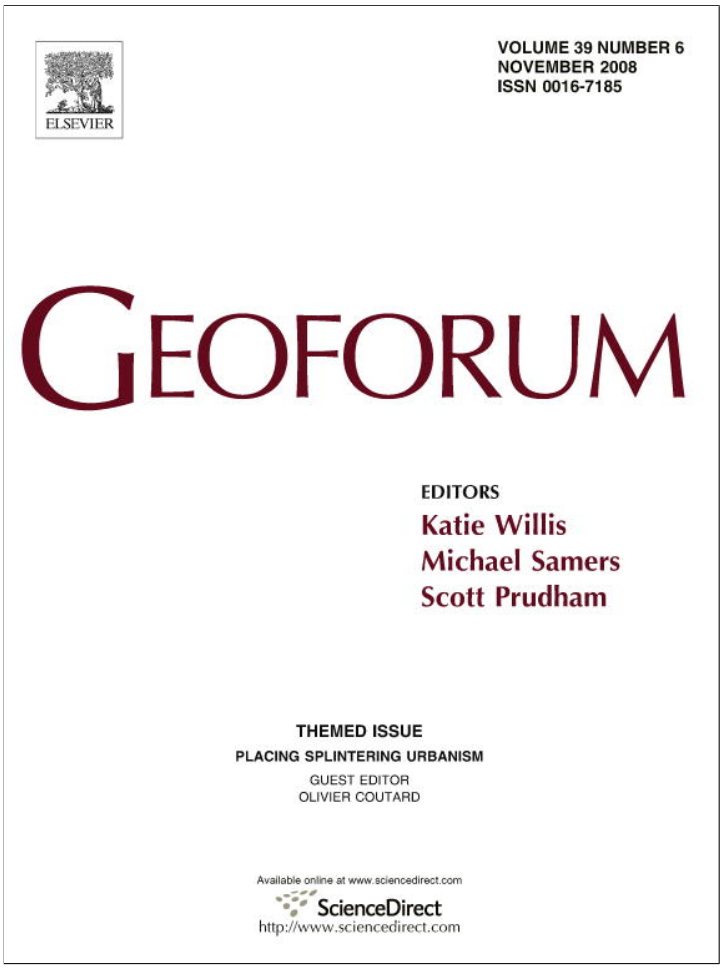

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Effective livelihood adaptation to climate change disturbance: Scale dimensions of practice in Mozambique

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ABSTRACT

Natural resource-dependent societies in developing countries are facing increased pressures linked to global climate change. While social-ecological systems evolve to accommodate variability, there is growing evidence that changes in drought, storm and flood extremes are increasing exposure of currently vulnerable populations. In many countries in Africa, these pressures are compounded by disruption to institutions and variability in livelihoods and income. The interactions of both rapid and slow onset livelihood disturbance contribute to enduring poverty and slow processes of rural livelihood renewal across a complex landscape. We explore cross-scale dynamics in coping and adaptation response, drawing on qualitative data from a case study in Mozambique. The research characterises the engagements across multiple institutional scales and the types of agents involved, providing insight into emergent conditions for adaptation to climate change in rural economies. The analysis explores local responses to climate shocks, food security and poverty reduction, through informal institutions, forms of livelihood diversification and collective land-use systems that allow reciprocity, flexibility and the ability to buffer shocks. However, the analysis shows that agricultural initiatives have helped to facilitate effective livelihood renewal, through the reorganisation of social institutions and opportunities for communication, innovation and micro-credit. Although there are challenges to mainstreaming adaptation at different scales, this research shows why it is critical to assess how policies can protect conditions for emergence of livelihood transformation.

1. Introduction

Rural land-users in many developing areas are facing increasing challenges to their day-to-day livelihoods (Francis, 2000). Whilst many are used to dealing with variability and change within the socio-ecological systems in which they live, today many more are facing increased pressures linked, for example, to global climate change and global economic change (Leichenko and O'Brien, 2002; IPCC, 2007). These pressures are received, interpreted and acted upon at multiple scales. The past thirty years in Mozambique have included disruption to socio-political systems through exposure to a civil war only ending in 1993; the influence of rapid economic adjustment (Bingen et al., 2003; Harrison, 2000); and variability of, and exposure to, weather extremes (Desanker and Justice, 2001; Usman and Reason, 2004). The risks and impacts of climate change in Africa are increasingly recognised as significant factors within the agenda of development agencies, particularly because of linkages to food security, poverty-alleviation and sustainable development. Climate change can bring both positive and negative impacts on different land users, but it also exposes farmers and rural households to new and unfamiliar conditions. Furthermore, the interaction and impact of both rapid and slow onset disturbances have contributed to extreme poverty with high levels of vulnerability and sensitivity to future disruptions.

Some sectors of society, including both individuals and groups, show clear signs of resilience because they have capacity to renew and reorganise their livelihoods in the face of such disturbances (Christie and Hanlon, 2001; OECD, 2005). The natural hazards tradition characterises generic individual and societal response patterns to specific events (Blaikie et al., 1994; Burton et al., 2003; Girot, 2002). But such structural analysis fails to provide robust explanations for actions on the ground or to explain inter-linkages between localised adaptation actions and national adaptation and development policy. Understanding how natural resource-dependent people cope with climate change in the context of wider livelihood influences is critical to formulating valid theory and adaptation frameworks, which are able to contribute to policy

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delivery, governance and development instruments in Africa (Adger, 2001).

Crucial within this debate is the recognition of scale: the representation of experiences, events and processes at different levels (Johnston et al., 2000). Geographical scales are not discrete, but rather are experienced as a continuum. Institutions and actors work across scales. These so-called cross-scale interactions (Cash et al., 2006) are prevalent when dealing with global phenomena with local outcomes, such as climate change, adaptation responses and environmental feedbacks to global economic flows (Adger et al., 2005; Willbanks, 2007). Recent debates within geography have critiqued the notion of vertical and hierarchical scalar engagements (Marston et al., 2005) in favour of site-based notions of explanation and comparison. However, the notion of scale remains central not only to geography but also to contemporary geographical enquiry (Jonas, 2006; Cumming et al., 2006). This paper builds upon studies of environmental governance in geography that find complex cross-scale engagements and diverse institutions to be essential in tackling environmental problems such as climate change, even where the impacts of global environmental change have a placed-based impact (Ostrom et al., 1999; Berkes, 2002; Lebel et al. 2005; Cash et al., 2006; Young, 2006; Thomas et al. 2007).

We adopt the approach of Mansfield (2005, p. 469, quoted in Cidell, 2006, p. 198) who suggests that analysis should address the 'scalar dimensions of practices, rather than practices occurring at different scales'. This sentiment resonates with Cash et al.'s (2006) distinction between cross-level interactions among levels within a scale and cross-scale interactions across different scales, such as between spatial domains and jurisdictions. In the analysis here we move beyond what Jonas (2006) calls site-versus-scale arguments to re-examine the more nuanced mechanisms and modalities of these linkages in practice. In particular, this means exploring scalar practice as the process of engagements between different institutions, policy, social networks and agents across different scales.

In the following sections we review how livelihood coping and adaptation has been approached in the literature and how these approaches relate to the debate on scale and institutional engagements. We then explore local responses to cope with livelihood disturbance, using a case study in rural Mozambique. We seek to understand what engagements are important, and identify the changing pattern of response in the process of reactive coping operating both cross-level and cross-scale. The paper then explores the intersection between these local responses and the role of agricultural policy initiatives to support disaster risk reduction and livelihood renewal, illustrating that density of cross-scale interactions is directly linked to successful livelihood renewal. We contribute to the debate on identifying emergent conditions for rural adaptation to climate change by asking which processes, institutions and types of agents characterise scalar engagements that facilitate effective livelihood renewal?

2. Coping and adaptation in rural livelihoods

Scale can differentiate livelihood responses to risk according to the agent responsible for their development and employment (Smit et al., 2000). A livelihood 'comprises the capabilities, assets (including both material and social resources) and activities required for a means of living' (Scoones, 1998, p. 5). Livelihoods research has helped to explain the differences in responses using understandings of endowments, entitlements and capabilities, within organisational hierarchy and power principles or by individuals or households (Giddens, 1979; Sen, 1981; Chambers, 1989; Pretty and Ward, 2001; Scoones, 1998; Feldham and Assaf, 1999). At the local level, Putnam (1993) asserts that social structures provide livelihood stability by binding individuals in a group together (bonding social capital), or by connecting people from social and economic strata (bridging social capital). Different motivators and barriers influence livelihood responses and these incorporate aspects of behavioural intention and context, including household assets, social norms and networks, gender, class, ethnic group or individual perceptions. The form of response will be different at different levels and scales (Carter et al., 1994; Smithers and Smit, 1997; Leach et al., 1999; Bryant et al., 2000; Few et al., 2007). Structural theories of vulnerability, such as the pressure and release model of Blaikie et al. (1994) take a holistic and scalar perspective, highlighting how processes that generate vulnerability link to the distribution of power and functioning of governments (Blaikie et al., 1994). Within the post-conflict development literature on Mozambique, these elements have been extensively debated (O'Laughlin, 1996; Paris, 1997; Cramer and Pontera, 1998; Pitcher, 1998; Hanlon, 2004a; Brouwer and Nhassengo, 2006) and point to the need to understand the context within which these complex cross-scale institutional relationships operate.

