not leave fishing even if another occupation were available that provided the same income" (Pomeroy et al 1997:116-7). Pomeroy et al (1997) give various reasons for the preference for fishing as an occupation "(e.g. better income, flexibility in hours, no boss, etc.)...and conclude that: "while it may be desirable to reduce pressure on fishery resources through provision of alternative employment, perhaps it would be better to build on the already existing tradition of occupational multiplicity in rural coastal areas and develop supplemental income-generating activities" (Pomeroy et al 1997:116-7).

Similar interpretations of fishers 'liking' fishing were found amongst Pulicat lake communities. For example, a marine fishermen at Pulicat told of his experiences working as a night watchman in Chennai, a job which he took for a few months, before resigning and returning to his fishing village to fish: "It is not a job for a young person, to stand in one place like that all night....in fact, I would rather die than do that job again ...fishing is better than city work".

However, our discussions of the Padu system, and the relevance of being a Talekettu member of the fishing community, illustrate that being a fisherman runs far deeper than a mere 'liking' of the livelihood. Understanding the non traditional vs. traditional fisherman divide at Pulicat allows a more informed understanding of the potential of alternative livelihoods as a form of practical management for Pulicat lake.

"Among the members of small-scale fishing communities who fish at sea, there is usually a profound pride in their occupational identity as fishers and a correspondingly high devotion to the fishing way of life" (McGoodwin 2001:2.5). This pride and status is evident throughout Pulicat lake Pattinaver fishermen, and the traditional vs. non traditional argument between fishing groups is evident throughout Tamil Nadu fisheries (Bavinck 2001, see chapter 4).

At Pulicat lake, Mathew describes: "when Tribals and non traditional fishing castes move into the lake waters, they are reminded of their caste origin and are asked to keep to their caste-based occupations. When marine fishermen who belong to the same caste as the lagoon fishermen move in, they are asked to keep to their own traditional fishing grounds and methods – which are the sea and the kattumaram fishery, instead of getting involved in the Padu system" (Mathew 1991:15). The use of caste as a means to access the fishery is deeply embedded within the society; there are some calls from Pattinaver Padu fishermen that a solution to the fisheries conflicts would be for the government to legally recognise their traditional rights to the Padu grounds and grant them title-deeds to the waters (Mathew 1991).

With the strength of feeling over tradition and culture in fishing at Pulicat lake, potential managers may have more successes in supplying alternative livelihoods with a focus on non-traditional fishers to relieve some of the competition, conflict and pressure on the resource. The opportunity for appropriate subsidiary livelihoods for traditional fishers should be made available, with consultation with fishers as to where it would be welcomed and most needed. As Pomeroy et al (1997) state, "Supplemental activities could be spread over a larger number of fishers, reducing rather than eliminating their fishing activity, and probably having as great or greater effect on improvements in the condition of the resource than trying to attract (or force) fishers to some alternative form of employment. The interventions are also more likely to be sustainable since they would fit into what is already identified as a successful adaptive strategy - occupational multiplicity" (Pomeroy et al 1997:116-7). At Pulicat, as Pomeroy et al (1997) also describe for Philippino fisheries, "Generating alternative employment opportunities should be based on information that would allow targeting of individuals willing to leave fishing for some other occupation" (Pomeroy et al 1997:116-7).

5. Summary and the current status of the Pulicat fishery

The ability for coastal communities to adapt to change, whether sudden or gradual is vital in today's world with drastic changes predicted by population growth in coastal areas, climate change, and sea level rise. Understanding the causes of resource dependency and barriers for coping in fisher households should be at the core of fisheries management, not only so that managers can learn from their successes and failures, but also because these are often the only active management schemes in force. Where state management interventions are continually uninformed, highly fragmented, ineffective, and in many situations completely lacking, coastal people are still managing themselves in a variety of ways.

This thesis has analysed the social-ecological interactions between fishers and the environment. It has shown the importance of institutions in understanding how people are able or unable to adapt to changes in the system. This chapter has illustrated how management can build upon this understanding, using the example of alternative livelihoods as a potential management option. It has shown that to create suitable alternatives to fishing, managers need to first understand the social and cultural fabric within which people can build their own adaptive capacity. This fits directly into Berkes et al (2003) arguments that sustainable resource management research needs two objectives: "1. how human societies deal with change....and 2. how capacity can be built to adapt to change and, in turn, to shape change for sustainability" (Berkes et al 2003:3). In order to understand social, cultural and institutional aspects of fishing, a much greater integration of qualitative research methodologies needs to be used in coastal management. Ultimately, this requires far better coordination and integration between the social and natural sciences; coastal management must be able to draw upon both fields as a matter of practice.

The research for this thesis was conducted prior to the tragic Boxing day tsunami in 2004. Pulicat lake fishing communities were thankfully protected by the absorptive powers of the lagoon's waters (illustrating the important role of lagoons in coastal protection from the sea). Marine fishing village losses were also at a minimum, the most affected areas lying south of Pulicat lake. However, Pulicat lake fishing communities have been substantially affected by a second tsunami: a tidal wave of

inappropriately distributed aid money. Throughout Tamil Nadu, aid money is being distributed to both affected and unaffected people living in coastal areas, by national and international NGOs and donor groups. At Pulicat lake, inappropriate distribution of aid money has resulted in a complete stoppage of fishing throughout the lake. Instead of taking advantage of the good prawn harvest, encouraged by the tsunami driven lagoon flushing and good rainfall throughout the year, all lake fishermen stayed at home to receive aid money donations instead. The first sight of somebody fishing meant a potential cessation of aid money to the area, and therefore, social pressure not to fish increased as time progressed and money continued to flow into communities. Subsequently, this scenario continued for eight months. Fishing village leaders were instrumental in encouraging the self-imposed fishing ban. There were even some reports of intimidation; fishermen who might have wanted to go fishing were soon dissuaded from doing so.

Events following the tsunami aid distributions present a good example of how Pulicat lake fits into ideas of a resilient system, and the importance of using existing adaptive capacities and community structure to administer aid relief.

"The tragedy of the tidal wave provides a stark example of the linkages between society and ecology, and on their entwined resilience in the face of rare catastrophes" (Hughes et al (In press:456). Hughes et al (in press) argue that degradation of natural forms of coastal protection, such as coral reefs and mangroves, alongside unstable social forms of change (poverty, lack of development and civil war), simultaneously hinder a coastal system's resilience to disturbances (such as the tsunami), and therefore increase vulnerability. "The tsunami can be viewed as an external disturbance that has the potential to move a complex social–ecological system to a new state that is either more or less desirable than the one existing before. The local, regional and global response to the tsunami will determine whether the system has the potential to develop alternative paths and new trajectories...Key components of resilience are likely to include leadership and insight, sustained mobilization of national and international aid, cultural and ecological diversity, development of multi-scale social networks, and the resolution of local civil unrest..." (Hughes et al In press:456). Sadly, there seems to be little uptake of these opportunities to build capacity for resilience in South India.

From August 2005, a new turn of events has been witnessed at Pulicat lake. As compensation for damaged fishing equipment continues to be distributed, lakeside fishermen have appropriated the means to acquire marine fishing vessels and gear. Therefore, the statement in this thesis that 'lakeside fishermen never go sea fishing', no longer holds any truth. At Pulicat lake the tables have been turned; where as conflicts were once over marine fishermen venturing into the lake, we may in the near future see new conflicts over lake fishers fishing in the sea. One wonders if traditional marine fishermen will attempt to impose in the sea the same 'caste' and 'tradition' based restrictions they have been fighting under the Padu system in the lake. This turn of events highlights the diversity and dynamism of a coastal fishery – stemming from one large disturbance, the entire system has changed around.

It seems Pauly's (2005) calls for establishing alternative livelihoods in the wake of the tsunami, have been neither heeded nor implemented, at least in South India. Aid money is reportedly replacing artisanal fishing craft with bigger and mechanised fishing craft (Kumara, personal communication 2005), whilst original and traditional fishing structures are completely overlooked. As Vivekanandan (2005) recently argued, "You are imposing your western ideas of fisheries reconstruction on top of 2000 years of fishing tradition...without even taking a look to see what has existed there before you" (Vivekanandan, personal communication 2005).

Bavinck (1996) illustrates how traditional fishing villages throughout Tamil Nadu have, for generations, employed mechanisms to filter out destructive fishing gears and promote sustainable fishing..."the banning of gear is part of a customary system of fisheries regulation and is rooted in local perceptions of ecological interdependency as well as conceptions of social justice" (Bavinck 1996:475). As Pulicat's Pattinaver fishermen flock to the sea, will the sustainable lake fishing upheld by the Padu system collapse entirely?

These important traditional structures are now being eroded as 'free' fishing gears are rapidly distributed, irrespective of traditional practice and original user groups. This can surely only lead in one direction: a loss of traditional knowledge on sustainable fishing, increased over fishing in the sea, and an intensification of fishing conflict.

Under the banner of re-development post tsunami, the need to consider the social mechanisms which already exist and the function of traditions and institutions in facilitating sustainable fishing livelihoods, has perhaps never been so urgent.

APPENDICES, GLOSSARY, ACRONYMS AND BIBLIOGRAPHY

APPENDIX TO CHAPTER THREE METHODOLOGY

Appendix 3.1 Surveys used in research

The basic structure of the household survey is detailed below. Each village survey included the following core questions, however questions specific to each village were also added where appropriate. For example, in Arangankuppam (a marine fishing village) a question was included which documented how often people fished in the lake and in the sea. Such a question was inappropriate for lakeside fishermen who only fish in the lake (see chapter 4).
Each survey was written in English with a Tamil translation underneath. All surveys were translated by my interpreter and spot checked for accuracy in Chennai city (see methodology chapter).

