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ARTICLE

A COMPARATIVE CASE OF THE IMPLICATIONS OF VARIOUS APPROACHES TO CLIMATE CHANGE ADAPTATION IN BANGLADESH, INDIA, SOUTH AFRICA, AND ZIMBABWE

Happwell Musarandega
Department of Geography
and Environmental Science
University of Fort Hare, South Africa
hmusarandega@gmail.com

Wisemen Chingombe
School of Biology and
Environmental Sciences
University of Mpumalanga, South Africa
Wisemen.chingombe@ump.ac.za

ABSTRACT

This article is a synthesis of literature on cross-country experiences on the strategies for adapting to climate change in Southeast Asia (Bangladesh and India) and Southern Africa (South Africa and Zimbabwe). The article shows that each selected country employs unique measures for adapting to climate change. In Bangladesh the specific strategies for adapting to climate change include the establishment of kinship and extended family ties to assist in difficult times. Other strategies include diversification from the seasonal crop and perennial crop, provision of micro-finance, and adoption of non-farm income generating projects. The adaptation strategies in India include the establishment of farmer groups—examples of such groups are the self-help groups (SHG), the National Rural Employment Guarantee Scheme (NREGA), the Pradhan Mantri Gram Rojgaar Yojana (PMGRY), and Public Distribution System (PDS). In South Africa the adaptation measures include rationalising farm expenditure, changing of planting and harvesting dates, water conservation, planting drought-tolerant crops, and agricultural insurance. In Zimbabwe, farmers are adopting conservation agriculture, moving to regions with more rainfall, and investing in irrigation. The essential lessons for climate change adaptation from the countries studied showed that there is a need to rationalise farm inputs, adopt early maturing crop varieties, plant drought-tolerant crops, sound water management practices, and conserving the soil. Equally important is the need to conserve the water bodies, diversify effective weather forecasting, and use of early warning systems.

Keywords: adaptation; climate change; impact; resilience; smallholder farmers; vulnerability

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INTRODUCTION

The world over, discussions about climate change are dominating workshops and conferences. Climate change has emerged as a major causal factor for food shortages around the globe. According to Tubiello (2012), there is a strong link between climate change, agriculture, rural livelihoods, management of natural resources, and food security. The scope of this article is to present cross-country experiences on the impact of climate change and the adaptation strategies that are in place in the Southeast Asian countries of Bangladesh and India, as well as in Southern Africa (South Africa and Zimbabwe). It is paramount to note that one of the challenges facing agriculture is the need to ensure food and nutrition security to increasing populations. There is also a need to adopt good agricultural practices (GAPs) for instance, soil and water conservation, and agro-forestry.

According to Loriente (2015), the projected increases in population will double the current food demand by the year 2050. Because of climate change, the problem of food insecurity will continue to pose a serious challenge. The global population is expected to increase from seven to nine billion by 2050, and equally, farmers will be expected to produce more food than they have been producing over the past 10 000 years. There is also a need for farmers to adopt better and efficient farming methods; as half of the available land surface globally is already used for food production. The global "food balance sheet", which denotes the food being produced versus consumption is at its lowest. Close to one billion of the world's population suffer from chronic undernourishment, while a further two billion has micronutrient deficiencies (O'Dame and Kangai 2013). Moreover, a study by Zunkel (2010) showed that five children die every minute because of under-nutrition, while one in four children suffers from stunting.

The preceding statistics show that the global food balance sheet is at its lowest, as food and nutrition insecurity is the order of the day in most countries. Indeed, there could be a reduction in the prevalence of hunger if there are appropriate policy interventions. If there is no tentative action, the threat of climate change will superimpose itself on the existing trends of food and nutrition insecurity. The result will be an increase in the agricultural production risk and rural vulnerability. The effects would be felt mostly in the regions that are already affected by the effects of bad agricultural practices such as soil erosion, siltation of rivers, and deforestation. The lack of adequate knowledge, infrastructure and resources, legal and institutional frameworks can also compound climate change pressures. Climate change pressures are also likely to have serious effects in the developing tropical, arid, and semi-arid countries. The result will be higher food and nutrition insecurity and the widening of the gap between the rich and the poor (Tubiello 2012).

This article therefore, presents a country-specific analysis of the impact of climate change, vulnerability, and adaptation strategies by smallholder farmers in developing countries. The focus is on Southeast Asian countries of Bangladesh and India, and Southern African countries of South Africa and Zimbabwe.

