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Climate Change Adaptation in Zimbabwe‟s Agricultural Sector

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Abstract: ***The aim of this paper is to discuss, with evidence from literature, the options, potential and constraints to climate change adaptation in Zimbabwe's agricultural sector. The desk research was conducted in Zimbabwe, and took place in July 2014. A multi-pronged approach was adopted to identify relevant literature. A web- and e-mail based search for documentation and a desktop review of printed literature was used to enable analysis of secondary data on adaptation to climate change in the agricultural sector in Zimbabwe. Sources consulted included government and international reports, state and non-state agency development and climate change response plans, public research organizations' reports, and academic and scientific literature. Zimbabwe is particularly susceptible to climate change because the livelihoods of the majority of its residents are dependent on rain-fed agriculture. Household level vulnerability in Zimbabwe is influenced by conflict and insecurity, inequitable land distribution, low education, poor infrastructure, gender inequality, dependence on climate-sensitive resources, poor health status, and HIV/AIDS. The ability of individuals, households and communities to adapt is shaped by their access to and control over natural, human, social, physical and financial resources. Agro-ecological approaches that build resilience to climate change include complex systems, use of local genetic diversity, soil organic matter enhancement, multiple cropping or polyculture systems, and agro-forestry systems and mulching. There is no comprehensive, specific national policy and legislative framework for climate change adaptation. Instead, legislative and programmatic adaptation responses are found in a plethora of development policies, strategies and action plans of various government sectors. The fact that adaptation strategies are inherent in the existing gamut of policy documents, but without much coordination, means a fragmented adaptation response is likely. Some of the current policies and programmes in Zimbabwe actually constrain climate change adaptation. There is a need to harmonize uncoordinated and fragmented pieces of legislation and strategies aimed at enabling and enhancing an adaptive response to climate change.***

Keywords: climate change, adaptation, agriculture, drought, floods, livelihoods

1. Introduction

Increasing temperatures and variations in rainfall patterns over time, coupled with frequent mid season droughts and occasional cyclones, are clear evidence that the climate is changing in Zimbabwe [1]. Smallholder farming is the chief source of livelihood in the rural sector, but the rain-fed agriculture is highly vulnerable to the vagaries of climate change. Responding to climate change through mitigation will take time and therefore adaptation becomes critical particularly where the ability to adapt is low [1]. Negative impacts of climate change can be reduced through adaptation, which requires involvement of the local community.

Climate change adaptation is an adjustment in natural and human systems in response to actual or expected climatic stimuli or their effects, which moderates harmful effects or exploits beneficial opportunities [2]. Adaptation can prevent future risks, it can reduce present adverse effects and it can refer to individual or collective action [3]. Adaptation implies capacity building (including skills, technologies, building stronger institutions and promoting social equity) and strengthening livelihoods for poverty reduction [4]. Climate change adaptation needs to take account of uncertainty by ensuring that livelihoods (and therefore also ecosystems) maintain and enhance the ability to ride out or respond to unexpected events. Addressing the risks and vulnerabilities of the poor who live in insecure places and need to build their resilience to cope with climatic fluctuations are among the most important challenges in adapting to increasing climate variability and climate change [5].

Zimbabwe is particularly susceptible to climate change because the livelihoods of the majority of Zimbabweans are dependent on rain-fed agriculture. In addition, the heavily agro-based economy makes the major sectors of the economy highly sensitive to climate change [6]. The United Nations Convention on Climate Change (UNFCCC) recognizes the need to adapt to climate change and to assist those countries least able to adapt [6]. Zimbabwe‟s climate is mostly semi-arid. The country lies in a region with limited and unreliable rainfall patterns, and has a national mean rainfall of 655 mm. Mean annual rainfall ranges from 300 mm in the low-lying Limpopo Valley in the South to over 3 000 mm per annum in some high mountain areas to the east. The rainy season extends from November to March with a peak in January, during which time rainfall exceeds 100 mm over most of the country. The rainfall regime is predominantly free convectional associated with the Inter-Tropical Convergence Zone (ITCZ). Inter-annual variability in rainfall is relatively high, ranging from 16% on the northern plateau to 48% in the Limpopo River Valley [7] On average, one to three droughts occur every ten years [6]. The mean annual temperature varies from 18 ^{o}C in the Highveld to 23 ^{o}C in the lowveld.