Village household survey

1. Name

2. Address

3. Age

4. Married Y/N

5. Main income provider

6. Is there any *other* income coming into the household: work done by relatives, wife or children or other people you are living with/ also can include seasonal work.

If yes, who earns the additional income?

7. Has your source of income ever been different?

If yes, what work did you do in the past?
Why did you change your occupation?

8. Types of fishing gear that you own:

Net Type	Estimated amount (Kilograms)	(Rupees)

9. Boat type owned: Wooden boat/ Kattumaram/ No boat

10. What improvements have you seen in the village over the past 20 years?

11. What are the top 3 problems that you feel people in your village are facing, which coastal managers should be prioritising?
(Stating the most important / prioritised problem first)

1.

2.

3.

What do you think can be done to solve these problems?

Suggestions

School distributed Ranking survey of coastal management priorities for villagers around Pulicat Lake

(All surveys were translated into Tamil)

This is a part of a university project to collect opinions on changes and problems that people face around Pulicat Lake. The following is a list of problems relating to current coastal management needs at Pulicat lake.

Please rank the problems in order of how important they are to you personally.

Number 1 represents the most important problem
Number 10 represents the least important problem.

Your Details:
Male / Female
Age
Profession/ (How is you main income earned)
Village name

Problem	**Ranking value 1=most important 10 = Least important**
Declining number of fish in the lake	
Difficulties in obtaining drinking water	
Lack of rain	
Chemical and sewage pollution in the lake	
Hot water discharge from North Chennai thermal power station	
Family or village Debt	
Insufficient education opportunity	
Lack of employment	
Family or village arguments	
Transport facilities from village	

Please write here any other problems or important issues you are affected by that are not included in the above list.

Once completed please return the form to the school with your child.
Many thanks from
Miss Sarah
University of Newcastle, UK

Appendix 3.2 Problems with survey techniques

The village household survey conducted in this research presented many problems at both practical and also analytical levels (discussed in the thesis, chapter 5). The problems with survey data bring into question the applicability of survey methodology to coastal management research, a debate, which is included in chapter 5 and the thesis conclusion. The limitations of participatory approaches in coastal management are also discussed in Chapter 6. In this appendix, some of the practical problems experienced in conducting surveys are detailed under three key problems (listed below). Many of these problems stemmed from employing a research team to carry out the household survey. This decision was made due to practical difficulties of conducting survey work in person, and to create more time for myself to engage with qualitative research methodologies. As is discussed in the methods chapter, the benefits of assigning survey work to others outweighed the disadvantages detailed below. A lack of personal involvement in the survey data collection may associate a degree of risk to the data robustness (as described below). However, the benefits from improved knowledge and understanding gained through more suitable qualitative approaches in the research were considerably higher than could have been achieved through a heavier reliance upon survey work – as is discussed in chapter 3 and throughout the thesis.

Problem 1 Researcher fatigue

'Researcher fatigue' became a problem when carrying out surveys of a large sample size. Most of the research villages were small, hence 25% of the village could be sampled (according to Rea & Parker 1997; Bunce & Townsley et al 2000:233). However, larger villages such as Nadoor Madha kuppam and Aranganku ppam meant this was not possible. Rather than insist on trained research groups to carry out large surveys with over 200 surveys per village, which could have risked fatigue of both the researchers (and the village), I had to find alternatives. Keeping the enthusiasm of the local research groups was vital to ensure they collected reliable information. Insisting on overly large numbers of surveys being filled out would have jeopardised this enthusiasm. Hence, in Aranganku ppam, I asked that one in 5 households be surveyed – to cover the entire village but with less intensity, whilst I chose a sample survey of 50 households to be randomly selected from the largest village Nadoor Madha kuppam (one in every 12 households).

In some surveys, far more than one quarter of the village was interviewed (despite instructions for only 1 in 4 households). According to the survey team one of the reasons for this was that sometimes inhabitants who were not asked for interview would request to be included the survey – (see below).

Problem 2 'Lazy' random sampling

Although I remained in the village during the days of survey to oversee the survey in action, I had to hand over a degree of trust and responsibility to the research team. I refrained from following the team around the village to check up on them, which would have detracted from the objective of maintaining as little fuss as possible during the survey work. Usually I was also engaged in employing other research methods in the village at the time of survey. As much as possible discreet checking was carried out to ensure random sampling had been done in each village. I frequently

visited 'random' houses to thank respondents for filling in the survey, whilst additionally checking that somebody had in fact been to survey them. Furthermore, often village residents would stop me in person to say the team had been to their house to conduct the survey. However, it is always a possibility since I was not doing the work myself, that corners could have been cut.

A habit the researchers may have picked up was group interviewing households rather than individual interviews of household heads. Often people are found congregated around village central points: temples, the village TV, playing cards etc... As detailed in chapter 3, people are not often in their houses (unless sleeping or eating), which are not particularly convenient times for survey questions. The research team sometimes argued that conducting the survey was much easier if they approached a group of people and documented their address. The team would then strike off those houses from the village list to be surveyed. Furthermore, rather than conducting individual interviews, the group may have been interviewed as a 'quicker' alternative.

The main problem with this is that when interviewed as a group, there is a risk of respondents agreeing with each other rather than stating their own opinions without external influence. In particular, some of the Dhonirevu surveys all state greatly similar perceptions of problems, which raises some suspicion that group interviews took place; respondents may have simply agreed with each other over one or two issues stated by group members. This problem was also found to occur when I carried out semi-structured interviews during pilot surveys. In a group – people often agree with what one person has stated, whereas responses might be different if elicited in isolation. Indeed the tendency of this to happen – people to form groups - is a good indication of the need for a far more PRA based technique rather than a random survey to gauge perception.

Problem 3 Estimating assets - net amounts in a household

Net amounts owned by households in villages were estimated by the head of the household is both monetary value and weight in kilograms. Generally people seemed to hold knowledge over the weight of nets they possessed rather than monetary value, which makes sense since many of the nets are old, prices of nets change and it might be difficult to quickly give an estimated current value. Additionally, people are generally reluctant to discuss the monetary value of their assets in a survey. These factors, along with some rather wild estimated values, are likely explanations as to why value of the same nets does not always match with weight of nets (calculated as Rs per kg) amongst different households. In general, net value estimations using kilograms of weight were better elicited during qualitative interviews with fishermen.

With hindsight it would have been a useful exercise to ask net prices from hardware store owners (the sellers of the nets) in Pulicat town.

Appendix 3.3 Feedback letter which accompanied village reports

Miss Sarah Coulthard
Centre for Coastal Management
Newcastle University
NE1 7RU
UK

Dear .....

I am sending to you a summarised *Preliminary* version of the report I will be writing about your village.....

Firstly let me thank you greatly for the help you and your village have already been kind enough to give me in my PhD studies on the Pulicat Lake. I certainly could not have managed to do my research without the great hospitality and kindness of the Pulicat Lake people.

I am giving this report to you in the hope you will discuss it with fellow villagers during a meeting for the following reasons indicated below.

1. I want to be sure that the information I am writing in my report is accurate and truthful. By giving this early version of the report to you, I can gain feedback and your comments on any errors or any parts of the report that you feel I have misinterpreted.

2. Secondly I feel it is my responsibility to ensure that you as a village are kept fully informed and updated on what I am doing with this research and on what I am writing. I am writing your views and opinions so it is my duty to ensure you have access to the reports.

3. Thirdly I feel yourself and others in the village might be interested in what I am writing, and may want to ensure I am on the 'right road' with my writing and to add extra statements or clarify misunderstandings. I hope this will be the case and if it is so, I will look forward to receiving all comments possible on the reports. You are the experts on Pulicat Lake, not I.

After receiving this report and agreeing to discuss it, I shall make an appointment with you in 1 WEEK (to be arranged through my translator Magesh) to visit you and listen to your comments personally.

I thank you in advance for being so kind as to take the time and effort to read the report and I look forward to receiving your views on what I have written.

Please don't worry to tell me if I am wrong in something and feel free to be as critical as possible. These reports will hopefully be used to inform the outside world about the people of Pulicat Lake and therefore it is of vital importance that the writings are correct and a true representative of your lives and opinions.

With many thanks
Miss Sarah

APPENDIX TO CHAPTER 4

Appendix 4.1 Further details on key fishing gears in use at Pulicat lake

Padu fishing gears

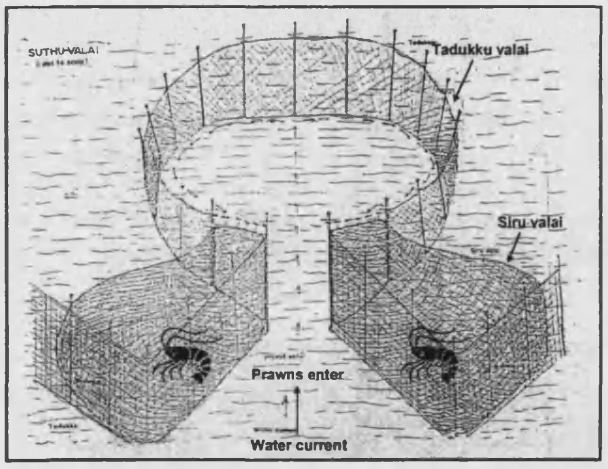
This section describes the most commonly used fishing gears in the traditional padu system at Pulicat lake. Within the Padu system, a degree of politics exists over who owns a particular type of net. These factors are also explained alongside practicalities of gear use.

