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Environmental Change in South Central Chibuto Southern Mozambique 1965-2000

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Chapter 1

Literature review, methods and local case study

1.1 Introduction

The Intergovernmental Panel on Climate Change (IPCC, 2001) has called attention to problems of global environmental change particularly with reference to climatic stress. Africa, for example, is singled out as being particularly vulnerable to climatic change. The populations and communities of the less developed countries are said to have less capacity to adapt and are therefore more vulnerable to stresses including climate changes (Blaikie *et al*., 1994; IPCC, 2001). The main issues of concern for less developed countries and the African continent, in particular, include possible adverse changes in seasonal river flows, floods, tropical cyclones and droughts. The impact of these adverse changes, it is suggested, will lower incomes of vulnerable populations and increase the absolute number of people at risk of famine (Pielke and Guenni, 1999**;** IPCC, 2001). These climate stresses, however, do not occur in isolation and often usually exacerbate or accentuate a range of underlying stresses (e.g., land-use conflicts, health problems, governance etc). Moreover, the role of multiple underlying scales and stresses, including those stresses driven at the macro-level but cascading through the system, to interact at the local scale, is an important features attracting attention in global change research (e.g. Berkes, Colding and Folke, 2003).

The overwhelming majority of communities in Africa live in economies of transition, which are neither fully traditional nor modern (Vogel, 2004). Typically, some communities, but not all, have lost their risk-avoidance mechanisms of the past, but they have not been sufficiently incorporated into the modern economy to take advantage of a new range of risk avoidance options. Thus communities[1] are often more vulnerable to ecological degradation (Ojima, Galvin and Turner, 1994; Turner, 1997, Ashley and Maxwell, 2002). Vulnerability is defined as system's ability to

[1] Communities although varied, share similar problems and opportunities and interact through various activities due to their relative dependence on local resources which enables them the construction of

restore and recover from stresses, its sensitivity and adaptive capacity (Blaikie *et al*., 1994; Luers, 2005).

In order to reduce people's vulnerability, strategies that sustain livelihoods over the long term are suggested (Ellis, 1999). Diversification of livelihoods is seen as a strategy for reducing vulnerability. Diversification means that livelihood strategies depend on a variety of resources (e.g. soils, forests, pastures, waters, capital) and activities to secure a living (e.g. cultivation, fishing, hunting, gathering, wage employment, informal commerce) (Smith, 2001). Diversification reduces vulnerability to stress and shocks, because it is closely allied to flexibility, resilience and stability. Diverse livelihoods are usually also less vulnerable than undiversified livelihoods, because in the diverse livelihood strategy households construct a portfolio of activities and social support capabilities for survival in order to improve their standard of living and adapt to a wide range of misfortune including long-term stresses and shocks (Chambers and Conway, 1992; Ellis, 2000; Smith, 2001). In addition to local-based strategies, a favorable macro-economic policy, is also important for vulnerability reduction, as is highlighted by IPCC, 2001:

> "Policies that lessen pressures on resources, improve management of the environmental risks, and increase the welfare of the poorest members of society can simultaneously advance sustainable development and equity, enhance adaptive capacity and reduce vulnerability to climate and other stresses" (IPCC, 2001, 5).

Smith (2001), however, cautions that instead of diversified activities, productive replacement is the more appropriate term because during periods of shock and stress households replace one productive strategy with another. This is particularly important in conflict and post-conflict scenario where the range of alternative activities is often compromised (Satgé, 2004).

To achieve sustainable and diverse livelihoods the analysis of the constraints and the strengths existing in communities and their interaction with their environment is

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their sense of community (e.g. Broderick, 2005).

critical. The importance of livelihood analysis rests on the consideration of people's ability to obtain access to resources and entitlements including the options they can seek to utilize when a negative hazard or shock occurs (Boudreau, 2001). These resources and access to them often undergo change, including changes to land cover and land use over time due to a combination of slow and faster moving drivers of environmental change (Geist, 2005).

In this study, both the impact of the land-use and land-cover changes in South Central Chibuto, Mozambique and responses (e.g. coping and adaptations) to such changes are examined for the period 1965-2000. This investigation also includes the impact of the 2000 catastrophic floods and other recent developments including HIV/AIDS and the consequences of globalization. This is because changes in political economy over time and the subsequent land-use changes cause cumulative vulnerability to various global environmental changes (Smith, 2001). Such changes induce a process whereby negative structural impacts percolate down and accumulate at the household and local levels often exacerbating individual and households' vulnerability (Smith, 2001):

> "Household level vulnerability, for example, might be in a (sic) regional political economy; a history of underdevelopment at a regional level not only results in that particular region becoming more vulnerable to change as a whole. Within the region, individuals, households and communities find themselves less able to deal with shocks and stress as their access to resources might be constrained by an economic down turn leading to job losses or the effectiveness of regional institutions in offering support and applying interventions my be lessen or their ability to do so is in turn constrained"
> (Smith, 2001, 37).

One of the biggest challenges in analyzing vulnerability is, however, capturing the evolution of the system's sensitivity, the effects of which are often not immediately apparent. This is because the vulnerability of people and place derives from a complex interplay of factors defined by a long history of human environmental interactions (Smith, 2001; Luers, 2005). There is therefore a need to monitor the factors that motivate decision-making that leads to changes in vulnerability of socio-ecological options over different temporal and spatial scales (Luers, 2005).

1.2 Land-use and cover changes: Drivers and consequences

A fundamental aspect of global environmental change studies is land-use and land-cover change and associated driving forces shaping change. Land-use and land-cover changes and global environmental change form a complex and interactive system linking human action to land use/cover changes to environmental feedbacks, impacts and human responses (Lambin, *et al.*, 2001). This view of land-use studies involves both the manner in which the biophysical attributes of the land are manipulated and the reasons underlying landscape change that are linked to human agency in many cases (**Fig.1.1**) (International Geosphere and Biosphere Program-International Human Dimension Program, IGBP-IHDP, 1996). Land use/cover changes are also studied at a variety of scales including temporal (short, medium, and long-term changes) and spatial scales (e.g., local regional and international) (**Fig. 1.2**).

Land-use denotes usage of the land (e.g. agriculture, cattle farming, housing), whereas land-cover usually denotes the physical and biological character the land (e.g., forestry, grasslands, urbanized areas) (IGBP-IHDP, 1996). A better understanding of the interaction between human and biophysical interactions therefore requires an interdisciplinary approach and cooperation between both natural and social scientists including policy-makers (Turner, 1997; O'Sullivan, 2004). This is because land-use and land-cover change are complex processes that are not linear continuous processes, but are rather often characterized by disjunct periods of rapid change (Beinart, 1996. Lambin *et al*., 2001). Land-use and land-cover change processes are often triggered by shock events, which can initiate a cascade of changes through the system (Behnke and Scoones, 1993; Lambin and Geist, 2001; Lambin *et*

al., 2001), accentuating or ameliorating changes inherent to a system that have accumulated over long periods of time.

