OXFAM RESEARCH REPORT

What Happened to the Seasons?

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Abstract

The timing of rain, and intra-seasonal rainfall patterns are critical to smallholder farmers in developing countries. Seasonality influences farmers' decisions about when to cultivate and sow and harvest. It ultimately contributes to the success or failure of their crops. Worryingly, therefore, farmers are reporting that both the timing of rainy seasons and the pattern of rains within seasons are changing. These perceptions of change are striking in that they are geographically widespread and because the changes are described in remarkably consistent terms. In this paper, we relate the perceptions of farmers from several regions (East Asia, South Asia, Southern and East Africa, and Latin America) of how seasons are changing, and in some cases, how once distinct seasons appear to be disappearing altogether, and the impacts that these changes are having. We then go on to ask two critical questions. Firstly, do meteorological observations support farmers' perceptions of changing seasonality? Secondly, to what extent are these changes consistent with predictions from climate models? We conclude that changing seasonality may be one of the major impacts of climate change faced by smallholder farmers in developing countries over the next few decades. Indeed, this may already be the case. Yet it is relatively unexplored in the literature. We also suggest some of the key adaptation responses that might help farmers cope with these changes.

Introduction and sources

Over the last three years, the issue of climate change and its impacts have risen rapidly up Oxfam's agenda as a result of field observations in a number of countries, along with the rise to prominence of climate change as a global political and media concern. Oxfam staff and partners in several countries have been actively exploring perceptions of climate change among people with whom Oxfam works, and strategies that are evolving to adapt to or cope with the changes observed.

These studies have been of several kinds and have varied in methodology and scientific rigor. Most of the evidence accumulated is primarily anecdotal (although in some cases attempts have been made to map it against what meteorological evidence has been available) and it is just beginning to be systematized by the organization. Nevertheless, we argue that what is emerging may be of interest because of the international spread of the studies the remarkable consistency of the observations and perceptions across them.

In writing this paper, we have drawn on research undertaken for reports published by Oxfam that give a national overview of climate change perceptions, impacts and adaptations. These have been written on Uganda (published July 2008), Russia (with WWF-Russia, July 2008) and Vietnam (November 2008). A related report on South Africa by Earthlife Africa (February 2009) looks mainly at energy futures. These reports are all published on the Oxfam GB website. Further reports are forthcoming on Malawi (June 2009), Nepal, Haiti, and Bolivia. For Bangladesh, we have drawn heavily on interviews carried out in each of the 30 agro-ecological zones through collaboration between the New Age newspaper and the Campaign for Sustainable Rural Livelihoods (Faces of Change, May 2008), and a forthcoming report on climate change adaptation practices in each zone for Oxfam International by the Department of Environmental Sciences, Jahangirnagar University, Dhaka. We have also used studies by or for Oxfam on people's experiences in some districts in Vietnam and Cambodia (October 2007 and October 2008, both with Kyoto University), and Kenya (by Energy for Sustainable Development, January 2009). In addition we have used testimonies gathered in Peru (February 2009) and an Oxfam report on pastoralism and climate change in East Africa (August 2008). This paper also builds upon previous collaboration with the ADAPTIVE project of the Tyndall Centre for Climate Change Research in South Africa and Mozambique and their findings (2002-2005). Finally, we have drawn on supplementary information from Oxfam programmes and from non-Oxfam sources known to us in other countries, including India (Orissa and Himachal Pradesh), Indonesia, Thailand, Tajikistan, Mali and Nicaragua.

A note on contents

We give examples of peoples' observations of changing climate and then some of the effects on livelihoods, agriculture, psychology and culture. We then examine the extent to which meteorological observations support farmers' perceptions using existing published analysis of meteorological records and climate models. We particularly focus on Southern Africa and Bangladesh. Finally, we consider some possible adaptation strategies.

Summary of climatic observations

The following observations are reported consistently across all our studies:

1. The seasons appear to have shrunk in number and variety, in that what could be termed relatively temperate "transitional" seasons are truncated or have disappeared altogether. People's perceptions are that they are progressively being replaced by a more simplified pattern of seasons whose characteristics are predominantly hot (hotter) and dry or hot (hotter) and wet.
2. Increased temperatures overall, particularly in winters.[1]
3. Rain is more erratic, coming at unexpected times in and out of season. In particular, there is less predictability as to the start of rainy seasons. Generally, rainy seasons are shorter. In mountainous areas there is considerably less snowfall. Dry periods have increased in length and drought is more common.[2]
4. Within recognizable seasons, unusual and "unseasonable" events are occurring more frequently, including heavy rains in dry seasons, dry spells in rainy seasons, storms at unusual times, dense and lingering fogs, and temperature fluctuations.
5. When rains do come they are felt to be more violent and intense and punctuated by longer dry spells within the rainy seasons. Dry spells and heavier rain increase the risk of flooding and crop loss.[3]
6. Winds – and storms – have increased in strength. They may come at unusual times. Prevalent wind directions have also shifted.

The emphasis changes, of course, depending upon the country, and also within countries. Concerning the countries we have particularly drawn on for this report:

- Communities in Nepal particularly express concerns about warmer and drier winters, with a lack of rain and of the snow that normally falls in hilly districts from December to January. They say the summer monsoons are much shorter, lasting for only three months instead of five. Their starts are more unpredictable. There is less regular drizzle and the period of very intense rain within the monsoon that used to last one to two weeks lasts only a few days. Destructive hailstorms are more common.
- In Vietnam, communities say that storms are increasingly tracking south into areas that had never experienced them before. Storms are more violent, bringing more floods. Temperatures are much hotter, although in the north communities also report more severe cold snaps. Rain is more intense but the main problem for farmers is the unpredictability of the rainy season, particularly in that it seems to be starting up to a month sooner than before. Coastal communities report stronger, higher tides that bring seawater further upriver and into fields.
- In Bangladesh, people report generally drier winters and more intense, but less predictable, monsoons. Temperatures have increased throughout the year, as has humidity (which may partly explain some comments that winters are "wetter" and fogs more common).
- In Uganda, the main difference noted by farmers is increasingly unreliable rain during the long rains from March to June. The rain does not fall consistently through the season but rather comes in short, often localized torrents interspersed with hot, dry spells.
- In Malawi, similar observations are made concerning higher temperatures and unpredictable rainfall, but farmers also made frequent reference to changes to the wind patterns, notably their belief that the winds no longer blow from the right direction at the right times but have become "mixed up" and often stronger and more destructive.

Observations of shrinking and shifting seasons

The noted Indian environmental writer Richard Mahapatra has written movingly about "the death of seasons" in his native Orissa[4], explaining how his mother's generation described a year of six distinct seasons, each of two months duration[5]. Each was reckoned to arrive on a specific date and was accompanied by the appearance of certain flowers, birds, or insects and each was marked by cultural events. According to Mahapatra, the six seasons have now effectively shrunk to two or three – a hot summer for close to eight months of the year, a 30-day rainy season, and a truncated and warmer winter forming a transition between the two. The seasons of spring, the dewy season and autumn have almost disappeared. Writers in Kashmir have noted the disappearance of a season called "sonth" (or "tsonth"), a rainy period that occurred in March–April, between the snowmelt and the start of spring[6]. Now an earlier snowmelt is followed by a dry period.