Stake nets

There are several different types of stake net classified with different names according to the water depth to which the net is suited. Only fishers with Padu fishing rights may use stake nets to fish the lake. The two most common stake nets in use at Pulicat lake are described below.

Suthu valai

Image source adapted from Mathew 1991



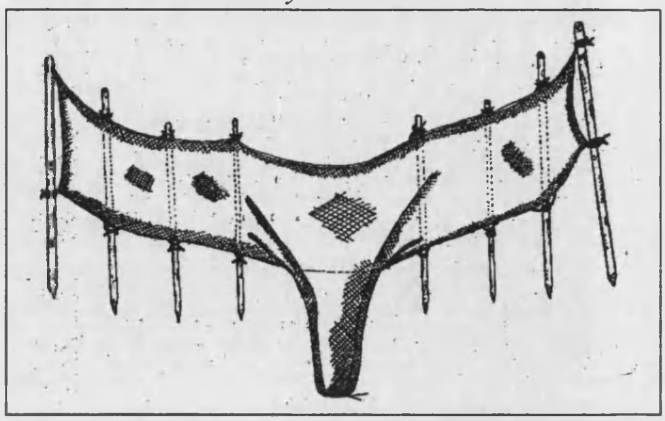
Suthu valai is the main stake net used by the traditional Pattinaver Padu villages (Kottaikuppam, Andikuppam, Nadoor Madha kuppam, and the more northern village of Annamalaicheri). It consists of two parts: the Siru valai and the Thadukku valai.

Suthu valai is the main stake net used in the Padu system. The village household survey revealed that in the Padu village of Nadoor Madha kuppam 96% of surveyed households owned Suthu valai (n=50), whilst in Annamalaicheri 95% owned Suthu valai (n=20).

Adaipu valai is the main stake net used in the deep bar mouth Padu area. The net was introduced after 1964, taking over from the traditional *Kattuvalai* that necessitated people to be in the water to operate it. This was preferred to the Kattuvalai as there is no need to get into the water when retrieving the net, which is a hazardous activity for the fishermen in the deep bar mouth area and fast flowing receding tide.

Adaipu valai (The stake net used in Dhonirevu village for deeper lake water fishing)

Source: Krishnamurthy and Rao 1970



Fishing with stake nets:

Mathew (1991) describes how fishing with stake nets is done mostly during the low tide when prawns migrate to the sea: "The tadukku functions as a barricade in the path of the mobile prawns. Once they encounter the tadukku, they tend to swim against the current and consequently get caught in the siru valai" (Mathew 1991:3). Mathew also describes that the Padu fishermen set up the stake nets in the evening, and then reclaim the catches in the following morning after low tide (on the incoming tide) "The same village will fish in both fishing grounds on its allotted days from 6pm to 6am" (Mathew 1991:8). It is my understanding that Stake net fishing is not restricted to overnight fishing, since tide times shift by an hour each day. Fishermen seem to follow the tide times and fish only during the receding tide. In the Kerala Padu fishing system documented by Lobe and Berkes (2004), stake net fishing is actively prohibited during the incoming tide, a rule enforced by villages independently from the state and the punishment ranging from a 100Rs fine to expulsion from the fishing society (Lobe and Berkes 2004). The authors state "Fishers were keenly aware of the importance of allowing the shrimp to enter the backwaters to breed. As one fisher states "if we take them now, we won't get the catch on the way out"" (Lobe and Berkes 2004: 277).

This awareness also seems to exist in Pulicat since generally fishing is done on the outgoing tide rather than the incoming tide. The most productive fishing days are centred around the full moon and spring tides since the stronger (spring) tides bring more prawns (more prawns migrate at stronger tides swimming downstream towards the sea[103]).

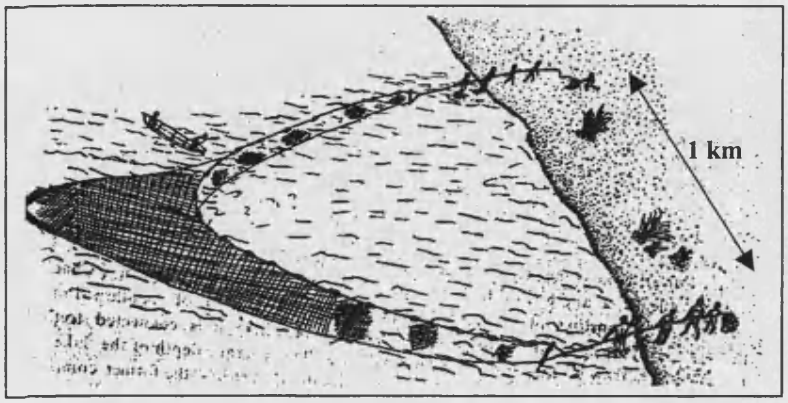
One 'padu' fishing unit comprising of a single boat with 2-3 fishermen usually will carry 3 sets of Siru valai, and in good season this can rise to 6 sets of Siru valai, which means that during a single fishing day bounty is so rich that the nets are emptied and replaced frequently and the number of times nets are replaced is not restricted

[103] Evidence of prawn migration at spring tides is vast – and this phenomena is discussed further in chapter 6

(Mathew 1991). Mathew also notes that the operation of the Suthuvalai extends across the entire lake (in parts) which blocks the movement of pawns and affects the catch of fishermen downstream (Mathew 1991), although this is less so during the monsoon when the lake water spread area extends.

Badi valai (Beach seine)

Source: Krishnamurthy and Rao 1970



Badi valai is a large beach seine (up to 1km wide), which also falls under the system of Padu fishing. Only Padu fishermen can use Badi valai, and only one Badi valai per village may be operated on the allocated Padu fishing day of that particular village. For example, in the Padu village of Kottaikuppam there are 12 Badi valai nets. Since only one Badi valai can be fished at a time, a net owner in this village can only fish with Badi valai once in 36 days (10 times per year). A single badi valai is usually owned by 2-3 people in the same village who share in the cost of the net (which can be as much as 200,000 Rs (£2500) per net).

It takes up to 70 people to operate the net, dragging the net along across Pulicat Lake, catching prawn, fish and crabs[104]. Workers operating the net are paid 120Rs per day by the net owner, and workers of Badi valai do not have to be Padu fishermen[105]. Operating Badi valai is a financially risky business for the net owners and this is one likely reason why only the more wealthy fishing families are associated with ownership (Mathew 1991, also notes that Badi valai is considered a symbol of affluence).

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[104] Mathew (1991) comments on the large capacity of this net to catch most living things in the lake, fish crabs and prawn included. The mesh size of the Badi valai gradually decreased from 50mm to 30mmin in the wings and further to only 15mm in the bag (Mathew 1991), and the results of this change in mesh size may have had adverse impacts on the fishery, or vice verse may be a direct adaptation to an already declining fish catch. Coherent data on Pulicat lake productivity is sparse and the changes on the fishery are so complex it is difficult to substantiate whether this change in Badi valai alone is a contributing factor to a possible fishery decline, at least within the scope of this thesis.

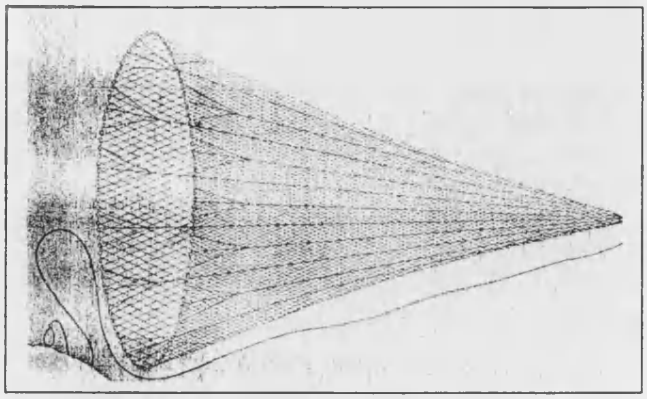
[105] Badi valai workers usually come from poorer sections of society, and lower caste villages, either northern agricultural workers (part time fishermen), or scheduled tribes. Also scheduled caste fishermen from Edamani work for the Badi valai – this village has poor Padu rights of its own and strict fishing restrictions- as is explain in the next chapter. In lean fishing times when everyones incomes are low Badi valai owners tend to employ net operators from their own villages (Dhonirevu Focus groups meeting Village elders).

The Badi valai owner/ owners have to pay costs for the hire of 4 boats and up to 70 people to operate nets (each worker is paid 120Rs daily wages, *regardless* of the catch worth). As well as the daily wage, food and Arrack (liquor) is provided to the workers who spend the whole day in the water operating the net. Net workers do not get any share of the catch, so if catches are poor it is the owner who loses, as he still has to pay the wages and costs for operation. Kottaikuppam Badi valai owners estimate it costs 15,000Rs to operate Badi valai for a single day. They also admit that sometimes they do not catch this worth and make a loss, although when catches are good, the few owners of the net receive all the profit. Mathew (1991) states that on a good day, a single day's fishing with Badi valai can fetch up to Rs 20,000 in value in 1991 (Mathew 1991), a colossal amount considering the Marine Fisheries Department Census data for 2000 states that few Pulicat inhabitants earn over Rs 15,000 in an entire year!