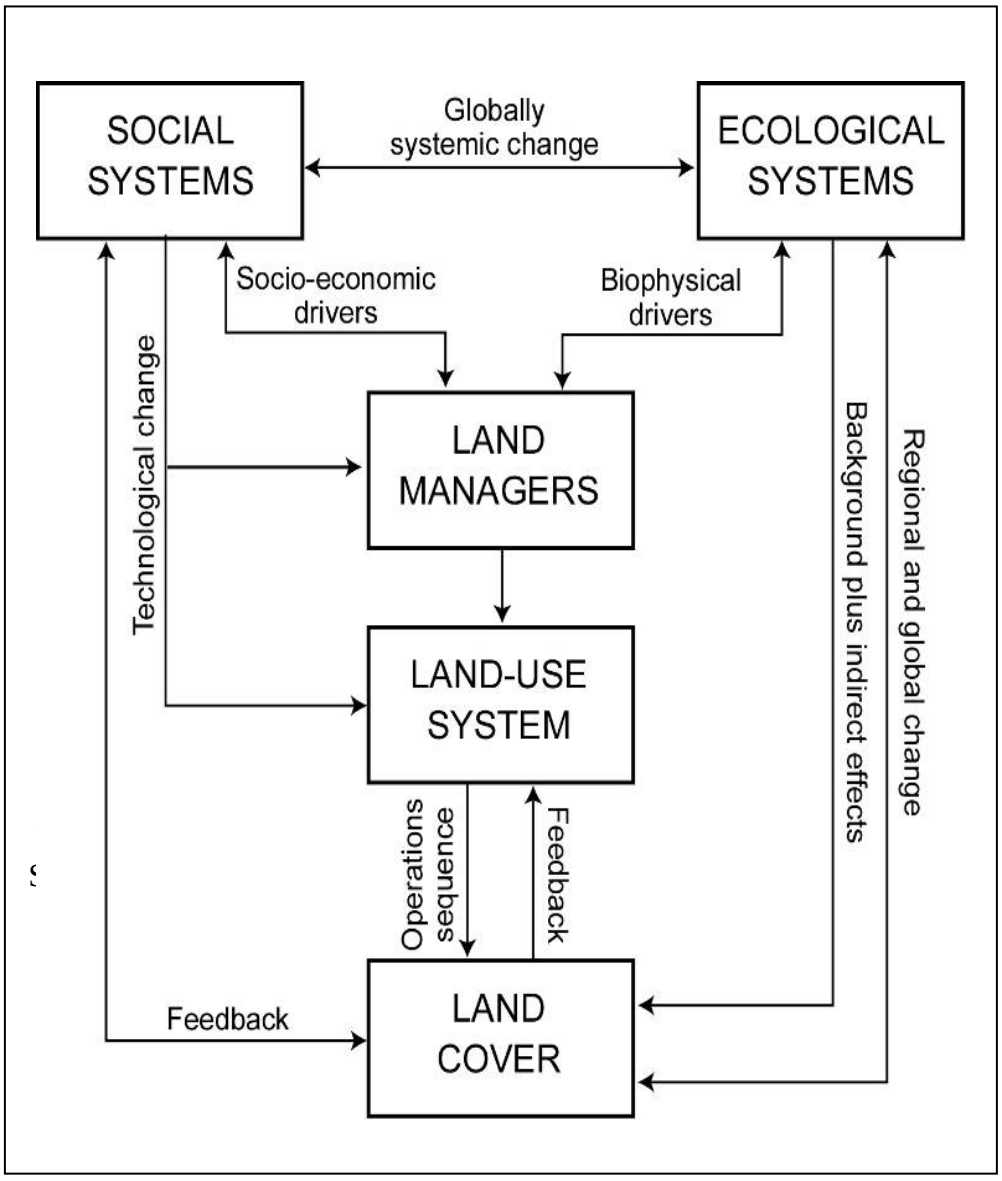


Fig. 1.1: The driving forces of land-use and land cover changes.

Source: IHDP (2005, 16).

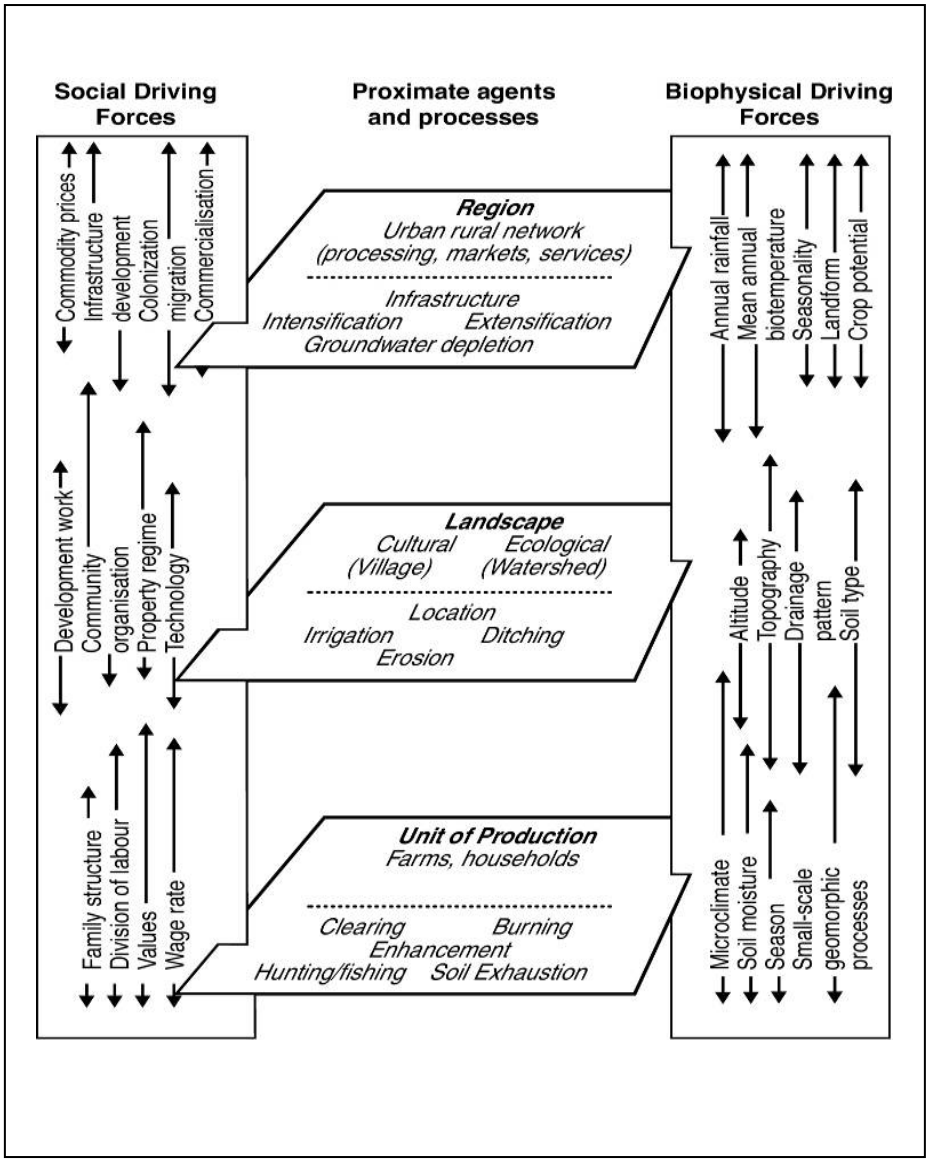


Fig. 1.2: Multiscale Driving Forces in Land Use/Land Cover Change. Source: IHDP (2005, 16).

The interaction of varied human driving forces of land-use and cover-change (e.g. population or development), mediated by existing socio-economic institutions (e.g., Government, NGOs) and influenced by existing biophysical conditions, may also lead to an intended land use, that changes the existing cover or biophysical conditions of land[2]. In some cases these manipulations are negative and can lead to land

[2] These changes may have different degrees of intensity from a total transformation from one land use

degradation (Blaikie, 1987, 1995; IGBP-IHDP, 1996; Kinlund, 1996; Kempf, 1997; Lindskog and Lofstedt, 1996; Turner, 1997).

Land-use change, for example, may involve impacts on the ecosystems in which both positive and negative consequences on human well-being are observed (Millenium Ecosystem Assessment, 2003). Ecosystem degradation furthermore usually tends to impact rural populations more directly than urban populations where poor people are often the most affected. In order to assess the drivers of change in ecosystems and their services, the assessment should include:

> "(…) the interaction of drivers at specific scale levels and over varying spatial temporal and organizational dimensions. Thus, any consideration of environmental change and proposal for action has to acknowledge the social political and cultural dynamics of environment-society interactions " (Millenium Ecosystem Assessment, 2003, 89).

The relationships between land-use and land-cover change and land degradation often act in mutually re-enforcing ways. On the one hand, land and ecosystem degradation will result in changes in land use. On the other hand, land, ecosystem degradation can frequently be ascribed to the effects of land-use and land-cover changes (Blaikie, 1987, 1995; IGBP-IHDP, 1996; Kinlund, 1996; Lindskog and Lofstedt, 1996; Turner, 1997; Millenium Ecosystem Assessment, 2003).

Land degradation that results in loss of potential productivity and utility of the land as a consequence of natural and anthropogenic factures is a contested concept, due to the diverse interpretations of its causal factors. What emerges from literature is that the specific interaction of social and natural factors determines the success or failure of resource management (Leach and Mearns, 1996). It is important to highlight that in this interaction not all declines in potential productivity may be considered land degradation because these responses may be related to climatic events with some decline normally remedied by proper management. Consequently not all processes of environmental change are necessarily processes of land degradation (Biot, 1993; Mortimore and Adams, 1999).

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type to another (e.g. conversion); Intensification of the same land-use type and slight change or

Environmental change and impact studies have therefore evolved from being simple 'driver-impact-consequence' sequences based on linear thinking to integrated assessments (Dahlberg, 1995; Beinart, 1996; Steffen, 1999). Earlier land-use assessments were seen in fairly simplistic ways, where recent, local spatially homogenous alterations of previously pristine land (mostly forest) are converted to agriculture largely due to population pressure (Beinart, 1996; Fairhead and Leach, 1996; Ojima *et al.*, 2002). In more recent assessments, environmental change effects resulting from land-use and cover changes, instead, are being shown to be complex, long term and uncertain; with various trade-offs between land-use choices often being unclear (Geist and Lambin 2001).

Perceptions of both problems and solutions of and for land-use cover and change are furthermore value laden and differ greatly among social groups (Leach and Mearns, 1996; Escobar, 1996, 1998; Adams and Mortimore, 1999). In studies of changes in the land under forest cover, for example, the idea of transition has been discussed. Long-term changes (e.g. decline and rise of land under forest) follow specific historical pathways depending on the specific historical features underlying them; they vary from place to place and in some places have not occurred (e.g., Boserup, 1965; Rocheleau, Benjamim and Diang'a, 1995; Fairhead and Leach, 1996; McConnell, 2004). In forest transition studies, for example, many causes of changes including economic growth and wealth, violence and depopulation and poverty are crucial in explaining the incentives and disincentives to forest growth and decline (Kasperson, Kasperson and Turner, 1995; Ite, 2005; Keys and McConnell, 2005; McConnell and Sweeney, 2005). This view of landscape transition, as will be shown in this thesis, is important in examining the consequences of the driving forces of environmental change in Chibuto where factors including Structural Adjustment Policy, resettlement and war impact on different strategies of resource use and are further mediated by changing institutions, and produce various landscape outcomes.