Statements that we have recorded bear such observations out. The following are typical.

Julius Nkatachi, 70, from Tsite village near Phalula in Balaka, southern Malawi, says: *"Originally there were very distinct seasons and we were very sure when things would happen"*. After enumerating the traditional seasons month by month he says: *"Now the seasons are not distinct, especially the hot and cold seasons… Now it's only cold for a few days"*.

"The summer now is winter", says Howard Fernández, a farmer in the remote San Andrés de Bocay community in north-eastern Nicaragua. *"April used to be summer, but it rained the*

entire month. In May – wintertime - it doesn't rain. We listen to the thunder, we see the lightning that should let us know that the rain is coming, but it is not coming. Because of this climate change we are suffering the decrease of our farm's production"

Radhika Devbarman, 45, from Kamalganj, Moulvibazar, eastern Bangladesh, says: *"In my younger days, the rain, the winters and summers all had specific times. The summers were not as hot. My father used to cultivate and harvest crops following the natural calendar. Now I am afraid of prolonged summer and sudden flood".*

Similarly, in Nepal people commented that, *"there is no stability in the cold or summer seasons"* and that *"now Margha (January/February is becoming Falgun (February/March) and Falgun is becoming Chaitra (March/April)".*

In the Arctic, average temperatures have risen at almost twice the rate of the rest of the world in the last few decades[7]. The observed effects seem correspondingly large. Gregory Rykhtyn from Vankarem settlement in Siberia says: *"Nature has got much worse, people have offended Nature. Spring comes two to three weeks earlier than before. Spring is getting harsh; it is raining or snowing all the time. The first thaw is in the end of April. The first rain is in May; it has never been like that before. The ice starts drifting much earlier than usual, approximately on May 25; before it used to begin on June 10–15. Summers have become unbearably hot. There is no good ice on the sea anymore. The sea ice usually started breaking in the middle of May but the ice floes did not drift too far. We could hunt on the ice all summer round".*

Observations concerning increased temperatures and lengthened dry periods

Fanny Nyasulu from Ntchenachena, Rumphi, northern Malawi, says: *"It used to be extremely cold here. Trees were dying of the cold. If you left a metal pot out at night, you would find it covered in ice in the morning. This is not the case now. These days you can count the number of cold days and there would be no more than five".*

Seken Ali, from Pangsha, Rajbari, Bangladesh, says: *"The temperature is changed greatly. Summer times never used to be so hot five years back, but this year we can hardly work on the fields in the morning. It is so hot that we get blisters all over our body."*

Shahida Begum of Manikganj, Bangladesh, says: *"Even three to four years back, the temperature was much cooler but the heat now is extreme all of a sudden and especially this year."*Afazuddin Akhand, 70, from Mymemsingh in north central Bangladesh, says*: "The winters have become unpredictable in the last five years as they do not provide the chill and shiver like before which is the main ingredient for winter vegetables like cauliflower, cabbage, while at times, unpredictable and excessive fog destroys those crops".*

Siri Chand in Jabbal village in Himachal Pradesh, India, says*: "My biggest worry is that the rains will fail. We have been getting less and less rain, especially in the last ten years. We put this down to the loss of the forest"*[8]

Binita Bikrar from Kapala village in Nepal said: *"Before, it used to snow during the winter, and the winter was much colder. But in the last three years there has been no snow… It should have rained between October and January last year, but there was no rain. So now the plants are dying".* Dila Pulami from Surkhet said: *"It is very hard now to work in the daytime because it's so hot, and we are getting problems like thirst, itching and skin problems".*

Baluku Yofesi, the Executive Director of the Karughe Farmers Partnership in Kasese district of western Uganda, says: *"We used to have much more rainfall than we are having now, that's one big change, and to me this area is hotter than 20 years ago. Until about 1988 the climate was OK, we had two rainy seasons (March to June, and October/November to*

December/January) and they were very reliable. Now the March to June season in particular isn't reliable, which doesn't favour the crops we grow. Rain might stop in April".

Observations of unseasonable events and erratic, violent rains

Osman Gani, 28, Ranishankhail, Thakurgaon, northern Bangladesh, says: *"Winters used to be fairly dry but they are becoming wetter and milder by the year. There are more frequent cold waves and the temperature fluctuates, which is not good for the crops".*

Willington Wamayeye, Managing Director of Gumutindo Coffee Co-operative in eastern Uganda, says: *"I've lived near Mount Elgon all my life and I have never known the weather to be so unpredictable. Rains now fall heavily for a short period and our dry season is much longer. The coffee plants are badly affected – flowering is stopped. Last year alone (2007) we lost about 40 per cent of our production. As a result, people struggle for everything".*

Wilson Chiphale, 86, from Bruce village in Balaka, Malawi, says: *"I have noticed that the rains no longer have a particular pattern. Sometimes they come early when people have not prepared, sometimes they end too soon and the maize wilts, sometimes we experience very, very heavy rains that last up to four days which washes away all the nutrients".*

Observations of stronger winds and more storms

Max Munyariwa of Bvumbwe in Thyolo, Southern Malawi, says: *"My house was destroyed last month (early March (2009). There was a very strong wind that night and fog. My house had a grass roof so it was just blown off and the house fell down. Wind and rain here is not a new thing... But the wind now blows in different directions. It's changing. I've noticed that the wind and rain here is getting more severe. It's causing us problems in two ways: it destroys our houses and our crops".*

In Vietnam fisherman Vo Viet Gia, 39, says: *"The wind is heavier on the sea, and there have been more storms. Normally the storms start in September or October, but recently we have had storms in March and April. We have not been able to go out fishing as much in the last two years because of the weather".*

In Nepal Lalit Sapkota Rawakot, from Dailek, says: *"For the last 15 years hailstorms have been frequent and intense. Now rainfall is followed by hailstorm….(that have) destroyed the standing crop".*

The effects of climate changes on seasonality

Such observations – and these are typical of many others – indicate that existing seasons are changing their nature to become more extreme (hotter and either drier or wetter); certain seasons – especially temperate periods that serve as transitions to more climatically extreme seasons – are disappearing; and seasons are "confused", with weather events typical of one season occurring in another, and weather patterns generally becoming less predictable.

Summary of effects

The precise effects of climate changes to seasonality are very geo-specific but broad patterns seem to hold true generally:

1. Unpredictable weather has always presented serious problems for smallholder farmers and fishing communities in poor countries. Farming is now becoming even more difficult and risky because of the greater unpredictability in seasonal rainfall patterns. Heat stress, lack of water at crucial times, pests, and diseases are serious problems that climate change appears to be exacerbating. These all interact with ongoing pressures on land, soils, and water resources that would exist regardless of climate change. The most common observation is that the changes are "shortening" the growing season.

2. Unpredictability requires greater investment of time, energy, and resources in order to seize the right moments and to maintain crops (and animals) through dry spells.

3. Rising temperatures and unpredictability together can be an incentive to diversification – whether desired or as a matter of necessity. But the ability to diversify is highly dependent on many factors and generally requires support to succeed.

4. Seasonality difficulties are strengthening trends within rural societies for people to move out of agriculture to a greater degree and to move to urban areas. These movements are gendered, although exactly how depends very much on each society.

5. Seasonality difficulties are likely to increase inequalities between those who are in a position to diversify – including taking advantage of the ability to grow new crops – and those who are not.