Due to these regular windfalls, which are witnessed by other non Badi valai fishermen within the Padu villages, Badi valai is the net that everyone in the village wants to one day own. The costs however are huge both for initial purchase and the trade off between good and poor catches and payment of operation. Some groups within the village of Kottaikuppam are trying to from larger cooperatives to raise money to buy their own Badi valai, but this is a precarious activity since there are already 12 Badi valai nets in this village and new additions would reduce even further the fishing opportunities of current owners. Any new Badi valai entrepreneur would have to be sure of highly profitable catches since they would be able to fish their net less than 10 times per year.

Non Padu fishing gears
Cast net 'Mani valai'[106]

A hand held Cast net with lead weight beads at the bottom fringe is used by many non Padu fishermen and non traditional fishermen. Since its operation does not require a permanent location for placing stakes, or consent from Padu fishermen, it is widely used throughout the lake. According to Hornell (1924) Cast nets have been used traditionally by fishermen throughout the Tamil Nadu coast for many years (Hornell 1924).

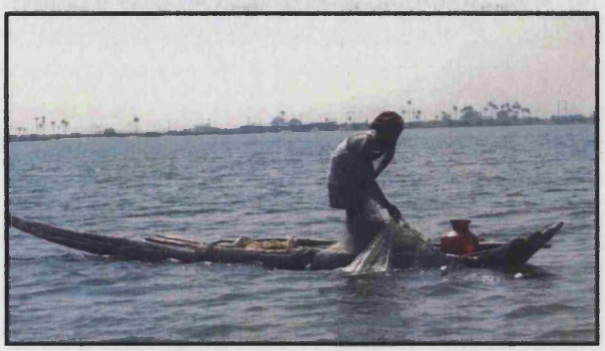


[106] Mani valai in Tamil means 'bead net' in reference to the small beads used as weights around the circumference of the net. Many forms of cast net exist throughout the backwater fisheries in Tamil Nadu, known by a variety of names (Hornell 1924).

Source: Hornell 1924

Gill net 'Araivalai'

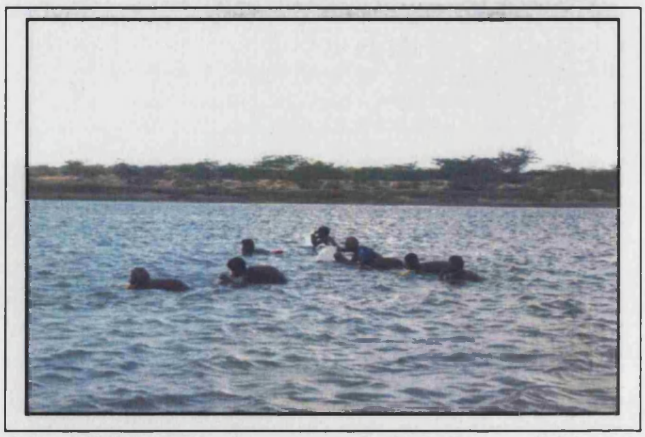
A half-inch small mesh sized net with floats on top edge and weights along the bottom. These gill nets are relatively small and tend to be placed in the edges of the lake well away from Padu fishing grounds (Edamani focus group pers comm).



Fisherman operating small gill net from a Kattumaram, Pulicat lake 2003

Prawn fishing by hand

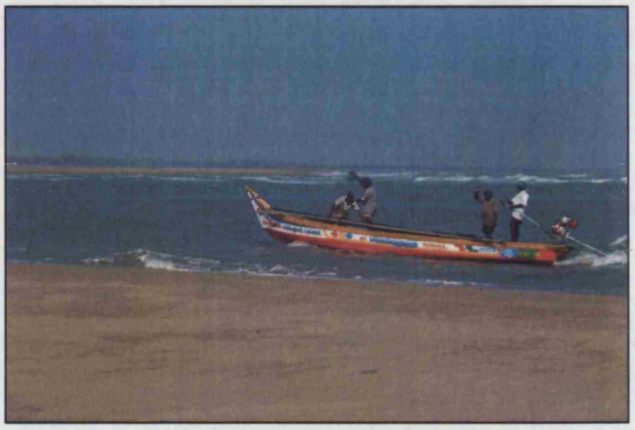
Those communities without either fishing rights in the Padu system or small non Padu fishing nets earn a living by fishing for prawns by hand. Hand fishers catch prawns for selling at market and also look for female prawns with eggs, which they sell to local aquaculture farms. This occupation is seen as the very poorest and lowest means of fishing, and usually only scheduled tribes will fish in this manner. This situation changes however when Pulicat receives good rains and prawn productivity in the lake booms. After any heavy rainfall, many more fisherfolk can be seen hand picking prawns – although in established fishing castes such as Pattinaver this is largely an activity confined to the women. However, I recall one morning after particularly good rains when even my interpreter stated his temptation to go hand fishing since, "literally people were scooping out large handfuls of prawns at every try".



Hand fishing for prawns in Pulicat lake, 2003.

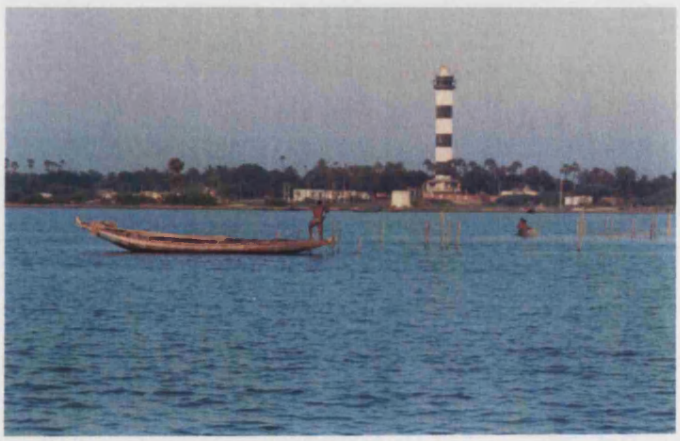
Fishing boats in operation at Pulicat lake

Marine fishing FRP (fibreglass plastic) boats are used only in the sea by Marine fishermen. All have outboard engines and most also have wind sails.



Small scale fishing in a Lake **Kattumaram,** the cheapest type of fishing boat used by many non padu fishermen, such as the cast net fisher below:

Setting up Padu stake nets in the evening using a traditional **country boat**



APPENDIX TO CHAPTER FIVE

Appendix 5.1 Rating survey data – Further analysis of differences in ratings given by inhabitants of marine fishing villages and lakeside fishing villages.

Coding of respondents villages

Analysis of differences in average ratings given for categories according to village required recoding of the village variable into the following categories:

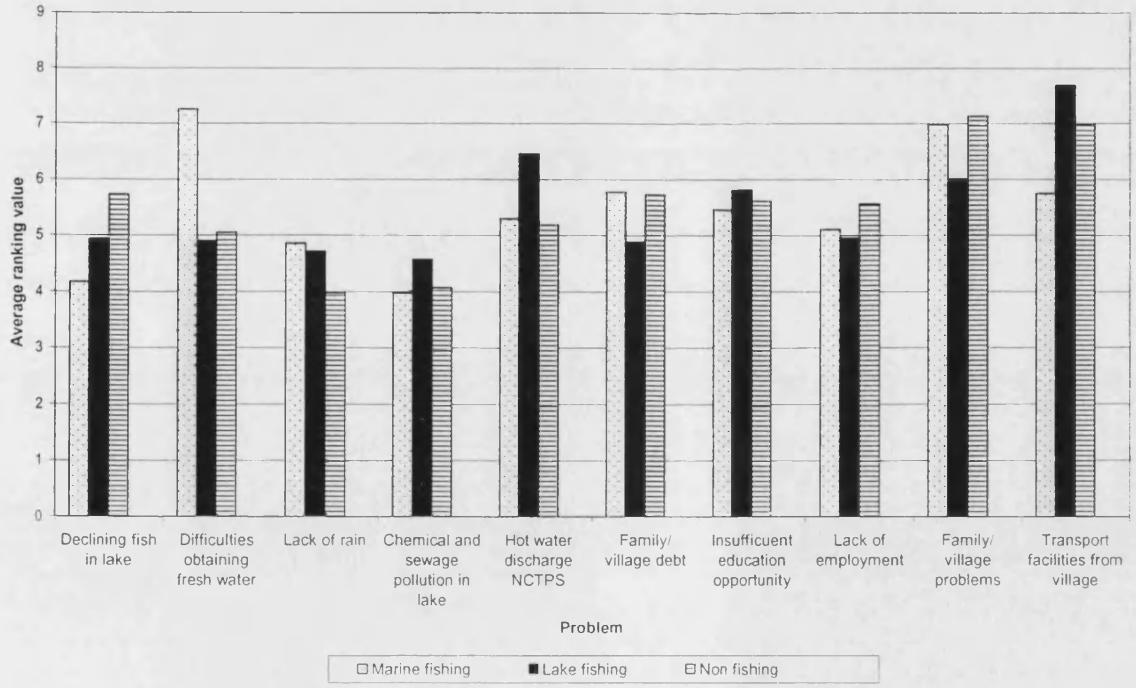
Village type	Category code	Frequency	Percentage of sample
Marine fishing village	1	53	28.6
Lake fishing village	2	58	31.4
Non fishing village	3	61	33*
Unknown village	4	7	3.8
Missing	0	6	3.2
Total		185	100

*All respondents are from Pulicat town

Each village was roughly categorized into the above sections, which essentially showed predominantly marine fishing villages and predominantly lake fishing villages. It is recognised that some marine villages also seasonally fish in the lake, but for this purpose – the *dominant* fishing type was used.