There is a major distinction made in many accounts of hazard and livelihood risk between coping and adaptation. The distinction is most often made in terms of the time scale along which each occurs. Short time scale actions are portrayed as 'coping' with change, where longer time scale actions are portrayed as 'adaptation'. Rapid onset or short-term disturbances to life and rural livelihoods, such as floods or short droughts, are seen as creating temporary reactive responses that can be put into practice quickly (Davies and Hossain, 2000). This distinction and dichotomy is not recognised by those experiencing livelihood stress. Rather coping is better described as a suite of responses taking place in short and long-term decision-making based upon the consequences for the livelihood asset base. Livelihood asset base is understood as the totality of human capital, liquid capacity and productive assets that household members deploy to reproduce and sustain the household. The food crises in Africa and Asia during the 1970s and 1980s generated a proliferation of research describing how households behave and cope with crises (Jodha, 1978; Corbett, 1988). From these descriptions, famine early-warning systems developed to alleviate the worst impacts, based on insights into how households use their productive and non-productive assets when faced with agricultural production failures (Tschirley and Weber, 1994; Davies, 1996; Ziervogel and Calder, 2003; Howe and Devereux, 2004).

Much of the climate change adaptation literature provides similar dichotomies in temporal and spatial scales. Local-level adaptation actions, for example are often portrayed as reactive, while higher-level institutions are assumed to plan in an anticipatory manner for adaptation through policies, programmes and, most recently through National Adaptation Plans of Action (Smit et al., 1996; Bohle, 2001; Burton et al., 2003). Adaptation is associated with planned action, either anticipating a threat or averting its impacts and infers some measure of progress or consistency of response. Longer-term disturbances may produce more lasting changes in behaviour and Smit and Skinner (2002) offer a typology based on intent and purposefulness, time and duration, scale and responsibility, and form. Here, responses undertaken spontaneously, or autonomously, as a regular part of ongoing management are differentiated from those consciously and specifically planned in the light of climate-related risks (Smit et al., 2000).

Simplistic representations of coping and adaptation have been challenged by research on natural resource management, which describes how most resource regimes involve cross-scale engagements by multiple actors (Berkes, 2002). Density of cross-scale interactions is hypothesised to be a key factor in the success of local natural resource management regimes (Berkes, 2006; Cash

et al., 2006). Different institutions and agents will facilitate adaptation across multiple levels, from farmer to local authority to public agencies, and the scale at which they operate will determine the resources and entitlements that allow resource use. Research on livelihoods and social theory has illustrated that multiple linkages across scale are more important than simplistic representation of coping and adaptation (Guerin and Guerin, 1994; Leach et al., 1999; Thomalla et al., 2006). Distinctions between anticipatory, concurrent or reactive actions are much less definitive in practice. Duration varies according to the timeframe over which responses occur, and reflects the triggering event. For example, agricultural adjustments made within a season, selling of livestock or the taking of a loan to deal with short-term drought are tactical whilst structural changes in management such as land use, livelihood activities or crop type are strategic. In reality, a combination of these factors results in a dynamic on-going pattern and thus adaptation is as a process influenced by broader economic, political and social forces, involving interrelated but different actors (Bryant et al., 2000; Leichenko and O'Brien, 2002).

Cash et al. (2006) argue that these scalar engagements, and the processes that facilitate them, are identifiable, but not enough is understood about the complexities of governance across multiple scales in practice. Folke et al. (2002) suggest that by identifying different levels of management (i.e. community-based organisations, boundary and bridging organisations or external policy interventions), it is possible to see how livelihood resilience can be eroded or enhanced. A better understanding of how policies can protect conditions for the emergence of equitable development institutions can then emerge (Powell, 1999; Tarp et al., 2002; Ashley and Maxwell, 2002). This is important if socio-ecological systems are to be able to absorb larger shocks, such as climate change impacts, without changing in fundamental ways and, when transformation is necessary, provide the components to help renew and adapt livelihoods.

3. Study location and methodology

Research was carried out in southern Mozambique, in a region of Gaza Province that suffers considerable year-to-year variability in rainfall. Average rainfall for the study area is 375–600 mm yr^{-1} with a winter season (April–September) and a summer (October–March) with rains between October–November and May–June. Although local land-use systems have evolved to accommodate this variability (Desanker and Justice, 2001; Usman and Reason, 2004), interannual patterns impact the biophysical system on which rural livelihoods are dependent, highlighting the importance of planning support, adaptation policy and forecasting technologies (Washington et al., 2006).

However, variability is also in the form of extreme events, such as storms, drought and flood, and the frequency, timing and intensity of events. The coastal areas are particularly prone to tropical cyclone impacts. There is some agreement that extreme events will become more frequent (Coelho and Maxwell Littlejohn, 2000; Benfica et al., 2000; Dixon et al., 2003) and already the south has more frequent heavy rainfall events (based on data from 1979 to 2002) (Usman and Reason, 2004), while still remaining prone to drought (IMF and World bank, 2003). An increase in intensity of rainfall rather than rain days is predicted (Cook et al., 2004) alongside a concomitant prediction of increased probability of dry years (i.e. increase in midsummer drought) in southern Mozambique (Joubert and Tyson, 1996; Usman and Reason, 2004). For example, although the rains improved in 2003–2004 after a series of drought years, they were erratic with heavy rains, keeping crop prices inflated until harvest in June. The Mozambique vulnerability assessment committee reported overall low crop production because of low rainfall at critical flowering period for maize. Annual average precipitation is modelled to decrease by 10–15% in the south, with temperature increases by 2025 of between 1.75–2.25 °C in the summer and 1.25–2 °C in the winter (Ragab and Prudhomme, 2002).

While rural populations are familiar with variability, the impacts of extreme events cause major livelihood disruption, such the flooding in 1977 and 2001, or drought in 1983–1984, 1994 and 2003. The floods of 1997 and 2000–2001 drew global media attention (Christie and Hanlon, 2001; Brouwer and Nhassengo, 2006), with more than 380,000 people in the region around Gaza Province displaced and a 50% cereal loss in 2000 (Forum for Food Security in Southern Africa, 2004). In the longer-term, regular extreme events undermine livelihoods and have brought hardship to rural and subsistence farming households as a result of damaged infrastructure and communication links, economic losses and resource scarcity (Arndt and Bacou, 2000; IMF and World bank, 2003). Ability to respond to environment and climate dynamics are determined by the socio-economic and political context (Adger, 1999; Desanker and Justice, 2001) and livelihoods are subject to a number of interacting factors within this vulnerability context.

Mozambique is unusual amongst many of its neighbours in southern Africa in having a relatively well-developed disaster preparedness plan, operational at district level, alongside a long-term poverty-alleviation policy. A history of civil war and natural disasters have led the government to update and review its policies on a regular basis, with 'development' ideologies still taken seriously by some within the ruling Frelimo party (Hanlon, 2004a). Mozambique has been reported as an example of post-war rehabilitation success, having embarked upon a series of macroeconomic and structural reforms that resulted in a remarkable rate of economic growth (OECD, 2005). However, while people have returned to places from where they were displaced, the rate at which rural populations have been able to renew their livelihoods has been much more variable. Rural populations remain physically and economically isolated with little access to markets or credit facilities, and incentives to diversify have been limited in many areas (Bingen et al., 2003). Over the last 10 years, decentralisation aimed to address these issues, however tensions between the ruling party Frelimo and opposition Renamo have often been played out through local politics, for example through the 'reinvention' of customary institutions and the misconception that there is an 'institutional vacuum' in rural areas (Cramer and Pontera, 1998). The relative lack of engagement with rural development following structural adjustment, and the struggles of the past that are still important in people's memories, have undermined many attempts at building community cohesion in rural areas (Harrison, 2000).

