Climate Change Impact on Agricultural Production and Adaptation Strategies: Farmers' Perception and Experiences
Summary Results of Focus Group Interviews in Zambia, 2012
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INTRODUCTION

In Zambia, agriculture continues to be an important source of livelihood, supporting about 70% of the population. The country's agriculture sector is dominated by small scale rural farmers, who largely depend on rain for crop production, mainly due to the absence of irrigation equipment in most rural communities. Thus any change in climate, mostly manifested as an increase in frequency and severity of extreme weather events such as drought, has a potential to significantly reduce agricultural production and household food security. Since the majority of Zambia's population lives in rural areas and depends heavily on rain-fed agriculture for food and income, climate change presents a challenge to the country's attempts to reduce rural poverty, which currently stands at 80% (CSO, 2010). Not only does climate change affect crop production but also water access and availability, human and livestock health and may also cause damage to dwellings and infrastructure. Information on climate change and its interaction with agriculture is important for farmers and policy makers. With this information, farmers are better able to plan for possible changes in yields, water shortages, and possible increases in pests and livestock disease incidence. Planners and decision makers can also benefit from such information as it provides a basis for designing effective climate change adaptation interventions.

Objectives

The objectives of this study were twofold: first the study assessed the impact of climate change on agricultural production (mainly focusing on crop and livestock production); secondly the study attempted to understand and document some of the prominent climate change adaptation strategies employed by farmers.

Data and methods

The study is based on data collected from farmers through focus group discussions (FGDs). Separate interviews were also held with agricultural research station officers and camp extension officers as a way of verifying some of the information that was obtained from FGDs with farmers. In order to obtain information that is representative across the 3 main agro-ecological zones, FGDs were conducted in all the 3 zones of the country (zone 1, 2 and 3). Two districts from each agro-ecological zone were selected based on, among other criteria, presence of meteorological station, agricultural research station and the area should already be experiencing climate change impact. Researchers from Zambia Agricultural Research Institute (ZARI) provided guidelines on selection of districts to ensure that the selected districts are a good representation of each zone. The following districts were selected: Sinazongwe and Siavonga representing zone 1; Chipata and Petauke representing zone 2, and Mpulungu and Mungwi representing zone 3.

Zambia is divided into 3 main agro-ecological zones with rainfall as the main distinguishing climatic attribute. Zone 1 covers the Western and Southern parts of the country and accounts

for 15% of the total land area. This zone receives an average annual rainfall of less than 800 mm. This region was once the breadbasket of the country, but for the last 2 decades it has been experiencing declining, unpredictable and poorly distributed rainfall. The observed meteorological data suggests that it is currently the driest zone, very prone to droughts and has limited potential for crop production (Jain, 2006).

Zone 2 covers the central part of the country, extending from the East through to the West, and has the highest agricultural potential, because of the fertile soils and the evenly distributed rainfall throughout the crop growing season. Average annual rainfall for this zone ranges between 800-1000mm. Zone 3 spans the Northern part of the country and receives over 100mm of rainfall annually. The high rainfall in this zone has resulted in the soils becoming leached, leading to high soil acidity making it less suitable for production of crops like maize, groundnuts.

FINDINGS

Generally, farmers in all the 6 districts, representing the 3 major agro-ecological zones are aware that climate is changing mainly through observation of rainfall and temperature trends over a long period of time. This finding is consistent with results from other studies such as in Zambia (Nyanga et al., 2011) Nile basin of Ethiopia (Deressa et al., 2008) semi-arid central Tanzania (Slegers, 2008) and Asia (Marin, 2010).

Rainfall and temperature

In Zambia there are three main seasons namely: 1)rainy season (wet warm season) normally from November to April; 2) cold season (cold and dry winter) normally from May to July; and 3) hot season normally from August to October (Saasa, 2003). There was a general feeling amongst all the farmers that seasons have become unpredictable and difficult to define compared to the past. One famer explained that unlike in the past, nowadays it is difficult to know which month falls under which season, because the seasons are now mixed up. "...You find that June is hot instead of being cold and December is hot instead of being cold and wet, this is very different from the way it used to be before the introduction of multi-party politics (referring to 1991)...".

