



**Tanzania: Country situation
assessment**
Working paper



PRISE

Pathways to resilience
in semi-arid economies

Research for climate-resilient futures

Tanzania: Country situation assessment

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This report has been produced as part of a series of preliminary papers to guide the long-term research agenda of the Pathways to Resilience in Semi-arid Economies (PRISE) project. PRISE is a five-year, multi-country research project that generates new knowledge about how economic development in semi-arid regions can be made more equitable and resilient to climate change.

Front cover image:*

Woman farmer in semi-arid lands in Tanzania

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Acronyms

ACRP	Agriculture Climate Resilience Plan
ASAL	Arid and Semi-arid Land
CCCS	Centre for Climate Change Studies
CPC	Climate Prediction Centre
CSA	Country Situation Assessment
DFID	Department For International Development
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IED Afrique	Innovation, Environnement et Développement Afrique
IRA	Institute of Resource Assessment
IPCC	Intergovernmental Panel on Climate Change
IDRC	International Development Research Centre
ILRI	International Livestock Research Institute
ITCZ	Inter-Tropical Convergence Zone
LTWG	Landsat Technical Working Group
LSE	London School of Economics and Political Science
MAFSC	Ministry of Agriculture, Food Security and Cooperatives
MAM	March-April-May
NAP	National Action Programme
NAPA	National Adaptation Programme of Action
NCEP	National Centre for Environmental Prediction
NCCS	National Climate Change Strategy
NEP	National Environment Policy
NLUPC	National Land Use Planning Commission
NSGRP	National Strategy for Growth and Reduction of Poverty (commonly referred to as MKUKUTA)
OND	October-November-December
ODI	Overseas Development Institute
PRISE	Pathways to Resilience in Semi-arid Economies
P/PET	Precipitation to Potential Evapo-transpiration
SDPI	Sustainable Development Policy Institute
TMA	Tanzania Meteorological Agency
UK	United Kingdom
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
URT	United Republic of Tanzania
WMA	Wildlife Management Area
WRI	World Resources Institute

Executive summary

This Country Situation Assessment (CSA) report seeks to provide an initial analysis of the past and current climate in Tanzania and to identify solutions to the complex challenges of natural resource management, economic development, poverty alleviation and resilience-building in the context of climate change.

It focuses on a few selected arid and semi-arid lands (ASALs) in the country and pays particular attention to rainfall climatology for the 1960-1990 and 1971-2000 baseline periods. The report indicates a slight decrease in rainfall in the latter climatological period. It also indicates that, although there has been no significant trend in rainfall at the central ASAL stations, there has been a significant positive temperature trend in both maximum and minimum temperatures at the two stations observed.

The trend in minimum temperatures has been more pronounced and much faster compared with the trend in maximum temperatures. This result is consistent with the latest Intergovernmental Panel on Climate Change (IPCC) findings and other observations in different parts of the globe. Nevertheless, it is important, and it will be more useful, to obtain more elaborate temperature and rainfall datasets from more ASALs of Tanzania to enable a detailed and thorough analysis.

Initial results also indicate that ASALs of Tanzania are endowed with various development opportunities. These include climate-smart agriculture, small-scale mining, sustainable pastoralism and community-based wildlife resource management. The roles of different actors in facilitating these opportunities will be the subject matter of future stakeholder engagement workshops and research that will aim to provide policy-makers with practical guidance on inclusive, climate-resilient development and to support emerging good adaptation practices within the ASALs of Tanzania.

The report also identifies several challenges that affect livelihood systems and sustainable natural resource management in ASALs, both climatic and non-climatic. Since climate change has implications for performance in several sectors, integrated approaches are necessary. These interventions need to consider the challenges and opportunities of various sectors (e.g. agriculture, livestock, water, energy, wildlife, forestry, mining, etc.) in ASALs in contributing to enhancing resilience.

Nomad in arid areas.

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1. Introduction

1.1 Overview of PRISE

Pathways to Resilience in Semi-arid Economies (PRISE) is a five-year, multi-country research project that aims at generating new knowledge on how economic development in arid and semi-arid lands (ASALs) can be made more equitable and more resilient to climate change and can enhance the sustainable use and management of these regions. PRISE aims to strengthen the commitment of decision-makers in local and national governments, businesses and trade bodies to rapid, inclusive and resilient development in ASALs. It does so by deepening their understanding of the strengths, threats and opportunities those semi-arid economies have in the context of climate change.

PRISE research adopts a ‘policy and development-first approach’ to engaging decision-makers in governments, businesses and trade bodies. Rather than starting with complex climate change projections, this research begins by identifying the decisions people need to make now about investment choices and development options for ASALs. Decision-makers and researchers decide jointly on the research questions and study areas to ensure the research corresponds to demand. This approach means PRISE has the flexibility to support policy-makers and investors with quick-response research whenever the need arises, as well as the capacity to lead longer-term collaborative studies.

PRISE research targets ASALs across six countries in Africa and Asia: Burkina Faso, Kenya, Senegal, Tanzania, Pakistan and Tajikistan. The research is organised around five work packages: climate risk management; governance, institutions and finance; markets; natural capital; and human capital.

Each work package is led by a consortium partner and engages researchers from across the five consortium members to ensure a blend of cross-disciplinary expertise and methodological insights.

The consortium’s five member organisations are the Overseas Development Institute (ODI) and the London School of Economics (LSE) in the UK, the University of Dar es Salam’s Centre for Climate Change Studies (CCCS) in Tanzania, the Sustainable Development Policy Institute (SDPI) in Pakistan and Innovation, Environnement et Développement Afrique (IED Afrique) in Senegal. The International Development Research Centre (IDRC) in Canada and the UK Department for International Development (DFID) fund the project.

1.2 Context of the Country Situation Assessment

This CSA acknowledges the importance of environmental resources, political and institutional mechanisms and socioeconomic activities in building climate resilience in ASALs. It also acknowledges that the fragile natural resource base in ASALs makes the livelihoods and businesses that depend on them highly vulnerable to mismanagement, overexploitation and climate change impacts. In many cases, economic development has accelerated the degradation of natural resources, with institutional and policy regimes unable to effectively balance exploitation with conservation, and national development objectives with the livelihood needs of the poor. These are challenges that climate change and increasing variability will exacerbate.

This CSA identifies the existing critical pathways from natural

resources to economic growth and poverty alleviation. Furthermore, it examines the political economy of key junctures in each development pathway, to expose underlying barriers and opportunities for action, which may apply at national, subnational or local levels, including the allocation of increasingly scarce resources (e.g. water, land) between different users and uses to ensure inclusive climate-resilient development.

Specifically, the CSA highlights the following:

- Natural resource management policies, processes and institutions and their relevance to climate change adaptation and development;
- Natural resource access and use in the livelihoods and adaptation potential of women and other marginalised groups;
- Natural resource governance arrangements on the vulnerability of these groups and options to strengthen their natural resource rights;
- Processes linking natural resource depletion and degradation with impacts on economic growth and poverty reduction, including valuation of important ecosystem services.

1.3 CSA methodology

The CSA drew heavily on the existing literature and stakeholder consultation across levels on key issues related to the ASALs of Tanzania. Secondary data sources included published books, reports, journals, maps and papers. It also involved revisiting documentary evidence from various relevant authorities such as ministries, municipal councils and government offices at district level. The CSA also undertook a consultative process to understand various issues, including

the challenges and opportunities in ASALs at both national and subnational levels. It was further informed by information obtained from the scoping exercise the PRISE research team in Tanzania carried out in the potential project sites.

The specific issues discussed in the assessment include natural resource endowment and associated climate risks in ASALs; the nature of policies related to natural resource management; and the social vulnerability of communities in ASALs in a changing climate. The

CSA further identified key problem areas where critically important natural resources for economic development and/or poverty reduction coincided with high vulnerability to climate change and other forms of natural resource degradation.



A farmer leads his cattle to drink water

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2. Understanding the semi-arid lands of Tanzania

2.1 Tanzania's arid and semi-arid areas

Various literatures acknowledge that defining ASALs in Tanzania poses a great deal of challenges. This is partly because of the complexity and environmental dynamics associated with the ASALs (Boesen et al., 1996; Mascarenhas, 1995). However, the definition of arid and semi-arid areas is based primarily on their climatic conditions and agro-ecological characteristics. According to the Food and Agriculture Organization of the United Nations' (FAO) definition, drylands (including arid, semi-arid and dry sub-humid lands) are areas with a growing period of 1-179 days (as cited in Koochafkan and Stewart, 2008). On the other hand, the United Nations Convention to Combat Desertification (UNCCD) definition of drylands employs the ratio of annual precipitation to potential evapo-

transpiration (P/PET) (as cited in Millennium Ecosystem Assessment, 2005). Under this definition, ASALs are commonly characterised by a P/PET of between 0.05 and 0.65 (ibid.).

Tanzania's National Adaptation Programme of Action (NAPA) (URT, 2007) defines the country's ASALs according to climatic, agro-ecological and physiographic characteristics. It maps them based on altitudinal features, precipitation patterns, growing seasons, average water-holding capacity of the soils and other physical patterns and processes. Accordingly, the semi-arid areas in Tanzania are defined as areas receiving less than 800mm of rainfall (Schechambo et al., 1999).