The village of Nwadjahane (Fig. 1) was selected in consultation with in-country partners (see acknowledgements), as part of a larger project investigating the adaptive capacity of natural resource-dependent societies to future climate changes within southern Africa. Nwadjahane was formally established in the 1980s as a refuge in Manjacaze District for displaced people from the civil war, and is now home to around 600 predominantly Shangaan people, living in 175 households. Traditional leaders have retained authority although, together with the school and church committees, now also work closely with district administrators and local Frelimo party representatives.

Due to its relative remoteness to major roads and large urban settlements, livelihoods are centred on subsistence farming, with production of cattle, goats, chickens and pigs, and rainfed/irrigated cultivation. Other activities include fishing, petty trade, migrant work, and the selling of processed natural resources. There are two agricultural seasons, known as the hot rainy season (*nyuva ya timpfula*) from November to February and the dry cold season

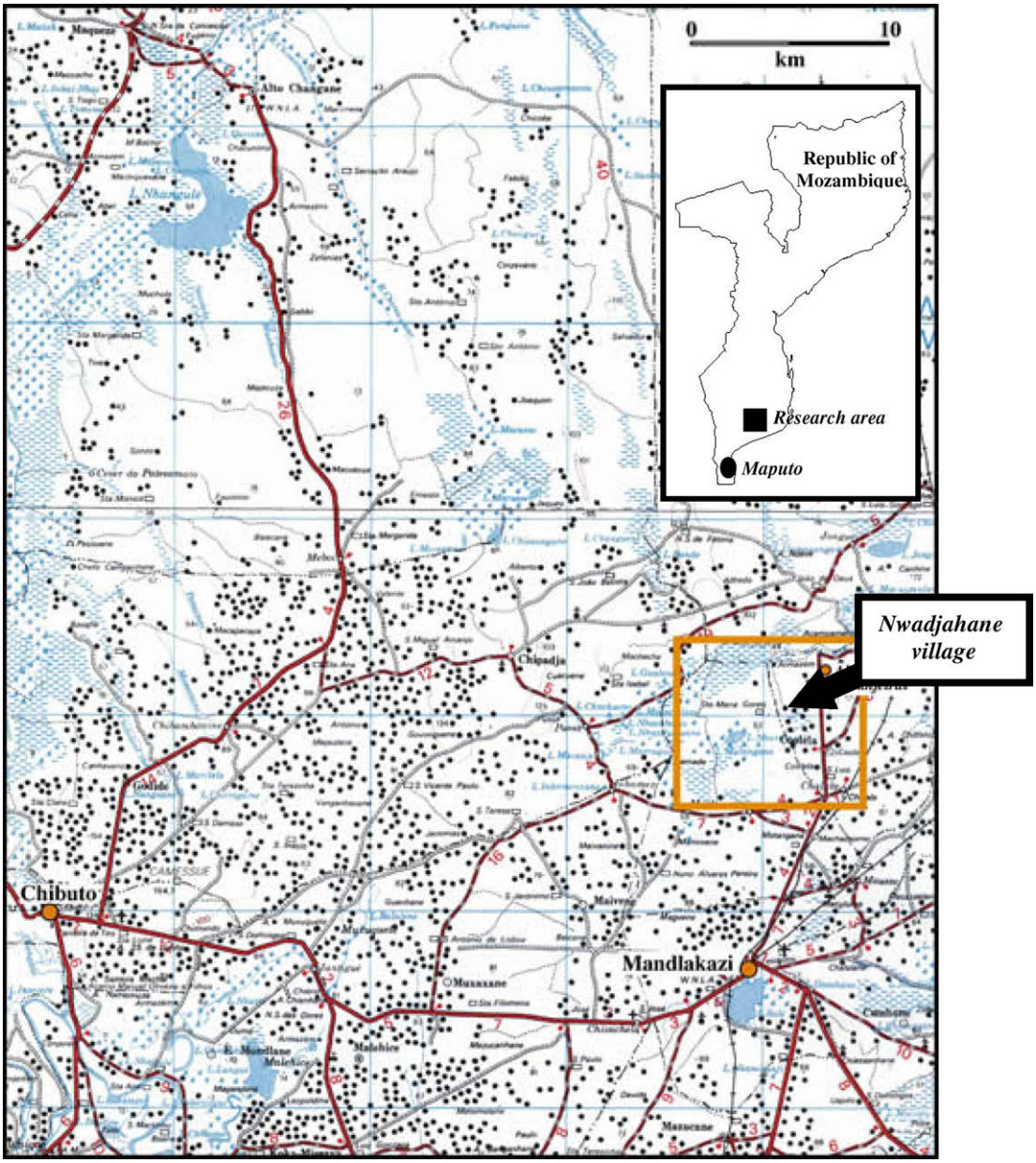

Fig. 1. Location of research area in Mozambique.

(*nguya ya xiwomiso*). Many households have access to both land on fertile loamy soils in the floodplain (shown in Fig. 1 as the blue floodplain) and sandy soils at a higher elevation around the village, however, the average land holding is only 5.3 ha. Staple crops include white maize, white rice, cassava, sweet potatoes and groundnuts, although beans, sugar cane, tobacco and vegetables are also produced. Much of the area around the village is wooded, and fruit and cashew harvests are an important contribution to household food security. People are dependent both directly and indirectly on the surrounding natural resources, and consequently their livelihoods are closely connected to the variability and productivity of the natural resource base.

The empirical information in this paper is based on data collected between 2003 and 2004. Fourteen groups representing the main formal and informal institutional divisions in the community participated in a series of 42 focus groups focusing on response to disturbance, sources of income, support networks and farming practice. These were followed by 31 semi-structured questionnaires with households (18% of the population), and repeated in-depth interviews with different members of each household in local language, covering information on assets such as labour, land use and employment (including understandings of risk, change and uncertainty, information transfer, social networks, institutions and capacity). The household was defined as those living in the same compound, and who worked or contributed food or income to the unit. Participants represented a cross-section of the community, embracing both genders, different age groups, social statuses and livelihood activities, and were selected by wealth-proxy records and information from local leaders and NGO officials. Participatory farm visits and the time spent living in the village, plus repeat visits, enabled triangulation of data. Analysis consisted of established mixed qualitative and quantitative techniques to explore patterns in the livelihood data, coded thematic narrative and interpretations of participatory and ranking exercises (Philip, 1998; Valsiner, 2000; Demeritt and Dyer, 2002). Research results were discussed with, and documents collected from, district,