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modification (IGBP-IHDP, 1996).

A recent assessment of the factors of the intensification of agriculture, for example, under GEC studies highlights the complexity of causal relationships between agricultural change and the underlying causes of both social and biophysical causes driving changes in Africa (Keys and McConnell, 2005). Various 'driving' factors including demographic changes, market access and demand, property regimes and standard of living were observed to be key drivers of change. The demographic factor, however, does not exhibit the traditional Malthusian linear relationship with land degradation coupled to population increase, rather it is shown to be mediated by a series of factors including the role of institutions (Keys and McConnell, 2005). Institutions (Dietz *et al.*, 2003 and Ostrom, 1999) were seen as:

> "(…) the ways that people organize their activities, including both formal rules-in-use that govern people's differential access to and enjoyment of the benefits of natural resources(…)"(Keys and McConnell, 2005, 323).

Although the above-mentioned study does not analyse the role of complex drivers such as conflict, it recognises the need to consider migrations and resettlements in agricultural intensification (Keys and McConnell, 2005). This is because the afore-mentioned processes have a potential to change the institutional arrangements and established environmental practices considered as the 'rules of the game' (Watson, 2001). Such institutional changes could then leave marked and dramatic changes in both land use and land cover changes

The examination of the interaction of contributing factors in a particular landscape thus emerge as key issues when clarifying issues of global environmental change. Specific human-environment trajectories, may lead to situations of criticality (Kasperson, *et al*., 1995). Criticality characterizes situations in which environmental degradation threatens to overburden the resources of the ecosystems leading to loss of life-supporting capabilities (Kasperson, *et al*., 1995). According to Kasperson, *et al*., (1995), criticality is likely to occur where economies exert increased pressure over ecosystems of low elasticity to external pressures. In these critical areas, economic vulnerability of human societies is highly dependent on local natural resources, and is persistently exposed to new forms of land use (Kasperson *et al*., 1995). The

examination of criticality is, however, value laden, and is subject to contested interpretations. It includes the identification of who is degrading and what is being degraded (Brockington and Homewood, 1996; Escobar, 1998).

Having outlined some of the main challenges in interpreting environmental change attention now shifts to a brief discussion of the political ecology approach, an approach that has been used to understand the complex, interactive dynamics of environmental change.

1.2.1 Political ecology approach

Since the early 1970s, environmental studies have expanded into a large variety of academic fields. Geography's contribution to this expanding field according to some was, however, slow and lukewarm (Dietz, 1996). Over time and as a result of growing debates on the potential of geography as an environmental issue, new areas of research have emerged including the political ecology approach that is used to understand environmental change (Blaikie and Brookfield, 1987; Dietz, 1996). The discipline of political ecology is an alternative approach to the neo-Malthusian problematic which dominated environmentalism in the 1960s (Adams, 2000; Smith, 2001):

> "The phrase 'political ecology' combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources and also within classes and groups within society itself" (Blaikie and Brookfield 1987, 17).

Previously ecology was seen as a relatively unproblematic technocratic academic enterprise comprising largely technical interventions and solutions (Escobar, 1998; Berkhout, Leach and Scoones, 2003). Political ecology, however, highlights the critical political, economic arena in which various people pursue various projects with very unequal access to power (Blaikie, 1995).

This discipline of political ecology, some suggest, is central to any meaningful analysis of human environmental interactions (Smith, 2001; Zimmerer and Bassett,

2003). It represents a substantial critique of the conceptualisation of the human-environmental relationships, because it attempts to encompass the multifaceted effects of development on environment and society. Political-ecology, however also draws on Marxist and, more recently, on post-structuralist theory that stresses environmental perceptions as social constructs (Escobar, 1998).

Research in political ecology privileges the impact in local communities of the causal relationships between social and environmental degradation and attempts to tease out resistance triggered by conflicts over access and control over resources (Escobar, 1998; Lansing, Lansing and Erazo, 1998; Robbins, 2004). The main theses of political ecology include (Robbins, 2004):

- Degradation and marginalization (e.g. interpretation of environmental change),
- Conservation and control (e.g. economic exclusion),
- Environmental conflict (e.g. environmental access), and,
- Environmental identity and social movements (e.g. the causes of social upheaval).

The political ecology approach, including the role of the political economy and the natural-resource base, can make a significant contribution to current debates on global environmental change. This is because, as previously articulated, global environmental changes are a result of an accumulation of human activities and decision-making processes, which are shaped by particular cultures, histories, political boundaries and national policies (Blaikie and Brookfield, 1987; Simmonds, 1993; IGBP-IHDP, 1996; Escobar, 1998; Adams, 2000; Smith, 2001 Lambin, Geist and Lapers, 2003).

Political ecology also seeks to integrate explanations across spatial and temporal scales so that local environmental problems can be seen as the product not only of local processes, but also of the political economy at local, national and international scales (Adams, 2000; Smith, 2001; Berckhout, Leach and Scoones, 2003). The study of environmental change and its consequences:

> "demands an approach which can encompass interactive effects, the contribution of different geographical scales and hierarchies of socio-economic organizations (e.g. persons, households, village, and region, state, world) and the contributions between social and environmental changes through time " (Blaikie and Brookfield, 1987, 17).

1.2.2 The critique of the political ecology approach

The main critique to political ecology rests in the need to broaden the scope of the research to developed countries where the political ecological framework is also relevant (Zimmerer and Basset, 2003). Although the critique of global capitalism and its impact on local communities fuelling social movements is important, political ecology is, however, seen to neglect differences between local people in the places under study, particularly differences, for example, in wealth, health, power and other variables (McCarthy, 2005). Political ecology therefore should be more nuanced in its approaches (Peet and Watts, 1996, 2004).

According to Smith (2001), such multiple perceptions of environment must be acknowledged within a biophysical reality. The failure to include biophysical contributions in environmental change may turn political ecology into a political ecology without ecology (Lansing, Lansing and Erazo, 1998; Walker, 2005).

> "Vayda and Walters (1999) are correct that in *some* political ecology the social and discursive politics of access and control over resources take center stage while the biophysical ecological implications of these struggles receive little explicit attention " (Walker, 2005, 78).

The biophysical reality of any environmental change must therefore be analysed in terms of its affect on natural and social and cultural groups and in turn how environmental change itself is shaped by these social and cultural groups (Escobar, 1998; Lansing, Lansing and Erazo, 1998).

The political ecology approach should also privilege the study of political action including the politics of regulatory knowledge questioning why particular knowledge is privileged and institutionalized, thus adding politics to political ecology (Peet and Watts, 1996; 2004). This direction of political ecology is termed *liberation ecology*, because it exposes the potential of environmental ideas for the pursuit of social justice (Peet and Watts, 1996, 2004). The liberation ecology approach is Marxist in origin and is strongly influenced by a post-structuralist approach that seeks to build "a sort of political ecology thick description" (Peet and Watts, 1996, p 38) that considers the nuanced beliefs and practices in different parts of the world rather than only considering the views of western developed countries (Peet and Watts, 1996; Escobar, 1998; Robbins, 2004). This includes local people's interpretation of environmental change and their specific interpretation of development (Escobar, 1998).

More recently, as a consequence of internal critiques, political ecology studies have expanded following on new directions of research thereby deepening the discussion of issues of knowledge (e.g. truth claims), power and practice. In these new directions, socio-ecological relations between global markets and politics and local people are considered as dialectically bound (Peet and Watts, 2004). Issues of indigenous people's knowledge and rights (e.g. identity, social justice and participation) have been privileged in recent case studies covering developing countries (Watts, 2004). Relying on a historical approach in investigating power and practices, hierarchies, entitlements and power are seen as influencing the social dynamics of groups, including land-use patterns and production of knowledge on the definition of environmental problems their causes, consequences and proposed solutions (Peet and Watts, 2004).

1.2.3 Political ecology issues in sub-Saharan Africa context

In the sub-Saharan African context, a political ecology approach has been used to interrogate land use and land cover changes, particularly in the rural agrarian context. Agriculture is the main sector of the economy in many countries, where the majority of the economically active population is usually engaged (African Academy of

Science, 1989). Using the political ecology approach one may track, for example, how social relations in specific political economic settings (e.g., Structural Adjustment Policy) may have and currently exert excessive production pressures on environmental resources that may be transmitted back to the land managers in the form of environmental degradation (Lindskog and Tengberg, 1994; Koening and Diarra, 1998).

