

Climate variability and rural livelihoods: assessing the impact of seasonal climate forecasts in Lesotho

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Climate variability acutely affects rural livelihoods and agricultural productivity, yet it is just one of many stresses that vulnerable rural households have to cope with. A livelihood approach is used to assess the potential role that seasonal climate forecasts might play in increasing adaptive capacity in response to climate variability, using Lesotho as a case study. An examination of the assets and strategies that rural households employ enables a holistic assessment of the impact seasonal forecasts could have on rural livelihoods. This research thereby bridges macro-level variability with local-level impacts and adaptation to provide insight into the dynamics of forecast use and impact among vulnerable groups.

Key words: Lesotho, adaptive capacity, livelihood approaches, seasonal climate forecasts, climate variability

Introduction

Rural livelihoods are subject to multiple shocks and stresses that can increase household vulnerability. Climate variability is one of the pervasive stresses that individuals and communities in rural areas have to cope with. Seasonal climate forecasts provide an indication of how variable the rainfall might be compared to past years and is therefore considered as information that could help to prepare for and adapt to climate variability (Goddard *et al.* 2001; O'Brien and Vogel 2003). The growing evidence of global environmental change and increased climate variability demands that adaptation options, adaptive capacity and ways to reduce risk should be prioritized (Rayner and Malone 1998; Kelly and Adger 2000; Smit *et al.* 2000). Because climate is only one stress on livelihoods, the impact of seasonal forecasts requires assessing not just agricultural activities that might change in response to forecasts, but the multiple dimensions of rural

livelihoods that constrain the uptake of information, have secondary effects and determine the system's ability to handle future stress (Yohe and Tol 2002). These multiple factors determine the adaptive capacity of individuals and households and are often ignored when a sectoral approach is used. The livelihood approach therefore provides a baseline to probe adaptation to risks such as climate variability.

Whilst there is growing evidence from both developed and developing countries of the utility of seasonal forecasts (Klopper 1999; CVAP 2000; Hammer *et al.* 2000; Plant 2000; Phillips *et al.* 2001; Patt and Gwata 2002), there is also evidence to show that forecasts are not always as useful as anticipated (Pulwarty and Redmond 1997; Pffaf *et al.* 1999, Bohn 2003). One area that requires further investigation is an exploration of how seasonal forecasts might support vulnerable farmers (Blench 1999; Hudson and Vogel 2003; Ziervogel *in press*). Research that explores responses and adaptation to global environment change should be a high priority

in southern Africa, where the climate is highly variable and is likely to become more variable and extreme in the future (Mason *et al.* 1996; IPCC 2001). It is also an area where the majority of the rural population is heavily reliant on rain-fed agriculture (Scoones 1996; Whiteside 1998; Washington and Downing 1999; O'Brien *et al.* 2000; Vogel 2000). Despite seasonal forecasts having been issued by national meteorological offices in southern Africa for between five and ten years (O'Brien *et al.* 2000; Basher *et al.* 2001), the extent of uptake is limited (Walker 2001; Ziervogel 2001; Archer 2003; Ziervogel and Downing *in press*). If climate stress increases, it is paramount to establish how best forecasts of variable skill might be integrated into the decisionmaking of vulnerable groups to facilitate improved adaptation to climate variability (Washington and Downing 1999; Sivakumar *et al.* 2000). In order to understand the constraints and potential impact of seasonal forecasts, it is useful to draw on a livelihoods approach.

In southern Africa, although many households depend on rain-fed agriculture for their food needs, it is often considered a risky enterprise with low returns. Many seek paid employment and off-farm income sources in order to increase their livelihood support base (Scoones 1996; Ellis 2000). Factors such as unstable economies, variable government policies and health crises threaten households directly. For example, HIV/AIDS is eroding many facets of rural livelihoods: financial assets deplete when used for health care and when those of working age are sick; agricultural labour decreases when the work force is not strong enough and social networks erode when young family members die and traditional practices are compromised (SADC 2003). Within this environment, climate variability is just one stress or shock. This paper focuses on climate variability and the potential for using seasonal forecasts to reduce the impact of this shock/stress.

The aim of this paper is to illustrate how an understanding of the impact of climate variability on vulnerable livelihoods can be used to assess the impact seasonal climate forecasts might have. It goes beyond traditional approaches of exploring the impact of climate on agriculture to consider this relationship within the context of the livelihoods in which agriculture occurs in order to provide a more holistic picture. This could help target future forecast dissemination strategies so that they are appropriate to users and draw attention to the fact that forecast use in agriculture can have multiple con-

straints and impacts. The paper starts by introducing seasonal forecasts and the role they might play within rural livelihoods. The fieldwork study area, Lesotho, and CARE's¹ livelihood approach are then presented. The impact of climate variability on rural livelihoods is investigated using participatory research methods. The impacts of seasonal forecasts on rural livelihoods are explored using hypothetical examples that examine scenarios of climate variability and how the availability of forecast information might affect rural livelihoods differently. The implications of the research are supported by actual forecast use by a small-commercial farmer and with suggestions of how future seasonal forecast dissemination might be more appropriately targeted according to livelihood typologies. It is concluded that appropriate forecast use has the potential to help vulnerable farmers adapt to climate variability, if certain aspects of forecast dissemination are appropriately addressed, although the multiple stresses and constraints on livelihoods might limit this.