6. Women are particularly badly affected by the combination of climatic and environmental stresses, but their particular needs and wishes for adaptation are less likely to be heard or acted upon.

Unreliability of climate, where there is no longer a recognisable pattern, is perhaps the most problematic factor for farmers. In a typical case, people interviewed in Ntchenachena in northern Malawi in March this year described how they used to identify a clear sequence of four rainfall events, with distinct names, starting in late September and running through to the beginning of August. The third of these would herald the start of the main rains. Each signaled the start of specific farming or other activities and was marked by cultural events. Since about 1990, but particularly since 2001, this pattern can no longer be recognized[9].

Farmers in Bangladesh say unseasonable weather events in the normally dry winter may include heavy rains, while clammy fogs persist into the summer monsoon season. But

they highlight fluctuations in temperatures between night and day as being as much or more of a problem than high temperatures per se, and erratic, unpredictable, unseasonable rains as more of a problem than simply drought or heavy rains. Likewise, in Vietnam prawn farmers blame large and sudden fluctuations in temperature for killing prawns.

Observations on the effects on agriculture

During a recent visit to Mutarara and Tambara districts of Tete province in Mozambique, community groups and local government administrators said that until the early 1990s, the rains usually started in October and it would usually rain fairly consistently for three months or so. Maize was sown in early November and harvested in March. Now the rains seem to be starting later and they come in a few intense downpours with dry weather in between that can last several weeks. This is having serious consequences for rain-fed agriculture. The late onset of the rains means that maize is sown later, and the erratic pattern of rain within the wet season means that the maize germinates when the rains come but then dies for lack of moisture in the dry spell, or gets battered down in the next heavy rains. As the maize is sown later it is also more vulnerable to flooding when the Zambezi River overflows its banks. These groups also suggest that windstorms are becoming increasingly common, as in nearby Malawi.

In Bulirehe, Bundibugyo, western Uganda, Florence Madamu says*: "Because of the current weather changes the yields have completely gone down. All this is a result of long spells of sunshine - the sun is prolonged until the end of September - and whenever it rains it rains so heavily it destroys all our crops in the fields. You can plant a whole acre or two and come out with nothing".*

Asked how she adapted farming methods she threw her hands up and replied: "*We've stopped even adopting seasonal planting, because it's so useless. Now we just try all the time. We used to plant in March and that'd be it (finished). Now we plant and plant again. We waste a lot of seeds that way, and our time and energy. We regret it so often, why we planted. Then we have to plan to acquire other seeds and the seeds here are very costly. Sometimes you feel like crying. Sometimes you've hired labour and you end up losing all that money for preparing your land".*

Explaining the impact on her food crops she says: "*The cassava no longer yields anything, there are flies that eat up the leaves. Bananas are attacked by mosaic (a virus). This area no longer produces beans; we've tried and failed. The only crop that currently does well is sweet potato; for the cassava there's no hope".*

Baluku Yofesi, quoted earlier, says*: "Because of the shortened rains you have to go for early maturing varieties and now people are trying to select these. That's why some local varieties of pumpkins and cassava that need a lot of rain, even varieties of beans, have disappeared. We need things that mature in two months - maize needs three months of rain to grow so two months is not enough".*

Changes to the seasons, and within seasons, seem to have become noticeably drastic in Nepal in recent years (and similar findings have been reported from Kashmir by ActionAid)[10]. In April 2009 the UN World Food Programme issued an emergency alert that two million people have been pushed towards hunger as a result of a serious drought, with most of the country receiving little or no rain during the winter months of November and December when wheat and barley are sown[11] Some 70 per cent of the wheat crop had failed this winter. Significantly, this winter drought is the latest of a series. This is particularly so at higher altitudes and the current drought has particularly affected the Hill and Mountain districts in the mid and far west.

In Nepal, Maya Devi Sarki, 24, from Tartar village, Dhaldendura district, says: *"We used to have wheat and maize, but now the harvest is low and we have to spend more money on seed and labour. This year all the wheat is dry in our field. The raspberries have ripened two months early. The quantity of rainfall is decreasing and the monsoon is changing – now we don't know what to plant and when".*

Gagane Bhul from the same village says: *"Before the main fruit we had was oranges, now these are gone. But instead mangoes are growing well – before these used only to grow in the terai([the sub-tropical plains). For three years now there hasn't been enough rain, the wheat we grow is nearly dry and the seed is not good for planting either".*

The treeline and the altitude at which crops can be grown is rising, so that farming is being extended uphill. On the other hand, the lack of snow means that water does not seep slowly into the soil and this has had severe impacts on winter crops and on grassland, meaning that there is less pasture and farmers with animals are finding life more difficult.

A speaker from Bag Bazar Farmer's Co-operative in Dhadeldura, Nepal, underlined the difficulty of adapting to a land with less snow: *"Wheat production in the high hills used to be helped by the snow – first they spread the seed, then the snow would come and this would melt slowly into the soil, providing enough moisture for the seeds to germinate and grow. 15-20 years ago we only had to plough once. It's more work to plough the crops now because the earth is drier and harder, and we are worried all the time about getting the right amount of water for the crops. It's a struggle".*

In Peru, communities report "crops are growing further up". There appears to be more rain on the higher ground (puna) and less in the lower Quechua area. Because of the higher temperature and greater rainfall, crops that previously only grew well in the Quechua area such as maize, Andean tubers like potato, olluco, mashua, and cereals like quinoa and beans, now grow up in the puna. The puna was previously only suitable for natural grazing and this encroachment is causing clashes with the stock farmers there that have sheep, cattle, alpaca and llamas.

In Quang Tri province in Vietnam rain coming "at the wrong time" in the last two to three years has been the common complaint. Many farmers said 20 or 30 years ago a light early flooding known as "tieu man" came regularly in May–June. But in 2006, there was early flooding in February; in 2007 and in 2008 it came in April. Ho Si Thuan and his wife Nguyen Thi Theo from the lowland village of Luong Dien lost their spring rice crop in February 2008 due to a cold period, replanted the rice seedlings, but then lost the crop again when the summer rains came early in April. The local authorities in Hai Lang said about 50-60 per cent of the rice crop and other crops were lost in the district due to the cold spell followed by the early tieu man.

Everyone interviewed in Ben Tre province said local weather patterns were changing with an increase in the period of drought, an increase in the intensity of rainfall when it rains and an increase in the unpredictability of the rainy season, and particularly an earlier start to the season, making the timing of planting more difficult. Villagers said they could no longer predict the weather from looking at the sky and the tides. The changes have seriously affected rice cultivation and hence household food security.