CLIMATE CHANGE ADAPTATION IN SOUTHEAST ASIA

In Asia, climate change is a huge challenge for the agricultural sector (Bantilan and Mohan 2014). Nevertheless, each Asian country experiences the effects of climate change in a different way. The variations are not only a result of differences in the projected change of climate parameters, but also of the extent of the vulnerabilities and adaptive capacities. Despite the differences in conditions, the adaptation strategies that the vulnerable farmers implement are crucial in the sense that failure to adapt could lead to serious consequences. This article therefore, also presents adaptation strategies in Bangladesh and India.

CLIMATE CHANGE IMPACT AND ADAPTATION IN BANGLADESH

Climate change affects agriculture disproportionately, and there seems to be limited information on smallholder farmers' overall vulnerability and adaptation needs (Delaporte and Maurel 2016). Nevertheless, due to the serious nature of climate change and the severity of its effects, policy makers in Bangladesh are now commissioning research studies, with the aim of mapping vulnerability and adaptation strategies. It is paramount to note that the smallholder farmers are not passive victims of climatic shocks, but rather respond to these natural and human-induced phenomena. In Bangladesh, the specific strategies for adapting to climate change include the establishment of kinship and extended family ties to assist in difficult times. Another strategy includes diversification from the seasonal crop and perennial crop, provision of micro-finance, and adoption of non-farm income generating projects. Farmers respond by adjusting their farming practices to mitigate the effects of climate change. Most of the farmers are implementing farm-level strategies such as changing the size of the land under cultivation, altering consumption patterns, diversifying into non-farm income generating activities, and migrating to other places. However, more action is needed to reduce the effects of climate change. Such interventions may include the development of drought-resistant rice crop varieties (research and development), as well as water conservation.

There is also a need to put in place sound financing mechanisms for agriculture. According to Bantilan and Mohan (2014), there are no credit facilities to insure against hazards caused by extreme events such as droughts and floods. Accordingly, easy access to credit and a high portion of the subsidy on the interest will help to cushion the resource-poor smallholder farmers. Smallholder farmers feel that appropriate crop insurance schemes will help them cover part of the risk. The present insurance schemes for crop insurance are in the hands of private players, and farmers perceive that they are not universal in their coverage. There is therefore, a need for a government-managed universal crop insurance scheme that would cover all crops (Shiferaw, Okello and Reddy 2009). In addition, there is also a need to invest in infrastructure facilities such as roads and bridges. Equally important is the need for agricultural extension so that farmers

can gain adequate knowledge. Also, farmers need to be linked with high-value chain players and sustainable markets; as these will help to increase the farmers' income. More income could help these farmers to withstand the effects of climate change (Bantilan and Mohan 2014).

CLIMATE CHANGE IMPACT AND ADAPTATION IN INDIA

The threat of climate change is also prevalent in India. The challenge seems to be worse, owing to the fact that more than 650 million Indians depend on rain-fed agriculture to sustain their livelihoods (Garg, Mishra and Dholakia 2015). In addition, more than 250 million people live along the 7 500 km coastline and are exposed to the high risk of the rising sea levels and extreme weather conditions. There is also a problem of deforestation and melting of the glaciers (Garg, Mirsha and Dholakia 2015). Moreover, climate change in India is largely characterised by rising temperatures. There have been substantial changes in the mean temperatures during the period 1951–2013, with an increase in the number of hot days and night time temperature (Garg, Mirsha and Dholakia 2015). The result of these changes has been the unpredictable rainfall patterns, with alternate droughts and floods occurring over the years.

Several strategies are in place to assist farmers to mitigate the risks and adapt to climate change. The options include improvements in crop varieties (climate-smart crops that are more profitable and shorter in duration), and the adoption of good agricultural practices such as water and soil conservation. There has also been improved access to finance, with affordable terms that include a grant element. Farmers have also adopted the group concept—examples of such groups are the self-help groups (SHG), the National Rural Employment Guarantee Scheme (NREGA), the Pradhan Mantri Gram Rojgaar Yojana (PMGRY), as well as the Public Distribution System (PDS).