Before 1990, most areas used to receive adequate rainfall for crop production, and the temperatures were normal. From the early 1990s, farmers started to observe changes in rainfall and temperatures. Rainfall has continued to change in amounts and distribution, with some areas, like Siavonga and Sinazongwe (zone 1) receiving as little as 600 mm of annual rainfall as opposed to 800mm before the 1990s. Although all the 3 zones indicated declining rainfall amounts, the decline has more devastating effects on zone 1 and 2, mainly because these zone have traditionally been receiving just about the normal rainfall amounts, such that a small decline in rainfall amounts has far reaching effects on agricultural production. Zone 3, being a traditionally high rainfall area (used to receive above 1000 mm of annual rainfall), still receives sufficient rainfall (about 900-1000 mm) to support rain-fed agriculture despite the general decline in rainfall amounts. Not only have the rainfall amounts changed but also the onset and offset dates. Farmers in all the 3 zones explained that onset of the rains is quite late in the year ranging from mid November to mid December. In zone 1 the onset of the rain season is now in mid to late November compared to mid October before the 1990s. The offset is, in general, earlier in March compared to April or May in the past.

In addition, the rainfall pattern has become more variable with increasing frequency and severity of intra-seasonal droughts and increasing differences across different geographical

locations within the zone, even within the same district. The intra-seasonal drought are very damaging to crops, especially maize, because they usually set in between January and February, a period when the crop requires sufficient and consistent supply of moisture for flowering and silking. One farmer in Sinozongwe mentioned that in some years, there is literally no rain from January to February, resulting in total crop failure. Another 60 year old female farmer narrated that, in the past, most of the areas in zone 1 used to experience droughts every 3-4 years, but since 1999, frequency of droughts has increased to 1-2 years.

Floods in all the 3 zones have become less common and less severe compared to the past. Farmers in zone 1 had a hard time remembering the year the area experienced a flood, with some saying 1997 and other 1999. In zone 3 farmers reported having experienced the last flood in 2009, which was quite destructive to crops and infrastructure. Consistent with Nyanga et al., (2011) farmers were more observant of, and knowledgeable about, rainfall changes than temperature. Asked to explain the changes noticed in terms of temperatures, farmers could only state that temperatures were on the rise, but could not explain the differences in temperature changes between night and day times. "...People even sleep outside because the heat in the house is unbearable..." explained one female farmer in Siavonga district.

Impact

One of the recurring themes with regard to climate change impact was declining crop yields, especially maize. One 56 year old woman explained that "...before 1999 maize productivity was reasonable as one could harvest about 20 ox-carts of unshelled maize in 2 hectares but from 2000 onwards you can only get about 4 ox-carts of unshelled maize from the same 2 hectares...". This represents a productivity decline of about 80% within a period of 12 years. Apart from the impact of reducing crop yields, climate change has also led to an increase in the disease burdens for cattle, goats and chickens. Farmers explained that lately, the burden of livestock diseases has become a major issue because of increasing temperatures and reduced rainfall. The drying up of streams has also affected livestock production because now farmers have to walk their livestock long distances to drink water. This results in reduced live-weight overtime, because the animals expend most of their energy walking instead of gaining weight. This is a major source of concern in zone 1, where most of the streams around villages dry up barely 2 months after the offset of the rains. In zone 2 and 3, the effect on livestock of climate change did not come out as strong as in zone 1, Farmers indicated that only a few streams dry up shortly after the rains cease. With regards to grazing grass, not only has inadequate rain affected the quantity of grass available, but also the quality of the available grass. One woman in zone 1 explained that "...Grazing grass for animals has also been affected by inadequate rains, so there is little grass for animals to graze on and the quality of the grass is also poor...".

Not only has climate change affected farm productivity but also the off-farm sector. In zone 3, farmers complained that the late onset of the rains has adversely affected collection of wild products, like ants/caterpillars and mushrooms, a vital source of off-farm income and food for most rural households in the area. Farmers explained that caterpillars and mushrooms normally come in season with the first good rains. However, when the rains delay, the caterpillars and mushroom have little time to fully grow and mature before they get out of season. A 38 year old female farmer explained that '...caterpillars reproduce and 'fall' if it is raining, but nowadays, as the caterpillars are reproducing and start to 'fall', rains disappear and so they die, resulting in loss of food and income for most farmers in the area. Mushrooms are no longer there, because the area has started experiencing longer dry spells just when mushrooms are beginning to 'come out of the ground'...".

Adaptation strategies

In order to adapt to the changing climate, farmers in all the 3 zones are employing a number of strategies. Because of the short rain season, most farmers in zones 1 and 2 are planting early-maturing maize varieties which are planted in mid November and mature around late February or early March. Varieties that have been adopted in the zones are Pop 10 and Obatampa (from west Africa), which are open pollinated varieties (OPVs), Pan 413, MRI 594, MRI 426, ZMS 621, ZMS 521, ZMS 421 which are hybrids. Asked which of the varieties was the most common, farmers indicated that Obatampa was very common because of its good storage properties and can be recycled without a significant drop in yield. However, most farmers in zone 1, mentioned that hybrids are avoided in the area because they are less drought tolerant compared to Obatampa and other OPVs. In zone 3, farmers complained that the maize seed that is distributed under the Farmer Input Support Program (FISP) is not suitable for the zone. They explained that the varieties distributed are short-medium maturing, but zone 3 being a high rainfall area and having a relatively longer rainfall season, these varieties tend not to do well. "...The relatively well-off farmers are able to buy their own seed that is suitable for the area, but the poor farmers who cannot afford to buy their own seed are left without a choice but to plant the wrong varieties they get from FISP, since it is subsidized and thus affordable..." explained a 54 year old male farmer.