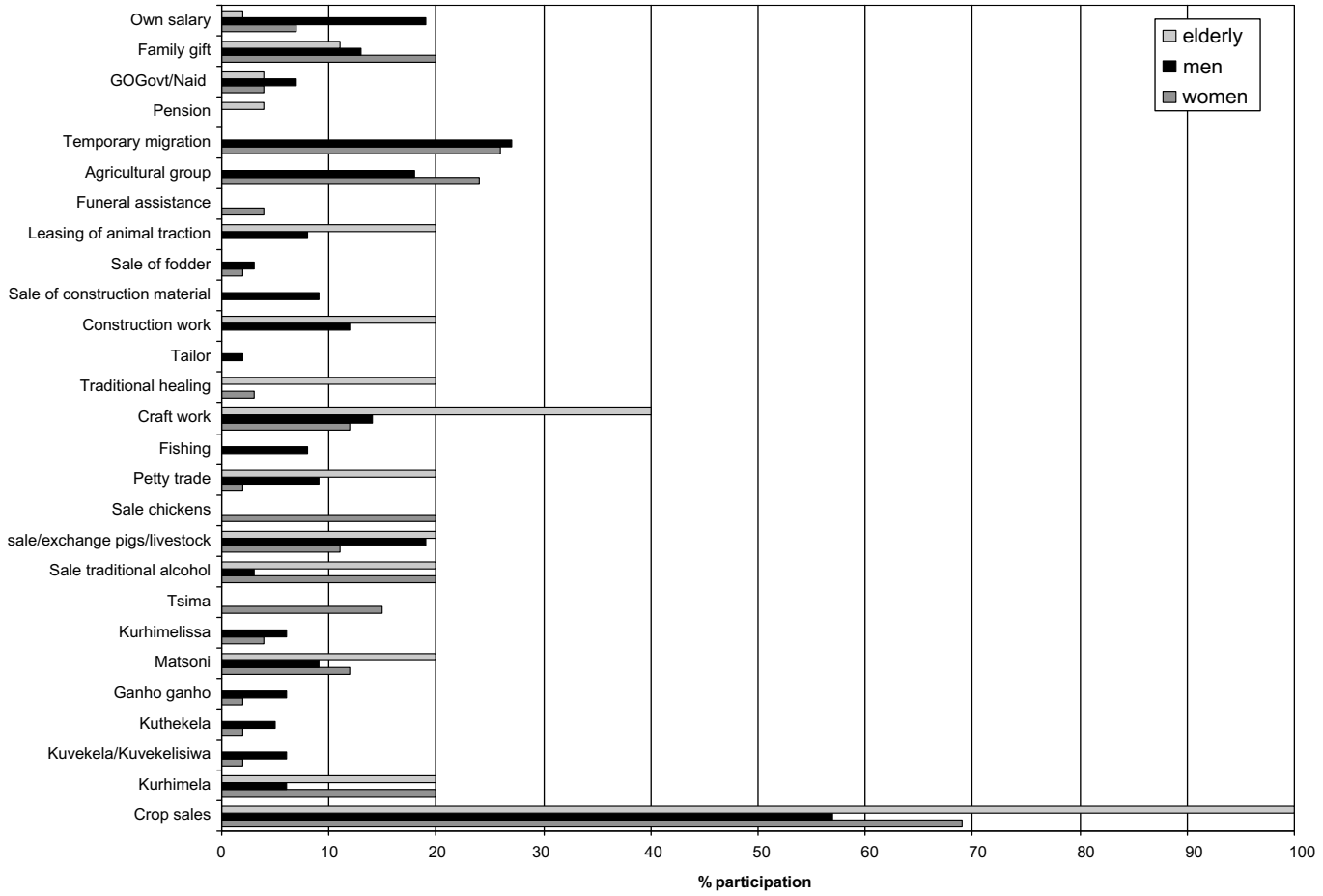

Fig. 2. Participation in livelihood coping activities by category (2002–2003) (129 cases (adults above 16 years who regularly return/live in each of 31 households participating in the study sample, elderly above 60 years)).

province and national level government, research institutes, traditional authorities and NGOs to analyse national policy response[1] and compared in the following sections to local livelihood response in one area of southern Mozambique.

4. Local responses to cope with livelihood disturbance

Rural people in developing areas accrue specific responses to cope with short-term shock events (Ellis, 2000). However, these are often responsive rather than planned actions, with capacity to regenerate and initiate planned livelihoods adaptations limited by poverty and livelihood shocks. They were also both cross-level and cross-scale. Coping responses in Nwadjahane attempted to secure immediate needs without depleting financial, capital and productive assets or diminishing the quality of their human capital. There emerged a distinct set of responses taken by individuals, which were generic to stresses from different types of disturbance (including drought, storms and floods, civil unrest, illness or the loss of a family member). Box 1 gives personal accounts of coping in two of the study households. Households commonly coped by being economical with resources and reducing food consumption or expenditure to preserve assets. Supplementary activities included the eating of birds and wild plants, and collection of fodder for kraaled animals. Retaining easily disposable assets such as smallstock was seen as essential for more serious disturbances, especially for the poor. Such assets are viewed as the cornerstone of resilient risk-averse livelihoods and can be linked to Carpenter et al.'s (2001) notion of 'shock absorbing' strategies. Depleting assets can also be considered the transfer of certain capital stocks (livestock, machinery, etc.) into financial capital with which to purchase basic foodstuff or pay emergency expenses. Within Nwadjahane, selling of assets was widely reported but normally as a tactical reactive action and part of regular ongoing farm management. Of those interviewed, 87% owned chickens and 81% owned pigs, and these assets were reported as the most commonly sold during times of stress. Serious disturbances caused households to make trade-offs between the benefits of livestock (e.g. milk, meat or potential income from ploughing) and the timing of sale in the market. Coping actions can have long-term consequences if the reduction in household productive assets undermines long-term capacity to escape from poverty or cope with future shock events. Fig. 2 details the multiple coping activities in Nwadjahane and illustrates how different household members practice different strategies. For example, women were most dependent on family gifts and friendship networks, while men relied on the sale of their labour, and the elderly resorted to petty trade or enforcing the sale of household assets.

[1] Agencies interviewed and documents collected from: Oxfam GB Pretoria, Save the Children US Maputo, DDADR Extension Service Manjacaze, DDADR Gaza Province in Xai-Xai, SETSAN/Fewsnet and MADER Maputo, Eduardo Mondlane University, Tribal Council Chalala.

Box 1 Coping experiences in Nwadjahane

Experience 1:

Carlos'[2] family moved permanently from the village of Nhofhoco to Nwadjahane in 1983 because of the civil war raging in the remote rural areas. This was also during one of the worst droughts in the last 25 years. The family coped by buying limited food using remittances sent from Carlos' mining job in South Africa and survived by eating wild fruits and plants from the river. The family lost most of their cattle during the drought. Carlos returned to farm in Nwadjahane in 1988 on land allocated by the traditional leader. In 2000, serious regional flooding destroyed the harvest and several cattle drowned. Carlos felt cattle have become vulnerable to flooding because they are often grazing in the lowland after drought. In 2001, a storm washed away their home and animals were sold to pay for the construction. There was a bad harvest after the early season drought in 2003–2004, which was compounded by damage by late heavy rains. The family sold some pigs and exchanged traditional alcohol to buy food. Goats and chickens that died from disease were replaced by gifts from relatives. They also rely on their friends to help and borrow money from family to support the large family of nine. Carlos has recently been sick and had to borrow heavily to pay for hospital treatment.

Experience 2:

Joana[2] returned to live in Nwadjahane with her two sons after separating from her husband. They have had to face a series of challenges and recently have coped with repeated climatic disturbances. The family lost their house in the 2000 storms and flooding and it was badly damaged again in 2004. Joana sold some pigs to pay for materials and her neighbours helped to rebuild a traditional hut. Then, in the early agricultural season of 2002 drought killed her crop seedlings. She decided to replant but the drought continued into the late summer, at the height of the rainy season. After a poor harvest, she was forced to sell some pigs and chickens to buy food and laboured on friends' lowland fields in return for a portion of the vegetables. Joana decided to plant a drought resilient cassava variety at the beginning of the 2003–2004 agricultural season. However, heavy rains brought flooding and destroyed the harvest. She asked her closest relatives in the nearby village of Chalala to give her food and seeds to plant on the lowland. The family borrowed cash from their neighbours because they have been able to collect firewood or labour the lowland fields in repayment. She has now temporarily sent her son, who is studying in Manjacaze, to ask family living in Maputo for money in order set up a business in clothing or cashew production which would be more resilient to climate disturbance.

The most significant mechanism to buffer disturbance in the village was the ability to reciprocate through informal institutions as a social safety net. Despite the erosion of social networks during the civil war, local connections and family were still critical in times of stress and ninety percent used their social networks to access resources during the study. Thus households were able to enact cross-level engagements with social networks in times of stress. Households maintained social connections through the traditional 'gift system', in order to ensure future reciprocity (84% had specifically invested in maintaining relationships during the study). Exchange of labour was used to cope with household labour shortages, repay gifts or receive food. *Kurhimela* was an individual informal labour exchange used regularly by 35% of households (particularly women and female-headed households) (Fig. 3a). *Tsima* was a group arrangement, used regularly by 35% of households, where food or alcohol is exchanged for farm labour (predominately male groups). These local labour mechanisms rebuild houses after storm damage and help replant fields after drought. The poor also practice *ganho–ganho* by sending a male household member to participate in charitable 'food for work' schemes run by NGOs in Manjacaze, Bilene and Xai-Xai to maintain roads, public facilities and irrigation systems.

Reciprocal obligations to support networks also extended outside the village but these tended to be spontaneous and reactive engagements. Matrilineal marriage ties were especially important, because forced movement to Nwadjahane in the early 1980s, followed by an influx of returnees after 1992, left a legacy of family connections to six surrounding settlements. While strong cultural norms exist regarding reciprocity of labour exchange, the key to successful informal exchange is having the available labour or resources to participate in the relationship in the first place. Thus once the limits of reciprocity are reached, households can become particularly vulnerable. This vulnerability was found to be highly differentiated by wealth and gender. Fig. 3a and b illustrates how female-headed and small households were particularly dependent on their social networks and, together with the elderly, had the most difficulty in reciprocating gifts or labour (more receive than give exchanges). Thirty-five percent of households reported that long-term illnesses exacerbated household labour constraints. In contrast, households with adequate labour were able to exploit the non-cash exchange system by manipulating access to extra labour and food. For example, they were more readily able to use their assets to activate *Tsima* and access additional labour, or use surplus family labour to practice *ganho–gando*. Larger households owned more goats and had greater access to lowland areas than smaller households, as well as having more labour to care for other people's animals and acquire pigs and chickens in payment. Repeated exploitation of the non-cash exchange system helps to explain patterns of inequalities in coping capacity that have developed across the community.