However, several factors constrain the ability to adapt and mitigate the effects of climate change in India. "Red tape" is one such a limiting factor. According to Garg, Mirsh and Dholakia (2015), most smallholder farmers believe that governance structures for monitoring and administering public assistance activities are riddled with bureaucracy, are not accessible, and are less lucid. There is lack of information on how the farmers could access the lines of credit and grant facilities. Another problem is that of infrastructure, especially in remote villages. Despite the fact that there have been commendable efforts to invest in value addition at the farms, some of the smallholder farmers do not have adequate links with the high-value chain players and profitable markets. In some villages, local agents act as intermediaries, or farmers have to travel long distances to sell their produce (Shiferaw, Okello and Reddy 2009).

CLIMATE CHANGE IN SOUTHERN AFRICA

The Southern African region is highly vulnerable to climate change. Agriculture is the backbone of many economies in Southern Africa; and there is a high dependence on rain-fed agriculture and subsistence-based farming, all of which underpin livelihood and economic development strategies in the region. This high level of vulnerability is further exacerbated by a complex mix of other socio-economic and socio-political instability, interacting with climate variability and change across the region.

CLIMATE CHANGE IMPACT AND ADAPTATION IN SOUTH AFRICA

South Africa is vulnerable to climate change because of its dependence on climate-sensitive economic sectors (Madzwamuse 2010). The agricultural sector is vulnerable because of the country's semi-arid nature and limited irrigation infrastructure in rural areas. According to Turpie and Visser (2013), the negative impact of climate change has a direct effect on rural communities, in the sense that it contributes to reduced food availability and income. Accordingly, there is a considerable strain on the social safety nets as more people are becoming vulnerable. The industries that process agricultural produce are also feeling the heat as raw materials are in the decline. As a result, climate change could lead to a fall of about 1.5 per cent in South Africa's Gross Domestic Product (GDP) by 2050; a fall that is roughly equivalent to the total annual foreign direct investment in South Africa for the year 2012 (Turpie and Visser 2013).

In order to adapt to climate change, there are several approaches that South Africa could follow—adaptation measures include rationalising farm expenditure, changing of planting and harvesting dates, water conservation, planting drought-tolerant crops, and agricultural insurance. It is essential to note that successful adaptive actions are those that promote system resilience and legitimate institutional change, as well as sustain collective action (Madzwamuse 2010). In addition, Turpie and Visser (2013) argue that the classification of the adaptation strategies to climate change can be farm management and technology, farm financial management, diversification (crop, agricultural enterprise, and non-farm), government interventions in terms of providing infrastructure. For the livestock farmers, the use of strategies such as accessing veterinary services and dipping could strengthen the resilience of livestock to climate change. External interventions aimed at facilitating adaptation within these communities should complement the farmers' individual responses to climate change. These interventions should include the development of new drought-resistant varieties, improved weather forecasts, the provision of financial services, mixed farming strategies, and the improvement of rural transportation (Turpie and Visser 2013).

CLIMATE CHANGE IMPACT AND ADAPTATION IN ZIMBABWE: SPECIFIC CASE OF CHIMANIMANI DISTRICT

Zimbabwe has a traditionally known savannah type of climate, whose main characteristic is hot, wet summers and cool dry winters. However, a change in climate has created more arid environments for agricultural production, shifting the five agro-ecological zones, and causing rainfall patterns and crop production to decline from the natural farming regions one to five (Brown et al., 2012). Some areas, for instance, Kwekwe and its surroundings, have shifted from natural region III to natural region IV, leading to natural region I getting reduced in size; natural region II shifting further east and natural region III shifting to the north (ibid). Musarandega and Chingombe (Unpublished Manuscript 2016) have recently confirmed these changes through field studies in Chimanimani District, which is home to the country's five major agro-ecological regions. The Zimbabwe Meteorological Services Department reported a daily minimum temperature increase of approximately 2.6°C during the last century, while daily maximum temperatures have risen by 2°C during the same period (Brown et al., 2012). Like many other Southern African countries, the country has been hit by several disasters such as floods, drought, lightning, and tropical cyclones due to the radical changes (Musarurwa and Lunga 2012).