Average rating values for villages categorised according to fishing type

Note: Rating scale is 1= most important, 10 = least important



(Note)

- Non fishing villages are included however the category only includes Pulicat town (33% of respondents were from Pulicat town).
- Unknown villages are excluded since it is not known whether these are involved in fishing and therefore little can be deduced from their inclusion

From this graph we can see some marked differences between average ratings of coastal management priorities:

1. Marine fishing villages rank difficulties in getting fresh water as less of a problem (average rating is at 7.25) where as Lake fishing villages rank water higher (4.9). This is probably due to most marine fishing villages located on the Lighthouse Island have access to their own fresh water through bore wells dug into the sand. There is one particularly well known reliable and plentiful bore well in Karimanal village and this well serves many of the island's villages, which are mostly located in close proximity to the well. During the fieldwork period, many of the villages on the main land (predominantly lake fishing) were reliant upon delivered drinking water due to shortages and the reduction in the number of working drinking water pipe lines.
2. Another difference is transport, which lake fishing villages consider as a less important problem than marine fishing villages. A likely explanation for this would be that most of the marine villages are located on Lighthouse Island and only accessible by boat. In the qualitative interviews, people from marine fishing villages frequently referred to the need for a bridge to be built across the lake. Evidence of the commencement of building the bridge was sighted in 2003 although details of the building are still to be confirmed.
3. Declining fish in the lake, lack of rain and chemical and sewage pollution all have important ratings and received similar scores regardless of village type. Pulicat town is one exception to this, which ranked 'declining fish in the lake' as a relatively less important problem than the fishing villages. This might be expected since unlike the fishing villages, Pulicat town is not fully dependent upon fishing.

Appendix 5.2 Pulicat lake fisheries data recorded in the 1960s and 1970s

Total landings of prawn and mullet between 1965 - 1972 (in metric tons)

Source: Bhuvaneswari (2003), Kaliyamurthy (1978)

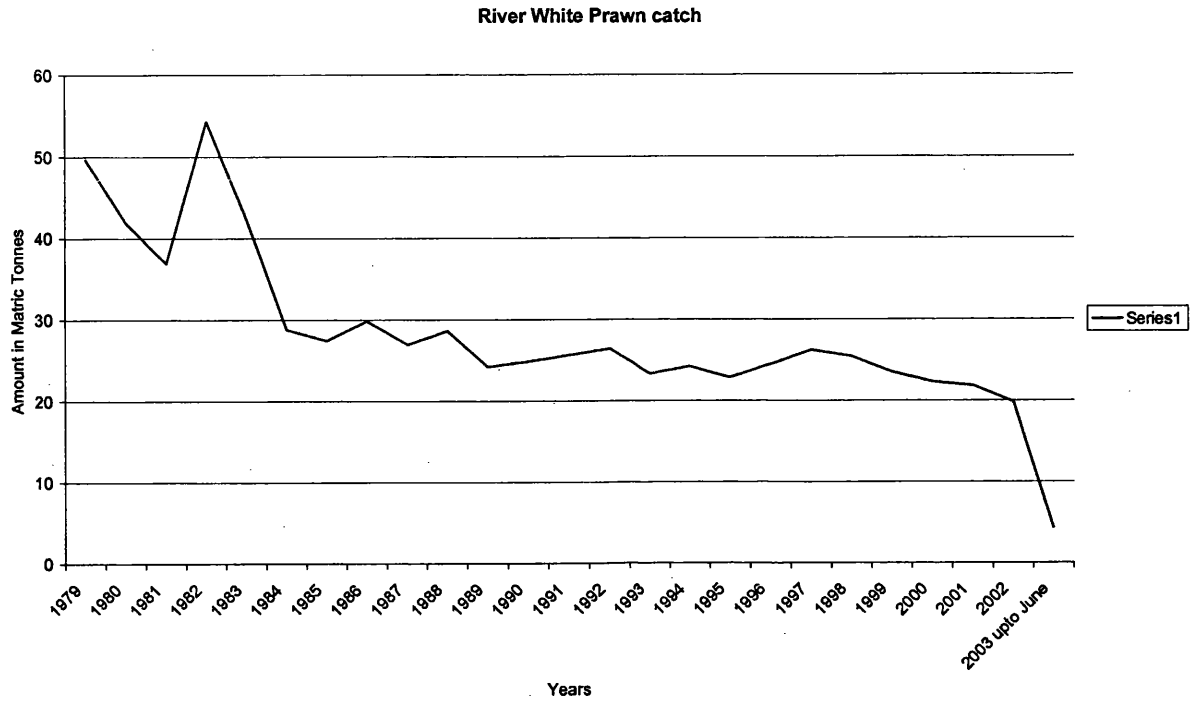
Group	1965	1966	1967	1968	1969	1970	1971	1972
Prawns	478	519	634	378	566	561	417	569
Mullet	317	204	202	193	215	214	297	382

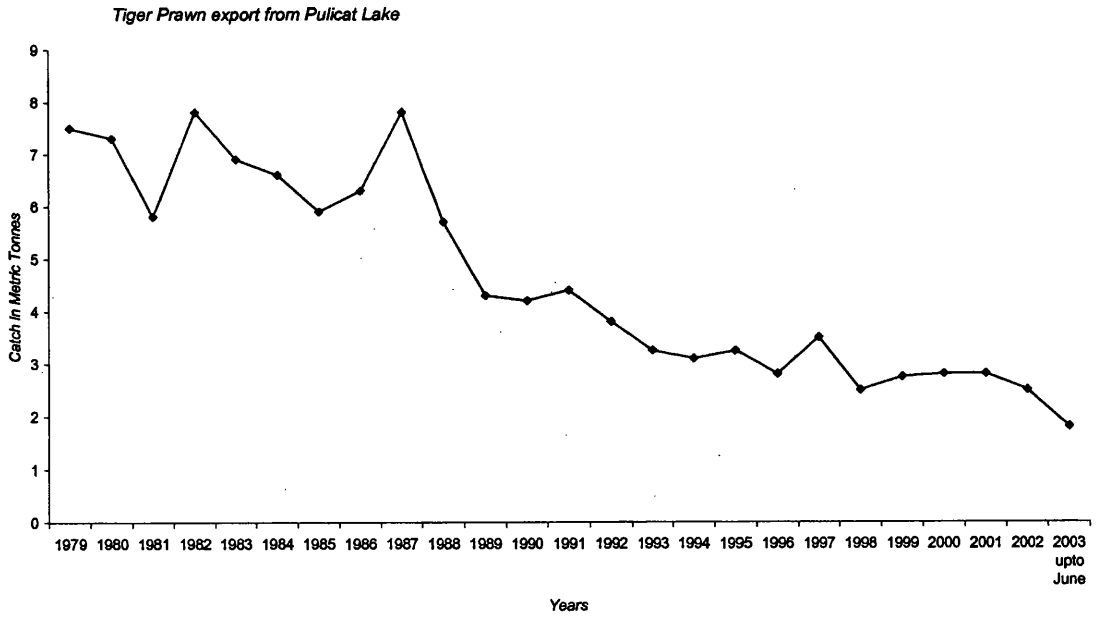
This data is a typical fragment of the available fish catch data records, which are currently drawn upon by academics to establish fish catch trends. Typically high variability between years requires a much longer time period for monitoring fish catch data. Short bursts of monitoring data such as this are meaningless in terms of establishing insight on the lakes longer term productivity and sustainability.

Appendix 5.3 Export data from 3 prawn export companies operating in Pulicat town

Combined data from 3 export companies operating from Pulicat lake were acquired through a local contact. Export details are extremely sensitive as competition and rivalry between export companies are high. Combined data show substantial decline in exports of both Tiger prawn and White prawn since 1979 to 2003. However, since data on the behaviour of the 3 prawn export companies during these years is not available, we can not be sure whether the decline is accountable to falling fishing catches and availability of prawn, or through reduced activity by the export companies in Pulicat lake. One might assume that high prawn catches could automatically create a high level of export activity, however, external influences such as increasing availability of farmed prawns from aquaculture development, and other unseen influences makes this a dangerous assumption. Therefore the declining trends seen from this data need to be treated with a degree of caution and unreliability.

Total Pulicat Purchase from three export companies (All in Metric Tonnes)





Appendix 5.4 An analysis of differences in net ownership between fishing villages

Differences in village net ownership were tested for using Analysis of Variance (ANOVA) around the average amounts (in Kgs) of the *most commonly found net* in each village.

The most commonly found net – is defined as the net type that appears most frequently in households throughout the village survey.

Fishing net types used in each village differ greatly, and hence it is not possible to analyse difference in amounts of the same net. Instead I have taken the most commonly found net in each village and analysed whether differences in amounts of this net owned can be found. This would be useless if total net weight was used since one net could theoretically weigh more than another type of net. It is also counterproductive to compare the number of nets that people have (available from SFD Census data) due to vastly differing sizes and lengths of different net types, a single beach seine 'Badi valai' for example would both weigh and cost far more than 1000 cast nets 'Mani valai'.

For the analysis of average amounts, those households with 0 amounts of the net were counted as 'missing values'. Kulathumedu was excluded from the analysis since only 5 households owned any sort of net.