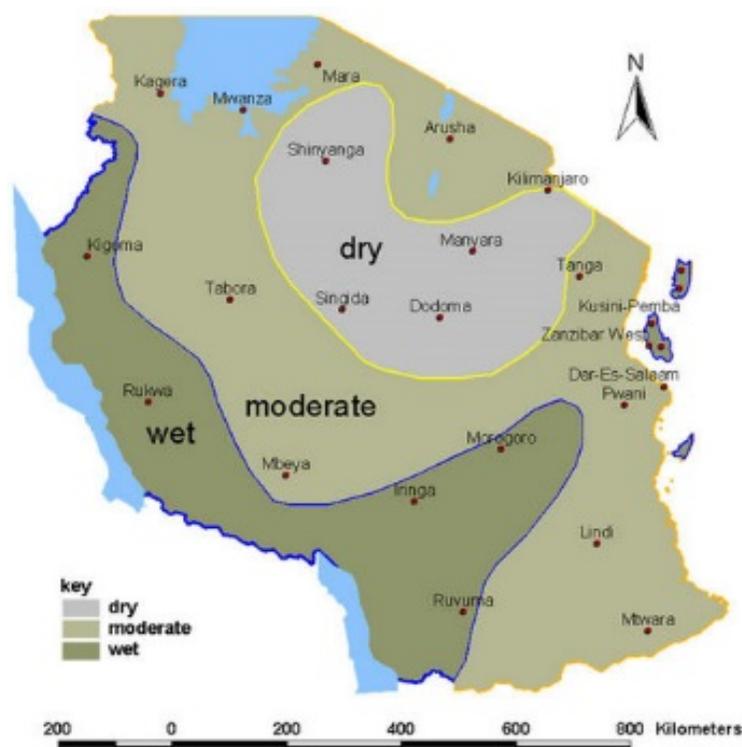
According to the FAO (2012), Tanzania's ASALs cover more than 50% of the country. From both the climatic and the agro-ecological

classifications, these ASALs are mainly located in Dodoma, Singida and Shinyanga regions of central Tanzania; parts of Manyara region; the lower areas of Arusha and Kilimanjaro region in the northern part of Tanzania; parts of Iringa region; and Lindi and Mtwara regions in the southern part of Tanzania (Schechambo et al., 1999; URT, 2007). Morris et al. (2001) also characterise some parts of Mwanza and Tabora regions as being semi-arid (see Figure 1).

2.2 Geophysical characteristics

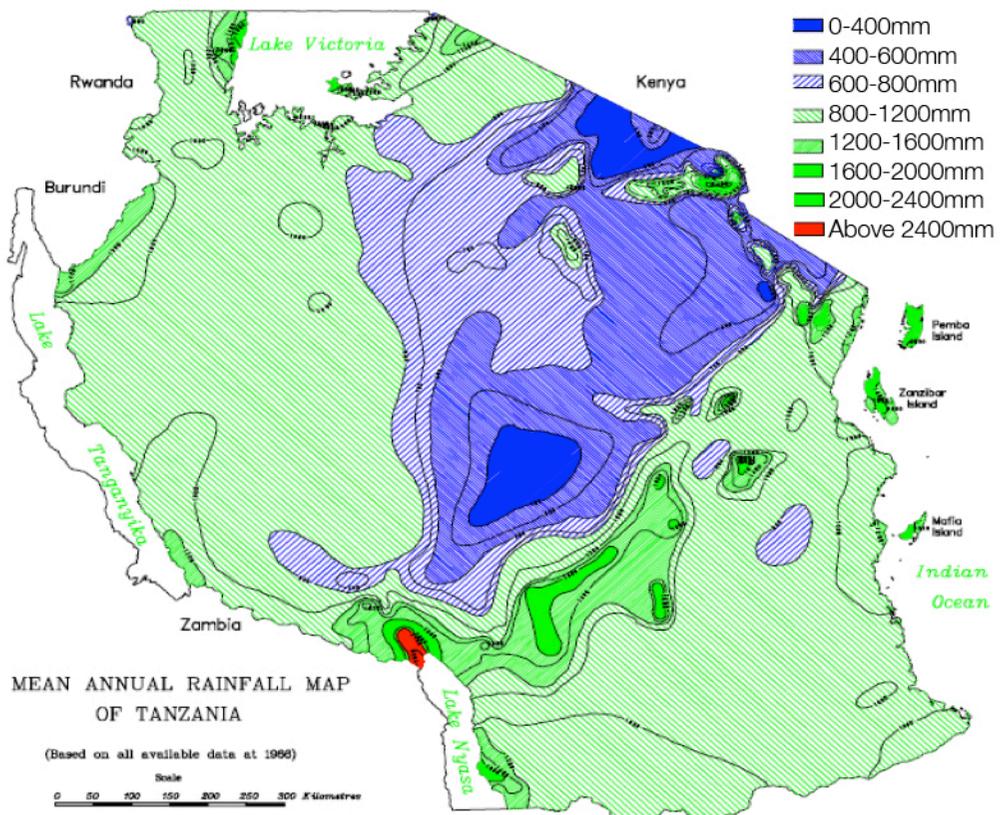
The ASALs in Tanzania are delineated in patches and therefore do not spread themselves across all parts of the country. Hence, each of the ASALs has unique characteristics that define it. In

Figure 1: Map of the semi-arid lands of Tanzania



Source: URT (2010).

Figure 2: Mean annual rainfall map of Tanzania



Source: Schechambo et al. (1999).

In terms of geophysical characteristics, these areas have an altitude of between 1000 and 1500m that consists of 'gently undulating plains, rocky hills, low scarps and rift valleys' (Morris et al., 2001, p.18). ASALs are also characterised by calcicisol, gypsisol and leptosol soils, which are poor-fertility, sandy, salty, low-moisture and well-drained soils (ibid.). Despite variations in scale in the ASALs, these soil characteristics influence communities in these areas to grow certain types of crops and keep livestock for their subsistence and income.

2.3 Rainfall patterns

ASALs are characterised by a relatively long, hot and dry season followed by a relatively short rain season (FAO, 2000). They also experience significant diurnal fluctuations in temperature, which restrict the growth of plants. In

addition, there is rainfall variability in terms of amount and intensity as well as prolonged droughts (Morris et al., 2001) (see Figure 2). The central ASALs that extend over Dodoma, Singida, Shinyanga and (less so) Mwanza and Tabora regions follow the unimodal rainfall pattern that prevails between December and March, covering a crop-growing period of 70-90 days (Morris et al., 2001; Schechambo et al., 1999; URT, 2007).

The south-eastern semi-arid areas, which include parts of Morogoro, Lindi and Mtwara regions, experience unpredictable but adequate October-December (OND) and March-May (MAM) rainfall (Shechambo et al., 1999). However, the ASALs of north-eastern Tanzania, specifically those in Arusha and Manyara regions (also popularly known as the Maasai Steppe), experience short and unreliable rainfall, with onset dates covering

only 2-2.5 months (Morris et al., 2001; Shechambo et al., 1999). The amount of rainfall in both areas is unimodal, mostly falling from December to March. Potential evapo-transpiration is over 2000 mm per year (Mutabazi et al., 2005).

2.4 Vegetation cover

Different types of vegetation occupy the semi-arid areas of Tanzania, including grasslands, dense thickets, miombo woodlands, baobab (*Adansonia digitata*), acacia and seasonally inundated grasslands (Kisanga, 2002). Human occupation has extensively modified these types of vegetation. As such, deforestation and land degradation in these areas are on the increase (Shechambo et al., 1999). Among the major causes of this are forest-clearing for agricultural expansion (especially shifting cultivation), fire, human settlements, charcoal-making and mining.

3. Development context

3.1 Policy environment

The Tanzanian policy framework puts emphasis on the implementation of Vision 2025, which aims to transform the country's economy from low-productivity agricultural activities to high-productivity semi-industrialised activities (manufacturing and small and medium enterprise) by the year 2025. Vision 2025 further aims at building a diversified and competitive economy. To realise Vision 2025, the government has formulated medium-term strategies at the national level. These include the National Strategy for Growth and Reduction of Poverty (commonly referred to as MKUKUTA), whose first phase ran from 2005 to 2010 and second phase from 2011 to 2015. Other strategies include the Five-Year Development Plan and the Property and Business Formalisation Programme, commonly known as MKURABITA (URT, 2010, 2011b).

These key national strategies focus on increasing and promoting community livelihoods by enhancing their capabilities to adapt to socioeconomic and environmental shocks. Other specific issues in these strategies include adaptation and mitigation options to reduce the impacts of adverse shocks that emanate from climate change and other natural and human-induced disasters. These options include the introduction of crop and livestock varieties to suit adverse conditions; provision of early warning system frameworks; skills development for farmers to adapt to new farming practices; and awareness creation on climate change and adaptation strategies. Other adaptation and mitigation options include the application of new technologies for crop production and livestock-keeping and measures for water and soil conservation. Sectoral plans and programmes already mainstream

most of these adaptations and mitigation options.

Apart from the key national strategies and budgeting, the government has also shown its commitment to building community capacity to adapt to economic shocks and to promoting environmental and sustainable land management through policies and strategies at the ministry, department and agency level. Although most of these policies and strategies are directly concerned with enhancing sustainable development and people's wellbeing, they do not focus directly on enhancing the livelihoods of communities in the ASALs.

This report therefore summarises only a couple of policies and strategies, in particular those that are related directly to enhancing the capacity of communities in drylands to adapt to social and economic shocks.