Smallholder farmer communities are the most adversely affected groups of people in Zimbabwe (CARE 2009; Musarurwa and Lunga 2012). The plight of these smallholder farmers has worsened, owing to the fact that the management of climate-induced disasters in Zimbabwe is largely biased towards emergency response—thus a reactive rather than proactive approach (Musarurwa and Lunga 2012), which depicts a gap in the area of mitigation is often followed. Such a scenario in Zimbabwe seriously calls for more effective, adaptive measures to be put in place. Lack of financial capacity inhibits smallholder farmers' ability to increase their resilience to climate change shocks and stress. These farmers lack the financial capacity to purchase desirable agricultural inputs and build water-harvesting reservoirs.

Evidence gathered from focus group discussions (FGDs) and key informant interviews conducted by Musarandega and Chingombe (Unpublished Manuscript 2016) in Chimanimani District, Manicaland Province showed that climate change has resulted in a reduction in the amount of rainfall, high temperature, and continued depletion of vegetation cover. In response to these changes, smallholder farmers have resorted to conservation farming, water harvesting, and planting short season varieties, and adopting early warning systems by liaising with the Chimanimani District Climate Change Committee. NGOs such as USAID, World Vision, and China Aid have also assisted farmers in the lower Chimanimani District with the drilling of boreholes to provide villagers with domestic and irrigation water supply. The villagers in the district however, reported lack of financial capital to enable the continued maintenance of projects left behind by NGOs.

Efforts to ensure effective resilience building to the impact of climate change are not successful; owing to the various socio-economic, political, cultural, and administrative challenges. Musarandega and Chingombe (Unpublished Manuscript 2016) have established, through their recent extensive field studies, that in the eastern parts of Chimanimani District, which is agro-ecological region one, the environment has suffered from the effects of the ongoing land reform; as well as job retrenchments effected by forestry companies in the area. Some villagers alluded to the fact that angry, retrenched former employees, who had not received an income for many months were retaliating by causing uncontrollable veldfires that have adversely affected the area. This area is home to Chimanimani's major watersheds that feed the district's major rivers such as Nyanyadzi, Mvumvumvu, Haroni, Rusitu, and Biriiri, which cater for the domestic and irrigation needs of most people. Again, smallholder farmers from the drier western areas of Chimanimani District are looking for productive farmlands in the eastern part, which receive more rainfall. The farmers are taking advantage of the Zimbabwean government land reform agenda; thus inversely putting the available resources under extreme pressure.

KEY LESSONS FROM THE CROSS-COUNTRY EXPERIENCES

The case studies presented in this article have shown that farmers in each country adapt in various ways to the change in temperature and rainfall. They have adopted diverse cropping practices and good agricultural practices such as soil and water conservation, as well as engage in off-farm activities. In Asia, farmers have adopted the planting of improved rice varieties, which allows for early planting and harvesting, and are high-yielding and adaptable varieties. Other strategies include the adjustment of cropping techniques, use of new technology, early and timely sowing, applying fertilizer, and rotating crops. Because of the high rates of deforestation, there has been advocacy for farmers to engage in the planting of trees. Erosion control measures have also been implemented, that are aimed at protecting the environment and natural resources—for example, fighting bush fires, stopping animals from wandering and preventing the excessive cutting of wood. The other regions have adopted spatial management as a measure, such as using lowlands, extending the cultivated areas, changing the production site and the fields; and practicing transhumance as far as animal husbandry is concerned. Finally, some farmers make use of new equipment/farm mechanisation, particularly the use of animal traction. The farmers in Bangladesh are adapting to the changes in temperature and precipitation through water and soil management and agro forestry techniques, followed by organic fertilizer amendment and improved crop varieties. The issues of sustainable agricultural financing and crop insurance are some of the measures that farmers in India are considering. However, there is a need for improvements in the schemes so that "red tape" is at a minimum level. Information dissemination to

farmers has also been identified as paramount to reduce the effects of climate change (Bantilan and Mohan 2014). Moreover, technological innovations have been prominent in agricultural production in the Asian countries; and there is small machinery for facilitating value addition at the farms. Nevertheless, the adoption of different packages of technologies by farmers has been only partially successful in terms of research and development initiatives (Mariano, Villano and Fleming 2012).

Countries in Asia have unique adaptation measures in place—for instance; the formation of farmer groups is an important climate change resilient-building initiative. In fact, farmers perceive this measure as effective. The groups could be instrumental in knowledge sharing, sourcing inputs, and accessing the markets, reforestation activities in the villages, construction of small water tanks (water harvesting), developing several alternate renewable power sources, and enhancing infrastructure development.