Table 1 *Most frequently occurring nets in analysed villages*

Village	**Most frequently occurring net owned by respondents**
Arangankuppam	Pannu valai (54% of respondents)
Dhonirevu	Adaipu valai (98% of respondents)
Christian kuppam	Suthu valai (96% of respondents)
Edamani	Suthu valai (61% of respondents)

Table 2 Average amounts (in kg) of the most frequently found fishing net owned by households of 5 study villages

Descriptives

NET1KGS Amount (kgs) of most common net

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
5 Naduvoor Madha kuppam	47	8.3404	2.95088	.43043	7.4740	9.2068	5.00	15.00
6 Arangankuppam	37	29.5676	42.27131	6.94936	15.4736	43.6615	4.00	200.00
9 Edamani	35	4.3429	.80231	.13561	4.0673	4.6185	3.00	6.00
17 Dhonirevu	81	7.1975	3.56167	.39574	6.4100	7.9851	3.00	31.00
21 Annamalaicheri	19	11.3421	4.07585	.93506	9.3776	13.3066	6.00	20.00
Total	219	11.1256	19.37946	1.30954	8.5446	13.7066	3.00	200.00

Table 3 ANOVA of mean amounts (in kgs) between and within villages showing significant differences between means amounts of nets owned in each village

ANOVA

NET1KGS Amount (kgs) of most common net

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15809.411	4	3952.353	12.803	.000
Within Groups	66063.386	214	308.707		
Total	81872.797	218			

Table 4 Post Hoc tests

Since a highly significant overall difference between average net amounts was found using one-way ANOVA between villages, it is worth further analysing the data using the Scheffe test to assess where exactly the major differences in net ownership amounts lie between villages.

Multiple Comparisons

Dependent Variable: NET1KGS Amount (kgs) of most common net

Scheffe

(I) VILLAGE Village	(J) VILLAGE Village	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5 Naduvoor Madha kuppam	6 Arangankuppam	-21.2271*	3.86157	.000	-33.2262	-9.228
	9 Edamani	3.9976	3.92281	.904	-8.1918	16.186
	17 Dhonirevu	1.1429	3.22171	.998	-8.8680	11.153
	21 Annamalaicheri	-3.0017	4.77661	.983	-17.8441	11.840
6 Arangankuppam	5 Naduvoor Madha kuppam	21.2271*	3.86157	.000	9.2281	33.226
	9 Edamani	25.2247*	4.14290	.000	12.3514	38.098
	17 Dhonirevu	22.3700*	3.48635	.000	11.5369	33.203
	21 Annamalaicheri	18.2255*	4.95895	.011	2.8165	33.634
9 Edamani	5 Naduvoor Madha kuppam	-3.9976	3.92281	.904	-16.1869	8.191
	6 Arangankuppam	-25.2247*	4.14290	.000	-38.0980	-12.351
	17 Dhonirevu	-2.8547	3.55407	.958	-13.8983	8.188
	21 Annamalaicheri	-6.9992	5.00679	.744	-22.5569	8.558
17 Dhonirevu	5 Naduvoor Madha kuppam	-1.1429	3.22171	.998	-11.1537	8.868
	6 Arangankuppam	-22.3700*	3.48635	.000	-33.2032	-11.536
	9 Edamani	2.8547	3.55407	.958	-8.1889	13.898
	21 Annamalaicheri	-4.1446	4.47872	.930	-18.0613	9.772
21 Annamalaicheri	5 Naduvoor Madha kuppam	3.0017	4.77661	.983	-11.8407	17.844
	6 Arangankuppam	-18.2255*	4.95895	.011	-33.6344	-2.816
	9 Edamani	6.9992	5.00679	.744	-8.5584	22.556
	17 Dhonirevu	4.1446	4.47872	.930	-9.7722	18.061

*. The mean difference is significant at the .05 level.

Post hoc tests shown in table 4 above clearly show that a statistically significant difference in average amount of 'main' net ownership (in kgs) exists between the marine village Arangankuppam and the other villages which are all lake padu villages. Arangankuppam owns in all cases far more amounts of nets than any other village. There is no statistically significant difference between net amounts owned by the Padu lake fishing villages. As stated in chapter 5, this is probably due to marine fishing nets being of larger size and greater weight than lake fishing nets.

Appendix 5.5 Coding of responses given in the Village Household Survey question:

"What are the top 3 problems that you feel people in your village are facing, which coastal managers should be prioritising?"

Finalised coding list of perceptions: PROBLEMS

New Code	Original Code	Perception category	Perception description / given responses
0	0	Blank	Perception not given
1	1	Building temple	Insufficient funds to complete a new temple (in Kottaikuppam village)
2	2	Insufficient drinking water	Lack of access to drinking water due to summer drought – dependency upon infrequent deliveries
3	3	Drainage problem	Poor drainage of rain water from the village/ flooding in monsoon
4	4	Domestic sewage water	Domestic sewage in the street/ open and poor sewer standards/ broken sewer pipes
5	5, 31	Lack of women's opportunities	Education, self employment, training or job opportunities specifically mentioned for women Inc. no small scale industrial opportunities (said once)
6	6	Jellyfish pollution	Pollution released into the lake from treatment of shoreline jellyfish processing units
7	7, 8, 11, 18, 46	Village problem	Diamond problem (Reference to an internal family feud in Kottaikuppam village) Lack of village unity (A lack of unity within and between villages – village fighting) Village problem (Internal problems to the village – politics/ feuding) Improper politicians, government officials and village administration Village s weak (lack of strength of village in numbers)
8	9, 10, 12, 49	Insufficient income	Unable to run family (Insufficient funds to feed and maintain family life) Insufficient income from the lake (fishing) Low income not specified due to fishing declines Poverty due to low income
9	13	Business problem	Not fishing related
10	14, 22, 45	Prawn farm problems	Aquaculture affecting fresh water table (Prawn farms located (300m from Edamani) affect the fresh water table) Too many prawn farms (No reasons given as to why that is a problem)

			Acquisition of village land for aquaculture
11	15	Not a member of the fisherman cooperative society	An individual problem rather than village problem
12	16, 47, 50	Problem of marketing prawns	Jellyfish sales impact prawn buying (Prawn interest declines due to interest from jellyfish companies) Reducing prawn sales Exploitation by prawn exporters buying for low prices and making high profits
13	17	Need a canal	The Buckingham canal facilitated trade between the lake and Chennai but is less used today
14	19	Pollution from Prawn farms	Aquaculture run off into lake water
15	20	Lack of prawns/ fish in the lake	
16	21	Pollution of lake (general)	No specific cause mentioned
17	23, 33	Lack of children's education	Including no village school
18	24	Pollution from NCTPS	Hot water realised from Power station into the lake
19	25, 37, 39, 43, 52	PADU problems	Restricted fishing due to Padu Imposed fishing restrictions for Edamani village (during monsoon season) Increased poverty due to reduced Padu from increasing population increase has caused Padu rights to be divided and restricted for village fishermen Marine fishermen fishing in Padu lake Padu caused problems (unspecified how they are a problem) Andhra Pradesh fishermen invade Padu places
20	26	Environmental problem	Not specified
21	27, 28, 29, 30, 53	Lack of employment	**Self employment and jobs for youth** No opportunity for self-employment Lack of employment for educated youth Lack of employment for youth Lack of opportunity for self-employment for youth Idleness of youth due to lack of employment
22	32,40	Insufficient housing/ living space	Including space for housing

23	34	No hospital / medical facilities	There is one hospital in Pulicat town but this I poorly equipped and poorly staffed.
24	35	No proper roads	'Proper' means tar covered and hence driveable in monsoon time.
25	36	Bar mouth closure	Refers to the seasonal closure (due to lack of rain) of the lagoon entrance – reduces the prawn catch
26	41, 42	Population increase	Population (unspecified why a problem) Population increase causing unemployment increase
27	38	Dependency on a single (fishing) profession	
28	44	Debt	
29	48	Lack of monsoon rain	Can be problem through drought, bar mouth closure, lack of drinking water
30	51	Jellyfish swarms affect nets	Jellyfish swarms become entangled and break nets

Finalised coding list of perceptions: SOLUTIONS

Code	Solution category	Solution description
0	Blank	Perception not given
1	Getting donations	Collect donations to do group activities, help the village as a whole
2	Government responsibility	It is wholly a government responsibility to provide the solution
3	People's responsibility	The people of the village should be responsible to help themselves and provide solutions
4	Government support to pensions	Government should provide support to old age people through pensions
5	Petitions	The village should organise a petition against the problems
6	Improve education	
7	Re-open / build a canal	The Buckingham canal facilitated trade between the lake and Chennai but is less used today
8	Make agitations / fight the government	In reference to the communities past agitations including strike, protest and riot against the state government
9	Improve unity	Unite villages
10	Communicate with government and officials	Better communication with officials about the problems of the lake
11	Leave the village/ migrate to other place for work	Leave the village and move elsewhere
12	Better unity between	Together work to solve the problems – Inc

	government and village	in Edamani talk of Helping hands trust
13	Supply jobs/ alternative employment (by government)	Other to fishing in most cases/ so not wholly dependent upon fishing
14	Increase finances	Through increasing incomes from livelihoods but also could be through loan access – loan access was not mentioned here directly
15	Increase access/ ability to go for another job	Not necessarily asking for job offer, but rather the opportunity to look for a job.
16	Improve drinking water facilities(no mention of government)	Includes facilities & more building tanks
17	Build a (government) hospital	
18	Open bar mouth	Physical opening and maintenance of lagoon bar mouth
19	Improve road facilities	
20	Create job opportunities for youth	
21	Government must solve drinking water problem	Government responsibility to provide sufficient drinking water, build new tanks and more facilities
22	Training for self-employment (given by government)	
23	Dredging of bar mouth (government not mentioned)	Instances where 'dredging' was suggested as a method to keep the bar mouth open. Usually states 'we should dredge' in reference to past dredging done by villagers
24	Restrict fishing by marine fishermen	
25	Government responsibility to dredge bar mouth	
26	Government should protect lake and stop pollution	
27	Remove illegal industries polluting without permits	
28	Dig more bore wells for more drinking water	
29	Government should stop sewage pollution	
30	Increase the lake resources	In reference to prawn fishery
31	Ban prawn farms from polluting the lake	
32	Government should allot more housing space	
33	Government should stop jellyfish industry pollution	
34	Government should give training and loans for women's self-employment	

Appendix 5.6 Indicators of household fishing dependency using data from village household village survey

Data on household fishing dependency is primarily derived from 3 questions included in the household survey:

1. Main income provider
2. Is there any other income coming into the house? (If yes from whom, for example, other family members)
3. Has your income source ever been different? If yes, what work did you do in the past?