By the end of the twentieth century, Zimbabwe was a warmer and drier country than it was at the beginning. Annual mean temperatures had increased by about 0.4 ^{o}C since 1900, and rainfall had declined by nearly 5 % across

the country [8]. The 1990s were on record as the warmest and driest decade of the century. Further, six of the warmest years on record for Zimbabwe have occurred since 1987 [9].

The pattern of temperature movements in the 1980s and 1990s has been closely reflected in the frequency of droughts and declines in agricultural production. Agricultural production has fallen dramatically in the face of rising mean annual temperatures, and droughts have become more frequent.

2. Methodology

A multi-pronged approach was adopted to identify relevant literature. A web- and e-mail based search for documentation and a desktop review of printed literature was used to enable analysis of secondary data on adaptation to climate change in the agricultural sector in Zimbabwe. Sources consulted included government and international reports, state and non-state agency development and climate change response plans, public research organizations‟ reports, and academic and scientific literature.

3. Results and Discussion

3.1 Green house gas emissions and climate change response options in Zimbabwe

Green house gas (GHG) emissions are the major cause of global warming and climate change. The bulk of GHGs responsible for climate change in Zimbabwe are emitted by countries elsewhere in the world, particularly the industrialized nations [7]. Zimbabwe contributes minimally to global carbon dioxide emissions, the most important greenhouse gas, in both absolute and per capita terms [7]. Most of Zimbabwe‟s emissions come from energy. Commercial energy use in the country accounts for only 0.1 % of global energy consumption, and just over 3 % of energy consumption in Africa [7]. As the second most industrialized country in southern Africa after Africa‟s largest emitter, South Africa [10], Zimbabwe emits only about half the global per capita average. The implication with regard to Zimbabwe‟s climate change response options is that adaptation is more important than mitigation. The latter option is less important because any actions leading to reduced GHG emissions in Zimbabwe (mitigation) is not likely to result in any significant impact on global warming and local climate change events.

More than 48 % of the country‟s emissions emanate from power generation. Industry is another significant contributor to GHG emissions, at nearly 15%. Agriculture emits 11%, transport 12%, and commercial activities 9.6 %. The rest of the sectors, including mining and households, contribute 4 % [9]. Over 70 % emissions in Zimbabwe come from energy production and use [9]. Biomass fuels are the principal source of energy for over 95 % of the rural population. Biomass fuels are used for cooking, lighting, and heating, mainly due to the unavailability of alternative sources of energy [11].

Some climate change response options in the agricultural sector in Zimbabwe, which are discussed in more detail later in this paper, include maintenance of local genetic diversity, soil organic matter enhancement strategies, use of seasonal forecasts, combating drought through improved crop varieties, use of water-efficient and water-saving technologies, shift to more resilient farming enterprises, adjustment of planting times and planting densities, training farmers to use technologies and formulate strategies that are appropriate to their needs, and livelihood diversification away from agriculture.

3.2 Vulnerability to climate change

Both small-scale, community (micro-level) studies and national, sector-wide (macro-level) studies have been conducted in Zimbabwe. However, very little work has focused specifically on the micro-level vulnerability of different social groups to climate change in Zimbabwe [12]. Most macro-level vulnerability studies have focused on the processes and conditions shaping the consequences of climate variation and change within a limited range of domains. These have included agriculture and national food security, water resources management, energy generation, and health [6].