Countries in Southern Africa are highly vulnerable to climate change, owing to the dependency of rural areas on rain-fed agriculture. In South Africa, agriculture is vulnerable because of the country's semi-arid nature and limited irrigation infrastructure in rural areas. The adaptation measures in this regard include rationalising farm expenditure, changing planting and harvesting dates, water conservation, planting drought-tolerant crops, and agricultural insurance. In Zimbabwe, a change in climate has worsened the aridity of the soil; and there has been a shift in the agro-ecological zones. Climate change has resulted in a reduction in the amount of rainfall, high temperature, and a continued depletion of vegetation cover. Smallholder farmers are resorting to conservation farming, water harvesting, and planting short season varieties, and adopting early warning systems.

However, even though efforts are in place to adapt to climate change in the countries under discussion, more still needs to be done in order to ensure food and nutrition security. There is also a need for a framework that facilitates better understanding of the impacts of climate change on smallholder and subsistence agriculture. According to the Intergovernmental Panel on Climate Change (IPCC) (2007), such a framework should recognise the complexity and high location-specificity of the agricultural production systems, and incorporate non-climate stressors in rural livelihoods and their contribution to vulnerability. Equally important is the need to recognise that climate change affects the livelihoods of smallholder farmers.

CONCLUDING REMARKS

According to Tubiello (2012), all countries are experiencing varying degrees of climate change and its related negative impacts. However, the earlier the adaptation measures are put in place and risks mitigated, the lower the impact. The adaptation strategies need to protect livelihoods and ensure food and nutrition security. There is a need for policy makers to recognise that a myriad of mutually re-enforcing synergies exist between specific mitigation and adaptation solutions that can lead to more efficient allocation of

climate response resources. In addition, climate change brings critical new perspectives to important global challenges relevant to food security and rural livelihoods. Mainstreaming climate change issues into development is a necessary step to overall development policy, because climate change will negatively affect all the dimensions of food security in the coming decades. While adaptation strategies that minimise expected impacts on access, stability, and utilisation of food resources involve largely local to regional-scale actions, safeguarding food availability also requires a global perspective. The strategies for adapting to climate change should aim to maintain and increase the availability of food. Any significant change in food production; including change resulting from climate change impact, has the potential to affect global and regional availability, stability and access to food through direct and indirect repercussions on international and local markets.

There are a number of specific adaptation strategies in agriculture. These include altering farm inputs, crop varieties, and species for increased resistance to heat shock and drought, and flooding. There is a need to alter the fertilizer application rates to maintain grain or fruit quality. Water conservation is paramount and the farmers need to alter the amounts and timing of irrigation. Sound management of river basins for more efficient delivery of irrigation services and preventing water logging, erosion and nutrient leaching, making wider use of technologies to harvest water and conserve soil moisture, and more effective transportation and use of irrigation water is critical. For livestock farmers, there is a need to match the stocking rates with pasture production, altered pasture rotation, modification of grazing times, alteration of forage and animal species/breeds, and integration within livestock/crop systems; including the use of adapted forage crops. Moreover, farmers need to diversify their income through the integration of activities such as keeping small livestock, apiculture, and aquaculture. There is a need for the introduction of forest conservation, agro forestry, and forest-based enterprises for diversification of rural incomes. With regards to fisheries; altering fish catch size, effort, improving the environment where breeding occurs, and reducing the level of fishing in order to sustain yields of fish stocks is essential. Early warning systems in the form of increased use of climate forecasting to reduce production risk are essential.

It is essential to note that policy actions at international and national levels are paramount if climate adaptation strategies are to be successful. There is also a need for climate monitoring efforts and communication of information in order to convince farmers that climate change projections are real and require response actions. Policies that support research, systems analysis, extension capacity, industry and regional networks need strengthening in order to provide managers with an understanding of the strategic and technical capacity to protect their enterprises. Investment in new technical or management strategies is required so that where existing technical options are inadequate, options necessary to respond to the projected changes become available. Finally, new infrastructure, policies, and institutions may be necessary to support the new

management and land-use arrangements, such as investing in irrigation infrastructure and efficient water-use technologies, appropriate transport and storage infrastructure, revising land tenure arrangements and property rights; as well as establishing accessible, efficient markets for products, financial services including insurance, and inputs including seed, fertilizer, and labour.

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