The main impact of climate change is the decline in crop productivity due to change in rainfall pattern and amounts. Livestock production is also a challenge due to lack of good quality grazing grass and lack of drinking water. When asked how they have responded to climate change, farmers, in general, pointed out 5 major responses: 1) adopting early-maturing maize varieties in response to short rainfall season; 2) crop rotation to improve soil fertility and yields; 3) participation in off-farm activities like hiring out labor, trading in crop output, livestock, second hand clothes and artefacts, which they sell in nearby towns. In Siavonga, it was reported that most male household members have migrated to urban areas either for work or business; 4) conservation farming e.g., ripping and pot-holing to improve moisture retention and maintain good soil structure was also cited as one of the adaptation startegies. However, most farmers cited labor intensity as one major drawback of pot-holing. With regards to ripping, weed pressure, requiring expensive herbicides to control, was cited as the major disadvantage; 5) planting in phases to reduce the risk of total crop failure as a result of intra-seasonal droughts. On planting in phases one 47 year old male farmer in Mpulungu (zone 3) explained that "...I'm confused especially with the rainfall pattern, which is now unpredictable. So I have resorted to planting maize in stages like an experiment so as not to lose out completely in case I plant at a wrong time. I plant some of the maize at the beginning of the rain season, some after a few weeks and so on, so that if the first planted maize dies out I will still have the other maize that I planted at some other dates...". Most farmers also indicated that they are applying fertilizer and practicing crop rotation to deal with the soil degradation problem.

CONCLUSIONS AND POLICY IMPLICATIONS

Generally, smallholder farmers in Zambia are aware that climate is changing mainly through observations of rainfall and temperature trends over a long period of time. Farmers indicated that temperatures have increased and there are more frequent droughts now than in the past. Generally, the rainfall season is shortening and so is the amount of annual rainfall in all the 3 zones. The main impact of climate change is declining crop yields, especially maize, and the shortage of water for livestock and increased incidents of livestock diseases. It was apparent from the FGDs that zone 1 is the hardest hit in terms of climate change impact (declining

crop and livestock production and water shortages). However, this does not imply that mitigation and adaptation measures should be tilted towards zone 1, but somehow equally across all zones, to prevent climate change impact in zone 2 and 3 from reaching the same levels being experienced in zone 1. Farmers in zones 1 and 2 are adapting to these changes by planting early maturing seed varieties, to mitigate the effects of shortening rainfall season. Farmers are increasingly considering conservation farming as an option to improve yields in the face of declining rainfall and soil degradation. Declining yields imply reduced household income and threaten household food security. Most farmers have thus started participating in off-farm income generating activities in order to supplement declining farm incomes. With scientific evidence indicating that climate variability is likely to increase, it is important that farmers understand climate change and weather, to plan for changing and variable yields, water shortages, and possible increases in pests and diseases. Policy makers, too, need to understand climate change and its impacts so that they can design appropriate policies that can enable farmers easily adapt to the changing climate.

Options for adapting to climate change

Because of the likely impacts of climate change and variability, which include yield reduction, soil degradation, increased disease and pest incidences, it is important that adaptation and mitigation strategies are put in place to cushion farmers from the adverse effects of climate change. In view of the mentioned likely impacts of climate change and variability, it is important that policies aimed at dealing with climate change begin with educating farmers about climate change and its impacts. This way, farmers can also come up with their own local sustainable adaptation strategies. It is also important that information regarding weather is effectively disseminated to farmers, so that they can plan how best to maximize yields given climate variability. Given the declining rainfall trend that has been observed over the years, it would help smallholder farmers if programs aimed at developing water harvesting and management techniques are implemented in rural communities, such as water harvesting trainings for farmers, construction of dams and sustainable management of water sources like rivers and streams. Interventions aimed at promoting conservation farming and adoption of hybrid seed varieties would be very instrumental in helping farmers improve yields despite the changing climate (reduced rainfall amounts and increasing temperatures). However, efforts have to be made to make hybrid seeds more accessible to farmers, as most farmers complained of lack of income to purchase hybrid seed.