Household-level vulnerability in Zimbabwe is influenced by conflict and insecurity, inequitable land distribution, low education, poor infrastructure, gender inequality, dependence on climate-sensitive resources, poor health status, and HIV/ AIDS [13]. If smallholder farmers are the product of an unfair or inequitable land distribution policy, they become more vulnerable to climate change. The smallholders cannot cultivate larger pieces of land to maintain production levels, as a climate change response option when droughts have reduced their yields, or production per unit area of land. Poor infrastructure such as poor rural road and transport networks also exacerbate small farmer variability to climate change. Underdeveloped infrastructure leads not only to late or non-arrival of inputs, but also to a curtailment of agricultural product marketing operations. The HIV/AIDS pandemic makes poor farmers more vulnerable to climate change through a number of agricultural labour force related effects. First, agricultural labour is decimated by AIDS-related deaths, leading to low available labour to work on farms. The labour shortages are felt more critically when farmers are supposed to adopt labour-intensive technologies such as conservation farming (which is one of the recommended climate change response options in smallholder agriculture in drought-prone Zimbabwe). Furthermore, the pandemic siphons household labour from agriculture, as the affected families divert time previously available for agricultural activities and channel it towards caring for the sick household members.

Although unequal distribution and access to markets, power structures and the breakdown of social networks affect vulnerability, they do so differentially. Climate-related water shocks such as droughts and floods create both opportunities and challenges for the agricultural sector, depending on the ability of the household to diversify its sources of livelihood.

Disease often also deprives households of labour during critical periods, adding to vulnerability. Women, the elderly, and orphans are particularly vulnerable. In predominantly

rural districts, the most vulnerable households include female-headed households, those lacking access to irrigation, and poor households. Rural to urban migration and cross-border migration have been found to compound vulnerability by leaving agricultural activities to less productive sections of the rural populations such as the aged and children, who may not be able to make maximum use of the land. It is important to note, however, that it is not always the poorest people who are most vulnerable to climate change. For example, in some cases irrigation farmers who are normally among the wealthier social groups may be at greater risk from increasingly frequent droughts, as they are less diversified and face a combination of both market and climate risks [7].

At the macro-level, Zimbabwe is vulnerable to climate change in various socio-economic sectors, particularly through shifting rainfall and extreme events. Perennial drought already affects water supplies, agriculture and access to food, impacting negatively on basic health and survival.

3.3 Climate change adaptation policy framework

The government of Zimbabwe acknowledges that climate change is a serious issue [15], although it currently does not have the capacity to implement a clear response strategy. Despite the importance attached to climate change by the government of Zimbabwe, the country‟s policy response is implied rather than stated [6]. There is no comprehensive, specific national policy and legislative framework for climate change adaptation [16]. Instead, legislative and programmatic adaptation responses are found in a plethora of development policies, strategies and action plans of various government sectors. These include the environment and natural resources management, agriculture and disaster management sectors.

The separate legal instruments include the Environmental Management Act No. 13 of 2002, the National Water Act No. 31 of 1998 and the Zimbabwe National Water Authority Act No. 11 of 1998, the Civil Protection Act No. 10 of 1989, the Meteorological Services Act of 1990, and the National Policy and Programme for Drought Mitigation.

3.4 Determinants of the ability to adapt (adaptive capacity)

Adaptive capacity is defined as “the ability of a system (human or natural) to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantages of opportunities, or to cope with the consequences” [17].The capacity of individuals, households and communities to adapt is shaped by their access to and control over natural, human, social, physical and financial resources [18]. Human resources include the knowledge of climate risks, conservation agriculture skills, and good health to enable the performance and productivity of labour. Social resources encompass women‟s savings and loans groups, farmer-based organizations, traditional welfare and social support institutions. Physical resources include irrigation infrastructure, seed and grain storage facilities. Natural resources include reliable water resources, productive land, vegetation and trees. Financial resources include such things as micro-insurance and diversified income sources [18].