Agricultural policy and other economic reforms, for example, in many African countries have involved changes in settlement policies, mostly by converting landscapes from traditional scattered settlements to more concentrated ones (e.g., Tanzania, Mozambique, Zimbabwe, Ethiopia, Botswana, Lesotho and Mali)[3]. These agricultural and settlement policies, aimed at improving the living conditions of the people by, better allocation of social services, have a great potential, however, to contribute to adverse environmental changes (e.g., Araujo, 1988; Dahlberg, 1995; Dahlberg and Blaikie, 1996; Östberg, 1996; Lansing, Lansing and Erazo, 1998; Mulatu, 2000; Ramakrishan, 2000; Robin *et al*., 2000; Thabane, 2000). Resettlement policy, for example, as part of an overall developmental policy, involves massive migration of the population from one landscape to another affecting the traditional land-tenure systems with the potential of fuelling land conflicts and affecting food production and livelihood strategies (Farina, 1994; Adams, 2000). Land degradation can thus be aggravated by large-scale processes, for example, macro-policies such as Structural Adjustment Policy, socialisation of the countryside and collectivisation, can all undermine local adaptation strategies to environmental change (Yoyng, 1991; Lambin and Geist, 2001; Smith, 2001; Watson, 2001; Lambin and Geist, 2003; Tan, Bryan and Hugo, 2005).

In certain countries (e.g. Mozambique, Tanzania and Lesotho) people have been, and are resettled due to big development programs and as a result lose their land. Rarely does the replacement of land in quantity and quality enable people to continue to rely on the types of cultivation strategies practiced prior to the replacement (Koening and

[3] These countries however differ in the ways in which state intervention in land use took place. Respoces to different needs and political economic pressures, including specific colonial economic legacies, (e.g. Moyo, 2000) are important considerations.

Diarra, 1998; Lansing, Lansing and Erazo, 1998; Thabane, 2000). Under certain conditions, development strategies lead to unemployment and proletarization of local people and may fuel social movements like that investigated by Moore (1996) in Zimbabwe, for example, due to the creation of a conservation area.

Rapid urbanization and deagrarianization[4] are also important driving forces of land use and cover changes in Africa, including the adverse social and environmental consequences of urbanization usually associated with conflicts. The political histories of Angola and Mozambique are the most paradigmatic examples (Bryceson, 1999, Jenkins, 2002).

In Mozambique, the resettlement process and deagrarianization are also linked to the rapid increase in foreign investment for the establishment of huge projects in the areas of mining and energy. In Southern Mozambique the main projects are related to the pumping of gas in Inhambane Province, the smelting of aluminium in Maputo Province and titanium mining and smelting in Chibuto, Gaza Province (Jenkins, 2002; Mondlane, 2004).

In the study of environmental change in South Central Chibuto, as is shown in this thesis, a political ecology approach is useful because the region being investigated is a gradient zone, contrasting various natural conditions, as well as reflecting a rich and complex socio-political history that has left significant imprints on the landscape in Chibuto. South Central Chibuto has, for example, experienced different regional, political, and economic policies and ideologies of rural transformation over time, ranging from colonial racist segregationist policies through to socialist collectivist to neo-liberal structural adjustment ideologies as well as globalization (Abrahamsson and Nilsson, 1995), all of which have resulted in some changes in land use.

[4] Deagrarianization according to Bryceson includes a complex process of economic activity reorientation (livelihood), occupational adjustment (work activity and spatial realignment of human settlement (residence) away from agrarian patterns (Bryceson 1999, 99).

1.3 Land use change management practice and consequences in southern Africa

Having broadly traced the political ecology approach and identified sub-themes in this framework critical to this thesis, attention now focuses on some of the factors driving land-use change in southern Africa, e.g. range management, land degradation and the role of various knowledge spheres in understanding environmental change.

1.3.1 The received wisdom on land degradation

A number of conclusions about the relationships between land use practices and degradation were drawn by colonial and post-colonial scientists in connection with policy-makers in Southern Africa (Beinart, 1996, 2002). 'Equilibrium' concepts have (in addition to their impact on ecological theory) greatly influenced the discourse on the management of natural resources.

The origins of the scientific explanation of degradation have their foundations in the concept of equilibrium developed in Darwin's evolution theory, and Clements's succession theory (Ellis, Coughenour and Swift, 1993). Range and livestock management has for years been built around the concept of carrying capacity and control over livestock numbers and grazing conditions (Brockington and Homewood, 1996; Beinart, 1996, 2002).

The equilibrium theory is based on the consideration that ecosystems evolve to a state of climax. An equilibrium is established between environmental factors (e.g., soils, climate and vegetation) that prevail in the absence of human interference. Each climatic region supports particular climax vegetation that thrives in the absence of disturbances. Every ecosystem has a specific carrying capacity which enables it to support a given human population and livestock, which once exceeded, will lead to a spiral of declining productivity (Leach and Mearns, 1996).

Many authors in southern Africa who challenge the received wisdom on land degradation in southern Africa, argue that degradation is explained by the disappearance of natural vegetation considered as being part of the state of ecological equilibrium, and this change is viewed as a linear divergence from the undisturbed original in areas of unpopulated wilderness (Leach and Mearns, 1996; Scoones, 1993; Brockington and Homewood, 1996; Jarosz, 1996). From the idea of equilibrium and climax and undisturbed wilderness, the relationship between growing numbers of people and animals and the resulting degradation is explained.

One of the colonial 'received wisdoms' on the causes of land degradation is that traditional communities in southern Africa are incapable of rational management of the land, forest or water, assets that they have traditionally used for centuries (Tapson, 1993; Beinart, 2002). Likewise, traditional land-tenure practices based on common propriety arrangements, when combined with high stocking rates, both trigger land degradation by mostly prompting soil erosion and bush encroachment (Biot, 1993; Scoones, 1993; Dahlberg, 1995). As a result of those interpretations, the private regime of land ownership is suggested as the most appropriate (Dahlberg, 1995).

Examining the "received wisdom" on land degradation in Zimbabwe, for example, aerial photographs have been used to measure the spatial distribution of the dynamics of historic land-use change and land degradation, focussing mainly on soil erosion (Whitlow, 1988). Soil erosion, for example, was shown to increase with the increase of population densities. The cultivation of marginal erosion prone sites also the increased when land became scarce. In the case of Zimbabwe, the main cause of the increase in population density was the fact that three-quarters of the rural population lived on two-fifths of the land (Whitlow, 1988):

> "Statistical analyses of the variations in the extent of erosion indicated that the most important influences on erosion are population density and land tenure, variables which govern the types of land use and degree of pressure on land. The most widespread and intensive erosion occurs within the Communal Lands…" (Whitlow (1988, 38).

Cultivation was undertaken by poor peasants, often farming communal and less fertile land, allowing the growing of too many animals. Similar studies to those in Zimbabwe have been undertaken in Botswana by Kinlund (1994), in Tanzania by Östberg (1996) and by Watson (1996) in South Africa, all of which showed similar results (e.g., a decrease in productivity with increases in population densities and livestock numbers).

1.3.2 Challenging the received wisdom

Despite the apparent linear relationship between population and livestock, the links from this to land degradation are not so direct and easily discernible. Much debate has been generated on land degradation, particularly regarding identification and causes of land degradation (Dahlberg, 1995, 1996; Scoones 1996). The afore mentioned authors, for example, scrutinised the definitions of land degradation and desertification and outlined some of the existing views on land degradation in southern Africa (e.g. Botswana, Zimbabwe, Lesotho and South Africa). The main conclusion of this review was that African pastoralists overgraze and that their husbandry increases soil erosion and increase thicket encroachment into grassland. Another conclusion was that pastoralists stocking rates have been held to exceed carrying capacity (Beinart, 1989, 2002; Scoones, 1996).

Recent thinking in ecology questions equilibrium theory and shows cases and data that emphasize the inherent variability of many ecosystems (Scoones, 1993). A different view of nature has thus began to emerge that stresses the random occurrence of external events and unpredictable effects of externalities on ecosystems under non-equilibrium dynamics and their impact on populations and species (Ellis, Coughnour and Swift, 1993). Studies in southern Africa show that the views and interpretations that any conversion of natural vegetation constitutes degradation often overlooks the potential of these changes in providing opportunities for local people under their traditional management strategies (Fairhead and Leach, 1996; Scoones, 1996; Escobar, 1998).

The physical extent of degradation is also being increasingly questioned (Stocking, 1996). In certain areas, an increasing number of scientists have shown that degradation of dry lands is not as severe and widespread (Scoones, 1997; Mortimore and Adams, 2004). In a study challenging the traditional view of land degradation, it was found that the relationship between population growth and increases in soil erosion or land degradation, in general, was not always a linear relationship (Tiffen, Mortimore and Gichuki, 1994). Erosion has been shown in Machakos, Kenya, for example, under certain conditions (e.g. introduction of certain conservation techniques, off-farm incomes and migration) to be a passing phase in a farming landscape during transition to different land-uses. Land degradation and land scarcity, together with agricultural extension and assistance, in this case, encouraged the population to find new and more sustainable strategies of environmental management, including intensification and a rise in the value of land relative to labour (e.g. livelihood resources including the regeneration of woody vegetation on the farms, providing fuel, browse, edible honey and medical products) (Mortimore and Tiffen, 1994). Hence it is argued here that an increase in population may actually lead to a reduction of erosion in certain cases.