Seasonal climate forecasts

The recent improvement of seasonal climate forecasts has meant that forecasts of how much rain to expect over the season, and so forecasts of the seasonal variability of rainfall, are widely available. The seasonal forecast is based on the fact that lower-boundary forcing, measured by sea surface temperatures, drives future atmospheric perturbations (Murphy *et al.* 2001). These boundary conditions evolve slowly and so enable predictions of rainfall and temperature to be produced (Palmer and Anderson 1994).²

The nature of seasonal forecasts means that they are not appropriate for all users (Orlove and Tosteson 1999). Seasonal forecasts are probabilistic and rainfall is often forecast as the chance of being 'above normal', 'below normal' or 'near normal'. The 'normal' amount of rainfall is the middle third (tercile) of the average rainfall for the past number of years of rainfall data used to develop the forecast. The forecast is usually issued for a period of one, three or six months and suggests the total amount of rainfall expected over that period, but not the distribution of rainfall within that period. If the amount of rainfall forecast were to fall over a few days, the seasonal forecast would still be correct but the impact could be catastrophic (Agrawala *et al.* 2001). It is this probabilistic nature that needs to be emphasized so that people do not assume it to be a

deterministic prediction that is wrong when the actual climate is not as forecast. Despite these limitations, the forecast is useful to a range of users.

In the agricultural sector, forecasts have provided information for numerous agricultural decisions relating to dryland farming, irrigated farming and livestock management (Marshall *et al.* 1996; Hammer *et al.* 2000; Walker *et al.* 2001). The types of decisions that seasonal forecasts can help with include both operational short-term decisions and tactical and strategic longer-term decisions. For example, the sugar industry in South Africa has benefited from using seasonal forecasts. The South African Sugar Association distributes forecasts to stakeholders and this has led to increased mill productivity and more profitable trade on the international market because mills have had more accurate forecasts of the amount of sugar cane they will receive (Bezuidenhout and Singels 2001). A strategic decision for smallholder farmers might be to maximize total crop yield. The accompanying operational decision might involve deciding what variety of crop to plant in order to achieve maximum yields. A forecast for below-normal rainfall could encourage drought-resistant seeds to be planted instead of long-maturing varieties that require more moisture and might fail completely without adequate water. If the forecast provides better than 'best guess' information about the rainfall in the coming season it can allow for better decisionmaking and maximization of conditions (Walker *et al.* 2001). This opportunity to manage variation is a strength of seasonal forecasts that is as important to realize as decreasing negative impacts of climatic variability.

There are few examples of seasonal climate forecasts being used successfully by vulnerable groups, despite international efforts to improve societal responses (Agrawala *et al.* 2001). One of the primary reasons for this is that forecast information does not specifically target vulnerable groups (O'Brien *et al.* 2000), which results in poor *availability* of information. There is also a barrier to vulnerable groups *accessing* the information: it is often not tailored to suit them in content and delivery style, which means that they may not be able to access it even if it was available to them (Patt 2001; Broad *et al.* 2002). There are also a number of constraints that vulnerable groups face in *applying* information; these include access to credit, land and inputs as well as social constraints (Stern and Easterling 1999; Roncoli *et al.* 2000; Vogel 2000). The forecast will only have an *impact* if the availability

and access are suited to the user and the user has the means to apply the forecast (Orlove and Tosteson 1999). The extent of the impact will depend on the interplay between household assets and activities and the contexts in which they are situated. A livelihood approach, as outlined below, enables these factors to be considered. If the impact of the seasonal climate forecast on resource management was examined through a sectoral lens or without incorporating consideration for local livelihoods, critical issues inherent in this interplay could be missed; for example, forecast access might be restricted by the scarcity of radios or the fact that the probabilistic nature of the forecast is not understood. A livelihood approach provides a more nuanced view that brings these household-specific and contextual issues to the forefront when considering seasonal forecast applications.

Forecasts and rural livelihoods in Lesotho

Research undertaken in Lesotho, a small mountainous country in southern Africa, aimed to assess the role seasonal forecasts might play in contributing to sustainable pathways of rural livelihoods. Many Basotho³ pursue rain-fed agricultural strategies and are therefore affected by the variability of rainfall and frost, which impact their livelihood security (Calder *et al.* 2000; Gay and Hall 2000; Turner *et al.* 2001). Although many try to subsist on the land, poor land quality, decreasing availability of land, resource and labour constraints make agriculture a declining support of rural livelihoods. This is also true at the national level. Although Lesotho has pursued a strategy of food self-sufficiency, agriculture only contributes 14 per cent of GDP (Chakela 1999) and they have had to import food every year, with the 2002 food crisis being no exception (LNVAC 2002).

While agriculture plays an important role in the lives of the Basotho, their livelihoods typically consist of 'bundles' of on-farm and off-farm activities. Although most households maintain some involvement in agriculture, the importance of alternative livelihood strategies is growing. Wage earning is the most favoured livelihood strategy and if that is not possible there are many other strategies in which households might engage (Turner *et al.* 2001). Remittances from Basotho males who worked on the mines in South Africa used to support a large majority of the rural population, with an average of 60 per cent of their pay deferred to their Lesotho