Mohammad Iyar Ali, 55, of Rampur, Moulvibazar, in Bangladesh, says: *"I have only 150 decimals (just over half a hectare) of land for cultivation. My eight-member family depends on the crops we grow in the land twice a year. Most of the paddy in the field has suffered from a lack of*

rainfall. I don't how the family will survive the spiral of food prices." He says last year's crop production was damaged three times because of sudden and untimely floods, which also damaged his house twice. *"During such floods children do not go to school. Persistent floods threaten our survival. Life is becoming tougher day by day".*

In previous years, Iyar Ali had more land and a good number of cattle. He sold his land to maintain his family. Of the ten cows that he had, he has kept only two. *"There is a huge crisis of food for cattle in our region. Due to the increase in temperature and less rainfall in summer, most of the land becomes barren which affects crop production as well as cattle rearing. You will not get grass for rearing cattle in the haor (wetlands) area this time because the land is dried up. I sold eight of my cows since I could not arrange food for them. There are no fish in the haor, which was famous for various species of fishes. During the dry season, we use surface water for the paddy fields because we do not get enough rain. If we do not use the surface water, it will dry up due to the high temperatures. As a result, we are neither getting fish nor sufficient water for cultivation. We are losers in both ways".*

Wider changes to rural livelihoods due influenced by climate change

Seasonality is having major effects on agriculture, encouraging widespread changes in crops grown, in farming practices and livelihood choices in many rural areas. Many such changes may be happening anyway, but seasonality is exacerbating some trends and may have a particular role in some changes in some locations. In particular, seasonality seems to influence changes in the variety of crops grown.

Shifts in crops and livelihoods such as those identified in Nepal have social implications, as some groups of people are able to take advantage of such opportunities, while others are increasingly disadvantaged. The poorest people have least access to water, land, capital, and expertise to change their crops to what might grow better, such as fruit and vegetables.

The effects on basic food crops would merit further investigation, as many reports indicate that it is staple crops that are suffering most from seasonal changes (and also "new" fungus and insect pests that are commonly reported). Depending on country, such crops include wheat, maize, rice and beans. In Uganda and Malawi longer dry periods and shorter, more intense rains that in combination effectively shorten the growing season appear to be one factor influencing decisions to shift from certain traditional food crops such as cassava, beans, maize, and matoke, towards crops that might get a higher value at the market, including cocoa. However, how much farmers benefit from growing cocoa varies widely depending on many factors.

Willington Wamayeye from Uganda, quoted earlier, says climate change means people struggle for everything, adding*: "Food is getting more expensive and key food crops like bananas are being threatened as well (as coffee). Without work and opportunities young people are being forced to move to the cities".*

In Bangladesh, Afazuddin Akhand, from Mymemsingh says*: "Due to irregular rainfall every year and random floods, growing rice has become a big risk. Many farmers switch to fish*

farming or sell their land to industrialists, which is more profitable but overall rice production is shrinking, which is our staple food".

Prawn farming in Vietnam has become a byword for a high-risk boom-and-bust industry that has sucked in many small farmers who have switched from rice cultivation. The decline of prawn farming can be put down to many factors, including non-climatic ones, but temperature fluctuations, intense rainfall and floods have all taken their toll. Nguyen Thanh Nhan, 39, from Binh Loc Commune, Binh Dai District, Ben Tre, said: *"Too much rain and too much sun make the prawns get sick easily. The owner lost the prawns so I lost my job. Earlier this year my wife and eldest daughter had to go to Ho Chi Minh City to find jobs because I don't get a regular income".*

His neighbour Dang Van Vong said: *"I had to sell 10 hectares of my 13-hectare plot recently to pay back part of the loan I borrowed from the bank. Bad weather is among the reasons why I am losing money. The rainy season came early this year. The unusual temperature changes…made the pond's temperature change from hot to cold suddenly. Three days like that and the prawns are badly affected".*

These changes are in turn strengthening associated social and economic trends, including shifts away from subsistence agriculture towards integration with the market; migration out of rural areas both towards urban centres and across borders, particularly by men; associated changes in rural societies and particularly, changes in gender relations. From our research it appears probable that in most cases seasonality has further increased the burden on women as generally the most disadvantaged farmers and collectors of water, firewood, and fodder.

Climate change impacts have different effects on women and on men and have been well attested in many places. The need to find water as well as firewood and fodder is a well-known reason for girls to be kept out of school, and male migration has been linked to the spread of HIV and AIDS.

In Nepal, increasing crop failure has increased the strategy of men migrating. Women are left alone to looking after families yet with the least access to resources to be able to adapt. They have less access to cultivable land to grow food and have to find water, wood and fodder. Any worsening of livelihood options has to be made up in physical labour, one of the few resources women control. So to compensate for the decline in food production, women are doing more daily waged labour. This is often extremely onerous – such as portering construction materials - and badly paid – women are paid only three-quarters of what a man would earn for the same work. Dalit women are particularly poor, isolated and have extremely limited access to cash income, information, investment or agricultural advice and services. Becoming increasingly dependent on buying food rather than growing it, they are vulnerable to food price changes.

Effects on psychology and culture

Further major effect of changes in the seasons can be described broadly as creating existential shocks, to individuals and to societies through threatening belief systems, cultural practices and, as a result, social relationships. Bewilderment, disorientation and a sense of loss are often palpable in interviews, along with sadness and fears for the future.

We have already noted how environmental writer Richard Mahapatra has written movingly about "the death of seasons" in his native Orissa. Each of the six seasons was reckoned to arrive on a specific date and was accompanied by the appearance of certain flowers, birds, or insects and each was marked by cultural events. With the disappearance of the spring, the dewy season and autumn have gone many of the animals, insects and "wisdom birds" whose appearances marked each season, or their behavior has changed, and, as a result, sayings, proverbs and ceremonies associated with these events are also dying out.

In northern Malawi villagers blame drought for killing plantain trees and drying up pasture with the result that the traditional diet of "mbalagha" – beef and boiled plantains - is much less common.

Mohammad Iliasuddin of Telkupi, Shibganj, Bangladesh, says: *"I know I am supposed to sow by a certain time or date. That is what my forefathers have been doing but then for several years the temperature and weather does not just seem right for what we have been doing traditionally. It is exasperating as I do not know how to cope with the problems."*

"The most disturbing thing that agonises me is that kal baishakhi storms (Nor'westers) are no longer arriving from the usual ishan kon (northeast) direction for the past five years at least. This is how our ancestors have known it – why is it changing?" asks Shahida Begum.

Marginalized minorities, that have been used relationships with the natural world as a protection and source of strength and cohesion, may feel such losses most acutely. Carlos Ling, an Oxfam Project Officer in the Atlantic coast area of Nicaragua, says that the elders among the Miskito Indian communities *"are baffled by the changes…The crop season has been moving from the traditional dates and this is very, very important because such climate change affects your understanding of the whole Universe, not just your way of living. For people it's very important to understand that on a particular date you plant the seeds in the ground and it is magical, it involves a lot of energy and also hope for the future, and also certainty of a new crop. When certainties move you feel a loss of control of your life, which is demoralizing…. Even if you had no control of your health or your education because of poverty or racism, you had that certainty inside you. Now there's nothing to stand upon; climate change has had that kind of impact".* It also means that the elders have lost respect in the eyes of the younger generation.

Interaction with local environmental stresses

The impacts of changing seasonality are often hard to separate from other effects of global warming (such as higher temperatures), and from the results of stresses on ecosystems due to demographic, social and economic pressures.

People interviewed have little or no knowledge of the global causes of climate change due to emissions of greenhouse gases. But in every case they express acute awareness of environmental change, and they see those changes, – notably deforestation, reductions in water quantity and quality, loss of soil fertility and the disappearance of fish and animal life – as connected to climatic changes. In many cases, people identify deforestation in particular as the cause of rising temperatures and reduced water resources (and in turn, rising temperatures increase demand for irrigation).