National Environment Policy

The 1997 NEP earmarks a number of problems and challenges associated with environmental changes, some of which directly adversely affect the livelihoods of communities living in drier parts of the country. These include but are not limited to land degradation, which is decreasing the ability of soils to produce quality products in ASALs and elsewhere in the country.

As a result, the NEP addresses crosscutting sectoral issues, in some cases to enhance the capacity of communities in drylands to adapt to shocks, proposing strategies under key sectors to achieve these objectives. These strategies relate to biodiversity conservation, soil and water conservation, sustainable forest management and climate change mitigation and adaptation. Apart from promoting the

conservation of the natural environment, the NEP also sets crosscutting objectives to ensure integrated and holistic approaches to land use planning and management; improved crop husbandry through the use of soil erosion control measures; increased soil fertility; and the expansion and diversification of agricultural production.

National Action Programme

Efforts to combat desertification in Tanzania were in place even before independence. For example, the colonial government implemented various programmes to deal with land degradation. The first initiative was the Sukumaland resettlement scheme of 1948-1954, implemented in Mwanza and Shinyanga regions. This was followed by a destocking and resettlement scheme, implemented between 1945 and 1960, covering the current administrative districts of Mbulu, Babati, Hanang, Ngorongoro, Monduli, Kiteto and Simanjiro. After independence, efforts were minimal. It was in 1977, with the UNCCD, and thereafter through the United Nations Conference on Environment and Development in 1992, that attempts were revived. These international conferences identified desertification as a major problem in need of immediate attention in order to ensure the sustainability of socioeconomic activities and environmental resources in ASALs. Tanzania's adoption and ratification of the UNCCD led to the development of the National Action Programme (NAP) in 2007 (URT, 2007).

The objectives of the NAP are long-term processes to ensure the sustainable management of natural resources in order to improve the livelihoods of communities in semi-

arid areas, which will result in multiplier outcomes to national development. In order to achieve these objectives, the NAP emphasises setting strategies to promote the sustainable use of natural resources for the wellbeing of communities and reduce natural resource degradation in drylands. The NAP also emphasises the effective engagement of key stakeholders for the sustainable management of natural resources.

Implementation of the NAP has been evident in various programmes, such as the Soil Conservation Programme in Dodoma, carried out in the Kondoa Irangi highlands, and the Soil Conservation Programme in Shinyanga region. These programmes were implemented in order to combat desertification, restore land productivity and conserve natural resources for community livelihoods and the sustainability of natural resources.

Other programmes focused on sustainable land management and the improvement of community livelihoods have included the Land Administration and Management Programme and the Soil Erosion Control and Agro-Forestry Programme, implemented in Babati and Lushoto districts, respectively. Other important programmes include the National Soil Conservation Programme and the National Agriculture Extension Programme, put in place by the Ministry of Agriculture, Food Security and Cooperatives (MAFSC). A nationwide afforestation campaign, launched in the 1980s, also demonstrates the efforts of the government and other key stakeholders, including development partners, to promote the sustainable management of natural resources and improved community livelihoods. Furthermore, in 2006, the government formulated and implemented the National Strategy on Urgent Actions on Land Degradation and Water Catchments, with the purpose of restricting cultivation on steep slopes in highland parts of the country.

National Adaptation Programme of Action

The 2007 NAPA describes Tanzania's climate change-related vulnerabilities in various sectors. Most of the sectors identified are important for socioeconomic development. The programme entails robust actions to curb impacts associated with climate change. The objectives of the NAPA are to build community capacities, especially in marginal areas such as drylands, to adapt to natural disasters, including climate change-related shocks. Other objectives of the NAPA are to mainstream adaptation activities into sectoral policies, strategies, plans and programmes; to raise public awareness on climate change impacts and adaptation options; and to support climate-compatible and sustainable livelihood and development activities across scales and levels.

Other ministry, department and agency policies and strategies

Sectoral policies such as the Land Policy, the Agricultural and Livestock Policy, the Livestock Policy, the Energy Policy, the Water Policy, the Forest Policy, the Wildlife Policy, the Mineral Policy and the Natural Gas Policy, to mention just a few, implicitly address the overriding issue of enhancing community livelihoods in ASALs by enhancing their capacities to adapt to shocks, including those arising as a result of climate change, and to attain sustainable development. Thus, the objectives set in each of these policies are in tandem with and cognisant of what is in all the other sectoral policies, including the NEP.

Tanzania's National Climate Change Strategy (NCCS) (2012) clearly sets out strategic interventions for climate change adaptation measures and greenhouse gas emission reductions (URT, 2012a). It outlines the objectives for all sectors and proposes strategic interventions in respective sectors and themes.

Tanzania's low national emissions profile, high vulnerability and dependence on natural resources for livelihoods mean emphasis is placed on adaptation.

Aware that climate change will continue to pressurise Tanzanian farmers, MAFSC has taken the lead by developing the Agriculture Climate Resilience Plan (ACRP) (2014-2019) so as to implement strategic interventions for the adaptation and mitigation of climate change impacts in line with the NCCS. The ACRP presents a wide range of adaptation options, including improvement of agricultural land and water management; risk management; and strengthening information and early warning systems (URT, 2014a). These will help integrate resilience into agricultural policy decisions, influence planning processes and implement investments on the ground.

Various sector ministries are establishing mechanisms to mainstream environmental and climate mitigation and adaptation issues, using guidance from the NEP, the 2004 Environmental Management Act and the NCCS. Environmental and climate change issues are also being integrated in the Medium-Term Expenditure Framework, which budgets for different sectors. All this is a clear indication of political will and commitment to ensuring sustainable development by enhancing the livelihoods of communities in the most vulnerable areas, such as those in ASALs. For this reason, it is possible to conclude that there are signs of hope from both the government and non-state actors in terms of policies, strategies and programmes; the institutional setup and legal framework; and budget (incentives) commitments to enhance ASAL livelihoods and build capacity to adapt to shocks, including those related to climate change.

The historical perspective

In order to understand the dynamics of ASALs in Tanzania, it is important to revisit the political and policy

processes and land ownership reforms of colonial to post-independence governments. The impacts of these processes through time are still felt today, especially in

ASALs. Table 1 provides a timeline of major land management policies and impacts on ASALs since 1923.

Table 1: Timeline of major land management policies with impacts on ASALs

Year	Land tenure policy	Implications
1923	Enactment of Land Ordinance of 1923: natives got customary land tenure and non-natives a 1-99-year granted right of occupancy with title deed	Institutionalisation of two parallel land tenure systems: one with proof of occupancy and the other without and prone to land disputes and conflicts
1926	Native Authorities Ordinance of 1926 enforced	Traditional chiefs (land-allocating authorities) replaced by Native Authorities, who managed land use using by-laws
1963	Freehold titles and the Government Act of 1963/Land Act	The Act converted colonial freehold into government leaseholds, affecting mainly large-scale landowners
1964/66	1964 Range Development and Management Act Cap 569 passed 1966 Village Act passed	The Acts aimed at regulating grazing and water use in range areas
1967	Arusha Declaration	The state owned land and all other means of production
1973	Rural Farmland Act passed	The Act enabled the government to seize any land and declare it as a specific planning area for use as deemed appropriate by the government
1975	Ujamaa Villages Act enacted	The Act provided for a villagisation in which settlement and land use patterns were altered and resources redistributed among households; affected customary land tenure where the programme was implemented
1982	Local Government Act passed	Villages became part of local government, districts and urban councils but issues of land tenure were not addressed
1983	Agricultural Policy formed	Never implemented, for political reasons
1991	Presidential Commission formed to look into land tenure problem	Comprehensive report published
1992	Land Tenure Act of 1992 passed	Customary land tenure abolished in Ujamaa villages
1995	National Land Policy	Provided security of tenure to smallholders and pastoralists; maximise land use efficiency; streamline land administration; facilitate implementation of development programmes; among others
1999	Village and Land Act passed	Decentralisation of land matters and provision of fair distribution of land between pastoralists and agriculturalists; men's and women's rights, among others; village councillors became land managers
2001	Rural Development Strategy	Improved rural livelihood quality by meeting basic needs
2002	Courts (Land Dispute Settlement) Act passed	The Act provides for different stages of dealing with land disputes: the Village Land Council; the Ward Tribunal; the District Land and Housing Tribunal; and the High Court and the Court of Appeal
2006	National Livestock Policy	Recognised pastoralism as a viable mode of production
2010	Grazing Land and Animal Feed Resources Act No. 13	As above

Source: Adopted from various URT documents.

The colonial period in Tanzania started in 1880s under the German rule, which lasted until the 1920s; the British took over until 1961, when Tanzania attained its independence. Colonial systems had negative implications for some socioeconomic activities, which are still visible in current policy frameworks. One of the important features of the colonial legacy is that it abolished the role of traditional pastoral systems and institutions by creating borders that restricted the free movement of pastoralists (Arhem, 1986).

Pastoral development policy during the colonial period was influenced by the widely held view that pastoralism was leading to environmental degradation (Brockington, 2004). Thus, the British imposed a sedentary life on pastoral communities by creating permanent rangelands under the Range Development and Management Act of 1964. These rangelands, administered by the Range Development Commission, were established with the view of providing public services to pastoral communities.

The Range Development and Management Act was followed by the 10-year long Maasai Range Development and Management Project, which commenced in 1970, funded by the US Agency for International Development and focused on costly technical inputs. The project aimed to achieve the formation of ranching associations; improved range management, animal health facilities, livestock quality and livestock marketing; and increased water supply and extension services. However, the final results were mixed negative impacts on pastoral communities, including the loss of property rights.