Successful climate change adaptation depends on technological advances, institutional arrangements, availability of financing, and information exchange [19]. The African negotiating bloc in the UNFCCC is pushing for an enabling environment that includes adequate, sustainable, predictable, new and additional financial resources and investment to support action on adaptation.

Lack of security of tenure to the newly resettled farmers in Zimbabwe poses a major challenge to adaptation [6]. Currently, resettled farmers are generally understood to possess ninety-nine-year lease permits, although very few of them have any documentation to this effect. Without guarantees of tenancy, farmers are reluctant to devote their total resources to making their land more productive, to the detriment of adaptation strategies [6]. The full productive potential and sustainable use of natural resources and environmental management of resettled lands will only be realized when farmers are guaranteed secure tenure [20].

Extreme climate variability (drought, floods and frost) can destroy the economies and welfare of poor rural families because they lack technologies, social protection mechanisms (such as benefits, insurance and savings) and adequate protection of their crops and animals. A recent study [21] showed that farmers‟ adaptive capacity in the smallholder sector in Zimbabwe is undermined by several factors that range from limited understanding of the nature and consequences of climate change, farm household members health status (particularly in relation to HIV/ AIDS), low levels of remittances from migrant workers, and poor rural infrastructure.

In a recent survey [22] more than 70% of farmers surveyed in one district in Zimbabwe highlighted the lack of access to timely weather forecasts, climate change information and credit facilities that were needed to motivate them in water-conservation strategies, as constraining their ability to adapt. Poverty posed a major bottleneck for farmers that did not have the necessary technology and resources to change or to adapt to the rigours of climate change.

3.5 Strategies for adaptation

Climate change adaptation includes initiatives and measures to reduce the vulnerability of human and natural systems facing actual or expected impacts of climate change [2]. Adaptation, then, involves the implementation of a range of strategies including local and introduced biotechnology, hard technologies (machinery, equipment, and tools), soft technologies (knowledge, capacity building, and awareness raising), and organizational technologies (institution building and resource user organization) [4].

In Zimbabwe, in the context of agriculture, individual/ household level activities of adaptation relate to technologies adopted by smallholder farmers (or livestock herders, or fishers), such as maintenance of local genetic diversity, soil organic matter enhancement strategies like

crop rotations, composting, green manure, cover crops and agro-forestry, conservation agriculture, and a shift to more resilient farming enterprises. Over centuries, smallholder farmers have independently developed agricultural production systems adapted to local climatic, economic and social conditions [23].These include cultivation of drought-resistant crop varieties and selective, rearing livestock that are resilient to adverse weather conditions, effective post-harvest crop handling practices, and storing adequate supplies of food for household consumption. [4]. Government as well as private sector institutions also play an active role in the spread of climate information among poor and vulnerable communities, as an institutional strategy for climate change adaptation [24]. Ensuring that the needs of remote, vulnerable and marginalized communities are fully integrated in national adaptation strategies is a significant challenge for the Zimbabwean government [4].

Other traditional and small-scale sustainable farming practices that are consistent with climate change adaptation in Zimbabwe‟s agricultural sector include cultivation of traditional cultivars and open-pollinated varieties, adding and maintaining soil organic matter, growing different varieties of crops simultaneously on the same field, mulching using crop residues, grass and leaves, and planting trees on agricultural land [23].

The fact that long-term climate change is likely to exacerbate both the frequency and magnitude of extreme weather events in Zimbabwe [26] means that seasonal climate forecasts should have a more important role to play in the future. Timely seasonal forecasts have the potential to help both governments and the local people cope with climate variability. Smallholder farmers could greatly benefit from seasonal forecasts in a number of ways. For example, knowing in advance whether the rainfall will be normal, below average or above average could help them choose the right crops/ varieties, adjust their cropping practices or take other necessary measures to maximize benefits or minimize losses One of the reasons why African farmers are reluctant to adopt improved technologies such as high-yielding varieties and chemical fertilizers is that they do not want to invest their scarce resources without knowing whether the rains will be adequate or not [27]. Seasonal forecasting can significantly reduce these uncertainties.