Rising populations and consequent demand for fuel wood, farmland, water and fish; increased use of fertilizers, pesticides and insecticides; and industrial pollution of the air and water courses are also commonly identified. In Malawi, villagers in Kilyati village described how the forest was a seven-minute walk away as recently as 1981, with its timber and wild foods in times of hardship; it is now more than seven hours walk away.

The spiral of climatic and environmental stresses and the way these interact with increasing poverty and vulnerability were illustrated by the comments of Iyar Ali earlier. Similarly, Mohammad Seken Ali, who was quoted earlier describing the much hotter temperatures in recent years, ascribes the hotter temperatures to deforestation and population increase. But he says falling crop yields are also due to the local embankment built to stop flooding but behind which stagnant water builds up, and to industrialists dumping waste into the rivers. Farmers interviewed commonly say climate changes are only part of their problems, and blame such things as excessive (but necessary) use of fertilizers, pesticides, and insecticides for spoiling water quality, soil fertility, and biodiversity.

Over and above these connections, however, seasonality scores highly in people's perceptions as a distinctly different phenomenon to other climatic and environmental changes, and one of considerable concern. It is often distinguished for example from the occurrence of floods or droughts. Even making allowances for a degree of false memories – that the weather was always better or more reliable in past times – it seems that seasonality is real; indeed, it is often seen as something quite out-of-the-ordinary and notable for that. When asked when the climate began changing, or what first caused the climate to change, people commonly associate it with a traumatic event in their lives, such as an earthquake (that released gases into the air), armed conflict or war (with smoke and gunpowder) or the arrival of roads and vehicles (with associated fumes).

Testing perceptions of change

Month	April	May-June	July-September	October	November
Activity	Prepare soil	Plant seedlings	Transport seedlings	Seedlings grow	Harvest jasmine rice
"Normal" climate	Starts raining	Rain continues, stops mid-June	Rain starts again mid-July	Rain stops at beginning of October	No rain
Climate now	Starts raining	Little or no rain	Rain comes at the end of August, heavy in September	Rain continues	Rain continues, even heavily, stops at the end of November
Effects		Drought	Drought		Water logging
Effects on crops			Seedlings wilt, hard to transplant		Rice rots

Changes in rainfall patterns according to jasmine rice farmers in Yasothorn Province, northern Thailand, 2008.

Oxfam partners working with jasmine rice farmers in Yasothorn Province, northern Thailand, in 2008, compiled the table above. The farmers said the "normal" rainfall pattern had always been subject to irregularities from year to year, but rain had become increasingly erratic and dry seasons longer in recent years. The last four years or so had seen a new pattern emerge, they said. This in turn is having serious effects on their rice cultivation with many farmers losing more than half their rice in 2008. Some farmers are converting their land to growing cassava or seeking to diversify into fruit and vegetables, mushroom cultivation, or rearing frogs or chickens.

The precision in the perceptions of the farmers interviewed lends credence to the idea that climatic patterns have changed. However, in any individual case, perceptions cannot be taken entirely at face value. There is evidence that northern Thailand is indeed becoming drier[12], but further research is needed to see how farmers' perceptions in Yasothorn specifically measure against meteorological data. Furthermore, Robert Chambers kindly drew our attention to a study by Gerard Gill in Nepal[13] looking at the conundrum as to what constitutes "real data" – farmers' observations or scientific data. Gill notes how neither is truly "real" and both are valuable, but different. For example, what farmers articulate is the mode – the most frequent or typical pattern – while meteorologists use the arithmetic mean. More important, though, is that farmer's perception of normality – the apparent mode - may be based not on long time-scales but rather on the prevailing patterns of just the last few years – as seems to be the case in northeast Thailand. A further point made by Gill is that the "amount" of rain measured is "measured" by farmers not in isolation but in relation to what it is supposed to do, that is, by in relation to the water requirements of certain crops. Small amounts of rain in the

dry season may be measured by farmers as being quite large, because the rain is assessed in relation to what it will grow, such as dry season wheat rather than rice.

Taking more of a meta-analysis of data, however, it is suggestive that perceptions of changes to the seasons are not only geographically widespread, coming from East and South Asia, Southern and East Africa, Latin America and elsewhere, but also that they are described in remarkably consistent terms: increased temperatures; longer dry periods; fewer, more 'simplified' seasons; changes in the onset of rainy seasons with increasing unpredictability; more intense rains punctuated by longer dry spells within the rainy seasons; stronger winds; and unseasonal, anomalous weather events.

In this section we go on to consider the extent to which meteorological observations support farmers' perceptions of changing seasonality. We then pose the question of how much these changes are consistent with robust computerized GCM (global circulation model) simulations of climate change under greenhouse gas emissions scenarios. For this we rely on existing, published analysis of meteorological records and climate models, using Southern Africa and South Asia as case studies.

Some of these perceived changes – and the causes of them – are of course well understood globally (Table 1, and IPCC, 2007). Whilst this suggests that the perceptions of the people we have interviewed may be broadly in line with observed meteorological changes, it says little about the changes that may (or may not) be occurring in a particular geographical area. Nor do these global observed changes tell us much about some of the more subtle changes of the timing of seasons and intra-seasonal patterns.

Table 1. Relevant global trends from 1900-2005 reported by IPCC

Perceived Change	Global Trend
Increasing temperature	Warming of the climate system is unequivocal, with a 100-year linear trend (1906-2005) of 0.74ºC; (very likely) that hot days and hot nights have become more frequent over most land areas; (likely) that heat waves have become more frequent over most land areas.
Earlier onset of northern spring	(very high confidence) that recent warming is strongly affecting … earlier timing of spring events
More intense rain	(likely) that the frequency of heavy precipitation events (or proportion of total rainfall from heavy falls) has increased over most areas.
Wind patterns	Anthropogenic forcing is likely to have contributed to changes in wind patterns.

Source: Intergovernmental Panel on Climate Change. Climate Change 2007: Synthesis Report. 'Very high confidence' denotes that there is at least a 9 out of 10 chance of a finding being correct; 'very likely' denotes a >90% probability of occurrence, and 'likely' a >66% probability.

Meteorological evidence from Southern Africa (Malawi and Mozambique)

The climate of Malawi and Mozambique is tropical (to subtropical in Mozambique) and highly influenced by topography. The main rainfall season is November to February (to April in northern Malawi and Mozambique). Wet season rainfall in both countries is highly influenced by variations in Indian Ocean Sea Surface temperatures, and especially the variations in this caused by El Nino Southern Oscillation (ENSO). Rain-fed agriculture predominates, with maize being the major staple crop, and agricultural production and thus food security are therefore highly dependent upon the timing, amount and distribution of rain within the wet season (e.g., Tadross *et al*., 2007).

As documented above, communities in Malawi and Mozambique consistently report hotter temperatures, delayed onset of the rainy season (longer dry season) more intense rains with longer dry spells between rainfall, and stronger winds (from unusual directions). How well do these perceptions accord with analysis of meteorological records, and how consistent are they with the robust simulations of GCMs?