The contemporary situation

Under the colonial administration's Land Ordinance of 1923, all land in Tanganyika (now Tanzania Mainland) was declared public under the direct

control of the British governor (Fimbo, 1992). Under the postcolonial government, the Freehold Titles (Conversion to Government Leases) Act of 1963 and the Government Leasehold Act of 1969 converted all freehold lands into government leaseholds. This implied that freehold titles were abolished.

Some key policy reforms have had significant impacts on ASALs. According to Tenga (1996), most land disputes are related to land rights suppressed through various reforms related to policy and legal frameworks. These include the Ujamaa land reform in 1974; land liberalisation policies in the 1980s; and the conservation of rangeland (Shivji, 2004).

The Ujamaa villagisation scheme (1974-1976), the Rural Lands Act of 1973 and the Villages and Ujamaa Villages Act of 1975, along with Arusha Declaration of 1967, are identified as being responsible for many of the land disputes in ASALs and elsewhere. Specifically, the villagisation programme led to land insecurity and people's loss of control over resources on their lands (Havnevik, 2000; World Bank, 1992). In implementing the villagisation scheme, previous land use systems and property rights arrangements were abolished, and traditional property rights were considered conducive to collective production. In addition, the Rural Lands Act of 1973 and the Villages and Ujamaa Villages Act of 1975 were not accompanied by any elaborate property rules (URT, 1994).

From the late 1980s, Tanzania liberalised its political system and economy. Some of these policy adjustments were adopted through the Structural Adjustment Programme and the National Economic Recovery Programme, which were implemented from the mid-1980s on. However, the economic and political reforms that took place did not address the issue of traditional land rights. Instead, the government launched the National

Agricultural Policy in 1983, which emphasised village titling through the demarcation of village boundaries with an introduction of 99-year rights of occupancy. However, the demarcation of village boundaries increased the number of boundary disputes in a number of communities in Tanzania. As a result, the policy was hardly implemented.

In the 1990s, it became clear land mismanagement was leading to a large number of land disputes, especially in ASALs (URT, 1995). As a result, the government came up with various approaches to improve the land rights system. In 1995, the new National Land Policy was published. However, this did not address all problems related to land rights. It did not change the *status quo* and the state remained the sole custodian of land (Shivji, 1994). Importantly, it amended the Land Tenure Act of 1992, and at least recognised land as a commodity that can be exchanged and included a promise to protect individual rights to land. However, recognising land as a commodity had serious negative implications for the ASALs, since it attracted commoditisation in the name of investors. Some investors fenced their lands, blocking migratory routes, thus causing chaotic relations with pastoral communities.

In April 1999, the Land Act and the Village Land Act of 1999, which constituted the Land Law Reforms, were passed and approved by the Parliament. They became operational in 2001. Whereas the amended Land Tenure Act of 1992 facilitated state administrative control over people's access to land, the Land Act and Village Land Act facilitated the right of citizens to access and own land (Alden Wily, 2000a).

In principle, under Section 25 of the Land Act and Village Land Act of 1999, groups of people including those in ASALs have the right to access and own land through issuance of a Certificate of Customary Right of Occupancy

“The Land Act and the Village Act of 1999 remain weak in fundamental ways. Slow implementation of laws, particularly, village titling and drawing up village land use plans, is a major hindrance. In addition, Village Councils do not function as a judicial entity but rather act as mediators.”

(URT, 1999a). The Village Council approves the right and has prime jurisdiction over all land declared village land. The Councils have the sole responsibility for overseeing decisions on the designation of land within the village, using land use plans as the land management tool.

According to the Land Act and Village Land Act of 1999, land in Tanzania is divided into general land, reserved land and village land. Village land is further sub-divided into three main categories: communal and public use land; land for individual or family or group use under customary law; and land reserved for future communal or individual use. Although these subdivisions had positive impacts on all people owning land, the people of the ASALs received the most benefits.

However, the two Land Acts remain weak in many fundamental ways. Slow implementation of laws, particularly village titling and drawing up village land use plans, is a major hindrance (Shivji, 1994). In addition, Village Councils do not function as a judicial entity, but rather act as mediators and assist different parties in land disputes. This has caused untold delays to justice in land disputes (ibid.).

To address the situation, the government proposed a new Courts (Land Dispute Settlements) Act to the Parliament in January 2002. The Act delineates different bodies at the village, district and state levels, each of which is to deal with land disputes in conflict situations and litigations. Before this Act, there was no known legitimate state-based process for settling land disputes. Ward Tribunals and traditional leaders used to be mediators in land disputes.

Other key sectoral policies that have been particularly relevant to ASALs and their people include the Livestock Policy of 1983, which aimed at stimulating livestock development in the centralised economy. This emphasised large-scale parastatal institutions for livestock production chains. The National Livestock Policy of 2006 and

the Grazing Land and Animal Feed Resources Act of 2010 underscore the importance of pastoralism as a viable mode of production. The policy aims to stimulate development in the livestock industry and increase the wellbeing of all national and rural stakeholders involved in the livestock industry.

3.2 Pastoralism and agro-pastoralism in Tanzania’s development perspective

As it has been pointed out, Vision 2025 sets objectives to foster the socio-political economy. It aims to transform Tanzania from a least-developed country to a middle-income country by modernising agricultural production and promoting medium- and large-scale investments. Vision 2025 has been adopted in various macro and micro policy frameworks. The 2005 MKUKUTA, for example, aims to alleviate poverty through the improvement of all productive sectors, including pastoralism. The strategy recognises the importance of the efficient use of rangelands as well as improving production in the livestock sector in order to empower pastoral communities.

Similarly, the local government reform process in Tanzania offers a valuable opportunity for pastoralists to become more engaged in the decision-making process. Likewise, decentralisation provides the potential for greater efficiency in the delivery of services to local communities, including their involvement in the bottom-up planning process and implementation of activities relevant to their priorities and plans. Under the new government reforms, the local government also acts as an intermediary between local communities and national policy and legal frameworks.

Although within Vision 2025 and MKUKUTA Tanzanian policy and legal frameworks recognise pastoralism as a viable productive

sector with significant contributions to make to national and rural income and livelihoods, several challenges still need to be addressed. One area that requires a favourable policy environment relates to the free movement of pastoral communities. Most policies emphasise sedentary lifestyles, which may not be favourable to most nomadic and semi-nomadic livestock-keeping systems. In addition, sedentary pastoralism may not be relevant to the ASALs of Tanzania – as confirmed by research from other ASALs in countries, such as Botswana, Ethiopia and Kenya.

For instance, Leach and Mearns (1996) indicate that pastoralism is more practical in free-range livestock-keeping than in ranching livestock-keeping systems. Furthermore, if properly managed, under mobile lifestyles pastoralism can minimise disease transfer, avoid the overexploitation of natural pasture and water resources and reduce the risks of coming into conflict with other land users. In recognition of the vulnerability and

potential of ASALs, the Tanzanian government has set up policy and legal frameworks to promote the productivity of the livestock sector in line with Vision 2025. In 2006, it established the Department of Pastoral Systems Development and, as we have seen, published the National Livestock Policy, and in 2010 it enacted the Grazing Land and Animal Feed Resources Act, in order to achieve Vision 2025 targets in the livestock sector (Sørensen, 2006).

3.3 Population and settlement patterns

Population growth in most parts of ASAL regions is close to the national average. However, in Lindi and Mtwara, the population growth rate lies at 2% and 1.4%, the lowest in the country. ASAL regions with the highest population growth rates include Singida and Shinyanga, at 3.7% to 4.6%. The high population growth rates in the two regions can be attributed to substantial rural to urban migration.

The ASAL regions are also characterised by out-migration. Dodoma is one of the ASAL regions with the highest levels of out-migration: out-migration to other areas is estimated to be higher compared with in-migration at a ratio of 205,200 out-migrants to 27,700 in-migrants, with a net migration of -177,500 (URT, 2006). Most out-migrants from Dodoma seek residence in neighbouring regions such as Iringa, Mbeya and Dar es Salaam (ibid.).

Various ethnicities and cultural diversity characterise populations in the semi-arid zone. Major ethnic groups include the Maasai, Gogo, Fyomi, Barbaig and Sukuma, who are traditionally pastoralists and/or agro-pastoralists. The Maasai and Barbaig are a major semi-nomadic system in Tanzania (Brockington, 2004). Other ethnic groups, traditionally agriculturalists, within this semi-arid zone include the Nyamwezi, Rangi, Iraqw, Taturu, Sandawe, Nyiramba and Nyaturu.



Local Tanzanian farmer.

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3.4 Livelihood strategies

Although Tanzania's ASALs have been marginalised for a long time, their landscape is changing very rapidly. They have actually proved to be vital in supporting animal-keeping, dryland agriculture, wildlife conservation, mining and human settlements. This sub-section ties down together key livelihood options that are relevant to the communities living in drier areas and also looks at how they have evolved over time, given their dynamic nature.

Agriculture

Agriculture is the key economic activity driving the lives of most of the communities living in the ASALs of Tanzania (URT, 2005). However, given the climatic conditions of these areas, which are characterised by low and unreliable rainfall, communities in the ASALs that practise agriculture are at very high risk of experiencing poor crop production. As a means of insuring themselves against crop failure, many of these communities, especially those in the Sukuma land and in parts of the north-eastern Singida and Mara regions, practise agro-pastoral farming and mainly grow drought-tolerant crops such as sorghum and millet (Morris et al., 2001; Ruthenberg, 1980). However, they sometimes grow maize, cotton, oilseeds and rice.