From these data, aspects of: 1) livelihood change and, 2) household income dependency upon fishing, can be used as indicators to assess the household dependency upon a fishing livelihood.

1. Livelihood change

The first indicator is an assessment of how many people in each village have changed their livelihood, both in terms of changing entirely from one profession to another and also in terms of diversification, a move from one job into two jobs (a job is defined as 'Main income provider' in the survey).

Ability to change occupation can indicate adaptability to change, which is further discussed in chapter 7 of the thesis. This appendix details how indicators of livelihood change were constructed and analysed.

Changes in livelihood - categorisation

Coding	**Main income provider**	**Alternative past income source**
	0 = Other (than fishing)	0 = No
	1 = Fishing	1 = Yes
	2 = Fishing + other	

Condition 1

When Main income provider = 1(fishing) and
Alternative past income source = 1 (Yes)
Result = **New fisherman**

New Fishermen - A Fisherman whose main income source was derived from other than fishing, but whose main income now comes from a fishing livelihood.

Condition 2

When Main income provider = 0 (other than fishing) and
Alternative past income source = 1 (Yes)
Result = **Ex fisherman**

Ex-fishermen - A fishermen whose main income is now from a source other than fishing but who had a different previous occupation

Note [since respondents in this situation were few, it was possible to check individual surveys and in all cases previous income source was from fishing, hence Ex-fisherman status]

Condition 3

When Main income provider = 2 (fishing + other) and
Alternative past income source = 1 (Yes)
Result = **Diversified fisherman**

Diversified fisherman - A fisherman whose main income comes from two sources, one of which is fishing, and whose previous occupation was different to this combined livelihood.

There are two types of diversified fisherman

Type 1 A fisherman who in the past only did fishing and now does fishing and another job

Type 2 A fisherman who in the past did not fish, but now does fishing and another job (this could also be counted in the 'new fisherman' category, but for the sake of clarity, here it is counted as a diversified fisherman, somebody who has adapted to fish as well as keep another job.

The results show that these types are quite specific to each village and very small in numbers, hence this categorisation seems to work.

Condition 4

When Main income provider = 1 (fishing) and
Alternative past income source = 0 (No)
Result = **Continuous fisherman**

A continuous fisherman - A fisherman whose main income comes only form fishing and has never had a different past income source or occupation.

Condition 5

When Main income provider = 0 (Other to fishing) and
Alternative past income source = 0 (No)
Result = **Non fisherman**

Table 1: Changes in Livelihood in 4 villages at Pulicat lake

Explanation of changes in livelihood

Naduvoor Madha kuppam

1 ex-fisherman who no longer fishes due to ill health is now involved in business
3 diversified fishermen are fishing alongside prawn business (note 1)
2 diversified fishermen are fishing alongside business
1 diversified fisherman is fishing alongside contract building work

Of the diversified fishermen all are of type 1 (were fishing originally and diversified into an additional income provider). Of those who went into the prawn selling business, one mentions this was through a contact with a prawn exporter and 'large prawn shed' owners, one mentions he was pushed through lack of fishing income and another mentions he was able to diversify into the prawn business with the help of his wife and friends. The building contractor was able to diversify due to being elected as a Union Panchayat councillor, and another was forced to diversify into fishing and business due to ill health (unable to fish full time).

Arangankuppam

Village	Total No. of valid respondents	No. of New Fishermen	No. of ex-fishermen	No. of diversified fishermen	No. of continuous fishermen	Non fishermen
Naduvoor Madha kuppam	47	0	1	6	40	0
Arangankuppam	70	0	0	0	69	1
Dhonirevu	84	28	0	4	51	1
Annamalaicheri	20	0	0	0	1	0

1 respondent was a non fishermen and was instead involved full time in selling fish to non-fishing villages.

Dhonirevu

28 New fishermen
4 Diversified fishermen

The 4 diversified fishermen are all of type 2 (those who were not fishing originally, but who have diversified into fishing as a main income provider). All 4 worked as both a fisherman and Kuli. Of those 4 fishermen, one was the village president, and the other three were originally 'Kuli' workers[107]. One plausible reason for their change is (as was highlighted by qualitative interviews) is the displacement of the

[107] In Tamil, Kuli is the word used to describe a hired labourer and is similar to the European colonial word 'Coolie' used to describe a hired labourer native to India.

village from Sriharikota island where there was a wealth of plantation work, to the mainland (plantation work is often described as Kuli work).

Past occupations of 28 new fishermen;

22 worked as Kuli in the past
1 watchman
1 Carpenter
1 tailor
Crale catching
Building contract
Plumbing and wiring

2. Household dependency on fishing income

Using the variables 1) Main income provider and 2) Additional household income

Condition 1

When Main income provider = 1 (fishing) and
Additional household income = 0 (No)
Result = **High dependency on fishing**

A high dependency household is categorised one where all money coming into the household is through fishing.

Condition 2

When Main income provider = 1 (fishing), 2 (fishing + other) or 0 (other) and
Additional household income = 1 (Yes)
Result = **Low dependency on fishing**

A low dependency household is categorised when either, the household head reports having a main income provider that is other than fishing, or additional to fishing, or / and that money other to fishing enters into the household from another source (not necessarily the main income, but could be through children or spouse earnings). Hence the household is not wholly dependent upon fishing as the only source of income.

Condition 3

When Main income provider = 0 (other than fishing) and
Additional household income = 0 (No)
Result = **High dependency on other than fishing**

These households do not fish as a main source of income but have no other income entering the household

Table 2. Degrees of household dependency on fishing derived from indicators of additional income for 4 villages at Pulicat

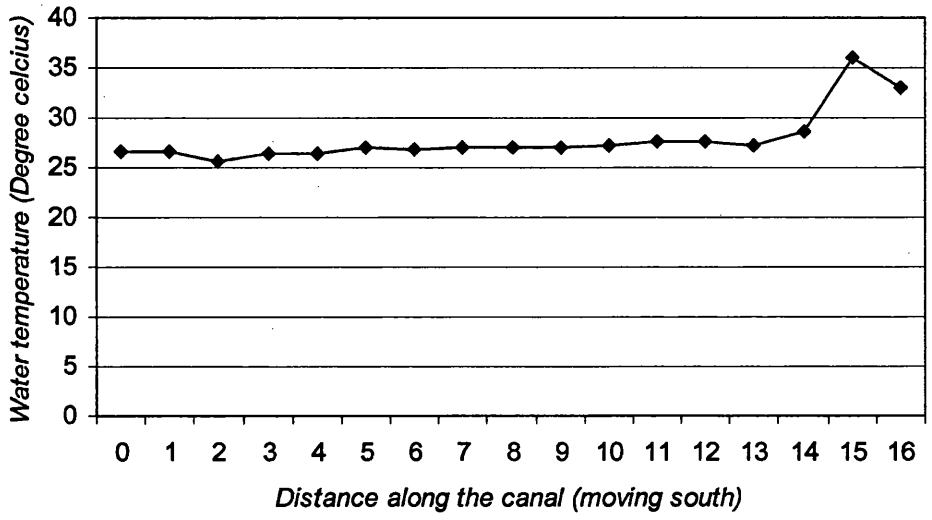
Village **(values in brackets are percentages of total number of respondents)**	**No. of high fishing dependent households (1 – 0)**	**No. of low fishing dependent households (1 – 1) (2 - 0) (2 – 1) (0 – 1)**	**No. of high dependent households – on other than fishing (0 – 0)**
Naduvoor Madha kuppam	41 (84%)	7 (14%)	1 (2%)
Arangankuppam	69 (99%)	0	1 (1%)
Kottaikuppam	82 (87%)	9 (10%)	3 (3%)
Edamani	43 (75%)	13 (23%)	1 (2%)
Kulathumedu	57 (79%)	9 (13%)	6 (8%)
Dhonirevu	70 (83%)	13 (15%)	1 (1%)
Annamalaicheri	20 (100%)	0	0

APPENDIX TO CHAPTER 6

Appendix 6.1
Figure 1 Thermal pollution by the NCTPS, Chennai

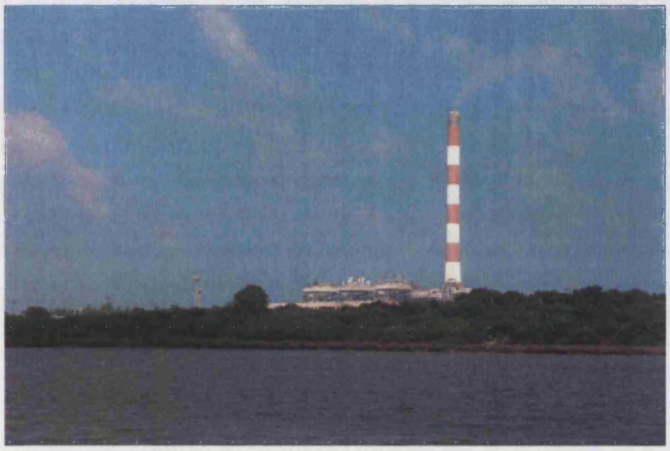
Water temperature was surveyed (July 2002) moving south from Pulicat lake bar mouth (located at distance 0) to the NCTPS thermal water release outlet (located 15km south of the bar mouth). The below graph indicates that a rise in temperature is only felt around 1-1.5km away from the NCTPS release point (see Box 1). The bar mouth at Pulicat lake was partially closed during the survey, however the opening to the sea at Ennore creek (close to the discharge point) was open. When these bar mouths are both closed, it is possible that temperatures may differ.