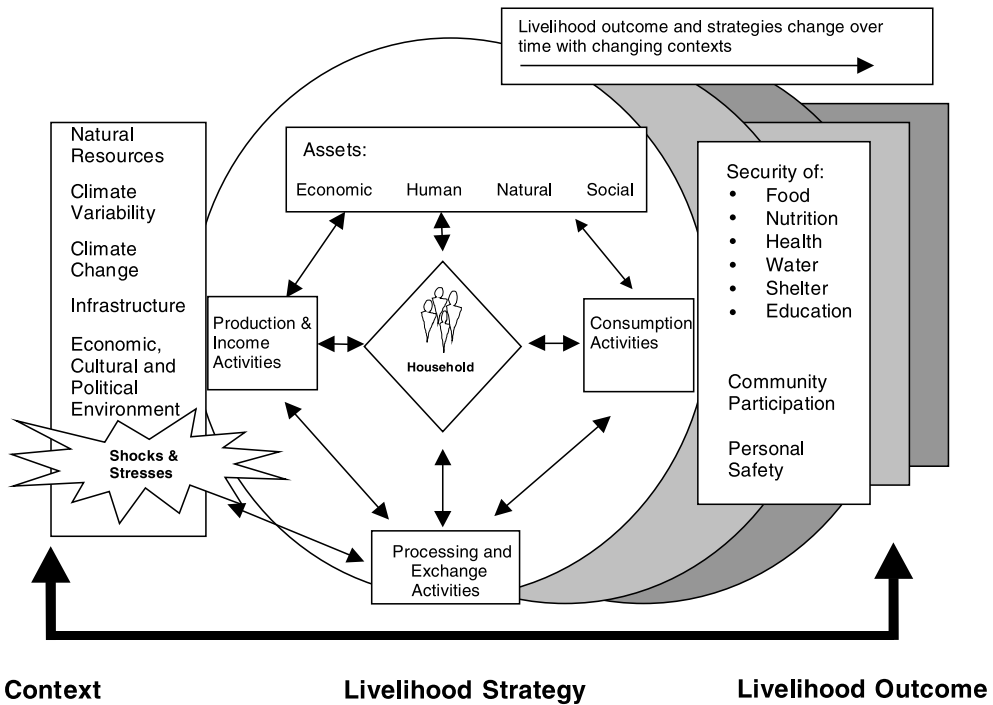


Figure 1 An adapted version of CARE's livelihood approach
 Source: Adapted from Carney *et al.* (1999)

Economic assets include financial resources, basic infrastructure and other means that enable people to pursue their livelihoods; *Human* assets consist of the skills, knowledge, ability to labour and good health, which are important to enable the pursuit of livelihood strategies; *Natural* assets include natural resource stocks from which resource flows useful to livelihoods are derived; *Social* assets depend on the quantity and quality of social resources (e.g. membership in groups, social relations and access to wider institutions in society) upon which people draw in pursuit of livelihoods

bank accounts until 1990 (Mochebelele and Winter-Nelson 2000). The restructuring of the mine industry resulted in many Basotho losing their jobs in the 1990s and hence households have had to find other sources of income (Crush *et al.* 2001). Alternative livelihood strategies include the sale of vegetables and firewood, making bricks, sewing, selling local beer (*joala*) or piece jobs in South Africa (Gay and Hall 2000). While some of these strategies are directly affected by the climate, others might be unrelated or only indirectly affected by the climate. We have chosen to focus on agriculture, as it is the one strategy that poor households are often able to pursue.

Rural livelihood approaches draw on both theoretical and practical spheres. The theoretical framework enables the components of rural livelihoods to be identified and the links between components to

be explored. This paper uses CARE's livelihood approach as a basis for exploring the theoretical interaction of livelihoods and climate. CARE's approach has been modified to provide a more appropriate means for assessing the impact of the climate on livelihoods (see Figure 1). The changes include:

- The environmental or climate signal has been added to the context.
- Capitals have been labelled assets (as assets are broader than capitals, which tend to have economic associations).
- A dynamic element has been added so that livelihood trajectories can be assessed (which is important when relating livelihoods to climate and should include monthly, seasonal and inter-annual variations so that livelihood outcomes can be re-evaluated over time).

- The arrow connecting context and livelihood outcome connects both ways (rather than just from outcome to context as in the original model).

In the context of rural livelihoods, climate can manifest itself as a shock or a stress. Discrete climate events that are significantly different to the average conditions, such as hurricanes, floods or drought, can be classed as shocks. More gradual changes in the climate, such as long-term climate variability or a few months of above- or below-normal rainfall, can be classed as stresses. These shocks and stresses fluctuate over space and time and contribute to patterns of household vulnerability (Francis 2000). For example, the varying spatial impact of climatic shock might be seen when frost decimates one side of a valley but not the other. Households on the affected side lose their crops and become more vulnerable, whereas households farming on the opposite side of the valley are only slightly affected, can still expect a good harvest and might have a better market. The level of stress or the impact of a shock will also depend on what coping strategies are available to the household to respond to or buffer the impact (Blaikie *et al.* 1994; Bohle *et al.* 1994; Carney 1998).

The possibility of managing the likelihood of variation from the normal climate, before it becomes a shock or a stress that has a negative impact, could contribute to increasing household resilience. For example, if a household plants a crop that is suited to above-normal conditions and the actual rainfall *is* above normal, then a good harvest might enable the household to sell surplus crops, purchase assets and invest in their children's education. Unfortunately, in developing countries the benefits might be short-lived as other stresses might start to erode these livelihood assets. The inherent variability of the social, economic and physical environments where vulnerable households tend to reside results in households not being able to store significant amounts of resources, and so net accumulation is often followed by net consumption which decreases the ability of households to buffer multiple or extreme shocks (Smith 2001). It is these complexities that demand a holistic analysis of how forecasts could be best integrated into rural livelihoods.

In this paper, two analytical approaches are used to explore climate–forecast–livelihood interactions. The first analytical approach draws on data from fieldwork to suggest how climate variability and related information is perceived. The second ana-

lytical approach uses hypothetical cases to illustrate the potential impact of climate variability and forecast use. Fieldwork data alone could not explore forecast use, as at present there are limited cases of vulnerable households using the forecast.