4.1. Changing patterns of social networks

Social networks within Nwadjahane have evolved and changed over the last 20 years in response to economic circumstances and environmental conditions. All respondents felt that drought, floods and storm damage had increased in severity and frequency over the last 20 years and, combined with the weak local cash economy, were largely responsible for the subtle changes in type of traditional exchange practices favoured. The most significant change was the process by which labour for cultivation can be accessed. There has been a shift from gaining access to labour by paying in cash to more reciprocal or non-cash exchanges. This largely reflects economic decline during the 1980s and 1990s and the current restrictions on migrant work that had previously provided the remittances and cash inputs into the farming system. In addition, there were heavy losses of cattle due to the war and the 1983–1984 drought and, even 20 years on, many households have been unable to compensate for these losses. This vulnerability was compounded further during recent flooding and drought. These major

[2] Names have been changed.

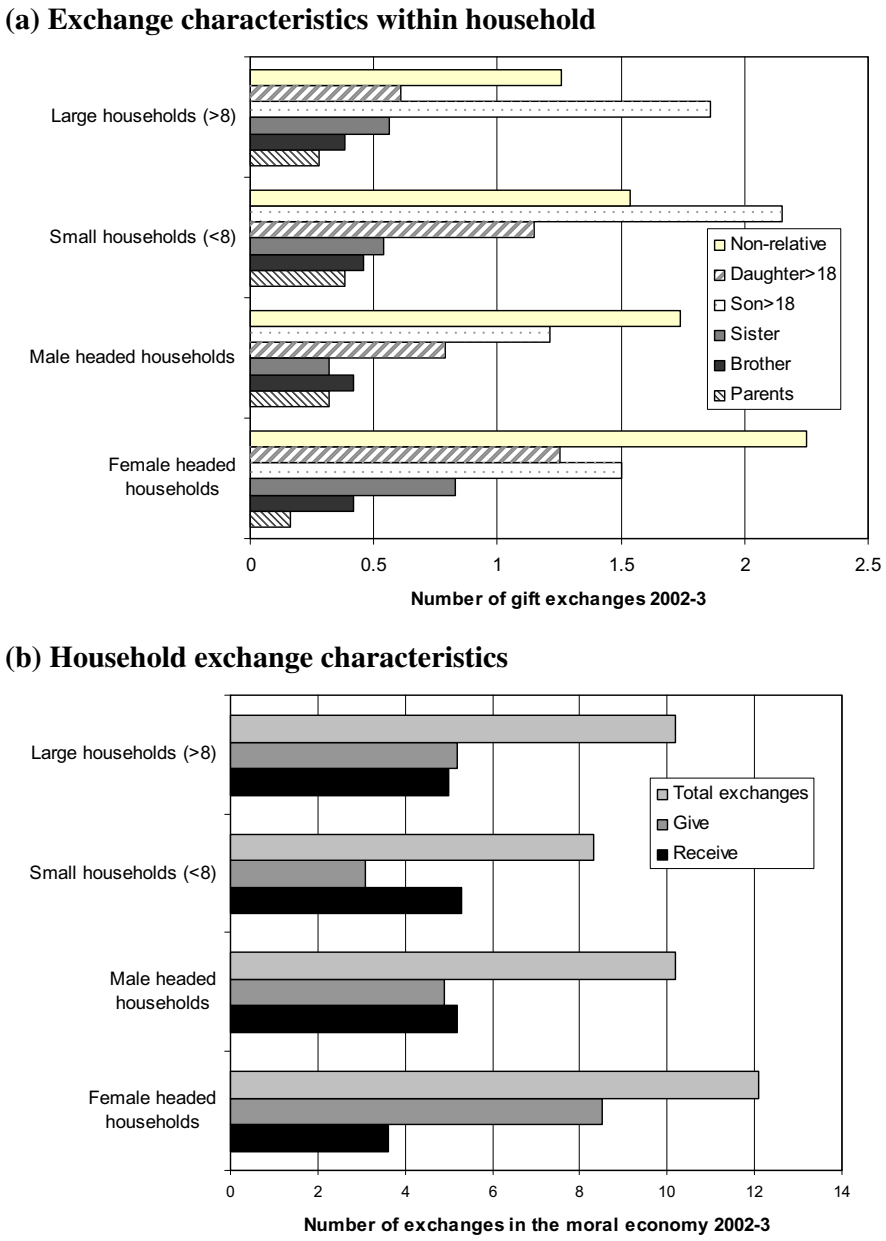

Fig. 3. (a) and (b) Understanding differentiated dependence and coping (within the moral economy active give and receive exchange include labour, food, cash, information, childcare, crafts, poultry, goats, etc.).

shocks increased the vulnerability of even the wealthiest, which had more assets to lose and were dependent on particular assets, such as cattle (Brouwer and Nhassengo, 2006). Consequently, labour exchange mechanisms, such as *matsoni* and *tsima*, are inevitably more popular than 20 years ago.

These popular labour exchanges reveal insights into adaptive strategies in the village. *Matsoni* was traditionally an informal exchange between women but has become more formal, with a self-organised network used by 21% of households during the study. It was considered to guarantee an 'insurance' dryland crop was planted. The villagers claimed that *matsoni* provided access to extra labourers (according to 45% of respondents), land (68%) and information (52%), as well as helping maintain solidarity between neighbours and ensuring families a share in limited food during times of difficulty. Likewise, the practice of *kuvekala* had increased since 1992 according to 70% of respondents. *Kuvekala* allows those looking after other people's livestock to keep the first born as payment. Villagers claimed such practices protect social norms, including the aspiration of livestock ownership, and strengthen trust within the 'community' through the promotion of the ideals of equity (at least in terms of access to productive assets). However, while there was a strong sense of responsibility and obligation, in reality the process had increased inequalities across the community because those with most cattle had increased power to demand cash payments for ploughing services, which went against traditional norms and more popular forms of exchange. Traditional cattle and smallstock breeding and exchange networks had been used more effectively by those with most cattle, in order to access support and information from neighbouring 'entrepreneurs' and District Livestock Extension Services. The livestock farmers commented that this had primarily been in response to increases in flooding and drought in the village: *'the situations drove us to become more organised...it has been very important for us to establish contact with people outside the village who could*

provide us with medicines or advice...and we are proud that we have established these contacts ourselves and have a system to maintain outside support...recently we have felt under pressure to make sure that we have good advice because there are many droughts'. (Livestock farmers workshop, July 2004). These informal networks exacerbated inequalities in access to information and reinforced the importance of *matsoni* to the poor.

If livelihoods begin to fail in the village, households reported sending members to seek piece work in urban areas or sell/exchange products at market (e.g. dried fish, grass mats, fruit and cashew), in a practice known locally as *kuthekela*. At least ten percent of respondents had been regularly forced to use this coping practice in Manjacaze, Xai-Xai and Maputo. The last resort under repeated or prolonged extreme situations was to move the whole family away temporarily. For example, following severe cyclone-generated floods in February 2000, 700 people were killed in Gaza Province and 500,000 people temporarily relocated to camps (Benfica et al., 2000; Forum for Food Security in Southern Africa, 2004). More recently, flooding after storms in October 2004 forced many in Nwadjahane to move temporarily to nearby villages and the town of Xai-Xai.

4.2. Cross-scale responses at the local level

We found evidence of two specific cross-scale local responses: forms of diversification and a collective dual land-use system. Both activities were responsive to the environment and household circumstance but helped to create livelihood security and flexibility.

(a) Forms of livelihood diversification

Diversification within and beyond agriculture is a widely recognised strategy for reducing risk and increasing well-being (Ellis, 2000; O'Laughlin, 2002; Ellis and Allison, 2005). Key drivers of diversification in Nwadjahane were historical processes (both economic and political), contemporary policy changes and climatic disturbances. Diversification contributes to livelihood resilience by spreading risk and there was an average of seven livelihood activities engaged in per household. This diverse portfolio, including traditional skills in craftwork, herbal medicine, or construction (Fig. 2), helps to establish flexible livelihood options. With climate variability causing particularly risk, additional cash-generating activities were favoured, with 74% of households conducting regular business activities. However, the benefits of diversification remain inequitably distributed across the community, reinforcing differences in resilience. Households with extra labour or access to transport were best placed to develop diverse portfolios, while larger households invested in goats which are hardy during drought and can be sold for cash locally.