Mean annual temperatures has been increased by 0.9ºC in Malawi (McSweeney, New & Lizcano, undated, a) and 0.6ºC in Mozambique (McSweeney, New & Lizcano, undated, b) between 1960 and 2006. Over 1961 to 2000, the averaged occurrence of extreme hot days and nights increased by 8.2 and 8.6 days per decade, respectively, over southern Africa as a whole, including significant changes in both Malawi and Mozambique (New *et al*., 2006). Ensemble GCM simulations for both Malawi and Mozambique suggest an increase in mean annual temperature and increased extremes under all greenhouse gas emissions scenarios they use (McSweeney, New & Lizcano, undated, a & b).

There are also indications that the maximum dry spell duration (corresponding in Southern Africa to length of dry season) has increased, although this is not statistically significant (New *et al*., 2006; see also Tadross *et al*., 2005). Climate model simulations show a coherent picture of decreasing dry season rainfall (JJA and SON), offset partially by increases in wet season rainfall (DJF and MAM), which suggests that a delayed onset of rains is potentially consistent with global climate change (McSweeney, New & Lizcano, undated, a & b).

New et al. (2006) also provide some evidence that rainfall intensity is increasing over Southern Africa: namely, a significant increase in maximum annual 5-day and 1-day rainfall. The proportion of rainfall falling in heavy events[14] and 5-day maxima have both increased in Mozambique from 1960-2005 (McSweeney, New & Lizcano, undated, b). No trend was found for Malawi (McSweeney, New & Lizcano, undated, a). In nearby eastern South Africa, Groisman et al. (2005) found statistically significant increases in the frequency of extreme precipitation events even though there was no significant change in annual rainfall. Ensemble GCM simulations for consistently project that the proportion annual of rainfall that falls in heavy events will increase under higher emissions scenarios in the main rainy season, as well as increases in 1- and 5-day maxima in both Malawi and Mozambique (McSweeney, New & Lizcano, undated, a & b).

We cannot find explicit analyses of possible changes in the frequency or duration of dry spells within the rainy season for this region. However, a decrease in the rainfall in the main part of the rainy season (DJF) combined with the reported increase in the

proportion of rain falling in heavy events implies that rain is less continuous in Mozambique (McSweeney, New & Lizcano, undated, b).

We are unable to find published analysis of the perceived increased occurrence of strong winds. We should record that Gray Munthali, Deputy Director of the Malawi Meteorological Service, confirms that strong winds are blowing roofs off at unusual times but that he ascribes the damages to the lack of trees acting as windbreaks rather than to any change in the wind regime.

In summary, in Mozambique and Malawi, there appears to be a high level of correspondence between communities' perceptions of local change and observed changes in the meteorological record. This includes temperature, timing of the rainy season, changes in intensity of rainfall and to some extent, dry spells within the rainy season. These same changes are also robustly simulated by GCMs to increase with anthropogenic forcing of the atmosphere

Meteorological evidence from Bangladesh

Bangladesh has a tropical monsoon climate. Three seasons are generally recognized: a hot, muggy summer from March to June; a hot, humid and very rainy monsoon from June to September; and a dry winter from November to February. The climate is one of the wettest in the world, with 80 per cent of the rain occurring during the monsoon. The south Asian monsoon is highly variable, making the detection of trends difficult. The Aman harvest is in December to January and the Boro (dry season) harvest is in March to May.

As we have seen throughout this paper, farmers in Bangladesh have highlighted changes including higher and fluctuating temperatures, and erratic and 'unseasonal' rains. Temperatures in Bangladesh have increased in recent decades, by 0.6-1ºC in May and 0.5ºC in November (Cruz et al., 2007). Over much of Asia, heatwaves are lasting longer (Cruz et al., 2007). The number of cold nights[15] has decreased significantly in Bangladesh over the period of 1961–2000, with a corresponding though greater increase in warm nights (Klein Tank et al., 2007). Cold days and nights show similar (though smaller) trends, again with hot days increasing in frequency more than hot nights. Maximum monthly temperatures have increased faster than monthly minimums from 1961–2000, indicating (Sheikh *et al*., undated).

We should note the curious observation that despite generally hotter temperatures, communities in parts of Bangladesh, Peru, Nepal, and Vietnam report the occurrence of shorter but – it is often said – harsher cold snaps. An unprecedented cold spell in central and northern Vietnam from January through to April in 2008 – associated with a La Nina event – killed 60,000 buffalo and destroyed 100,000 hectares of rice.

It is possible that the reported perceptions of 'fluctuating' – especially "colder" – temperatures are a reflection of the fact that warm days and nights are becoming relatively more common than cold days and nights (even though the diurnal temperature range may be decreasing). Nevertheless, peoples' perceptions of what constitutes "cold" deserves more investigation. Such snaps are commonly said to be particularly bad for

vegetable cultivation because they are associated with cold fogs. In some agro-ecological zones of Bangladesh dense fogs are said to be new and unusual events; people describe weeks or fortnights in which the sun is blotted out. In Nepal too, the cold has been described as "thicker". Such phenomena may be linked to higher humidity.

There is considerable evidence that annual rainfall has increased in recent years almost everywhere in Bangladesh (Egashira *et al*., 2003, Cruz et al., 2007, Sheikh *et al*., undated). Seasonal changes in rainfall are harder to determine, but Egashira *et al*. (2003) indicate a reduction (not statistically significant) in winter and pre-monsoon rains (except for Chittagong), whilst late (October) monsoon rains have increased since 1979 in South Asia (Syroka & Toumi, 2002). These observations of a drier winter and pre-monsoon period, with increased rain in the rest of the year, are consistent with the predictions of most climate models (Christensen *et al*., 2007), also confirmed by a recent study which indicates that anthropogenic climate change may cause a delay in the onset of the monsoon and increase monsoon precipitation over most of Bangladesh (although rainfall will decrease over most of India - Ashfaq *et al.*, 2009).

Rainfall extremes have also shown clear trends over Bangladesh. The frequency of days of heavy rainfall has increased significantly over the period 1961–2000 (Klein Tank *et al*., 2007). The frequency of more intense rainfall events in many parts of Asia has increased, causing floods, etc, (Cruz *et al*., 2007) although as farmers observe, the reasons floods occur are as much or more to do with hydrological engineering, land use changes and water-management regimes as more water per se. More generally, increases in the frequency of extreme rainfall events are widely predicted for south Asia (e.g., Goswami *et al*., 2006; (Christensen *et al*., 2007).

In summary, for Bangladesh there appears to be some consistency between communities' perceptions of local change and observed changes in the meteorological record. This includes increasing temperatures, subtle shifts in the in the pre-monsoon, late monsoon and winter rains, and putatively, the divergent rate of change of extreme hot and cold days and nights. Many of these changes are also simulated by GCMs to increase with anthropogenic forcing of the atmosphere.