Further increasing the risk of crop failure for communities in ASALs is the increasing human and livestock population. According to Mwalyosi (1992) and Shem et al. (2005), the high numbers of humans and livestock in ASALs has led to over-cultivation of croplands and overgrazing of rangelands. A consequence of this has been soil erosion and the exhaustion of a land that already has a low fertility status. This has further affected already dwindling crop yields (Collinson, 1972; Kisanga, 2002; Rounce, 1949). In response to this, agro-pastoralists, mostly men, from the semi-arid areas of Sukumaland are

moving into the southern regions of Mbeya, Morogoro and Lindi, leaving their wives and families behind. This increasing trend of out-migration has left a burden on women at the household level.

According to Dejene et al. (1997), the increasing burden on women has increased their need to hire farm implements such as oxen ploughs. However, the unpredictability of the rainfall season means women are not the only ones using these; more and more people are now ploughing their land using oxen. It helps them reduce the amount of time they spend cultivating.

A few pertinent questions remain. How can we increase the resilience of the agro-ecological system in ASALs? One promising pathway is the adoption of water harvesting technology. In support of this, Mutabazi et al. (2005) note that rainwater harvesting has the potential to alleviate poverty by giving impressive returns to land and labour even during average seasons. This implies that interventions to improve productivity through rainwater could result in tremendous economic benefits.

Water harvesting technology can also complement interventions in market-focused watershed development, which focuses on promoting the food and income security of farmers while conserving the eco-hydrology and other natural systems in the watershed (Mutabazi et al., 2005). However, as Mutabazi et al. (2005) warn, one of the major challenges of market-focused watershed development lies in balancing between using water for improving human livelihood and using it for ecological services.

Another promising pathway to resilience is the adoption of commercial crops that can withstand the climatic conditions of the ASALs. In Tanzania, one such crop has been jatropha, which is believed to have enormous potential in terms of changing the face of agriculture in the ASALs. However, the crop does not come without

risks, which include the fact that its broad success for rural producers is largely dependent on the development of a yet very limited market.

According to Kempf (2007), the establishment of responsible projects can mitigate the risks. For example, when growing jatropha, periods of three to four years without yield have to be endured. Accordingly, during this time, it is advised that jatropha not be planted as a single crop: instead it should be intercropped with other annual crops. Kempf (2007) and the Rural Livelihood Development Company that is experimenting with this crop in Dodoma believe that, if jatropha is introduced as a side-profit-generating complementary crop rather than as an all-curing miracle tree, the experiment can work for the rural poor. Most importantly, Kempf (2007) cautions that expectations should be kept low and realistic.

Livestock-keeping

The ASALs are home to over 70% of the livestock population in Tanzania (URT, 2006). This makes them a major contributor to the livestock industry in the country. Most of this livestock population is subjected to uncontrollable movements in search of forage and water during dry season. Hence, most of the livestock population in ASALs is kept in agro-pastoral and pastoral systems, with very few kept on commercial ranches. However, it is argued that the livestock population in the few commercial ranches is given more emphasis in terms of investment in comparison with the livestock population kept in agro-pastoral and pastoral systems (ibid.). Poor animal husbandry practices in pastoral and agro-pastoral systems attract little support from the government. Despite these challenges, the livestock population in ASALs provides pastoral communities with a means of livelihood. It also provides Tanzania with most of its meat, milk products and other indirect benefits, which

can be exported and thus contribute to the country's gross domestic product (GDP).

According to the 2005 Economic Survey (URT, 2006), the livestock industry in Tanzania contributes 4.5% to the country's GDP. However, the specific contribution of the livestock population in ASALs is not known. In relation to this, Schechambo et al. (1999) and Shivji (1994) observe there is no proper record of the value of goods from pastoral production, which could assist in making informed choices on investment and policy in ASALs.

For instance, the land on which livestock-keeping is practised is often treated as vacant land that can be put to better use with more permanent structures (Brockington, 2004; Mwalyosi, 1992). Hence, problems related to land grabbing and insecurity of tenure have become so grave that there are cases of outright land-grabbing of the perceived vacant lands to build private ranches (Shivji, 2004).

Pastoralists in Tanzania have also fallen victim to the establishment of national parks and game reserves that have often left them excluded (Brockington, 2004; Homewood and Rodgers, 1991; Shem et al., 2005; Sørensen, 2006). This can be attributed partly to the lack of understanding of livestock movement and that of pastoralists to territories that are outside their traditional grazing areas (Galaty, 1993). Consequently, it has become quite acceptable, among policy-makers, to label pastoralism as a system that destroys the environment. However, according to Benjaminsen et al. (2009), arguments that blame pastoralists for environmental degradation and desertification do not have any scientific basis.

Poorly informed policies and the exclusion of pastoralists have led to pastoralist communities becoming impoverished (Kipuri and Sørensen, 2008). Further complicating the situation is the increasing livestock population, which has led to overgrazing and has ultimately

caused soil erosion problems. Additionally, the increased movement of livestock to places that in the past had few livestock has in most cases resulted in land use conflicts (URT, 1995).

Solutions advocated in the 2006 National Livestock Policy, such as the use of commercial ranches, have been tried as a panacea for the uncontrolled mobility of pastoralists. However, in most cases such attempts have failed miserably because they have not considered the local Tanzanian context but rather have paid more attention to other contexts that are not comparable with what is happening locally. Methods, philosophies and management tools used in developing nations such as New Zealand and Canada have fallen short when applied to the East African pastoralist context (Behnke and Scoones, 1993; Homewood and Rodgers, 1991).

Additionally, the past few years have seen pastoral communities delve into farming, getting paying jobs and keeping fewer animals as a means of diversifying the risk of drought. Some studies have actually established that pastoralists who take up agriculture as a means of insuring themselves against droughts are more likely to maintain their livelihoods than those who keep livestock only (Thornton et al., 2008).

Wildlife conservation and tourism

Wildlife conservation requires larger portion of lands. These are meant for national parks and wildlife sanctuaries. This in turn has created pressure that is increasingly forcing pastoralists off their lands (Sendalo, 2009; Shem et al., 2005). Under the Wildlife Conservation Act of 2009, the minister for wildlife conservation can make decisions on land use, especially in terms of the declaration of Game Controlled Areas, without clear recourse to affected communities and/or villages.

Establishing national parks or game reserves on traditional pastoral lands

“The land on which livestock keeping is practised is often treated as vacant land that can be put to better use with more permanent structures. Hence problems related to land grabbing and insecurity of tenure have become so grave that there are cases of outright land grabbing of the perceived vacant lands.”



has always excluded pastoralists from grazing lands, while expanding cultivation and wildlife reserves or parks, reduces rangeland resources and increases pressure on the remaining smaller piece of rangeland. Although most of the national parks and game reserves were established before independence, the current move of creating Wildlife Management Areas (WMAs) is causing more conflict, induced by competition for grazing land and water between livestock and wildlife, such as in Serengeti National Park. Competition between livestock and wildlife is also a major concern among pastoralists in many protected areas of Tanzania (Talbot and Olindo, 1990).

Beekeeping and exploitation of non-timber forest resources

Despite the importance of agriculture, particularly in rural areas, some 40% of rural household income is derived from sources outside household on-farm production activities. However, both

on- and off-farm earnings depend as well on other rural natural resources, including forestry products, fisheries, etc. (URT, 1998; 2005). Monela et al. (2000) studied communities living within or adjacent to Miombo woodlands in Dodoma and Morogoro regions and found forest products contributed about 50-70% to annual household incomes. Direct forest products are firewood, wild fruits and herbal medicines; non-timber forest products that are often ignored in the literature include the beekeeping products of honey and beeswax (Mwakatobe and Mlingwa, 2006). It is estimated that Tanzania has about 9.2 million honeybee colonies, and the production potential of bee products is about 138,000 tons of honey and 9,200 tons of beeswax per annum (URT, 1998). These products are increasingly becoming tradable goods and sources of household income. However, utilisation of wood and non-timber forest products has in some instances resulted in natural resource degradation.

The ASALs of Tanzania have a good environment for beekeeping, partly because of the presence of many plants for nectar and pollen production. Although demand for honey as food and a medicinal product is steadily increasing, there is no well-established internal market for honey and beeswax (Mwakatobe and Mlingwa, 2006). However, if properly packaged, there are potential unexploited internal and external markets for honey in large towns, hotels, airlines and tourist centres (ibid.).

Minerals and mining activities

Some semi-arid areas, including parts of Shinyanga and Geita regions, are endowed with various forms of minerals. In Tanzania, mining has become an important sector contributing to rural and national economic growth, supported by new mining legislation.. The drastic change in the mining sector is visible through the increase in mineral production and earnings since 2001 (Curtis and Lissu, 2008;

Kabwe, 2012). According to the Central Bank of Tanzania, earnings from gold exports in 2011 had risen by 47%. Despite this promising economic trend, the mining sector has the least impact on the living standards and general wellbeing of the country and the people of Tanzania, especially local communities living adjacent to the mines (Kabwe, 2012; MacDonald and Roe, 2007).