Social networks with other villages and towns offer opportunities to access resources unavailable locally and establish regular remittances. Off-farm diversification included economic migration for piece jobs or wage labour in Manjacaze, Xai-Xai, Maputo and South Africa. Households had a particularly high dependency on remittances from sons, with 71% of households having a son away from home and 19% having more than three males regularly seeking work in urban areas, often in illegal or temporary activities. Migrant work is part of local identity, described as a right of passage for young men, with the youth investing socially in their urban contacts. However, migrant work is a legacy of wider social adaptation to historical shocks of forced labour, civil disturbance and rapid economic transitions of liberalisation. For example, both the collapse of the local cashew industry and reliable migrant work have created rural unemployment and dependency on temporary work in the area (O'Laughlin, 2002; Lubkemann, 2004). Young people felt they were alienated from local decision-making structures, making it difficult to gain access to land (which remains managed under a traditional inheritance system). Most preferred to seek skills through training during migrant work rather than work on the farm. While NGOs working in the area recognised these needs, the findings highlight the importance of incorporating youth identity in rural policy.

(b) Collective dual land-use system to access natural diversity

People living in Nwadjahane creatively used the natural diversity of the landscape to cope with the increased frequency of drought during the last 20 years. Of those interviewed 90% had been able to maintain a dual land-use system, though plots were very small. The higher elevation sandy soils only support an 'insurance' crop of cassava, beans, sweet potatoes, maize, fruit and nuts. Although this soil performs poorly in drought, it provides reliable cropping during normal and wet years when the fertile lowlands are flooded. The irrigated lowlands are worked preferentially for vegetable produce, rice, maize and fruit, which have commercial potential, however the loamy soils require ploughing (Walker et al., 2004). Villagers felt that decisions about the dual land-use system were increasingly proactive in order to manage climate variability. However, not all people had access to the lowlands to participate in this coping strategy. Larger households were best able to utilise their dryland 'insurance' fields because they had more land and family labour ($R^2 = 65$; at 0.0001 significance). Those with a smaller productive labour force, focused on the lowland despite the risks. Since lowland fields were inherited or distributed by the chief (no land sales), households that could negotiate rights or foster favourable relationships with the chief were in a better position. In 1992, returnees after the war requested lowland fields, which resulted in existing poor households becoming further marginalised, vulnerable to frequent drought on the highland sandy fields, and forced to identify new ways to negotiate access to the lowlands.

5. Disaster risk reduction and livelihood renewal: supporting cross-scale agricultural initiatives

Recent government policies and statements claim to embrace concepts of disaster risk reduction by building livelihood resilience to climate, economic and political disturbances and reforming mechanisms that transfer development benefits to the rural poor (Republic of Mozambique, 2001, 2006). The government has sought to take a deliberative approach to these scalar livelihood interactions through direct engagement with local livelihood renewal. Supporting adaptive responses to disturbance have transformed effective local coping responses and collective activities in Nwadjahane, with differences in scale, intent and length. Generating coordinated oversight in national planning strategies is central to integrating practical development agendas, especially those that stimulate agency for planned adaptation to climate change and variability across different scales.

A multidisciplinary group from the different ministries was established to undertake vulnerability mapping analysis (Diriba, 1997; Groupo inter-sectoral de Availcao e Mapeamento da Vulnerabilidade, 2000) and liaise with external forecast networks (e.g. Southern African Regional Outlook Forum, Harare's Drought Monitoring Centre and USAID's FEWSNET) in order to provide oversight, prioritise rural development and provide early-warning forecasts. Many of the outputs (e.g. flood risk maps, NDVI identification of drought risk areas, food systems, land use, market access, health and nutritional profiles) have emerged as useful tools for service delivery, monitoring and communication within the extension programme. This Vulnerability Assessment Committee (VAC) is coordinated by the Food Security and Nutrition Secretariat

(SETSAN), which is part of the Ministry of Agriculture and Rural Development (MADER). Although inter-sectoral coordination facilitated rapid identification of disaster preparedness and response for cyclones, floods and drought, it did not proactively attend to long-term vulnerability reduction through livelihood renewal. This was only seriously addressed in 1999 when the Department for the Prevention and Combat of Natural Disasters was replaced by a National Disaster Management Institute (INGC). The INGC was charged with coordinating disaster prevention strategy and from 2003 its Disaster Management Technical Sub-Committee advised the government on the first and second Action Plan for the Reduction of Absolute Poverty (2001–2005, 2006–2009) (Republic of Mozambique, 2006), both of which sought to mainstream concerns about natural disasters and impacts of climate change across the development agenda. Government-led programmes under these action plans tend to be delivered in partnership with NGOs, the latter providing technical expertise and often much needed funding, within a government-coordinated framework. The growth in NGO activity in Mozambique has been partly driven by the opening up of the country since 1992 and partly a response to the floods of 2000.

The multi-donor 'PROAGRI' programme, coordinated by the Ministry of Agriculture and Rural Development from 1999, was an example of this type of partnership. Its activities cut across different livelihood areas, from micro-finance to communication, and set out to support small scale farming in rural areas by supporting technical extension training, infrastructure development and local organisations (VAC, 2003). The integrated rural development approach was taken forward in 2003 when the Ministry of Agriculture and Rural Development developed a long-term plan to be delivered at national and provincial level. It hoped to create emergent conditions for local-level resilience to climate disturbances, with a focus on resilience to drought, food security and poverty-reduction. The facilitation of human capacity through training and agricultural experimentation programmes, implemented through government extension services and local NGO activities was seen as the cornerstone for livelihood renewal. Similar models have successfully been employed elsewhere, such as in West Africa since the 1980s (Bingen, 1994; Seebörger, 2003). This deliberately cross-scale initiative successfully links spatial, temporal, jurisdictional, institutional, and management scales at different levels.

5.1. Reorganisation of social institutions that formalise reciprocity and facilitate innovation in Nwadjahane

The strategic creation of formal agricultural associations in Nwadjahane since the late 1990s has been a proactive response between the local community, international NGOs and the district government to address local vulnerability. Three formal agricultural associations were operational at the time of the study, as part of the District implementation of National Agricultural policy. Table 1 outlines their key characteristics, which we later draw on to help explain why the associations have endured and acted as a formal buffer to the risks of individual farming.

First, while villagers would prefer to work their own land instead of borrowed or shared land, a cultural ideology based in cooperative action, group associations and solidarity was important in the endurance of these new associations (Braathen, 2003; Hanlon, 2004b). The patterning of local associations is highly political, with relationships between associations, the party and the state. While this has made it easier for local leaders to initiate a leadership role, it does mean that the role of NGOs in the process cannot be seen as apolitical. Igreja et al. (2004) noted how war and natural disasters were considered a collective rather than individual experience, with all disasters entwined in local belief systems. The impact on the individual psyche means people still turn to these collective support networks and the role of the traditional authorities. A shared sense of the past continues to encourage community cooperation, making it socially unacceptable not to participate in group activities, and providing an ideal platform for the Agricultural Extension Service to exploit. However, such cultural norms, where it is difficult to promote the 'individual' or talk about the success of individual fulfilment, makes the establishment of entrepreneurialism more difficult, despite the concept of smallholder entrepreneurs in South Africa and role models in the area (the *privados*). Second, experiences in Nwadjahane suggest that the process of formalising social institutions has been popular because it has increased gender equality within the community. The formalisation of informal institutions, such as *Matsoni*, has provided women, who carry out the majority of farm work, with more control over farming and a share of any profits. Third, the farming associations have helped the poor to secure access to the natural resource base, who previously had little access to the lowlands for the dual land-use system. Two-thirds of those interviewed

Table 1
The characteristics of formal farming associations initiated in Nwadjahane

	Save the Children	INAS	ADRA
Year started	2001 (externally initiated)	2002 (initiated by village)	2002 (externally initiated)
Membership	55 members	75 members (part of larger district group)	40 in 2002 20 in 2004
Area	2 ha lowland, 0.5 ha dryland (traditional authorities)	2 ha lowland, 2 ha dryland (donated by villager)	0.5 ha lowland, small plot dryland (traditional authorities)
Activities	Rebuilding irrigation system, planting vegetables, experiments: yellow sweet potato, cassava, sorghum (DDADR programme for food security and drought planning)	Planting vegetables, experiments: maize and rice, group copied cassava trials from STC	Cashew breeding, planting pineapples, groundnuts, vegetables
Organisation and external links	Bi-monthly member meetings Monthly village meetings (attended by all farming representatives) Links via traditional authorities to District Government, Extension Service and STC Accounts and records audited by STC	Informal meetings on fields Group representative attends village meetings Links via traditional authorities to INAS, extension service Financial reports audited by Extension Service	Informal meetings on fields Group representative attends village meetings Links via traditional authorities to District Government and Extension Service Finances and records groups audited by Extension Service
Rules to participation	Work groups Tuesday or Thursday, Contribute money, Vote at meetings	Work groups Monday or Wednesday, Vote at meetings	Work groups Tuesday or Thursday, 5000Mt deposit per plant
Training and equipment	Extension Service Tools, drought/disease resilient seeds/ tubers from STC	Extension Service 16 head cattle donated by INAS in 2002 for ploughing and breeding	Extension Service, Plant breeding and equipment from ADRA, Training visits to successful farms in other villages