There exist a number of constraints that need to be addressed before the potential of climate forecasts can be fully exploited by governments, relief organizations and local communities. For example, poor interpretation and communication of forecast outputs has been a major problem, and this has much to do with the probabilistic nature of seasonal forecasts [27].

Drought is likely to be the biggest obstacle to the achievement of food security in southern Africa. Zimbabwe provides a compelling example of this. In the first years of its independence from Britain (the 1980s), Zimbabwe performed what became known as the „maize-based Green Revolution“ [29], or the „smallholder agricultural miracle“ [28]. During this period, production of maize and other crops such as cotton and groundnut experienced a dramatic increase, making Zimbabwe a major maize exporter. Then came the repeated droughts from the late 1980s and suddenly the varieties and cropping techniques that played a significant role in the Zimbabwean miracle were no longer appropriate. There was a clear need to develop, test and release new varieties that would be adapted to the changing climate and ecological conditions of Zimbabwe. It is in this context that research partnerships have been built around organizations such as the International Maize and Wheat Improvement Centre (CIMMYT) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), both supported by the Consultative Group on International Agricultural Research (CGIAR).

The widespread adoption of improved varieties provides clear food security, socio-economic and environmental benefits. These benefits include their potential for reversing land degradation. Because of the high risk of drought, many farmers tend to grow large areas of maize to compensate for poor yields. If the fear of crop failure is reduced through the use of adapted varieties, farmers may be more inclined to invest in their crop and purchase fertilizer, or to take other steps to improve soil fertility and conserve water. Since drought-tolerant maize varieties can ensure improved food security on smaller areas, farmers may be able to allocate more land and labour to legumes and cash crops, thereby improving income, enhancing soil quality and reducing land degradation which is rampant in Zimbabwe and southern Africa [27].

Adoption of new and improved varieties by smallholder farmers requires that a number of conditions are met, including the early involvement of farmers in varietal selection; the rapid release in response to farmer preferences; and government commitment to the rapid multiplication and dissemination of high-quality seed [30]. Although reasons why new varieties are not rapidly adopted in southern Africa, including many parts of rural Zimbabwe, are numerous and may vary from one place to another, accessing seeds is a common problem. There are many examples where smallholder farmers are not aware of the existence of new varieties, or if they are, they just do not have access to them. Purchasing seeds from the private seed companies is not an option for most African farmers due to poverty. The major challenge in Zimbabwe is how to design and implement a sustainable seed distribution system. Unlike maize, a functional seed market does not yet exist for sorghum and millet, and many traders are reluctant to stock seed because of the periodical seed hand-outs going together with relief operations. This uncertainty in demand is not conducive to the involvement of the private sector in the production and commercialization of seed [27].

Although stress tolerant varieties can contribute to stabilizing food production, the „cultivar-alone approach“ may not be sufficiently effective to reduce the small farmers‟ vulnerability to climatic variability and change. Since water resources in southern Africa are likely to become increasingly scarce as a result of climate change, technologies that combine the improvement of soil fertility and the storage and efficient use of water will be necessary to build resilient agricultural systems [4]. Soil and water conservation techniques such as terracing, soil bunds and micro-catchments can significantly improve the water

holding capacity of soils and mitigate the negative effects of dry spells. Conservation tillage has the potential to improve soil fertility, reduce erosion and enhance water use efficiency of crops [4] Developing simple techniques for harvesting runoff water and use it for supplemental irrigation also has great potential when rainfall decreases or becomes more erratic as a result of climate change.

One major problem with soil and water conservation, however, is that many of the promising techniques are labour or energy intensive and require an appropriate training of extensionists and farmers. Conservation tillage, for example, is a useful option for improving the storage of rainwater in the soil and can help mitigate agricultural drought [27]. However, it requires adequate draft power, appropriate machines and good training of farmers to be effective. Seldom are these conditions met in smallholder farming conditions. External support from governmental institutions and development agencies is often needed to implement soil and water conservation projects.