There are several caveats that some analysts believe undermine mining from benefiting the country and its people. First, in its more modern forms, mining is a highly capital-intensive activity: it cannot make a massive contribution to direct local employment levels. Second, its contribution to a country's gross national income is likely to be even smaller because of the outflows of mining company dividends (e.g. Curtis and Lissu, 2008; Kabwe, 2012).

Are there any prospects for reforms in the mining sector to benefit communities in ASALs? The new Mineral Policy of 2009 and the

amended Mining Act of 2010 address these issues, but progress in the aforementioned areas remains nonetheless tenuous. The new Act imposes a mining royalty of 5% of gross value in the case of rough gemstones and uranium; 4% of gross value in the case of gold and metallic minerals; and 3% of gross value for other minerals. One of the ongoing debates among industry players is whether the increases in royalty rates will actually confer tangible benefits to Tanzanian nationals. One of the architects of the 1998 Mining Act said, for example:

To the extent that the country will receive more revenues, yes there is a benefit to Tanzanian nationals from the royalty increase. However, mining generates local spinoffs that are even more important than government revenue: school projects, water, roads infrastructure and power. More can be done in these areas, but the little that is happening has definitively had an impact on the communities around mines.

Major policy reviews are therefore needed, especially in the promotion of parliamentary and public scrutiny of existing and upcoming mining contracts so as to foster transparency in the mining industry, and in the strengthening of governance at the subnational level so as to enhance mining's contribution. This will be particularly useful in ensuring better local use of revenues raised and promoting stronger collaboration between the government and the private sector in enhancing benefits for communities. It will also help in strengthening local economic linkages and responding to issues surrounding artisanal and small-scale mining.

4. Climate and economic development in Tanzania's ASALs

4.1 Climate situation in Tanzania

Climatologically, Tanzania is located in the tropics. Its climatic condition is driven entirely by tropical processes. However, the range in altitude and associated climatic impacts results in significant climate gradients across the country. In addition, proximity to major lakes such as Lakes Tanganyika and Victoria, on the one hand, and the Indian Ocean, on the other, provides a potential source of moisture to surrounding areas and enhances meso-scale weather systems.

The major climate trends in Tanzania and in most parts of the East African region are the Inter-Tropical Convergence Zone (ITCZ), monsoon circulation, the El Niño Southern Oscillation (ENSO), tropical cyclones, easterly waves, the Congo air mass and the Mascarene, St Elena and Siberian high pressure cells. Complex topographical features, including high mountains such as Mt Kilimanjaro and proximity to large water bodies, mean some areas are characterised by distinct meso-scale circulation features, which have a pronounced influence on the spatial distribution of rainfall in the country.

Tele-connections between rainfall anomalies in the region and anomalies in the general circulation worldwide play a significant role in modifying the spatial and temporal distribution of rainfall in Tanzania. The tele-connected systems include, among others, ENSO, sea surface temperatures and solar activity. Several authors have discussed the relationships among many of these regional systems and atmospheric circulations (Chang'a et al., 2010; Kijazi and Reason, 2005, 2009; Ogallo, 1989; Ogallo et al., 1988).

The ITCZ migrates north and south following the movement of the sun, with a time lag of one month (Ogallo, 1982). From December to February, the ITCZ lies between 10 and 15° S. During that time, the prevailing winds over the East African countries are the north-east monsoon, changing their direction to north-west after crossing the Equator (Amaglo, 1997; Ogallo, 1994). These winds are relatively dry as a result of their continental origin and their long track over the dry land of north-eastern Africa and Arabia. As a result, the northern parts of the country experience relatively dry weather.

From March to May, the ITCZ migrates to Tanzania from the south. Owing to large-scale convergence and instability of the prevailing air masses originating from the Indian Ocean, a significant amount of rainfall, mostly of a convective type, occurs. These rains are known as long rains (Mistry and Conway, 2003; Zorita and Tilya, 2002). From May to September the prevailing winds are the south-east monsoons, changing their direction to south-west after crossing the Equator (Glover et al., 1954; Jury et al., 2002; Nieuwolt, 1974). They are relatively dry and cold as they originate from the anti-cyclone area (Mascarene high pressure cells) around Mascarene Island in the Antarctic, losing much of their moisture along the mountains in Madagascar. From September to December, the ITCZ moves from the north to the south relatively faster than the vice versa movement from the south to north. During this period, the northern part of the country and the Indian coast receive the Vuli short rains.

4.2 Rainfall and temperature characteristics in Tanzania

Rainfall patterns

Rainfall patterns in Tanzania and the entire of the East African region are in principal characterised by two main rainy seasons – the long rains (Masika) and the short rains (Vuli) – which are associated with the southward and northwards movement of the ITCZ. The Masika long rains begin in mid-March and end at the end of May. The Vuli short rains begin in the middle of October and continue to early December. Most of the rainfall is convective in nature and distinctly organised.

The northern parts of Tanzania, including areas around the Lake Victoria Basin, experience a bimodal rainfall regime, whereby the first maximum rainfall occurs in the MAM period and the second in the OND period. Central, southern and western areas of Tanzania have a prolonged unimodal rainfall regime starting from November and continuing to the end of April.

Figures 3 and 4 present a comparative analysis of rainfall climatology for selected meteorological stations for two baseline periods, 1961-1990 and 1971-2000. The analysis indicates a slight decline in rainfall in the period 1971-2000 climatology as compared with the 1961-1990 climatology for most of the stations. Figure 5 presents a spatial distribution of mean monthly rainfall for the months of April and November, respectively, during the period. Figure 6 presents a spatial distribution of the mean number of rain days in January, April and

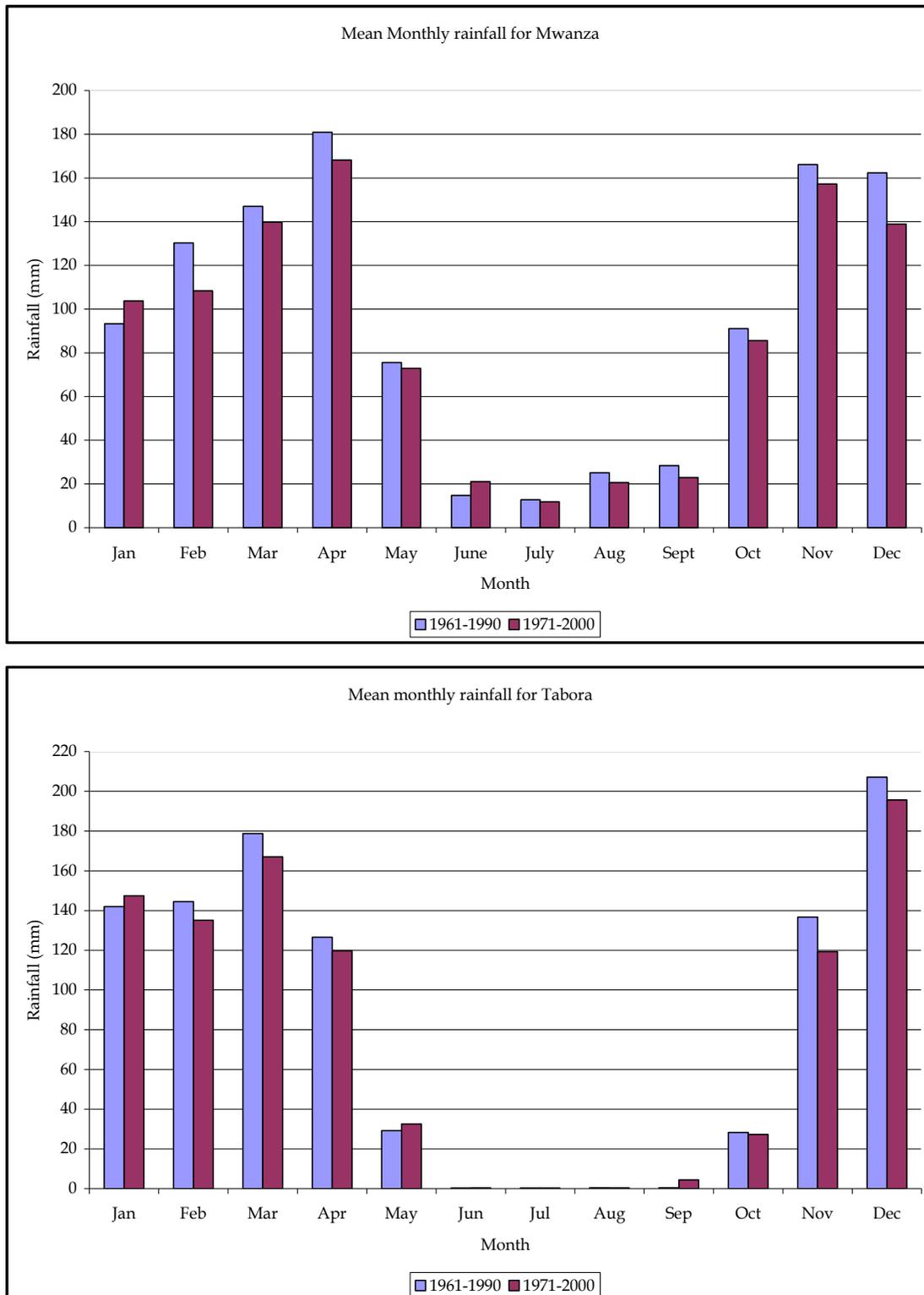
November, respectively, during the period.