Studies in South Africa, for example, covering veld management, showed that linearity and character of change, including continual build up of stock numbers was possible for many decades even after alarmist reports several decades ago indicated considerable losses of livestock during droughts. The number of livestock feeding in the same pastures could sharply rise due to rainfall increases, so that absolute stock numbers was not found to be the only factor affecting pastures (Beinart, 2002; Scoones 1993; Asher, 2002). It was also found that in the non-equilibrium paradigm explanations of environmental change, in areas where rainfall is highly variable over time, the correlation between the state of the vegetation and the grazing pressure is weakened. Plants, for example, were found to be scarce because of the lack of rain rather than being caused by the increase in the number of animals (Scoones 1993; Asher, 2003)

In an analysis of existing views on pasture degradation and their management in southern Africa, Scoones (1996), for example, found that some scientists and policy makers in certain cases could neglect the heterogeneity of the environment, and people's coping strategies in their interpretation of grazing systems. Some interpretations of the causes of land degradation often lay the blame on traditional pasture management for provoking overgrazing due to the ignorance of scientific concerns of carrying capacity. Studies in Zimbabwe, however, show, that in most years local cattle owners are able to avoid irreversible damage, measured in terms of productivity, on animals and land, by utilizing strategies of herd mobility (e.g., moving cattle from poor pastures into richer grasses) and local ecological knowledge. Studies in southern Africa showed that policies that apply fixed rules for achieving constant yields or fixed carrying capacity, can contribute to systems that lack resilience (Asher, 2002), rather than increasing robust resilient systems.

Flexibility in land use "management", therefore allows a diversity of responses, which can change from year to year to include the spatial and temporal nuances of droughts or to enable people to switch between different habitats patches. Such activities, however, need to be supported by policy measures that protect tenure rights and access and that facilitate movement during periods of stresses (e. g., Scoones *et al*., 1996; Scoones, 1996):

> "Typically this involves the movement of animals from clay soil grazing areas, where grass production collapses early in a drought, to sandy soil areas, where under low-rainfall conditions, grass production is higher" (Scoones *et al*., 1996, 212)[5].

The new views of resource management and environmental change also call for more detailed studies that could consider recent findings in the fields of environmental management. This includes, for example, indigenous knowledge, that has been

[5] The flexibility and mobility are subject to change as different political economies are introduced through time. Land use change also affects these copying strategies. In the South Central Chibuto case study this issue is often raised. Under political ecology approach many social movements may derive from the denial of flexibility under new management strategies imposed by (e.g. globalization). Changes in flexibility and movement are likely to affect especially women (Carney, 1996; Mortimore and Adams, 1999).

recognized as relevant for the sustainable livelihoods of many communities in Africa (e.g. Richards, 1983; Blaikie, 1985 and Scoones *et al*., 1996):

> "The European aesthetic ideal of the tidy and ordered landscape was very powerful, as were scientific ideas about optimal farming methods imported from the temperate zones of Europe and North America. These emphasized concepts of carrying capacity, stable grass species composition, mixed farming, and so on; all concepts based on notions of stability and equilibrium, and alien to the highly dynamic, opportunistic approaches to farming found in dry land Zimbabwe" (Scoones, 1996, 47).

Most recent studies, as shown above, therefore call for an interdisciplinary approach and the need for the inclusion of the views of local people and their knowledge (Dahlberg, 1996 and Dahalbeg and Blaikie, 1996). The recommendation for an interdisciplinary approach has arisen after the revision of problems of using only technical approaches to manage landscape, e.g. satellite imagery to detect landscape change (Dahlberg, 1996). These methods used alone, without the detailed consideration of local conditions and interpretation by local people, can lead to erroneous conclusions on land management and degradation. Another problem is that most of the derived models (e. g. mathematical and statistically derived models) can be predicated on inaccurate data bases that in turn provide inaccurate assessment of land degradation (Stocking, 1996). Studies undertaken in Zimbabwe, for example, showed that bare ground detected in remote sensing sources is not an unquestionable evidence of soil erosion.

Evidence counteracting the received wisdom was also found in Lesotho, for example, where soil erosion, instead of being caused by inappropriate agricultural practices of local people was a consequence of inadequate conservation works (Showers and Malahleha, 1992). Similar conclusions were also drawn in Botswana, for example, were several studies highlighted that changes that occur in the environment do not result from a degradation of a former pristine uninhabited environment but rather an environment in which people have learned to adapt for long periods living with various environmental stress (Dahlberg, 1996).

Several methods have therefore been suggested to overcome these limited assessments of land-use change including estimations of degradation, using oral history, PRA (Participatory Rural Appraisal), and careful ground-truthing of satellite images. Consideration of the oral history of local people to reconstruct past events has, for example, been recommended when examining land-use changes (Showers and Malahleha, 1992). Qualitative data sets, for example, were used to develop a sequence of events that enabled the measurement of rates of land-use changes in Lesotho. Colonial and post-independence written sources about agricultural development in Africa, often do not pay sufficient attention to the specificity of place and rarely reflect the views of African farmers that are rarely captured in official reports (Showers and Malahleha, 1992). Qualitative data used in the case of Lesotho, was able to overcome the scarcity of written site-specific sources (Showers and Malahleha, 1992):

> "Archives produced official documentation of government activities but not site descriptions. The first aerial photographs were taken in 1950. The only source of direct information about the environment at the research sites during the mid-1930s is questions posed to elderly people about the conditions of the landscape in their youth" (Showers and Malahleha, 1992, 287).

And that:

> "Since general written documentary sources of information rarely had a study of the environmental change as their subject, the challenge is to extract information which can be useful as a (sic) guide in the collection and interpretation of oral testimony, in a study of environmental change at specific locations, the observations and explanations of local people should be seen as preferable *sources of data* to general writings of non-residents - especially if the writers are not natural or environmental scientists" (Showers and Malahleha, 1992, 279), parenthesis and italics added.

The main lesson to be learned from the analysis of the origins of the various different views and approaches on environmental change in Africa and southern Africa in particular, some of which have been highlighted above, is that there are a number of popular views about environmental change that arise from generalisations based on a rather limited number of case studies (Leach and Mearns, 1996). The use of historical data sets of various types, including the oral testimony of local people, provide additional rich sources of evidence that can be used to help improve our

understanding of environmental change and possibly better inform our understanding of landscape change. For improved environmental science, the careful documentation and interpretation of history, rather than inference, is thus an additional and necessary way that can be used to explain environmental change (Blaikie, 1989, 1995; Fairhead and Leach, 1996; Leach and Mearns, 1996).

1.4 Land - use change in South Central Chibuto

Several small-scale case studies or place-based investigations have been undertaken worldwide including those in Asia (e.g. Fox *et al*, 1995; Robin *et al.*, 1999); Latin America (e.g., Lambin and Geist, 2003); and in Africa (e.g. Dahlberg, 1996; Watson, 1996; Scoones, 1997; Stromquist *et al.*, 1999; Smith, 2001) to begin to capture the more nuanced understanding of land-use change argued for in the previous discussions. These studies have all enhanced details in investigations of the linkages between people and landscape (Farina, 1994).

Few such studies have, however, been undertaken in Mozambique. South Central Chibuto and Southern Mozambique in particular, for example, has experienced a very dynamic environmental transformation during the last three decades owing to changes in political economic strategies, war and several environmental stresses (e.g., droughts and floods)(Abrahamsson and Nilsson, 1995; Christie and Hanlon, 2005; Hanlon, 2004; Mushove and Vogel, 2005). This complex environment, however, provides a rich canvas for undertaking a detailed place-based investigation.

In this study, an analysis of different developmental strategies (socio-economic and political driving forces), and their impact on land-use and land degradation are therefore examined. Several studies have been undertaken about agricultural policies in Mozambique (e.g. Wuyts, 1977; Munslow, 1983; Hanlon, 1990). What is missing, however, is the consideration of the environmental consequences of such changes on land-use and land-cover in the country, and deciphering the complex inter-actions of a myriad of drivers or causes of such environmental change. Attempts to capture the changes in land-use and cover, that have occurred in South Central Chibuto between 1965 and 2000 including such an interactive approach, are undertaken here. This period is characterized by a considerable record comprising a collection of historical

dynamics and successive changes in strategies of economic development in Mozambique that will be shown to have shaped land-use and land-cover change in the country (Abrahamsson and Nilsson, 1995).

The driving forces, both human and natural, are considered here, within the political ecology and environmental-history frameworks. The objective is to analyse the main factors, which have led to different strategies of manipulating the land and ultimately changes in land-use and cover in South Central Chibuto. Among the human driving forces of land-use changes, the war, for example, is shown to have had a profound impact on the landscape. Biophysical drivers have also played a significant role in the land-use dynamics in Chibuto, including notably the 1977 and 2000 flood events. Floods are events that frequently mark the beginning of resettlement programs and a host of consequent environmental changes. By studying past environmental developments, including the impact of biophysical extreme phenomena such as flooding, as well as a host of that human drivers of change, this study illustrates some of the dynamic land-use changes and their causes over time. By identifying some of the root-causes of change, the study provides a baseline for future intervention and policy. This is because the political ecological debate over issues of land degradation in southern Africa, challenging the 'received wisdom' on the causes of land degradation, does not imply that the investigation of land degradation, including soil erosion and exhaustion of natural resources and consequent impoverishment of local livelihoods, is of little importance[6]. However more reliable and accurate investigation of causal factors of degradation is required in order to foster more sustainable solutions for environmental problems (Dahlberg, 1995; Hamandawana, *et al*., 2005).