Graph 1: Changes in water temperature (Degrees Celsius) with distance (km) moving towards the NCTPS

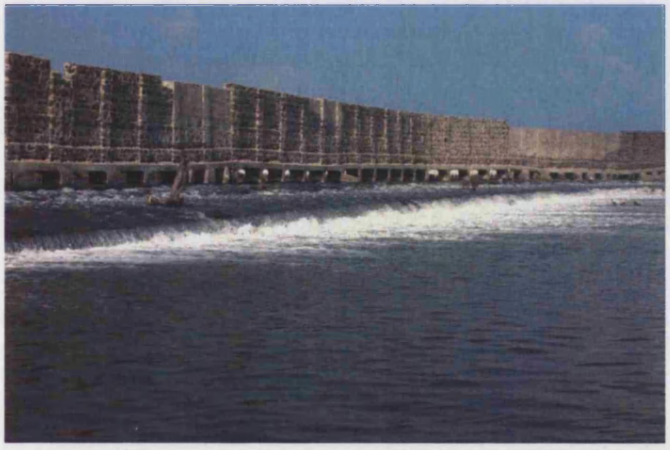


Box 1: Images of the NCTPS

1. View of the NCTPS from the Buckingham canal.



2. Release point of thermal waste water into Ennore creek backwaters. Recordings of water at the release point showed temperatures of 36 Degrees Celsius, 10 degrees above the water temperatures recorded at Pulicat lake during the same survey (Pollution control board states that a minimum of 5 degrees higher is only permissible)



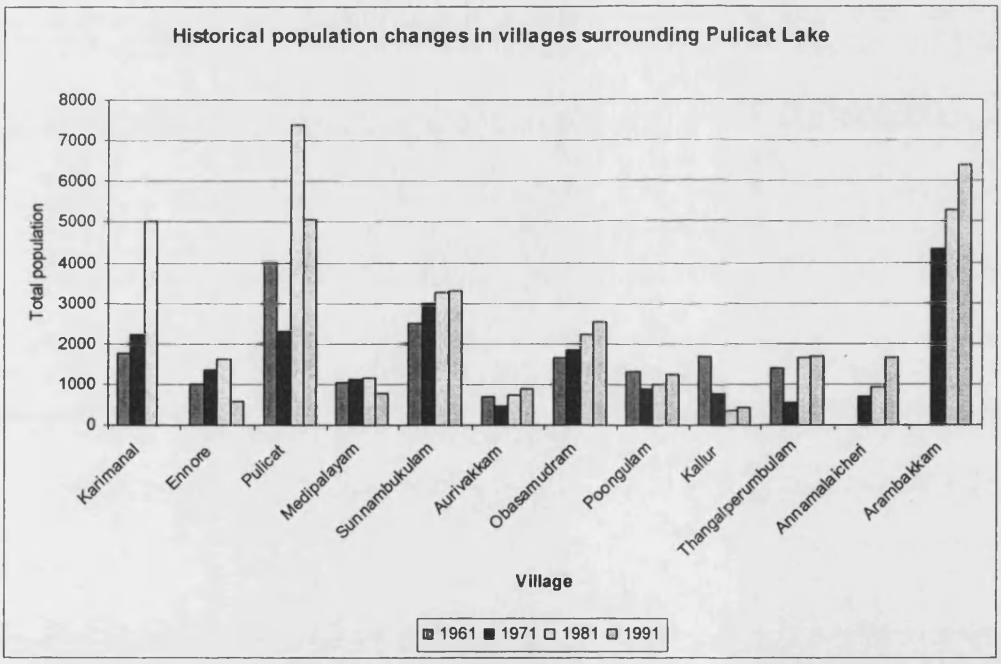
Appendix 6.2 Population change in Pulicat lake town and surrounding villages according to State census records.

State census data were documented and analysed. Since population *change* is the point of interest, only those villages that appear in more than one census have been included (12 villages in total). These include the main villages (and small towns) at Pulicat Lake and cover the district of Gumminipundi Panchayat union in the West of the lake to Minjur district in the south.

Natural population change in villages surrounding Pulicat Lake

An analysis of population change (graph 1) reveals the highly different nature of individual villages and towns around Pulicat Lake. In some villages there has been a population decrease, following a boom in the 1981 census (Pulicat, Karimanal and Ennore). In other villages there has been a steady fall (e.g. Kallur) or rise in population (Sunnambukulam, Obasamudram, Annamalaicheri and Arambakkam).

Graph 1: Population change in Pulicat town and surrounding villages



Note: Karimanal population after 1981 falls to zero as the village was displaced from Sriharikota Island, and was excluded from the following years census.

This analysis suggests a dynamic aspect of change in the area. In one decade a village can be a thriving fishing village, the next decade it can become a ghost town. A good example of a changing town whose population has risen and then fallen is Pulicat town. Downsized to 'village' status in the 1991 state census, it has a history of a famous cloth and weaving industry, which has now completely vanished and been replaced by predominantly trade for the lake's fishery. Other villages such as

Arambakkam and Annamalaicheri have steadily grown in population. These are both *fishing villages* and are located in the western areas of the lake.

However, livelihood change which may accompany growth and decline in village populations are difficult to reliably ascertain from census data, since the census categorisation of 'fishing' is inclusive of many other livelihoods (Livestock, forestry, fishing, hunting and plantations, orchards and allied activities, and Mining and quarrying).

GLOSSARY

TAMIL TERMS

Arrack	An illegal liquor distilled from Palm trees
Crore	One million
Gram Panchayat	Village council installed by the government
Kattumaram	Simple boat of lashed timbers usually Casuarina pole
Kuppam	Village
Kuthagai	An agreement between a fisherman and a fish trader. The fisherman will sell the trader an agreed portion of his catch for one year in return for a monetary loan. Kuthagai can be set up between a trader and individual fishermen, fishing groups or an entire fishing village.
Lakh	One hundred thousand
Padu	Fishing space
Padu Kulukkal	A yearly meeting held on an auspicious day when lots are drawn for each fisherman of the Padu system
Padu system	The traditional fishing management system in use at Pulicat lake
Panchayat	Traditional village council *not* installed by the government
Talekettu	Membership to the Padu system which is bestowed on male Pattinaver caste fishermen
Valai	Fishing net

Relevant Castes:

Pattinaver	The traditional fishing caste in Tamil Nadu (includes Marine and Lake fishermen)
Scheduled Caste	The lowest of the caste system and includes within it 'Untouchables' or Dalits (meaning 'depressed') which fall outside the caste system.
Scheduled Tribes	(Tribals, Irular or Adivasi- meaning aboriginals) are external to the caste system. They are considered a lower social status than Scheduled Caste.

Tamil terms for fishing gears

Suthu valai	Stake net consisting of two parts: *Siru valai* (Bag net) and *Thakkaku valai* (Wall net)
Adaipu Valai	Stake net adapted for use in deeper water
Badi valai	Large beach seine used in Pulicat lake
Mani valai	Hand held cast net
Kendai valai *Or Araivalai*	Small gill net
Sirutholil	Small-scale fishing with non Padu fishing gear The littoral meaning is 'small occupation'

ACRONYMS

BoBP	Bay of Bengal Programme (funded by FAO) Chennai India
CIFRI (now CIBA)	Central Inland Fisheries Research Institute (now Central Institute for Brackish Water Aquaculture)
CMFRI	Central (Central government) Marine Fisheries Research Institute
CMNRM	Community Based Natural Resource Management
CRZ	Coastal Regulation Zone Act 1991
DOD	Department of Ocean Development (Central Government), Chennai, India
EPA	Environmental Protection Act 1986
FAO	Fisheries and Agricultural Organisation of the United Nations
HTL	High Tide Line – the point of the shoreline where the highest spring tide can not pass
ICM	Integrated Coastal Management
ICMAM	Integrated Coastal Marine Area Management Project (ongoing) between the DOD and IOM
ICSF	International Collective in Support of Fishworkers, Chennai, India
IOM	Institute for Ocean Management, Anna University, Chennai, India
MPEDA	Marine Products Export Development Agency
NCTPS	North Chennai Thermal Power Station
SFD	State Fisheries Department (Government of Tamil Nadu)

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