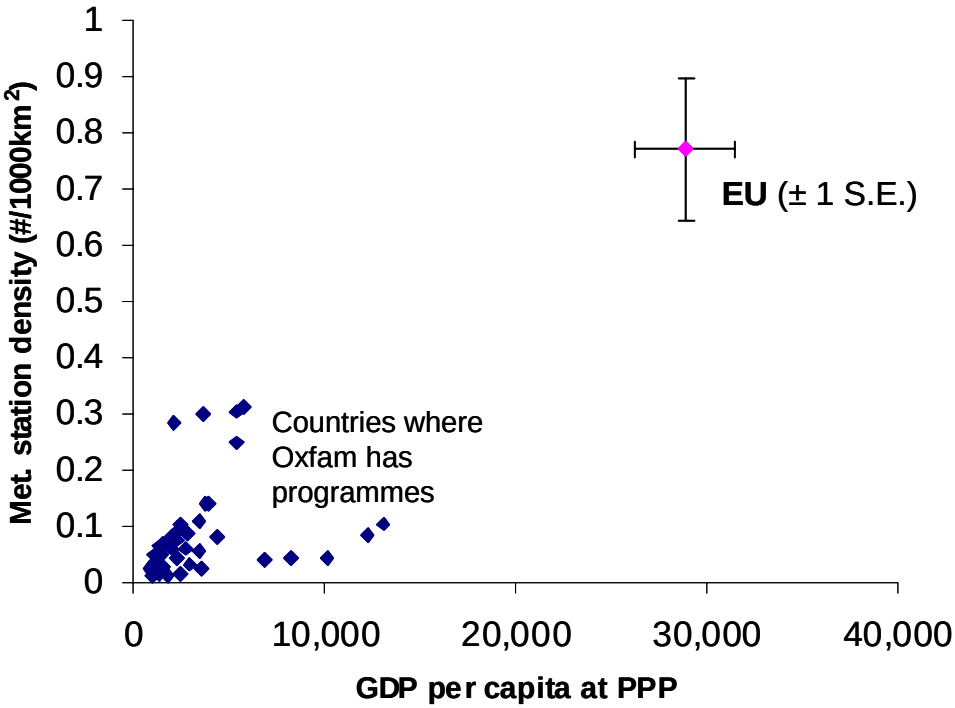
Perceptions vis-à-vis measured change

We do not claim here that the perceptions of farmers around the world of local change are universally consistent with meteorological observations and with the robust predictions of climate models. Clearly, farmers, meteorologists and climate scientists often 'measure' different things. But what is clear is that:

- Local perceptions of changing seasons are remarkably consistent around the world. These include the changing of the timing of seasons, and changing characteristics within seasons (e.g., intense rainfall events becoming more common).
- Farmers widely hold these perceived changes accountable for significant crop loss and degradation of their livelihoods, as well as for 'cultural bewilderment'.
- These perceptions of changing timing and character of seasons seem to often find support in the meteorological record and are also to some degree consistent with climate model simulations.

A better understanding of the relationship between perceived change and scientifically measured change is constrained by numerous factors. On the one hand, what people express is often 'imprecise'. For example, a perception that a particular season is becoming 'drier' might be a summation of increasing temperature (reduced soil moisture through increased evaporation) and changed patterns of rain (greater run-off caused by a higher proportion of rain falling in intense events) even if the total amount of rainfall hasn't changed. It might also reflect changes in the water storage capacity of land and soils, and even the disappearance of certain animals. In Malawi, for example, farmers in Gwadani village, Kunthembwe, described their belief that large snakes store water, but due to deforestation such snakes are disappearing, leading to less water.

On the other hand, there are clearly huge constraints on analyzing the meteorological record in many parts of the developing world, not least the paucity of long-term meteorological records. Figure 1 illustrates the well-known global inequality in meteorological station coverage, but there is similar inequality in the human resources available to process, analyse and forecast weather between rich and poor countries. This is exacerbated in many parts of sub-Saharan Africa, by the high rates of absenteeism in government agencies caused to a large degree by HIV and AIDS.



Data sources:

(1) Met stations - National Oceanic and Atmospheric Administration - National Weather Service

(2) GDP per capita at PPP – IMF

(3) Land area - wikipedia

Some evidence of increased rainfall intensity in Uganda is mentioned in a study of impacts on tea and coffee production by the fair trade organization Cafedirect and German technical Co-operation (GTZ). They say Uganda received a total amount of rainfall of 1410.2 mm in 2001 and 1373.8 mm in 2006. The difference is small. However, in 2001 the rain fell over 136 days with an average of 10.36 mm per day; in 2006 it fell in 98 days with an average of 14 mm per day.

In the absence of extreme changes to mean annual rainfall and temperature, subtle changes in the timing of rainy seasons and the intra-seasonal patterns of rain will have a significant impact on smallholder, rain-fed agriculture. Yet the vast majority of analyses of meteorological records and climate model data focus on mean annual temperature and precipitation change rather than the timing of rains and intra-seasonal rainfall patterns. We argue that there is enormous potential, and utility, in examining meteorological and model data with a 'farmer's eye'. In particular, data could be collected on seemingly anomalous events that farmers comment upon as being especially destructive, notably hailstorms (e.g. in Nepal) and fogs (e.g. Bangladesh and Vietnam).

Similarly, predictions of the impact of climate change rarely take into account seasonal and intra-seasonal changes and variation (with Tadross *et al.*, 2007 being a notable exception). We argue that this is likely to lead to an underestimate of the adverse impact of climate change on agriculture in the developing world. Given the severity of the predicted impacts on smallholder farmers, especially in sub-Saharan Africa (Boko *et al.*, 2007) this is a truly frightening proposition.

Responding to seasonal change

The farmers that we have spoken with have been unanimous in asserting that the changes in seasonality that they perceive are having an impact on the success or failure of their crops. Given the fact that some of the changes in seasonality are simulated to become worse under climate change scenarios, this implies that farmers will have to increasingly adapt to changing seasonality. And indeed, they already are. Farmers are not passively waiting but, within their limits of knowledge and resources, are experimenting with new crops and varieties. There is a particular demand for quick maturing, heat tolerant, and drought resistant crops.

We highlight some of the options that will be necessary to support adaptation for smallholders, rain-fed agriculture, concentrating specifically on some of the key adaptation mechanisms that will enable farmers to adapt to changes in seasonality. Of course, climate change as a whole will necessitate many other adaptation strategies, the details of which will be specific to geographical, socio-economic, and cultural contexts, and which will be 'successful and sustainable when linked to effective governance systems, civil and political rights and literacy' (Boko *et al.*, 2007). However, some of the key strategies for adapting to changing seasonality would seem to be:

Access to forecasts: Many of the changes described above are essentially issues of (un)predictability. If rains come early, or late, or if rain comes as intense downpours followed by significant dry spells rather than as prolonged rainy periods, farmers are less able to make decisions about when to cultivate, when to sow, what to sow, and when to harvest. Traditional 'calendar' or local 'indigenous' forecasting systems are and will increasingly become less useful for decision-making. Access to reliable, appropriate forecasts is an essential step in overcoming unpredictability, and particularly when farmers themselves are intimately involved in the process (e.g., Helmuth et al. 2007).

Access to crops and varieties: There is abundant evidence that overall climate trends and changing, and unpredictable seasons are and will increasingly affect the sustainability of crops that are traditionally grown by smallholder farmers in the tropics and sub-tropics (e.g., Faisal & Parveen, 2004; Benhin, 2006; Tadross et al., 2007). In many cases, this is not a 'research exercise', in that a suite of crops and varieties are often already available within a country or district, but are not necessarily widely available or widely grown.