Impact of climate on livelihoods: fieldwork evidence

The villages where the research was undertaken were in the Mohale's Hoek and Quthing districts in the south of Lesotho. There is a rich variety and depth of secondary data available on these villages, as they were all involved in CARE Lesotho's Training for Environmental and Agricultural Management (TEAM) project, a project explicitly concerned with improving rural livelihoods (Mohasi and Turner 1999). CARE staff were used as facilitators and conducted the exercises in Sesotho.

Surveys and participatory methods were used to elicit data from households. Participatory methods have gained exposure and use since the promotion of participatory rural appraisal (PRA) (Chambers 1994; Haggmann *et al.* 1999). These methods aim to involve the community in interactive ways that encourage participation of all and enable local stakeholders to drive development processes. Although this sounds good in theory, the reality is that existing power relations often drive the process (Nelson and Wright 1995), which can mask the diversity of individual perceptions and needs (Cleaver 2001). Participatory approaches do have benefits. This research used surveys to ask about seasonal forecast use and it emerged that it was difficult to get meaningful answers when asking questions about information that had not been received or used. The use of participatory and exploratory tools, such as role-play exercises, helped people to think through the process more thoroughly (Ziervogel *in press*). Although they still provide subjective information, it is hopefully more reflective of individual perceptions than just using survey data. Other tools, including timelines, seasonal calendars, Venn diagrams, preference ranking, matrices and focus groups, were used. Two of the tools are presented in this paper.

A timeline exercise was conducted to explore people's recollections of the rainfall pattern and its impact on the harvest over the past ten years. First the group was asked to remember significant events that had happened in the village to make it easier for them to remember what the rainfall had been like at a particular time. For example, they could

Table 1 Timeline of significant events, rainfall and yield quantities

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Significant events					a	b	c		d		
Amount of rainfall	2	1	2	4	4	1	4	4	3	1	5
Amount of yield	4	3	4	4	4	3	4	5	2	1	–
Rainfall total for JFM in Lesotho	399	460	135	233	467	242	354	332	540	195	518

Notes: 1 is low rainfall or drought/poor yield and 5 is high rainfall/high yield. JFM: Average rainfall for January, February and March (Peshoane 2000). a: People from Matatiele (South Africa) came and stole cattle and killed many people and animals. b: Trees (not fruit) were planted in the village by the Farmers Training Centre. c: The government installed taps and the number of diseases decreased. d: SADC was in Maseru; Maseru was burnt and people were killed

remember that the year when taps were installed was associated with a decrease in disease. In that year, they remembered receiving a lot of rain and obtaining high yields. They were asked to assess the quality of rainfall and harvest by ranking them out of five, with one being drought or low yields and five being a lot of rainfall and high yields.

The timeline of significant events, rainfall and yield quantities (see Table 1) shows that participants perceive years of high rainfall to be linked to years of better harvest (i.e. 1993 1994 1996 1997). This echoes what participants said in previous surveys: that rainfall determines whether yields will be high or not. This is based on their perception. The row at the bottom of the table gives the total amount of rainfall for January, February and March (Peshoane 2000). It should be noted that this is the average for those months for the whole of Lesotho and so could have varied at this mountain location, but it illustrates some consistency between perceptions and actual amounts. Participants indicated that the years at the beginning of the decade (1990–1992) had poor rainfall, but were accompanied by average to good harvests. The total rainfall for Lesotho indicates that the rainfall was above normal in these years, suggesting that early years of memory are perhaps not as close to the actual. They also said that the 1998 rainfall was average when those records show that those months had the highest total in the last ten years.

The inconsistency between rainfall and yield is important to establish, as rainfall cannot always be used as a determinant of whether the harvest will be good or not, although in some years it can (Zubair 2001). It is therefore important to convey the fact that high rainfall is not always associated with high yield. Hearing this information at the same time as receiving

the forecast would help to highlight the nature of the forecast. It should be noted that because the forecast is probabilistic, it should not be used as a deterministic tool for providing a definitive prediction of what the season (or the yield) will be like, but rather as a guide. The reality is that although rainfall amounts play a major role in influencing the success of the harvest, there are numerous other factors that might decrease the yield. The response from one participant shows that although high rainfall may bring high yields, it also brings problems:

There is a Sesotho saying, 'Pula ke mahlopha a seea' that means the rain is good and bad. The roads become impassable and it is hard to work but crops grow.

This quote highlights why the interplay between livelihood assets and their contexts is crucial for understanding the double-edged impact climate and seasonal forecasts might have on livelihoods. Yes, the forecast and actual rain may be useful in some years, but other constraints may result in it being only one piece of information that might not be trusted or useful enough.