During the month of January, the mean number of rain days was significantly higher over the central and southern parts of Tanzania, where on average the areas saw an average of above 22 rain days (Figure 6). This was mainly caused

by the migration pattern of the ITCZ, as during this time the ITCZ is more profound and organised over the southern parts of Tanzania. In April, the mean number of rain days was relatively higher (20-22 days) over some parts of the coastal areas in Tanzania and around the Lake Victoria Basin (Figure 6).

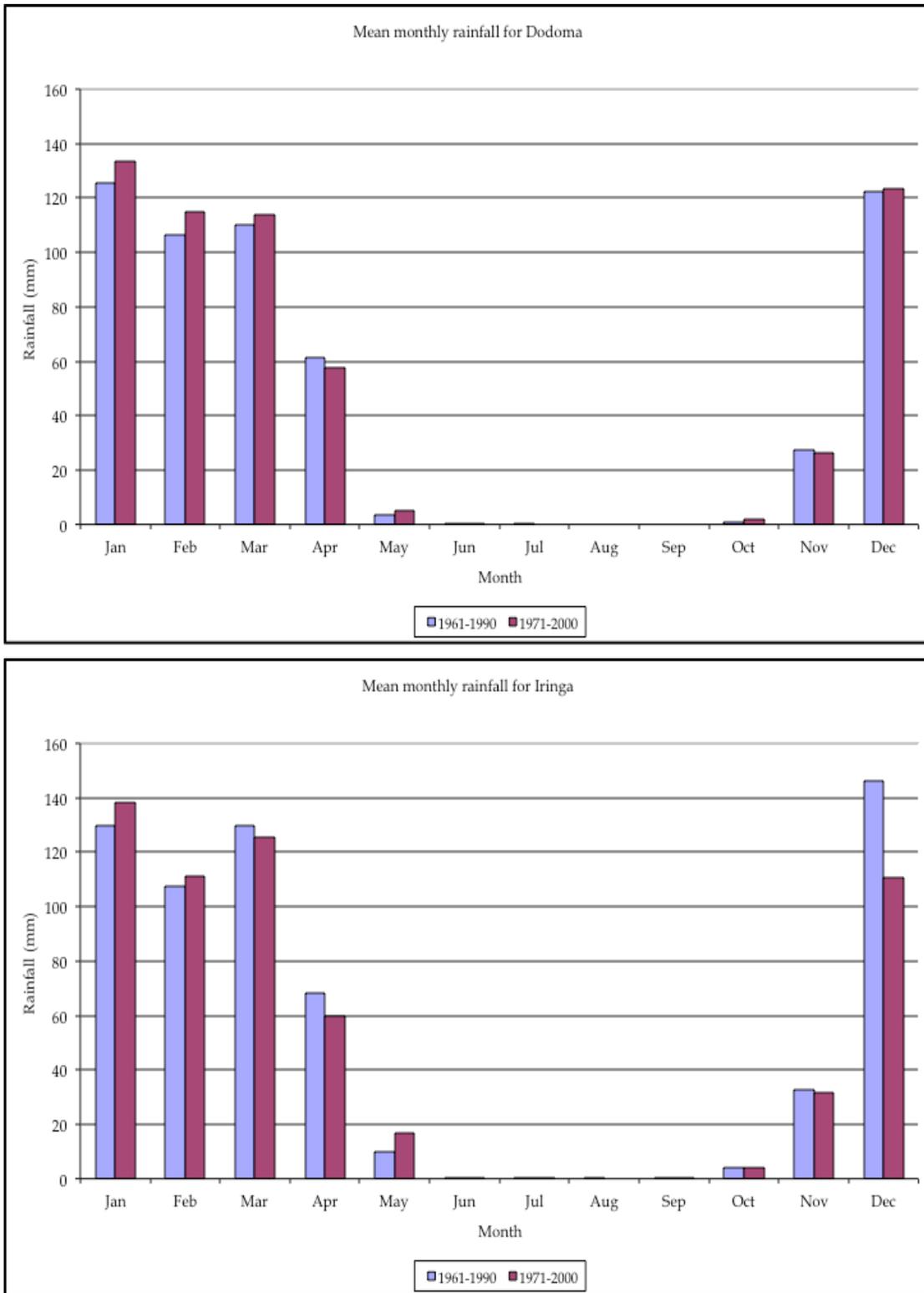
Arid and semi-arid areas in Tanzania saw a mean number of rain days of between 10 and 20. In November, the higher number of rain days was concentrated over the western part of the Lake Victoria Basin. These areas experienced on average above 22 rain days in November (Figure 6).

Figure 3: Comparative analysis of current rainfall climatology (1971-2000) and climatology of the recent past (1961-1991) in Mwanza and Tabora



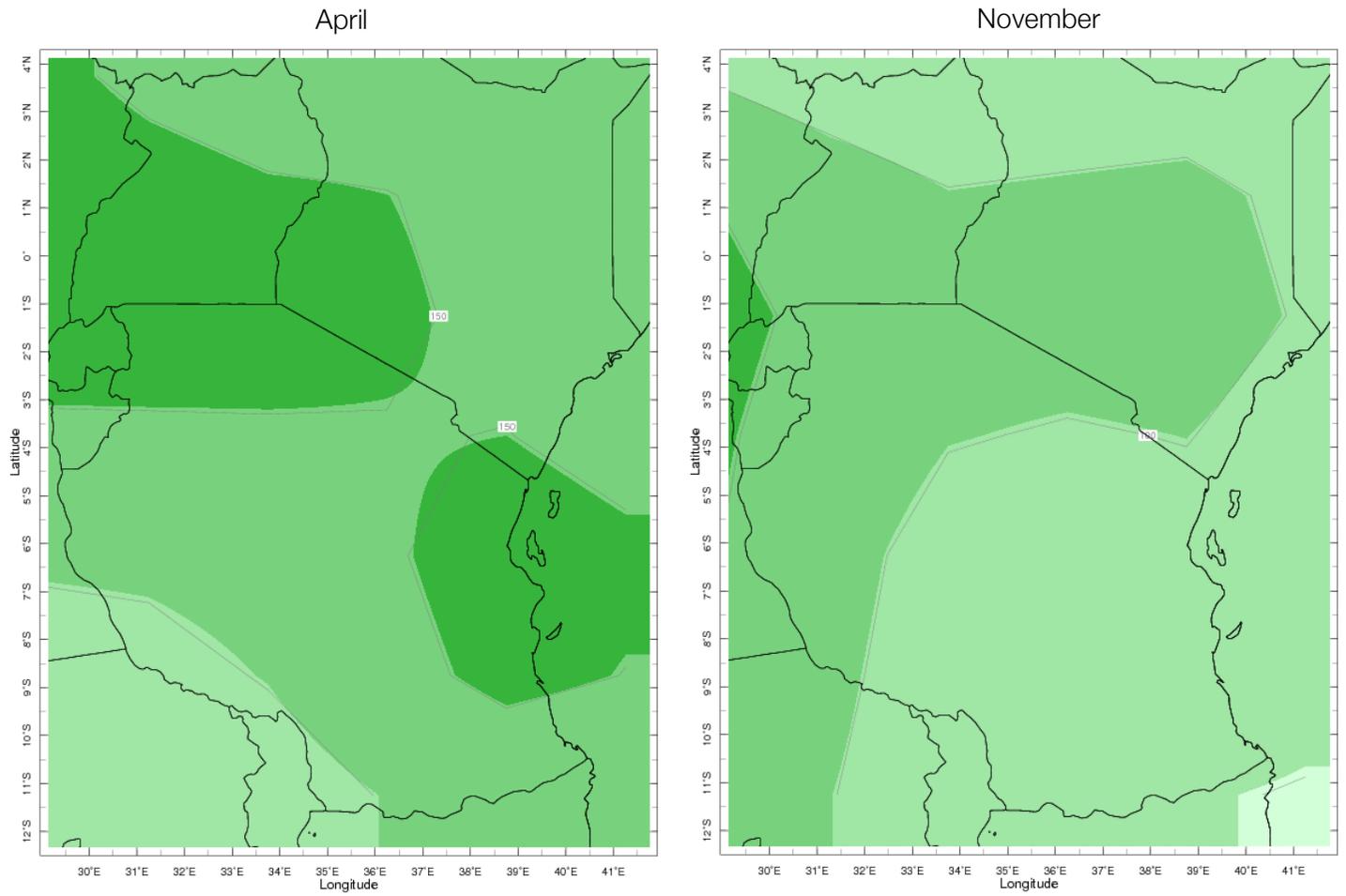
Source: Tanzania Meteorological Agency (TMA) data analysis (2014).