Livelihood diversification has increasingly become an important adaptation strategy in many parts of rural Zimbabwe among smallholder farmers [21]. Climate change-related migrations to neighbouring mines and towns have been reported in recent research [21] Some rural youths are even going to neighbouring countries in search of jobs and they remit their incomes to families and close relatives left behind to supplement agricultural incomes, particularly during periods of food shortages. Other activities, such as gold panning, and collecting and selling wild fruit, are on the increase.

It has been predicted that Zimbabwe will experience a warmer and drier climate by 2075 [15]. As a result, low-lying areas will cease to be suitable for maize production. In addition, the length of the growing season will be reduced by 25 % of its current length. The following adaptive measures have been suggested as an appropriate response to these projected changes. First, it will be found beneficial to introduce livestock and dairy production in areas where maize production becomes uneconomical. Second, adaptation measures will include promotion of drought-tolerant crops, improvement of irrigation techniques, and promotion of agricultural diversification. Adjustment of the timing of farming operations and changing planting densities are yet other adaptation measures. Additional measures could include installation of medium to large dams throughout the country for the development of irrigation projects, and a shift from a subsistence to a cash-crop economy to boost rural incomes.

Some of the current adaptation strategies practiced by smallholder farmers include growing legumes (such as cowpeas and beans) towards the end of the rainy season when crops fail, mainly due to excessive rainfall, and application of more fertilizers when nutrients are heavily leached from the soils [21]. Legumes mature fast and provide nutritious relish. They also fetch good prices on the market. Application of more fertilizers as an adaptation strategy has its own challenges, such as the exorbitant pricing and scarcity of chemical fertilizers in Zimbabwe, which places them beyond the reach of most smallholder farmers.

In cotton producing areas such as Gokwe in Zimbabwe, the preferred adaptation measures include use of irrigation, diversification into more drought-resistant varieties, diversifying into other crops, and timing the planting period to coincide with the onset of the rains [22].

Agricultural activity in Zimbabwe is highly sensitive to climate change, largely because it depends on biodiversity and environmental conditions [4]. Sufficient freshwater supplies, fertile soil, the right balance of predators and pollinators, air temperature and average weather conditions all contribute to maintaining agricultural productivity. Changes in rainfall cycles are impacting on agricultural yields and water availability is decreasing in the semi-arid zones. Smallholder farmers are among the first to feel the impacts of climate change because of their greater dependence on the natural environment.

People whose livelihoods depend on agriculture have developed ways to cope with climate variability autonomously but the current speed of climate change will modify known variability patterns to the extent that people will be confronted with situations they are not equipped to handle [31]. Adaptation has to be understood as a process through which communities gain access to resources, information and the ability to shape their lives and their livelihoods as the environment changes around them.

The ongoing nature of climate change and the inherent uncertainty in weather and climate projections necessitate an approach that empowers communities. This includes building their capacities and opportunities to play an informed role in decision-making over the technologies and strategies that are appropriate to their needs, over which resources are needed and available, and when [32].

To be successful, adaptation policies and measures in Zimbabwe need to be gender-sensitive [6]. To understand the implications of adaptation measures for all people involved, it is necessary that all members of an adapting community are represented in climate change planning and government processes. Social roles and responsibilities of women and men create different degrees of dependency on the natural environment. Women are usually the ones engaged in household subsistence activities. Thus the degradation of forests, watersheds and agricultural lands places enormous responsibility of adaptation on women under conditions of climate change [33]. The existing policy frameworks for management and protection of the environment in Zimbabwe do not explicitly take gender issues into account [6].