It is also important to establish what type of information about rainfall and climate might be required in order to improve the management of climate variability. A participatory climate information ranking exercise was used to establish what type of climate information was most important to Basotho farmers. A matrix was drawn and people were asked to rank what information would be most helpful in the management of their crops and livestock (as seen in Table 2). These exercises were carried out with four different groups. The information of primary importance for decisions related to both crop and livestock sectors is the distribution of rainfall during the season

Table 2 Ranking of type of climate information desired

Information	Crops	Livestock
Start of rainy season	2	2
Distribution of rain through the season	1	1
Maximum rainfall in one month	3	4
Total rainfall in season (seasonal forecast)	7	7
No. of days/month without rain	6	6
Maximum temperatures	5	3
Minimum temperatures	4	5

Note: 1 is most important and 7 is least important

followed by the onset of the rainy season. The third most important piece of information for crop management is the maximum rainfall in a month and, for livestock, the maximum temperatures. The distribution of rainfall throughout the season appears to be important for livestock management because during long dry spells the grazing deteriorates and the animals suffer acutely. Information about the start of the rainy season is important because the first rains are accompanied by improved pastures, so if one knows when the rains will start, the livestock can be moved up to higher pastures where food will shortly be plentiful. Some information, such as the minimum temperature, is of interest only at a certain time. One farmer stated, 'I would want the minimum temperature around April when maize is reaching maturity'. So, although this information may not be important all year round, at certain times it is considered useful.

Potential impact of climate and seasonal forecasts on livelihoods: exploratory cases

Given that past years of rainfall have had varying effects on crop yield and that different types of climate information have different priorities for crop and livestock management, it suggests that climate information is important to rural households. In order to explore how different climate stresses might impact livelihood assets, we developed a matrix to track some of the complexities of the impact of climate on livelihoods, as shown in Table 3. Different climate stresses and shocks bring about a variety of impacts on assets and strategies. The impact of different types of climate variability range

from minor to major and will depend on both the household and the environmental characteristics. The impacts can be both direct and indirect. For example, a stress, such as delayed onset of rain, has the potential to affect not only crops but education, nutrition and social networks. The focus on different assets and strategies enables some of the indirect impacts to be uncovered.

The impact of climate variability on rural livelihoods has been shown above. The next step is to ask what implication this has for seasonal forecast utility. Seasonal forecasts can be described as the total amount of rainfall expected during the season or over a given time period. Most groups ranked the total amount of rainfall as the least important information. Unfortunately, much of the information desired does not exist as pre-season forecasts at present. Information on the start of the rainy season is a forecast that climatologists are improving upon but do not yet have a high enough skill to permit dissemination.⁴ The only climate forecast that is currently produced in Lesotho is the seasonal climate forecast. A six-month forecast is issued in October and is divided into two three-month periods of October to December and January to March. An update of a revised forecast for the January to March period is issued in December. When it was explained that the only information available was the total rainfall for the season, farmers indicated that if they could not access preferred information, they would like to know the total amount of predicted rainfall during the season, as it would be better than nothing.

Fieldwork and secondary sources suggest that climate has both a direct and indirect impact on livelihoods. Forecast information seems to be desired, although other information is preferred. Seasonal forecast use among poor and average households is low and so it is necessary to use an exploratory approach to assess the impact of forecast use on livelihoods. This section contrasts two hypothetical livelihood cases, one of a poor household and one of a better-off household, to illustrate the varying impacts climate and forecasts might have on rural livelihoods. In the discussion, these hypothetical cases are complemented by an example of a small commercial farmer who has used the seasonal forecast.

The potential impact of climate on different livelihood assets and strategies in different contexts is clearly illustrated in Table 3, where it serves both an explanatory and a predictive purpose. We argue

Table 3 Potential impact of climatic variation on household assets and strategies

Source of livelihood (assets and strategies)	Prolonged drought	Delayed onset of rains	Normal rains	Above-normal rains
Economic	Crop failure, livestock death, deterioration of dwellings (due to diminished thatch grass), erosion of savings, depletion of seed resources in granaries, trees cut down for income generation, wealth and productive resources liquidated, reduced animal feed	Shortage of water resources, delayed planting leads to short maturing and lower yielding varieties and less sale, animals get weak and sick, vegetation suffers, resources not as plentiful for crafts such as weaving or thatching, wealth resources liquidated	Potential good harvest improves food security and excess for sale, good grazing conditions, adequate water supplies, housing can be repaired, nearby sources of firewood, animals strengthen	Water logging and increased pests destroy crops, increased diseases affect humans and livestock, water damages housing and grain stores, increased pests in grain stores, small animals drown or washed away, disrupted transport reduces sale of goods
Human	Increased labour migration, malnutrition, undernutrition, disease epidemics (cholera, dysentery, AIDS) due to poor sanitary conditions and increased unsafe sex as income generation activity, morbidity and mortality of income earners	Malnutrition, undernutrition, education suffers as children can't concentrate and sometimes have to stop school until money is acquired to pay school fees	Clinics function more efficiently as not overloaded with epidemics, education is readily available, fewer epidemics and less undernutrition	Disease epidemics, schools and clinics might be structurally damaged or closed because of restricted access
Natural	Firewood depleted, poor pastures, limited water supply, dry soils, increased erosion, gathering of wild food	Firewood depleted, poor pastures, limited water supply, dry soils, increased erosion, gathering of wild food	More firewood available, improved pastures, moist soils, increased pests	Abundant pastures, areas of flooding and waterlogging, increased pests
Social	Kinship networks weaken as resources depleted (claims not met) and increased migration, exploitation of common property resources, increased conflict	Temporary exploitation of communal resources, minor claims not met	Kinship networks able to support poorest households, personal resources used so communal resources can improve, increased competition as many households try to sell goods	Kinship networks weaken as resources are depleted (claims not being met), increased conflict, safety nets destroyed, employment opportunities decrease, increased migration for work

Box 1 Ha Madla case study – village background information**Ha Madla Village**

Ha Madla is fairly large village, with about 100 households. A range of mountains that serves as a border between South Africa and Lesotho surrounds the village. Qacha's Nek is the nearest big town, about 50 kilometres from Ha Madla, and has a shopping centre, a hospital, a taxi rank and other businesses. Ha Madla does not have electricity, but there are water taps that were installed four years ago. There is a communal river that runs through the village. There is a nearby clinic that helps residents with minor ailments and for major ones they go to Qacha's Nek. The village has two major shops and a number of small shops. It is one of the villages where the national Food For Work (FFW) project operates. The project, run by the government, involves getting people to build roads in return for food.