The South Central Chibuto case study, although it constitutes a local-scale investigation, possesses rich temporal and spatial heterogeneity in both political economic events and biophysical characteristics that make this region relevant for the investigation of global research themes including issues of transition and criticality. It is also important to highlight that the Chibuto case differs from several areas that

[6] For example Hamandawana *et al*., 2005, have found that where natural factor endowments prohibit intensive land utilization, high population densities tends to induce dereriorating trends in the state of the environment (Hamandawana *et al*., 2005, 249).

have a single causation factor driving changes, for example areas under deforestation with expanding agricultural frontier including the construction of roads to facilitate logging such as in Amazonia in South America or export commodity expansion privatisation and urbanization Asia (Jiang *et al*., 1995; Kasperson *et al*., 1995; Lambin *et al*, 2001; Yichun e*t al*., 2005). In addition to this consideration, the South Central Chibuto case, unlike other southern African cases studies (e.g. Botswana, Lesotho, South Africa, Zimbabwe) that draw heavily on elements of range ecology due to the specific environments and similarities in political economies of those regions (Scoones, 1993; Abel, 1993), this study, also allows the consideration of local-scale internal differences in cycles and transitions of land-use in complex historical pathways of change.

Finally, local-scale differences in resistance to external stresses including floods and droughts and the use of the local diversity by local people in an interactive way are also a focus of this study. This is because the identification of a region as being local in scale and reasonably homogenous should not neglect the importance of differences across sub areas and social groups within it, for example the distinct interests and skills between peasants of the high land *serra* and lowlands vale or *bila* within South Central Chibuto. A local scale study may reveal a microcosm of different driving forces including their outcomes the understanding of which important for larger-scale studies (Lambin and Geist, 2002; Keys and McConnell, 2005). As will be shown the specific variability of socio-political factors underlying causes of land use change interact with a very high variability in the biophysical environment, at varying temporal and spatial scales creating a rare opportunity for analytical study of environmental change problematic.

Having given some of the theoretical literature that underpins this work, highlighting various pertinent approaches frameworks and methods, attention now turns to outlining the aims, scope, objectives of the South Central Chibuto case study.

1.5 Aims, scope, objectives of the South Central Chibuto case study

1.5.1 The aim

The aim of this research is to assess the interplay of land-use, land-cover, and wider environmental changes in South Central Chibuto over the period 1965-2000. An examination of socio-economic and physical driving forces, that have shaped such changes, is also provided. The case study focuses on South Central Chibuto and aims to illustrate the complexity of the human-environmental interactions that are often masked at coarser scales of investigation (Mertens and Lambin, 1997).

1.5.2 The Scope

The scope of the study is South Central Chibuto in Southern Mozambique, which falls within the Chibuto District, Gaza Province in Southern Mozambique. This area lies between the parallels 24° 40′ and 24° 55′ South and 33° 30′ and 33° 50′ East.

1.5.3 The Objectives

The objectives of this study are to:

- Identify land-use, cover and environmental change and their driving forces between 1965 and 2000 (a period spanning various institutional land-use changes, war and periods of severe droughts and floods).
- Determine, where possible and data permitting, the approximate rates of land-use and environmental change during the above-mentioned period.
- Assess the main forms of land-use changes during the period, and the impacts these changes have had on local livelihoods. Finally,
- suggest a set of recommendations that could improve environmental management to mitigate negative impacts of change in the future.

A number of factors and attributes are addressed. These include:

- The natural environment, natural resources and their changes, e.g. geology, climate, relief, soil, vegetation and land-use suitability;
- Population dynamics (settlement and migration);
- Agriculture (history, land holding, land tenure, production systems, gender);
- Non-agricultural activities (mainly commercial activities including both formal and informal activities);
- Use of and accessibility to social services (including water supply, education and health); and, finally,
- Ecosystem management strategies.

Some of the information related to population, informal economic activities and production, however, lack reliable statistical data for more rigorous examination of these variables. To overcome this situation, use is made of indirect and anecdotal information from archival, secondary sources of data together with interviews and information derived from PRA.

1.6 Research questions

As indicated earlier, the examination of environmental change using an historical, integrated human-biophysical perspective is under-researched in Mozambique. The investigation of the interaction of human and physical driving forces shaping land-use and environmental change in South Central Chibuto therefore contributes to the growing wider lexicon of studies of economic historians and geographers who have focused on the changes in developing policies in Mozambican agricultural history. Studies on the colonial period (1965-1975) (e.g. Munslow, 1983; Wuyts, 1977, 1985: Young, 1977; Roesh, 1986,1991; Egero, 1987: Wadman, 1992; Covane, 1996;); the post-independence strategy of socialization (1977-1987) (e.g. Rogersson, 1981; Roesh, 1986; Egero, 1987; Araujo, 1988; Wadman, 1992 Abrahamsson and Nilsson, 1995) and the war and reconstruction (1987-2000) (e. g. Egero, 1987, Vines, 1990, 1996; Myres, 1994; Kreike, 1996; Roesh, 1996; Coelho, 1997) are some examples of

research from a variety of disciplines. Despite this literature and other emerging research, little has been conducted in the Chibuto region on what Blaikie and Brookfield (1987) call “regional political ecology (p.17)” whereby a systemic approach, that captures both human and physical driving forces of environmental change in a interactive way is used (**Fig 1.1 and 1.2**) (IGBP-IHDP, 1996; Lambin *et al.*, 2001).

During the last four decades, as will be shown in this thesis, South Central Chibuto has undergone accelerated transformation due to various driving forces, different political economic and developmental strategies, that all contributed to produce different land-uses and landscape changes. Changes in the settlement pattern, such as those introduced by the communal villages policy, population dynamics, and the war, are argued to have generated environmental problems, particularly soil erosion in less resistant ecosystems such as the slopes of the ancient dunes and riverine landscapes of the area (Ombe, 1991, 1998; Macuacua, 2000; Feitio, 2004). During the period under study biophysical changes, such as extreme floods, have also contributed to shaping land-use and environmental change.

In order to address the objectives, the following questions are posed.

1) What are the most important environmental policy regulations at national and district level that have had an influence on land-use, land-cover and environmental change in South Central Chibuto between 1965 and 2000?
2) How have different systems of agricultural production and agricultural policy influenced land-use and cover change?
3) How has the natural environment influenced particular land-use and cover patterns and the rate of environmental changes that have taken place?
4) How do the people of South Central Chibuto perceive and interpret environmental change?
5) How have communities responded to such environmental change?

1.7 Methodology

Having outlined the focus and rationale for this research, attention now turns to identify the methodology that underpins the research. As has been indicated above, the interplay of various factors, both biophysical and socio-economic, requires that a broad range of various methods is used.

Traditional research methods, used by both historians and environmental scientists, were employed (e.g. measurements and interpretation of areial photographs as well as interpretation of archival materials and interviews). The research paradigm applied was both an explanatory and descriptive one. Informal and structured interviews with key informants, participatory rural appraisal, interpretation of satellite images and aerial photographs, and a bibliographic study of documents on social and economic history from the Mozambican Historic Archive Maputo, Jan Smuts and William Cullen libraries at the University of the Witwatersrand were undertaken. Using these data a historical picture of environmental change was constructed. The political ecology approach was used where causal explanations for the environmental changes and their consequences were sought in the changing political economic context over time triggering changes in relationships between the land users and theirs biophysical environment (**Table 1.1**).

A multiple research strategy was adopted due to the complexity of the society – environmental relationships and the need to produce a 'thicker picture' of the issues investigated (Peet and Watts, 2004). Some of the methods are more interpretive including the use of maps and aerial photographs; others rely mostly on interactions with individuals and groups to elicit meanings. This strategy allows at the some time to obtain both causal explanations (e.g. literature review, aerial photographs and questionnaires) and meaningful (e.g. PRA and field observation) interpretation of the events. The choice of the case study and the sample frame were guided by an attempt to assure typicality and representativeness in order to build a picture of the past with relevant sources and allow further theoretical interpretation and possible attributions (Eyles and Smith, 1988). Due to the intrinsic limitation of each of the data sources, in

spatial and temporal resolution as well as the ability to provide social and cultural explanations the inference from one source of data was, where possible, checked and triangulated against those from others (Smith, 1975, Eyles and Smith, 1988). The combination of data from different sources, however, was not applied unproblematically (Smith, 1975; Eyles and Smith, 1988).