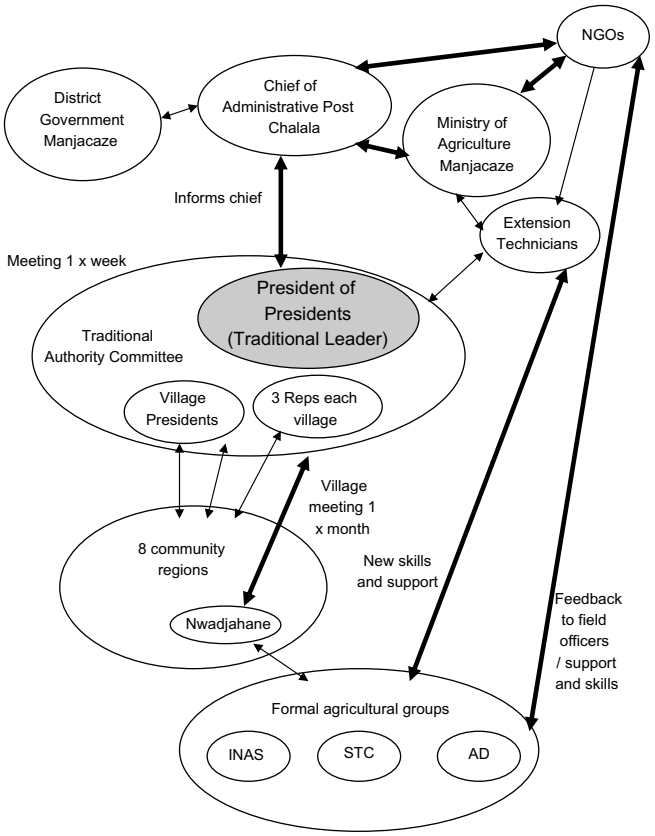

Fig. 4. Linkages between formal institutions and Nwadjahane (drawn by villagers during a group exercise in 2004).

now had access to more than two hectares of lowland, and half had access to more than two hectares of dryland. In addition, from 1994 the State promoted a governance system which sought to encourage participation, accountability and trust, as well as increase communication between villages, NGOs and local government. Fig. 4, a representation drawn by Nwadjahane villagers, illustrates the institutional linkages they were able to draw on, especially to build links with external institutions during times of crisis and for longer-term scientific training. The conceptualisation of scale is clearly not strongly hierarchical but instead emphasises the cross-scale linkages identified as important. Eighty-seven percent participated in a farming association in 2004, and of these, 52% did so to gain access to information, 45% to gain access to extra labour and 68% to gain access to more or better land. Over half of the sample had recently joined a village farming association for these reasons in the last five years.

While farmers have always responded to seasonal climatic variability, only since the late 1990s and the formation of farming associations have farmers in Nwadjahane been collectively developing specific regenerative responses, which plan for drought, heavy rains and increased variability. The associations have created better opportunities to adapt, learn and plan. Access to scientific information and agricultural extension training provided a catalyst for local innovation initiatives and helped villagers feel more confident about experimenting by combine existing local knowledge with new skills. Over half of the respondents claimed to be actively experimenting with new technologies and drought-resistant crop varieties. Government rural development strategy specifically encouraged experimentation with improved crop varieties, through its support of farming association programmes (Gomes and Carr, 2003), and this has clearly had a direct impact upon farming practice in Nwadjahane. Forty-five percent of respondents (including both wealthy and poorer households) had changed to drought-resistant or shorter-maturing crop varieties, including rice, maize, cassava and sweet potato, as a direct result of extension advice disseminated through the farming associations. Using new technologies in response to recent extreme climate change can be considered as strategic adaptation because the changes included structural management and longer-term livelihood activities.

Representatives from each farming association group were trained as 'para-extensionists', responsible for sharing information between the groups. For example, the Save the Children funded association had monthly meetings (Table 1) which were attended by all farming representatives, with information from these meetings reported to general village meetings, thus transferring information cross-scale. As a result, there were formal knowledge channels within the village where information was diffused to those outside the associations, inspiring others to copy and modify new practices, including better crop, pest and fertiliser management. Regulated financial support and micro-credit from the NGOs was seen as 'insurance' for these experiments and more families (beyond larger wealthy households) were prepared to take farming risks.

Active development of agro-forestry in the area has been the other focus for the associations, supported by the Ministry of Agriculture and Rural Development. In the region around Manjacaze, the cashew industry used to provide work until a market collapse following economic restructuring in the 1980s/90s. With exposure to the global market place, competition makes the development of strong local markets and skills in processing more critical. The government estimates that 10% of cashew farmers have received training and subsidised fungicides (Kanji and Vijfhuizen, 2004). In collaboration with local NGOs, the village agro-forestry association has offered farmer-to-farmer learning through visits to other villages, and provided training on planting, breeding and nurturing a variety of trees which are a valuable source of food and income (Table 1). In particular, the association has facilitated investment in citrus plantations better suited to dry conditions and provided opportunities to exploit urban markets. Through villagers' own networks, they now have established links to government-run training centres for dryland agro-forestry in a nearby village and information is shared at group meetings. Significantly, young people felt the planting of trees increased their access to land and cash cropping. The success of the association can be attributed to supporting innovative individuals as well as collectives. The impact of the government programmes can be distinguished from trial and error practices by individuals because of the intent and purposefulness of the action, its strategic impact on management structures and the uniformity of uptake by formal groups.

5.2. Renewal and reform for rural livelihood adaptation

The central advantage with the policy strategy explored in this study was the recognition by the government of the scalar nature of intervention planning and implementation. This study highlights how both local coping and planned adaptive responses operate at, and operationalise across, different institutional levels and scales through the form and timing of response. Fig. 5 conceptualises the overlapping institutional engagements that frame people's everyday livelihood practices in Mozambique. The central area in the diagram represents collective action (or community adaptation), while other interacting areas represent institutional links with which NGOs and local government can engage. The associations had stepped beyond top-down implementation routes for transfer of technology or knowledge to recognise the trans-local (as well as trans-provincial and trans-national) intersections and the conceptual collapsing of scales through direct engagement

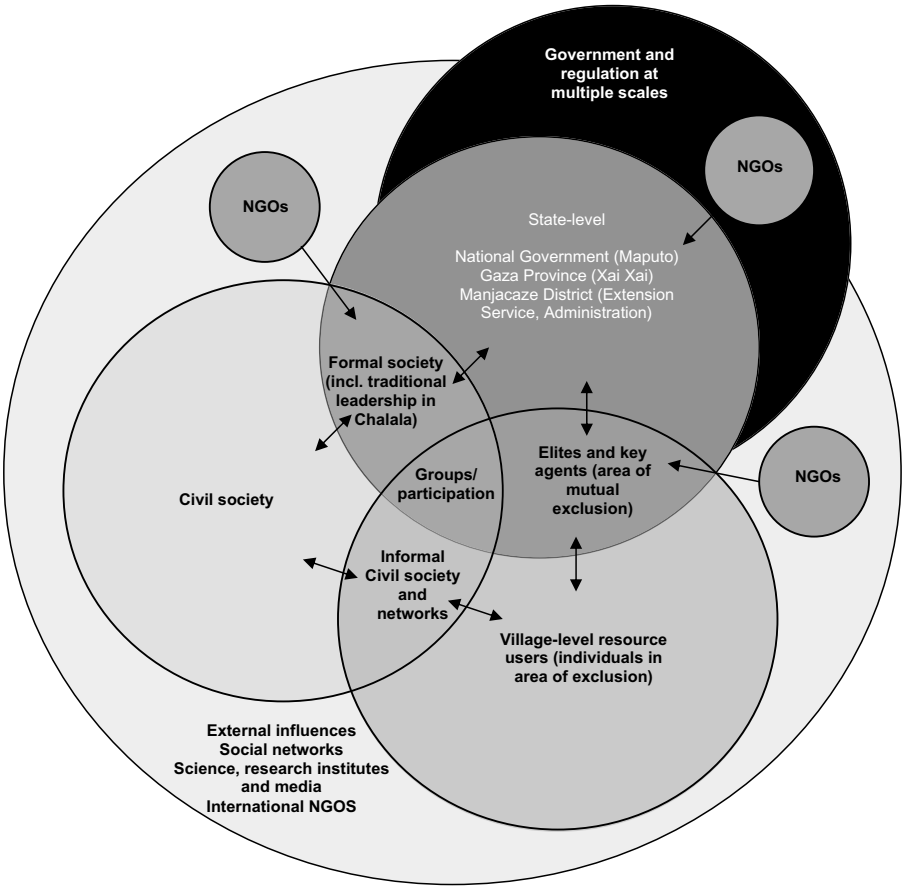

Fig. 5. Framework of interactive institutional scalar engagements.