The weather tends to be quite harsh during the winter months with frequent snowfalls. It is a summer rainfall area, with around 700 millimetres falling per year, although this amount varies significantly between years. The soil favours plantation of potatoes and most villagers grow them in their yards but grow the staple crop, maize, in their fields. Because of its close proximity to the South African border, stock theft is a constant worry for to the stockowners of Ha Madla.

that once the impact of climatic shocks and stresses on vulnerable households is understood, the forecast can be targeted to deal with specific assets and strategies for different livelihood typologies. The matrix presented in Table 3 is used as a template for exploring the impact of seasonal forecasts on two rural households presented in Box 2 (adapted from CARE South Africa 1999). Background information on the village is provided in Box 1. The cases illustrate the varied impact of a climatic stress – below-normal rainfall – on different livelihood typologies; one that is highly vulnerable and one that is more resilient. Once the impacts of the climate stress are suggested, the potential use and impact of a seasonal forecast of below-normal rainfall is assessed. This provides illustrative information, which could assist in designing more appropriate seasonal forecast intervention to suit different livelihood typologies to improve availability, access and use.

The impact that a climate stress, of below-normal rainfall, might have on the livelihood assets of the two households presented in Box 2 is seen in Table 4. It highlights the different assets that are affected by the climate, which leads to the uncovering of the indirect climate impacts. The climate does not just impact on agriculture and resources as might initially be thought, but also impacts on social and human capital. The dynamics of each asset can be taken further by focusing on key questions in more detail, which is good for development-type work as it allows the impact of the concatenation of stresses to be explored, rather than focusing on extreme

shocks. For example, the lack of food and money that restricts Masentle's household from paying for the burial society could make her household less welcome at some community meetings. If this was the case, then meetings aimed at providing relief for vulnerable households might not be appropriate if members of those households felt they were unwelcome. The table is therefore a good point of departure for exploring how development interventions could be focused to impact positively on livelihood security.

How might a seasonal forecast of below-normal rainfall have been used by either of these households and what impact might it have had? If Masentle had heard that there was a 40 per cent chance of below-normal rainfall for the season, there are a few coping strategies that she could have employed to help buffer her household from the stress. She could have sought more work with the FFW project or worked on a piece job basis for someone else in the village in anticipation of her not having enough money to feed the family or not being able to send her son to school. She could have planted vegetables in her garden that grow better under drought conditions, such as spinach, radish and pumpkin. She could have started collecting organic matter to retain moisture in her vegetable garden.

Victoria's household could have used the forecast information to invest in different assets and strategies. If they had heard that there was a 40 per cent chance of below-normal rainfall, they could have bought drought-resistant or short-maturing maize

Box 2 Masentle and Victoria's livelihoods**Masentle Letsie**

Masentle is a 57-year-old widow. She worked for the Food for Work (FFW) project as a road builder (earning M28.00, equivalent to £2 in 2003, per day for two months in two phases). She lives with her three children; a 24-year-old daughter who has a 18-month-old baby, another 20-year-old daughter and a son who is 14 years old. The eldest daughter has passed her final year of school but is not working, while the second one had to drop out of school while she was in her second last year of school as Masentle could not afford the school fees for her. Her son is still in school and completing his ninth year of school.

The Letsie property has two mud-thatched huts. One of the huts has a bed, a stove, enamel plates, a few pots and buckets to draw and store water. They have a vegetable garden in which Masentle grows carrots, cabbages, potatoes, pumpkins, beans and beetroot that she sells when she has good yields. The vegetable garden is also used to feed the family. The family owns four chickens and one pig.

While she was employed in the FFW project, Masentle started a small shop where she sold paraffin and candles and traditional beer. The shop is no longer functional as Masentle does not have money to purchase more stock. She spends most of her money on food and paying off credit at the shop. Masentle belongs to a sewing project. She paid a M10.00 joining fee, but it has not started as most of its members were employed by the FFW project. She also belongs to four different burial societies although she finds it difficult to pay the membership fees. Other members pay on her behalf and when she has money she pays those people back. She used to get help from her mother who is now deceased. Her eldest daughter is not getting any maintenance from the father of her child.

The family eats twice a day when food is available and once a day during difficult times. The family uses firewood to cook and to warm up the house and candles and paraffin for lighting.

Victoria Mokhothu

Victoria is 47 years old and is married to Sechaba as his second wife. They do not have any children. They are staying with the first wife's two sons. None of the family has participated in the FFW project.

The Mokhothus own two shops, one in Ha Madla and another one in the neighbouring village. They have 50 cows, 20 goats, five pigs, four sheep, five chickens and one tractor. The family owns one field and hires one field from another villager. The one field is used to grow maize and they use their own maize grinder to grind the mealies. The other field is used for growing potatoes and cabbages. Other vegetables are grown in a home vegetable garden and Victoria sells them at the shop. They also own a brush cutter machine and hire four people to cut wood (wattle) and sell it in other villages. They charge M5.00 a bag and M180.00 for a small truckload.

On the Mokhothu's property there is a house, a well-stocked shop and a thatched hut. They own another electrified five-roomed house in Qacha's Nek. From the shop in Ha Madla the family makes a profit of about M200.00 a day when not busy, and when busy M300.00 per day. During the FFW project they make over M400.00 a day.