It is known that some times, evidence derived from some kind of data, such as aerial photographs, may not fit the assumed relationships between phenomena due to the non-linearity of the environmental change. Early evidences of erosion in aerial photographs often represented by bare soil may not appear some years later due to rainfall variability and land use dynamics. Another problem of cross checking different sources of data lies in the contingent rather than structural character of certain phenomena leading to social and environmental change (Dahlberg, 1996; Stocking, 1996). In the postmodern constructivist approach the views of the environment that challenge the more structuralist scientific generalizations are valued (Peet and Watts, 2004). The ’place’ bounded knowledge is considered as offering valuable insights into environmental issues (Peet and Watts, 2004). This place-bounded knowledge may be reached through the multiple researches suggested above.

Table 1.1: An outline of the methodology.

Issues	**Methods, starting from the most important tasks**	**Types of data collected**
Political economic context in a given period	Literature review, Informal interviews	General political situation (e.g. colonization , independence, peace or war), periodization, development strategies, development plans, laws, institutional arrangements(**Chapters, 1,3,4and5**).
Natural Environment	Literature review, remote sensing and cartographic methods, PRA and field observations	Landforms, soil types, water bodies, climatic variability, vegetation cover, mineral resources, and land use suitability assessment (**Chapter 2**).
Land-use and land-cover	Literature review, Questionnaires, PRA, remote sensing and cartographic methods, lifestories.	Land-use and cover types, economic activities, and population dynamics, social relations (**Chapters 3, 4, 5and 6)**.
Environmental change impacts and local livelihoods	PRA, lifestories, field observations remote sensing Literature review	Changes in vegetation and water bodies, soil erosion and sedimentation, land conflicts, adaptive strategies (**Chapters 3,4,5 and 6)**.

1.7.1 Sources of data

1.7.1.1 Aerial photographs and satellite images:

Aerial photographs: (1: 40 000) for the years 1964, 1973 and 1989 as well as Landsat images of 1998 and 2002, were used to determine change in land use and cover

(**Appendices, 4.1, 1.2 and 4.3**). These were the only remote sensed data sources available in Mozambique. These data sources were complemented by various topographical maps (1:50 000) of Chibuto and other Limpopo areas. Larger scale maps of Chibuto and the plans of all communal settlements of the Gaza province and Chibuto, in particular, made between 1977 and 1997 were used to identify land-use features and changes. Smaller-scale maps of Mozambique and Gaza Province were also used to complement the above-mentioned sources of data from aerial photographs. Recent data, particularly for the period from 1992 to 2000, was determined from personal fieldwork and observation. Additional information from PRA, questionnaire and direct observation helps to avoid oversimplifications which in many cases leads to consider the whole areas as degraded or to assume that all areas of bare soil are eroded or of high erosion hazard risk (Stocking, 1996; Dahlberg, 1995).

The identification of the land-use classes was based on the visual interpretation of tonal variations across aerial photographs combined with a set of contextual data: topography, drainage and soils and terrain knowledge obtained from ground field observations (Chonguiça, 1995; Fox *et al.*, 1995; Mertens and Lambin, 1997). Tonal variations in aerial photographs permitted the determination of homogenous land-use classes (e. g. areas without significant variations perceived in the aerial photographs) (Larsson and Stromquist, 1991). The examination of the texture of the photographs and levels of grey was employed to detect land use types. Certain land use and cover units including: urban areas, roads, rivers lakes, cultivated areas, including the degree of intensity in cultivation were easy to identify (Dahlberg, 1995). Other land use and cover units were rather difficult, for example the limits of cultivated plots in sandy soils, the type of vegetation etc.

Mapping was undertaken by transferring the identified land-use classes from aerial photographs onto a 1: 50 000 base map. Because of the differences in scale between the photographs and the topographical map, ground-truthing was undertaken to determine the boundaries of several classes of land-use. For the determination of the area of each type of land-use a grid of 0.5 cm squares on a plastic overlay was used. The designations given in the classification of land-used are based on the types of

management and cover existing in the region (Larsson and Stromquist, 1991). These designations have been adopted on the basis of consideration of the land-cover and political economic aspects and were adapted from the studies undertaken in Southern Mozambique (Chonguica, 1995) and recommendations on visual interpretation of aerial phoptographs and satellite images for SADC countries (Larsson and Stromquist, 1991).

Several scientists have made use of sequential aerial photographs to assess changes over a period of time (Whitlow, 1988; Tiffen Mortimore and Gitchuki, 1994; Chonguiça, 1995; Kinlund, 1996; Watson, 1996; Smith, 2001). This method was used in the identification and interpretation of different categories of land-use and cover. Sequential aerial photographs of 1964, 1973, and 1989 were used to detect change in addition a Landsat satellite image of 1999, as well as several topographical maps and smaller scale maps were also used. Finally an Arc-View GIS technology was used to examine and map the changes, which occurred during the period under study.

1.7.1.2 Historical Documents

Various statistical yearbooks, reports from agricultural inspection censuses and secondary sources of data were consulted at the Mozambican Historical Archive; William Cullen Library (at Wits University) and the African Studies Institute in Pretoria. The National Institute of Agronomic Research, National Institute of Physical Planning, and the National Institute of Meteorology of Mozambique were used to gather data on the natural environment, land-use change and climatic data as well as agricultural development.

The main archival sources were found at the Mozambican Historical Archive (AHM) in the fund of the Administration of Chibuto and the Special Section of the Fund of Civil Administration. Statistical yearbooks and newspapers were consulted at the William Cullen Library at the University of the Witwatersrand, Johannesburg.

Studies on Mozambique, dealing with Africa contemporary history, have attracted a great attention from an increased number of scholars from various parts of the world.

Part of the literature on Mozambique using a political economic-approach is found in various journals including Journal of Southern African Studies, Journal of Modern African Studies, the Canadian Journal of African Studies, The Review of African Political Economy and various academic dissertations. Other sources of data include government reports, newspapers, speeches and oral testimonies.

Some secondary literature sources of data on Mozambique concentrate on the nature of Portuguese colonialism and its consequent impact on the Mozambique's post-independence economic structure (Muslow, 1983; Newitt, 1995; Abrahamsson and Nilsson, 1995; Wuyts, 1997, 2001). The main characteristic of colonial Portuguese capitalism, emerging from the literature, is that of 'weak capitalism'. This weakness is illustrated in the Mozambican economy exhibiting strong dependence on non-Portuguese foreign capital interests derived mostly from British and South African economies including the lack of capital for investment in infrastructure modernization (Abrahamsson and Nilsson, 1995; Newitt, 1995; Wuyts, 1996; Munslow, 1983, Covane, 1996).

The integration of Southern Mozambique as the role of manpower supplier to South African mines is highlighted in many studies (e.g. First, 1983; Covane, 1996, Wuyts, 1997); as a consequence of the Portuguese comparatively less developed colonial economy, the colonial power lacked capacity and willingness to impose formal land tenure laws (Wuyts, 1977; O'Laughlin, 1995).) As a consequence most parts of the country operated under customary land tenure rules. This situation assured cheap labour, both for South African Mines and Portuguese plantations by easing the access to land for left behind women (Wuyts, 1977, 1997; Young, 1977). The relatively ease access to land and comparatively low population density made Mozambique a country with little landlessness and making the land debate very different from that of other countries in southern Africa.

Various studies on post-independent Mozambique focus on FRELIMO, political ideology and the politics of the state bureaucracy in implementing development strategies highlighting both successes and failures. The radical changes in political economy under centralised economy including the Communal Villages

developmental strategy are also discussed(e.g. Araujo, 1988; Casal, 1996; Abrahamsson and Nilsson, 1994; Coelho, 1997).

Other studies concentrate on the post-independence extreme and prolonged violent conflict causing resettlement of millions of people, the politics of the state response to conflict and the analysis of the causes of the war including the role of the former Rhodesian and South African racist regimes. The broader international order prevailing under the Cold War fuelling conflicts and the impact of natural disasters, are also highlighted (e.g. Hanlon, 1990; 1991; Vines, 1991; Roesh, 1995; Christie and Hanlon, 2001).

More recent studies assess post war politics including the IMF and Structural Adjustment Policy and their implementations in specific conditions and their outcomes. The analysis of the relationships between globalization and poverty and the operation of the national institutions in a liberal economy, emerge frequently in these studies (e.g. Abrahamsson and Nilsson, 1995; Knauder, 2000; Pitcher, 2000, Hanlon, 2004; Saul, 2005, 2006).

The analysis of the above-mentioned literature allowed the periodization of environmental change in South Central Chibuto and helped to structure chapters 3, 4 and 5. By relying on other sources of data, including cartography and PRA, the impact of developmental policies and various biophysical drivers on local communities presented at a theoretical level were assessed (**Table 1.1**).

1.7.1.3 Informal interviews and Participatory Rural Appraisal

Participatory approaches to rural research revolve around critiques of traditional positivist, approaches, and concepts of what knowledge and development is and should be and an increasing acknowledgement of the legitimacy of rural, indigenous knowledge (Smith, 2001). The traditional, positivist research paradigm usually followed, is a way of thinking that assumes a researcher, who controls the research situation, is objective and value free (Neuman, 1997). In PRA, local people, instead of being objects of research, are rather active participants in producing and

constructing knowledge through interpretation of the local realities together with the researcher, using simple techniques (e.g. drawing maps on the sand use of stones and sticks to symbolise issues) (Chambers, 1983, 1984; Neuman, 1997). PRA, however, demands a great amount of creativity and flexibility within the research group, including effective communication capacity and skills.