The fact that adaptation strategies are inherent in the existing gamut of policy documents, but without much coordination, means a fragmented adaptation response is likely. Some of the current policies and programmes in Zimbabwe actually constrain climate change adaptation. There is a need to harmonize uncoordinated and fragmented pieces of legislation and strategies aimed at enabling and enhancing an adaptive response to climate change. The existing policy

frameworks for management and protection of the environment in Zimbabwe do not explicitly take gender issues into account. Such enabling provisions as increased access to water, weather information, land tenure and micro-credit finance, among others, need to be preferentially extended to women and the elderly. Evidence elsewhere has shown more success with women in revolving micro-finance schemes than with men [33].

Seasonal climate forecasting could play a major role in climate change adaptation in the future, but before that happens, more research is needed to improve regional model outputs by using more powerful models and better quality data; and produce forecasts that are tailored to the needs of local farmers/ end users by downscaling regional model outputs to a national and sub-national level. In addition, more research is needed to improve skills to include more useful information such as the start and the end of the rainy season and the probability of dry spells, or a proxy for these; to ground-truth model outputs through targeted pilot projects using farmers‟ plots for demonstrations; and to better interpret and communicate forecasts outputs to various stakeholders and end-users.

There are two major ways of ensuring successful implementation of climate change adaptation strategies in Zimbabwe. The first is to get the farmers actively involved in hybrid and drought resistant seed production. The second is to create benefits for farmers who participate in bio-geo-physical conservation activities. A common example of the latter is to pay the farmers in the form of food or cash for the work they do to protect the environment. [27]

4. Conclusion

Household-level vulnerability in Zimbabwe is influenced by conflict and insecurity, inequitable land distribution, low education, poor infrastructure, gender inequality, dependence on climate-sensitive resources, poor health status, and HIV/ AIDS. The government of Zimbabwe acknowledges that climate change is a serious issue, although it currently does not have the capacity to implement a clear response strategy. Despite the importance attached to climate change by the government of Zimbabwe, the country‟s policy response is implied rather than stated. There is no comprehensive, specific national policy and legislative framework for climate change adaptation. Instead, legislative and programmatic adaptation responses are found in a plethora of development policies, strategies and action plans of various government sectors. These include the environment and natural resources management, agriculture and disaster management sectors. The capacity of individuals, households and communities to adapt is shaped by their access to and control over natural, human, social, physical and financial resources. Agro-ecological approaches that build resilience to climate change include complex systems, use of local genetic diversity, soil organic matter enhancement, multiple cropping or polyculture systems, and agro-forestry systems and mulching. The fact that long-term climate change is likely to exacerbate both the frequency and magnitude of extreme weather events in Zimbabwe means that seasonal climate forecasts should have a more important role to play in the future. Adoption of new and improved varieties by smallholder farmers requires that a number of conditions are met, including the early involvement of farmers in varietal selection; the rapid release in response to farmer preferences; and government commitment to the rapid multiplication and dissemination of high-quality seed. Soil and water conservation techniques such as terracing, soil bunds and micro-catchments can significantly improve the water holding capacity of soils and mitigate the negative effects of dry spells. Conservation tillage has the potential to improve soil fertility, reduce erosion and enhance water use efficiency of crops. Developing simple techniques for harvesting runoff water and use it for supplemental irrigation also has great potential when rainfall decreases or becomes more erratic as a result of climate change. Livelihood diversification has increasingly become an important adaptation strategy in many parts of rural Zimbabwe among smallholder farmers The ongoing nature of climate change and the inherent uncertainty in weather and climate projections necessitate an approach that empowers communities. This includes building their capacities and opportunities to play an informed role in decision-making over the technologies and strategies that are appropriate to their needs, over which resources are needed and available, and when these needed resources are available. The fact that adaptation strategies are inherent in the existing gamut of policy documents, but without much coordination, means a fragmented adaptation response is likely. Some of the current policies and programmes in Zimbabwe actually constrain climate change adaptation. There is a need to harmonize uncoordinated and fragmented pieces of legislation and strategies aimed at enabling and enhancing an adaptive response to climate change.

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