Victoria and her family spend their money on food, school fees and uniforms for the husband's sister's children and on health care as she suffers a lot from headaches. Most of the money is invested in insurance policies; social clubs like burial societies for the family and the community. The other money is spent on clothing the family including the sister's children. The Mokhothus give help to other less fortunate relatives like Victoria's family. The family uses candles, paraffin and gas for lighting and firewood for cooking.

Victoria and her husband help out in the community by employing local people and giving credit to the elderly and poorer people. At the same time, the family does not have enough time to attend community meetings or participate in community projects. The only project that Victoria has participated in is the water scheme, and only to pay for water scheme contributions and the pipe installation because she wanted to water her vegetable garden. Sechaba has control over the money and Victoria asks him to buy things that she wants. Victoria is pleased to be working at the shop the whole day and goes home to cook and perform other household chores in the afternoon. Victoria is happy that Sechaba can listen to her advice, even if he has all the control over the money issues.

Table 4 Impact of below-normal rainfall on two rural households' livelihoods

Source of livelihood	Impact of below-normal rainfall	
	Masentle's household	Victoria's household
Economic	Have to eat/sell chickens and pig so have little insurance; firewood resources are depleted so daughters have to spend most of the day walking beyond the village to gather shrubs to burn; food stocks are slowly depleted; no income from vegetable garden	Lose a few cows that are undernourished but then buy feed for them to ensure it does not happen again; maize crop is unsuccessful, but get some yield from the cabbages; shop does well as people do not have vegetables in their garden and so have to find food elsewhere; wood still sold as cheaper than paraffin and people cannot afford paraffin when cash resources are limited
Human	Son has to leave school as cannot afford school fees; cannot find work as he does not have high enough qualifications to work in the capital, Maseru, and jobs are scarce because the economy is suffering; the family only eat once a day, which results in poor health but they cannot afford to go to the clinic; the baby is undernourished and may get sick; Masentle might trade her labour for sorghum so she can brew beer	Family cannot invest as much as before but continue their high standard of living as they still have steady income from their two shops; Victoria's husband's sister's children can still go to school although may not get new uniforms
Natural	Firewood depleted; poor pastures; limited water supply; dry soils; increased erosion	
Social	Use any money available for food so cannot pay for burial societies; no family members to support them and the friends cannot support them as they are also struggling	Leave half of one field fallow and so cannot employ as many people to work in the field; still support some households financially

varieties and applied kraal manure to their fields, as this helps to conserve water. Surplus maize could have been sold in the shop for a profit if other community members' maize had failed. Instead of potatoes, they could have planted animal feed such as rye or lucerne, which can withstand drier conditions. They could also have ensured that they paid their fees for the water scheme so that they could water their vegetables if there was still water in the river. The animals could have been sent to the highlands, where the pastures are better; they might also have considered selling a few cows before the drought to reduce potential loss later, something other households might have delayed if they had few other forms of insurance. Victoria's household might not suffer as much from the impact of climate variability, despite having assets such as field crops and livestock that are directly affected by the climate. This can be attributed to the multiple livelihood strategies employed by the household and its relatively rich diversity of assets, which reduce the impact of shocks and stresses.

Discussion: using the livelihood approach to target seasonal forecast developments

In Lesotho, the forecast does not reach many households involved in subsistence and small-scale farming, which makes the impacts hard to measure. For that reason we chose hypothetical cases to illustrate why the impact of climate and forecasts cannot be considered for a single sector but should be integrated into the diverse fabric of rural livelihoods. The forecast does reach a few commercial farmers. A small-commercial farmer, Teboho, heeded the forecast for above-normal rainfall one season. He planted his crops despite the dry conditions. When the rains arrived and watered his crops, he was rewarded, unlike his neighbours, who had not planted because they were waiting for the first rains but were then unable to sow their seeds because the fields were waterlogged. If the forecast had been incorrect it is likely that Teboho would have lost a large proportion of what he planted. He might not have had the resources to

Table 5 Possible uses of the forecast by livelihood typologies

Possible decisions	Poor	Average	Better-off
When to plant	✓	✓	✓
What crops/vegetables to plant	✓	✓	✓
When to sell livestock and small-stock	✗	?	?
Water/soil management	?	✓	✓
Whether to send children to school	?	?	?
Seek alternative income sources	✓	✓	?
Marketing options	✗	✓	✓

✓ forecast could help decision

? forecast might help decision

✗ forecast probably won't help decision

continue farming at a commercial scale the following year, but he had alternative strategies that he could pursue to secure his livelihood and could have invested in irrigation or hired additional labour to hand-water the fields if critical. This reflects the importance of understanding the probabilistic (rather than deterministic) nature of the forecast and the alternative strategies that exist for each household that might choose to use the forecast. Teboho accepted that the forecast was probabilistic and knew that he was taking a chance in using the information. He was prepared to take the risk and this time he won. Someone who was unaware of the risk might not have been prepared if the forecast and the actual rainfall were different.

The two Ha Madla households and Teboho provide examples of how different household typologies might be impacted by climate and forecast information. The seasonal forecast will have different impacts on decisions for different typologies because of household resource availability and ability to respond to information. Table 5 highlights some of the decisions that are impacted on by climatic information and whether households could use the information or not. These are preliminary uses, but allow for the forecast information to be targeted according to typology.