One of the disadvantages is that PRA requires a relatively long period of time in order to ensure that participants understand the scope and outcomes of the research. In order to minimize this disadvantage, local diversity (e.g. people cultivating different soil types and different interests of people regarding land use were considered when selecting the site and relevant participants (Brace, 1995; Dahlberg, 1995; Mushove and Vogel, 2005).

The main participatory techniques used in this thesis were focus group and individual informal interviews including transects. These techniques were used when seeking data and explanation on land-use and the causes of change.

Informal interviews were administered to approximately 15 key informants. These informants were all Chibuto dwellers and possess valuable knowledge about the physical environment and local history. For the selection of the informants, the heads of the villages were consulted. Some of the informants were leaders of cooperatives and peasant associations, retired miners and civil servants of ages averaging 50 years and above, including both women and men. Young people were also interviewed seeking data on recent events such as the war and the year 2000 floods. Informal conversations were also undertaken with the author's aged relatives during traditional ceremonies such as burials. Informal interviews were also undertaken with Mozambican Government officials in Maputo and in Johannesburg, seeking information on migrant labour to South African mines (Showers and Malahleha, 1992).

Detailed PRA activities were undertaken in January 1999 with 20 informants from 25 de Junho and Samora Machel communal settlements seeking historical information about land-use and cover change and environmental change. In order to organize the

PRA, meetings with the leaders of the 25 de Junho and Samora Machel communal settlements were held to explain the objectives and methodology to be used. Informants were selected due to their pre-recognised knowledge of the land use change.

It was possible using the PRA to examine people's perceptions and interpretation of changes and the main problems affecting their lives (Leach and Mearns, 1996; Scoones, 1997; Mushove and Vogel, 2005). Wherever possible, informal interviews were recorded via tape recorder and in other cases written notes were taken. The PRA consisted mostly of group interviews about land-use changes including both recent and more distant reflections. Questions about the impact of the communal village creation and the war arose repeatedly and were covered in detail. PRA was also a type of an historical ground-truthing for the interpretation of certain aspects of land-use, not clearly detected in the remote sensed data.

Lifestories of aged people of Chibuto were also recorded in a research project supervised by the Mozambican Historical Archive seeking data on changes in livelihood strategies. Approximately 30 persons were interviewed in the years 2002, 2003 and 2004. These data were important to assess past trends in land-use and cover changes. Lifestores (e.g. long interviews covering the whole lifecycle)[7] were recorded in the place of residence of the informants allowing observation of continuous dynamics of change through time. Lifestories were tape-recorded and transcribed. "Oral lifestories have been used and are recognised as complementing traditional participatory techniques" (Smith, 2001, 61). In order to maintain and capture the contributions from the interviewees focused from the PRA and lifestories, the main events in Mozambican and local history were used as reference points. "The memories, experiences and perceptions of people that can be brought out in interviews, are important complements to the knowledge and indications provided by other data sources" (Dahlberg, 1996, 13), thus enabling the construction of 'thicker'

[7] Lifestores exposed diverse problems and opportunities and interactions among residents through various activities and the patterns of local resource use, enabling the construction of the sense of community in the study area (e.g. Broderick, 2005).

picture of changes s when added sources of data obtained from remote sensing and archival material (**Table 1.1**).

1.7.1.4 Questionnaires and site selection

In order to complement data from PRA and other sources, and to ensure triangulation of evidence, a questionnaire was also administered. Questionnaires allowed a more rigorous analysis of the events, while PRA and lifestories enabled a more interpretative analysis, by including values meanings and motivations of human agents (Neuman, 1997).

For the questionnaire, a purposeful sampling approach was used. The purposive sampling, rather than probability approach, aimed at capitalizing on the identification of residential areas of high potential to provide data on diverse land use trajectories. The assistance of local authorities and other key-informants was crucial in selecting the site and households.

A site that has undergone land use change and 'functions', from a rural area to a urbanized environment, was chosen. 146 households were interviewed through a questionnaire seeking data on land-use changes and their impact on the people's livelihood in January 1999. Interviews were undertaken in the 25 de Junho and Samora Machel communal settlements (**Fig. 4.2**). These are the most populated areas of South Central Chibuto and have appeared to have experienced radical land-use change through Villagization (see further details in chapters 4 and 5 on socio-economic context). The households of these villages also have a long agricultural history, cultivating land from both sandy and clay soils and a history of dealing with aspects related to droughts and floods and rainfall variability. The war also affected the selected settlements. The 25 de Junho settlements are closer to the old Chibuto Town while the Samora Machel settlement is relatively further from the old Town, a factor important in the investigation of rural transformation in the area, especially in gradient zones.

For the administration of the questionnaire, the interviewer approached 146 interviewees in their residences. Because the questionnaire sought land-use and land-cover aspects, the interviewers were able to take notes on relevant data including the type of houses, and also biophysical and other socio-economic aspects.

An additional questionnaire was finally, administered to 44 interviewees displaced by the 2000 catastrophic floods in households in a resettlement camp in October 2000 in Chimundo, Chibuto, in order to capture data on the human dimension of the flood disaster, including the role played by the Mozambican institutions in disaster management as well as the main problems affecting the resettled community. The Chimundo area is the only organized resettlement camp in the region under study. The questionnaire was administered to the heads of the households who agreed to respond. The administration of the questionnaire was undertaken by approaching the interviewees in their residences, which enabled notes to be taken of relevant aspects of land-use and land-cover. Besides this questionnaire, local aspects of the floods were discussed during three seminars held in Maputo and one International SADC meeting. During some of these seminars, local people were also invited to give testimonies of the events. Videos on the floods were displayed and photograph exhibitions were also organised. Field visits in groups were also part of these workshops.

The questionnaire and informal interviews including PRA activities were undertaken in the Shangana language and were carried out with the assistance of five students from the History and Geography Departments from both the Eduardo Mondlane University (2) and the Pedagogical University (3). The students were trained in the interview procedures. Two were 3rd - year agronomy students and three were 4th - year History and Geography students who were familiar with the main questions addressed in the research process. The students lived in Chibuto during their primary and secondary studies and they were also familiar with parts of Chibuto History.

1.8 The constraints of the sources of data and methods

Sources of statistical data in many cases are discontinuous and inconsistent; colonial censuses, for example, were compiled using different classification criteria. In one census, for example, the population is divided into, “civilized” and “non-civilized”, and in another census, such a division is absent and people are classified in terms of race. Existing accounts on Chibuto also often excluded many groups, with archival accounts covering most the economic activities of the white settlers (Showers and Malahleha, 1992).

Sources of data on agricultural production also lack consistency. In certain years production is given in kilos but in other years in sacks or in hectares. Peasant production is also difficult to quantify. In many cases, the harvest is done on a daily basis beginning by harvesting leaves and then fruits and roots, etc. The production is also shared among relatives, so that the overall harvest is difficult to quantify.

Another constraint is related to the costs of high-resolution satellite images that could have improved the resolution, both spatial and temporal, of this study that was not possible to obtain. Due to economic difficulties in Mozambique, serial aerial photographs were made with large intervals of time and the scale of the photos for rural areas is predominantly of 1: 40 000, thereby affecting further the resolution and detail obtained. Despite these problems, the variety of methods used, has enabled a ‘thick’ reconstruction of past land use and cover change in Chibuto. The detailed and rich inputs from many inhabitants and officials, among others, have also enabled a rich tapestry of ‘meanings’ and ‘interpretations’. That helps us to better understand environmental change in this part of Mozambique.

Finally the thesis is divided and organized into different periods: 1965-75; 1975-87; 1987-2000. These periods coincide with main drivers of land-use and land-cover change, related to both socio-economic and biophysical stresses (e.g. floods).

Summary

A review of the literature, including some of the theoretical and methodological approaches on environmental change was undertaken in this chapter. Environmental change was seen as a resulting from a complex interplay of political, economic, social and cultural driving forces that operate within an existing biophysical context. The review of existing debates on environmental change in Southern Africa was also undertaken. The political ecology approach is shown to enable a more nuanced investigation of the drivers and consequences of environmental change in the study area.
Land-use cover changes and related issues of land degradation are outlined in this chapter. The variety of methodologies used in the study is also covered. Limitations of collecting reliable data have been discussed. PRA, and other informal interview methods, were used to supplement data sets, that may have been limited

South Central Chibuto, as will be shown in the next chapters, is an area that has undergone notable environmental change over time where issues of rapid population growth, urbanization and extreme phenomena such as catastrophic floods have all interacted to produce environmental change.

The study that unfolds here is therefore a comprehensive geographical and environmental change analysis of South Central Chibuto. This detailed study will hopefully, contribute to land-use change studies in Mozambique and to various international global environmental change research programmes e.g. the IGBP and IHDP.

In chapter 2 the natural environment is describd setting the biophysical context for the study. This includes the resource base and the way in which locals interact with their environment, including the coping strategies to natural environmental constraints posed by various stresses and shocks.