For example, the communities that live close to the Zambezi River in Tete province, Mozambique, traditionally cultivate maize on fertile land on the floodplain. As said earlier, the delayed onset of the rainy season is effectively shortening the growing season between the onset of rains and the onset of floods, contributing to these crops being at risk of being destroyed by river floods. Fast-maturing maize varieties would reduce the chance of flood losses. At the same time, government resettlement of communities to higher land that is safe from floods means that families increasingly cultivate the higher, drought prone land. Existing drought-tolerant crops that are sometimes grown but which are not widely available (e.g., sweet potatoes, manioc, and local cowpea), as well as more drought resistant varieties of sorghum, are all promising alternatives for these areas. Access to more appropriate crops and varieties would also give farmers the option of spreading risk by diversifying their crops. At a national level Malawi has had very good harvests of maize for three years in a row, in part because of successful initiatives by the

government to subsidize seeds and fertilizer and enable more farmers to get access to them. However, apart from lack of access to varieties, or lack of knowledge, or aversion to perceived risk, culture may present obstacles to diversification, such as perceptions that only maize (in Malawi) or rice (in parts of Nepal) count as "food". These may act as powerful restraints to diversification.

Water management: A range of water management options is available that could help farmers deal with that rains that are less predictable, and that increasingly arriving as intense downpours followed by dry spells. These include soil management for greater moisture retention (e.g. increasing soil organic matter); water harvesting; physical barriers against flooding, etc.

Food storage: Greater unpredictability increases the need to be able to store crops for longer periods to even out more violent fluctuations in supply. Better storage and / or preservation are also able to provide protection of stocks against pests, whether animal, insect, or fungal[16].

Gendered adaptation: Adaptation thinking in least developed countries (LDCs) has reasonably focused on the agricultural sector. Measures such as the above, and also commonly reforestation schemes and measures to reduce further deforestation, are staple parts of most of the completed National Adaptation Programmes of Action (NAPAs). However, when Anna Taylor of Stockholm Environmental Institute, who was commissioned by Oxfam, asked women in Malawi what would enable them to adapt to climate change, she received equally specific but very different answers. Women interviewed said, for example, that to adapt they would want help such as a crèche to care for child orphans. They argued that until they had help to look after HIV and AIDS orphans they had not got the time or energy to cultivate their gardens, still less carry out the conservation measures that development agencies were encouraging them to adopt. They also called for family planning measures, access to loans, and credit to help them to start up small businesses in addition to or as a substitute for agriculture, vocational training, and free health care.

Communities – especially women – see adaptation as difficult because there are limited alternative livelihoods, and creating these livelihoods needs to be part of long-term plans to deal with climate change. This is a challenge to policy makers and to international donors, because it challenges tendencies to see adaptation as essentially agriculturally-focused, technocratic, about hard infrastructure and quantifiable supplies, and an additional extra to "normal" development processes.

The words of Karna Bahadur of Tartar, Dhadeldura, Nepal, stand for the views and desires of many people in many countries: *"After testing the soil and getting advice, we think we can get more money from planting ginger and turmeric – they don't need much water, unlike rice and wheat. Other options are farming goats and chickens. But we need support to do so. In future, the government and NGOs need to build capacity in our villages, in our communities, rather than sending experts. If the government has a system for subsidizing seeds, that would help us. Also, we don't have enough water, even to drink. Those who grow vegetables have to fetch water from small streams far away. We need advice about crop irrigation. We need industry and jobs to come here too, to use our agriculture and produce jobs for local people".*

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Endnotes

[1] In some places, notably Bangladesh and Tajikistan, greater *extremes* were reported i.e. perceived incidences of abnormally low temperatures as well as high temperatures.

[2] The definition of "drought" is recognized by interviewees to be influenced not only by lack of water per se but by factors such as water usage patterns and water storage resources. Farmers interviewed in Vietnam for example cite diversion of water upstream and failure to maintain reservoirs as factors behind "drought".

[3] As with droughts, farmers observe that the reasons floods occur and/or persist are as much or more to do with hydrological engineering, water management regimes and land use changes as with there being more water per se.

[4] Infochange India May 20 2009; first published April 2006. See www.infochangeindia.org/200604116870/Disasters/Related-Features/Death-of-the-Seasons.html

[5]

Previous Status		**Present Status**
Season	No. of Months	No. of days(approx.)
Grishma(Summer)	2 Months	250
Barsha(Rainy)	2 Months	30
Sarata(Autumn)	2 Months	5 – 10
Hemanta(Dewy)	2 Months	5 – 10
Sisira(Winter)	2 Months	30
Basanta(Spring)	2 Months	5 – 10

[6] Notably Rais Akhtar, University of Kashmir, rais13@rediffmail.com. Speaking at the Montreal COP/MOP 2005.

[7] Arctic Climate Impact Assessment, 2004.

[8] Siri Chand had been interviewed in 1974 and was interviewed again in 2007.

[9] In Ntchenachena, people perceived rain as falling throughout the year and had specific names for the major rains as follows:

Chizimyalupsa: In late September or early October. This was the time when most bush fires were raging and this rain was seen as meant to put out those fires. This rain would also bring down temperatures at the height of the hot season.

Chithuulamakuni: This rain would come after chizimyalupsa and just after trees have started to grow green leaves, around October. It was seen as giving new life to trees.

Nthumbuka: These were the first rains that indicated the beginning of the growing season, mostly coming at the beginning of November. When these rains fell, people who had not prepared their land were jolted to action. The main rains would fall evenly throughout the growing season, breaking at particular times to provide room for weeding.

Chisindilanthamba: This rain would come at the end of July or at the beginning of August just after harvest when people had stocked maize in their granaries but had not yet thatched them.

[10] See On the Brink? A report on climate change and its impact in Kashmir, Arjimand Hussain Talib, ActionAid India, 2007, www.actionaidindia.org/download/on_the_brink.pdf.

[11] Emergency Alert 5, WFP Nepal, April 2009.

[12] The Oxfam partner study was reported in the Bangkok Post, 5 May 2009. According to Dr Anond Snidvongs, Director of the Global Change System for Analysis, Research and Training (START), the average number of tropical depressions over Thailand has fallen from 30 to 10 over the last 30 years, tropical storms from 55 to 35 and typhoons have likewise declined by nearly half. See http://www.bangkokpost.com/news/local/16165/study-finds-farms-need-help-to-weather-climate-change

[13] But how does it compare with the real data? Gerard J Gill, Winrock International, Kathmandu, undated (1991?).

[14] A 'Heavy' event is defined as a daily rainfall total which exceeds the threshold that is exceeded on 5 per cent of rainy days in current the climate of that region and season.

[15] 'Cold nights' ('hot days') are those below (above) the 10th (90th) percentile for the period 1961-1990.

[16] See also Dr Daniel Davou Dabi and Prof Anthony Nyong, University of Jos, Nigeria: Incorporating Community-Based Adaptation Strategies into Rural Development Policies in a Developing Economy, presentation at Montreal COP/MOP 2005. They studied changes in Sahelian agriculture via 27 communities in Northern Nigeria subject to increasing drought. People are growing early maturing crops and looking for higher-yielding varieties. This has meant a search for new crops, and a revival of old ones, such as a crop that can grow on residual soil moisture. But they observe the main strategy has been a revival in food storage methods. See http://www.iisd.org/pdf/2005/climate_cop11_daniel_dabi.ppt

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For further information on the issues raised in this paper please e-mail enquiries@oxfam.org.uk or go to www.oxfam.org.

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