The information in Table 5 can be used to tailor forecast delivery. Poor households are likely to have more constraints with regards to available assets and strategies than better-off households. Targeting forecasts so that they are available, accessible and usable for poor households might therefore be more appropriately achieved by targeting livelihood assets and activities. This might involve ensuring that drought-tolerant seeds are available and that water

conservation methods are taught. Targeting the forecast for use by better-off households might require less intervention with regards to assets and activities and more focus on the support of forecast use, such as extension officers that can explain exactly what the forecast is and provide suggestions on how it might be used or what alternative market options might be available. Combining the climate impact matrix with use of the forecast according to livelihood typologies provides a set of tools for targeting seasonal forecast developments so that they are suited to the user and their livelihoods.

If the seasonal forecast had been factored into the household decisionmaking process of Masentle or Victoria, as it was with Teboho, it would have increased the amount of information available when making climate-related decisions. This does not necessarily improve the decision, but better information can decrease uncertainty and so might enable households to better withstand shocks and stresses. As was shown in the example of Victoria's household, they could have used the forecast to their advantage by planting drought-resistant maize and selling it. This could have decreased the impact of the potential shock and turned it into an opportunity. Households with fewer resources could also benefit, although possibly not as much. They might respond to a forecast of below-normal rainfall by decreasing their cropping density and so not planting all of their seed but keeping some back, which could be used as food stores or kept for planting the following season. Similarly, they may have been made more vulnerable by using the forecast if they had made decisions expecting below-normal rainfall and the actual rainfall had been normal or above normal.

Risk is associated with using the forecast. If Masentle's household had anticipated below-normal rainfall and planted drought-resistant vegetables, the vegetables might have perished if there was excessive rainfall. This could have resulted in a deficit food supply, which would have increased their vulnerability. Victoria's household had more economic assets, income and climate-dependent resources to start with, and so had more options of responding to the forecast information. If the forecast had been incorrect and normal or excessive rainfall had fallen, they would have lost out financially. The yield from drought-resistant varieties would have been lower than regular maize varieties and they would not have had potatoes to sell if they had planted animal feed. Although this would decrease their income, they are not likely to be significantly more vulnerable, as they have other livelihood strategies, not dependent on the climate, that support them. If their sole income was from their fields, they would have been more vulnerable as their resource base would have been severely depleted. The inherent risk of using the forecast does not mean that it should not be issued, but rather that users and disseminators should understand and be prepared to cope with the associated risk.

We suggest that this research could be developed further by using a larger sample and by examining in more depth how different livelihood typologies might use the seasonal forecast. In particular, research needs to focus on the implications of forecast use by the poorer and more vulnerable households. Previous work in Lesotho has shown that there are many options for responding to the forecast and, more importantly, that many of the options do not need a lot of resources and so are appropriate for a range of livelihood typologies (Ziervogel in press). This research could be used to contribute further to discussions on adaptation to climate variability, as the forecast provides an opportunity for adapting to a variable environment and learning how to integrate information about climate variability.

Conclusion

This paper has shown that climate has a significant impact on rural livelihoods, through both direct and indirect means. The availability of the forecast to vulnerable farmers is therefore important to pursue, as it could contribute to improved management of climate variability and so increase adaptive

capacity. Caution should be exercised when disseminating the forecast, as we have shown that forecasts also have the potential to increase vulnerability.

Field-based evidence and hypothetical cases have illustrated the need for a holistic assessment of different stressors and adaptation options for rural livelihoods. The matrices presented in Tables 3 and 5 are heuristic tools that can be used for assessing the multiple dimensions of a stress on livelihoods. In this case, they explored the impact seasonal forecasts might have on rural livelihoods and how different livelihood typologies might have different uses for the forecast. This is paramount when targeting seasonal forecast end-users, as it highlights that users should not be addressed as a homogenous group (O'Brien *et al.* 2000). The application of the forecast will depend on how the forecast information fits with existing information and livelihood strategies (Orlove and Tosteson 1999). Existing livelihood approaches were not suitable for assessing this and so had to be adapted to include climatic variables in their context as well as temporal dynamics.

If the utility of seasonal forecasts by vulnerable households was looked at solely as a function of the impact of climate on a sector and so how the forecast can mitigate that impact, it is likely that the fundamental building blocks of livelihoods that determine availability, access and application of the seasonal forecast will be excluded. By applying a livelihood approach, one is more likely to recognize and consider how and why the forecast can make households more or less vulnerable. This increases the likelihood of more appropriate development of the seasonal forecast, so that if suitable, it can be integrated into rural agrarian livelihood strategies. The ability to integrate new information would facilitate learning and increase adaptive capacity, which is particularly important if variability increases in the future. An increase in adaptive capacity is therefore critical in contributing to future household resilience that could increase the sustainability of both livelihoods and information networks.

This paper has gone beyond assessing direct impacts of climate on agriculture to include livelihood assets and strategies that suggest secondary impacts and constraints. If adaptation to climate variability is a priority, it is the enabling conditions that need to be explored and, in the case of seasonal forecast use among vulnerable farmers, a livelihood approach enables this.

Notes

- 1 CARE International is an aid and development organization that is composed of a confederation of 11 separate member organizations that have programmes in over 60 countries (<http://www.care-international.org>) Accessed October 2002.
- 2 The term seasonal forecast is used from here on to refer to seasonal rainfall forecasts.
- 3 Basotho is the name given to the people who live in Lesotho. They speak Sesotho.
- 4 In a workshop with the meteorologists from Lesotho Meteorological Services, the consensus was that the start of the rainy season might be possible to predict in ten years time.

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