with stakeholders. Most importantly, the government had recognised that the development of specific national adaptation product choices or policy prescriptions (i.e. direct adaptation measures) may not be the most useful means of promoting flexible response in agriculture to climate change, or in any sector. The INGC's strategy plans, while recognising the importance of addressing vulnerability to natural and climate-related disasters, also acknowledge that climatic disturbances are part of a suite of conditions to which people are continually responding. Involving stakeholders in the decision-making process on broader livelihood issues can enhance adaptive capacity, and ability to cope with climate-related risks and opportunities (Dolan et al., 2001; Smit et al., 2000; Bias and Donovan, 2003). However, building human capacity requires a long-term and focused commitment to ensure smallholders can engage with the market and develop their own networks across institutional levels, and management and jurisdictional scales. Agricultural projects that failed in the region had limited opportunities to develop farmer capacity for problem solving by continuing to define a role for the NGOs as the outside mediator (Bingen et al., 2003).

Mainstreaming climate concerns into development policy has to be supported by careful planning of cross-scale structures, decentralisation and participatory decision-making processes that create, strengthen and delegate power and economic responsibility to local and village organisations (Nuijten, 1999; Bruck, 2001; Ribot, 2002). This is not a new concept, as addressing empowerment and poverty are part of the path to improving livelihood resilience for those dependent on natural resources, but the threat of increased disturbance caused by climate change is new (Mercoiret, 1990; Serageldin and Noel, 1990). While the World Bank has called for efforts to reduce obstacles to collective action and the creation of powerful coalitions for rapid development (World Bank, 2000), this case study highlights how it is important to consider the impacts and inequality in the process of local adaptation.

Activities of the farming associations may have increased community resilience to drought, but their ability to cope with more frequent shocks are uncertain, and household-level inequalities still exist (Pontera, 1997; Tschirley and Benfica, 2001; Jayne et al., 2003; DFID, 2005). District-level disaster risk reduction policies have not integrated the role of migrant income or engaged local entrepreneurs as much as they might, and it remains unclear how entrepreneurship might be sustained when there is a weak market, poor infrastructure and limited access to micro-credit (Tschirley and Benfica, 2001; Issufo, 2003). This is important because migrant labour has historically driven rural investment and is central to current livelihoods (Waterhouse and Vifhuizen, 2001; O'Laughlin, 2002). Walker et al. (2004) note that off-farm income sources are used to grow the small-farm commercial sector, and that its promotion may be a viable option in southern Gaza Province. Thus, it is difficult to talk about developing a renewal policy for 'rural farming villages' in Mozambique without considering these characteristics. Likewise, it is not clear how building human capacity will support long-term resilience to climate change without also addressing other constraining factors, such as institutional and trade structures, land rights, elite capture and poverty (Hanlon, 1996; Pontera, 1997; Unruh, 1998; Ellis and Biggs, 2001; Hanlon, 2002; IFPRI, 2002; Schafer and Bell, 2002; Braathen, 2003; Adger et al., 2005).

Harmonisation in planning responses between different institutional levels and across different sectors has helped to create, somewhat limited, opportunities for negotiated partnership between farmers and the private sector, such as shared technology,

infrastructure, access to markets and knowledge sharing. These partnerships could create long-term opportunities for collective farming associations. Smallholder farmers will only benefit if there are concurrent incentives for private companies to accommodate smallscale production demands (outside mainstream business contracts) (Heltberg and Tarp, 2002). While the government has acknowledged the cross-scale nature of rural livelihoods, it has continued to promote a modernisation renewal approach, rather than integrate multiple renewal approaches (Bingen et al., 2003). In the rush to meet rapid liberalisation, politicians courted Zimbabwean and South African private farmers to bring investment in cash crop production by offering concessions and land (Hanlon, 2004b). Commercial farmers and local entrepreneurs, such as those in the irrigated river valleys neighbouring Manjacaze District, could take advantage of this political climate (Selvester and Castro, 2004). For example, there is a class of private (local) commercial farmer in the study area, logging near Chalala and cash cropping around Chibuto, who have taken advantage of World Bank-financed programmes to gain access to water pumps and vehicles, and create a stronger local cash economy and wage labour.

The antipathy to larger farms in the area is informed by the 'sustainable development' orthodoxy that proscribes faith in the viability, desirability and inherent superiority of smallholder farming (Ashley and Maxwell, 2002). This perspective prevents real investment in multiple rural renewal approaches, with opportunities linking smallholders with the private sector. Meanwhile, international donors continue to remain wary of calls for rural credit programmes, unsure whether subsistence households can transform accountably without better coordination, services and transport (although the National PARPA mentions financing roads, interviews in 2002–2003 with donor organisations in the area reinforced this perception). More targeted efforts are needed to integrate the building of farm capital, improve market access, create contract incentives and diffuse ideas about new crop technologies. The dualistic distinction between the need to commercialise and the desire to support traditional smallholder systems has meant that the state has not fulfilled multiple rural renewal strategies and donor agencies work within a framework of prioritising smallholder agriculture with the necessary credit options, which does not fulfil local innovation potential and continues to limit market possibilities and define labour characteristics. While local diversification in household activities can be a resilient strategy to cope with disturbance in the short-term, it does not necessarily contribute to longer-term rural renewal, innovation and planned adaptation to climate change.

6. Conclusions

This paper explores scalar practice as the process of engagement between different institutions and agents across scale in order to understand emergent conditions for rural adaptation to climate change. We identify processes, institutions and types of agents that characterise cross-scale engagements and facilitate effective livelihood renewal. By exploring the local livelihood approaches to coping in Mozambique, it is clear that the poor are increasingly reliant on traditional coping mechanisms of reciprocity and exchange operating across different network levels. However, two specific cross-scale local responses have been used to cope with climate disturbance involving diversification and collective land-use management. These responsive actions are used only during temporary coping and are not without their winners and losers because some household are better able to exploit these strategies.

Planned agricultural initiatives which involve government, NGOs and local communities have helped to create emergent conditions for local-level adaptation to drought, food security and poverty reduction. These deliberately operate across traditional levels of authority for the management institutions. These policies potentially protect conditions for emergence of livelihood transformation and provide the components to help resilience to shocks, renewal and adaptive strategies. The agricultural initiative described in the sections above supports community-led reorganisation of social institutions that formalise reciprocity and facilitate innovation. The initiative built on the historical ideology of collective action, but has increased access for marginal households thus increasing gender equality, securing access to the dual land-use system for the poor, and helped the poor to enact entitlements to information or micro-finance. The density of cross-scale interactions in planned adaptations facilitates more farmers to undertake risk strategies, and to plan and learn. The findings here give an account of complexity in scale issues that resonate with those of Leach et al. (1999), the theory of bridging organisations (Olsson et al., 2004) and the dislocation in risk strategies recognised in the pressure and release model of Blaikie et al. (1994). The impact of the government programmes can be distinguished from trial and error practices (responsive coping) by individuals because of the intent and purposefulness of the action (planned initiatives), its strategic impact on management structures (supporting self-organisation) and the uniformity of uptake by within the village.

A number of challenges remain for planning effective adaptations in Mozambique, notably how District-level disaster risk reduction policies can integrate the role of migrant income, engage local entrepreneurs, or provide opportunities for negotiated partnership between farmers and the private sector. Underlying structural issues, such as weak markets for agricultural commodities, poor infrastructure and limited access to micro-finance exacerbate the difficulties for smallholder farmers. Multiple options for renewal and reform need to be mainstreamed into Mozambique's development agenda, especially those that facilitate emergent conditions for diversification and support social institutions, which both assist innovation and reinforce scalar communication. The current political situation in Mozambique and its lowly place in global league tables of human development suggest that it may be highly vulnerable to climate change and the vagaries of the world economy. Yet the evidence presented here suggests that adaptation actions, effective at least to present climatic challenges, can flourish at different levels and scales in society.

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