Figure 4: Comparative analysis of current rainfall climatology (1971-2000) and climatology of the recent past (1961-1991) in Dodoma and Iringa



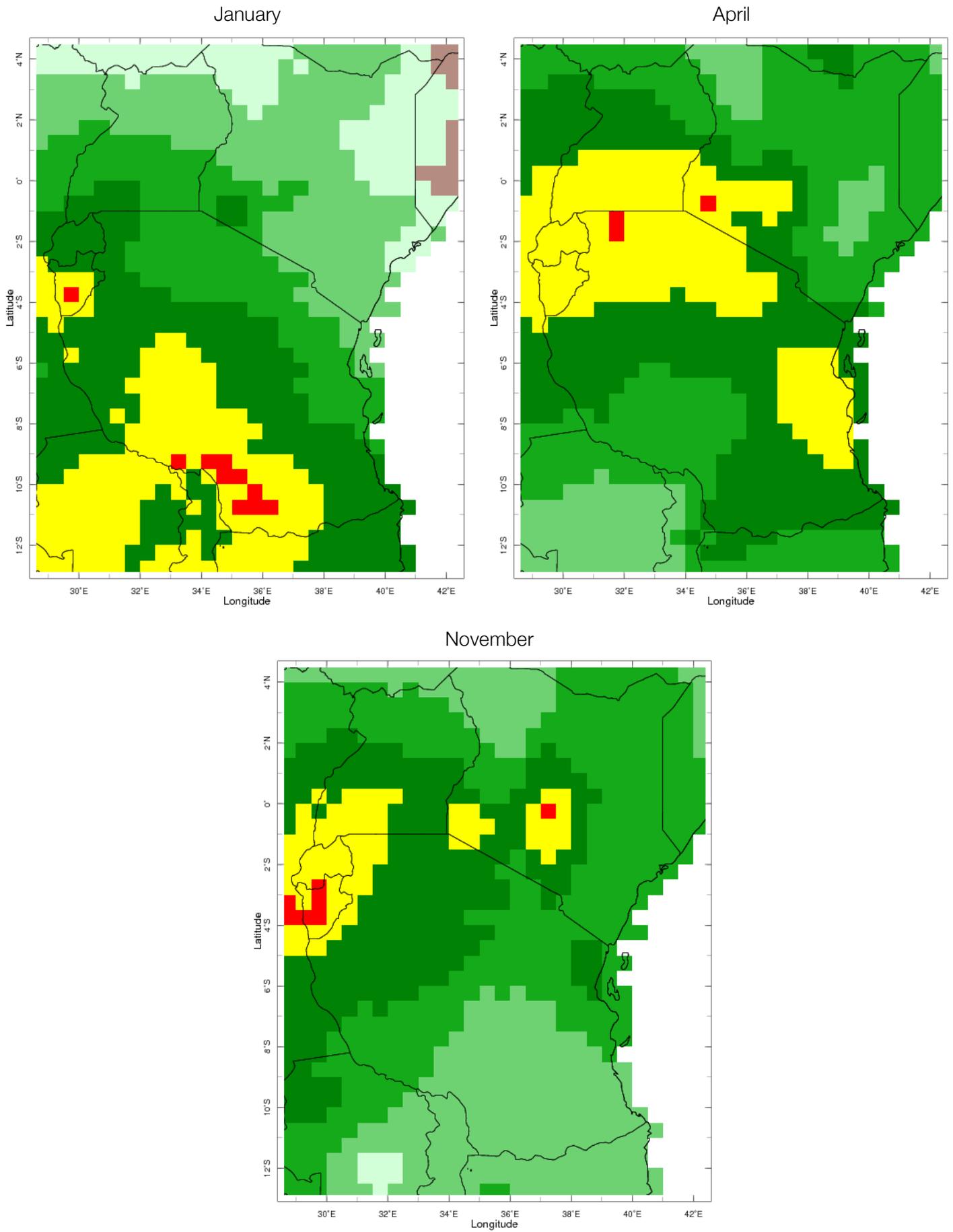
Source: TMA data analysis (2014).

Figure 5: Mean rainfall for 1981-2010, April and November



Source: TMA (2014). Based on the Climate Anomaly Monitoring System at the Climate Prediction Centre (CPC) at the National Centre for Environmental Prediction (NCEP).

Figure 6: Mean number of rain days in January, April and November, based on 1971-2000 climatology



Source: TMA data analysis (2014).

Temperature trends

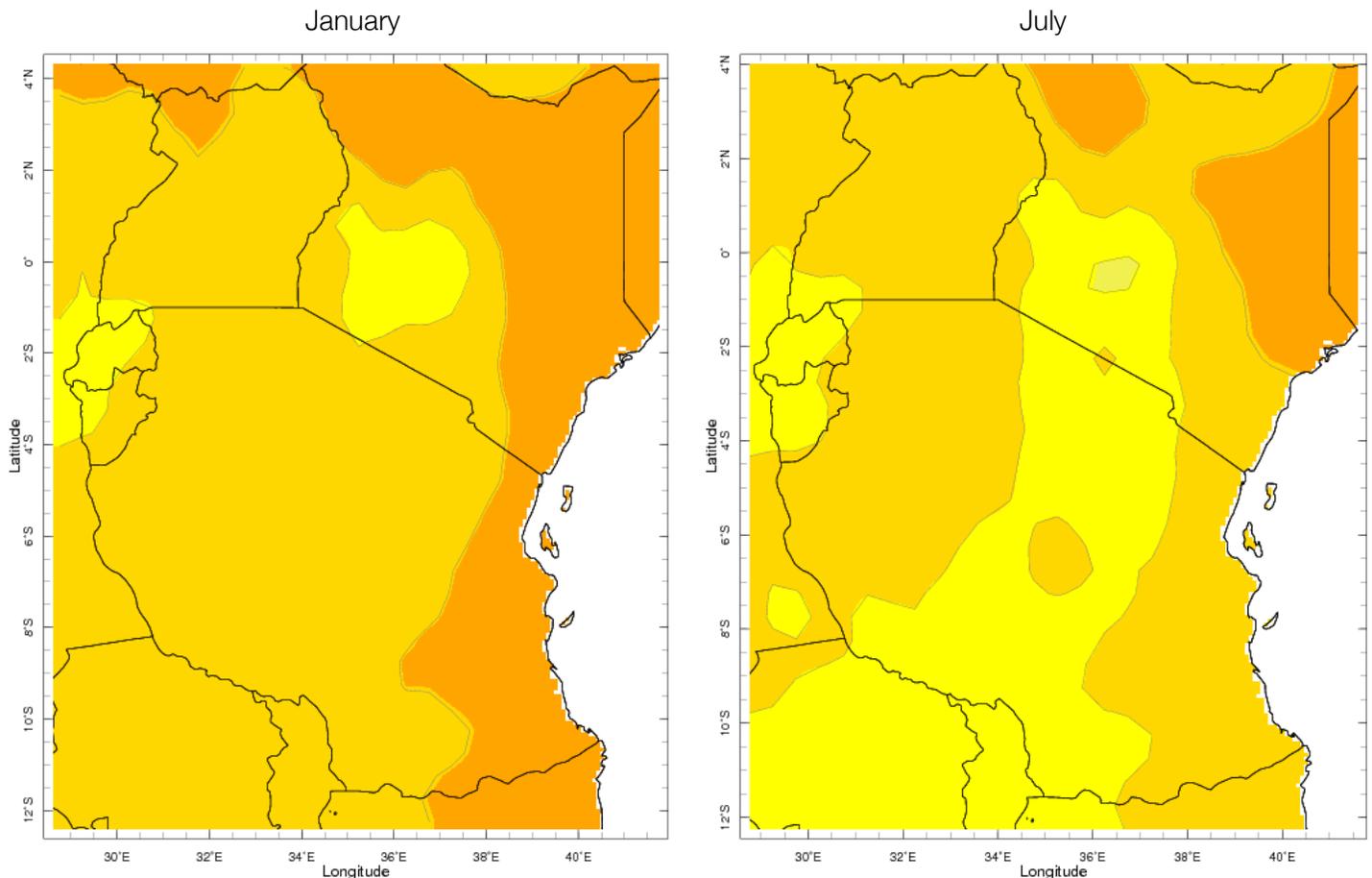
The climate of Tanzania is typically equatorial, with high temperatures year round with little seasonal variation, especially in areas along the Indian Ocean coast. Large variations in temperature are caused by altitude. The higher you get the cooler it becomes. The islands off the coast, such as Zanzibar, have a tropical climate. Cooling sea breezes relieve the hot temperatures. Temperatures vary more in the highlands, with hot days and chilly nights.

Figure 7 presents the spatial distribution of mean monthly temperatures for January (the warmest month) and July (the coldest month). January is characterised by higher temperatures as compared with other areas in the region. In most of the coastal areas, mean monthly temperatures in January are above 25°C (Figure 7).

The summary statistics of temperature and rainfall for Tabora and Dodoma in Tanzania show that, in Tabora, the mean annual

maximum temperature ranged from 27.7°C to 30.9°C with a mean of 29.6°C, while the mean annual minimum temperature ranged from 15.9°C to 18.0°C with a mean of 17°C for the period under review. In Dodoma, the mean annual maximum temperature ranged from 28°C to 29.8°C with a mean of 29.0°C, while the mean annual minimum temperature ranged from 16.0°C to 18.0°C with a mean of 17.1°C.

Figure 7: Mean January and July temperatures based on 1971-2000 climatology



Source: TMA data analysis (2014).

4.3 Past and current trends in climate

Analysis of recent climatological data has revealed a significant positive temperature trend and a slight negative rainfall trend in most meteorological stations in the region (Shongwe et al., 2011) including in Tanzania (Matari et al., 2008; Mwandosya et al., 1998). A typical example is shown in Figures 3-7 for Zanzibar, Arusha and Mbeya stations. Late onset of rainfall and early cessation are becoming common in most parts of Tanzania. Observational evidence from local communities in most parts of Tanzania suggest seasonal shifts in

rainfall patterns, a decrease in the amount of rainfall and an increase in temperatures in most parts of ASAL regions. Detailed trend analysis results for temperature, rainfall and relative humidity are presented below.

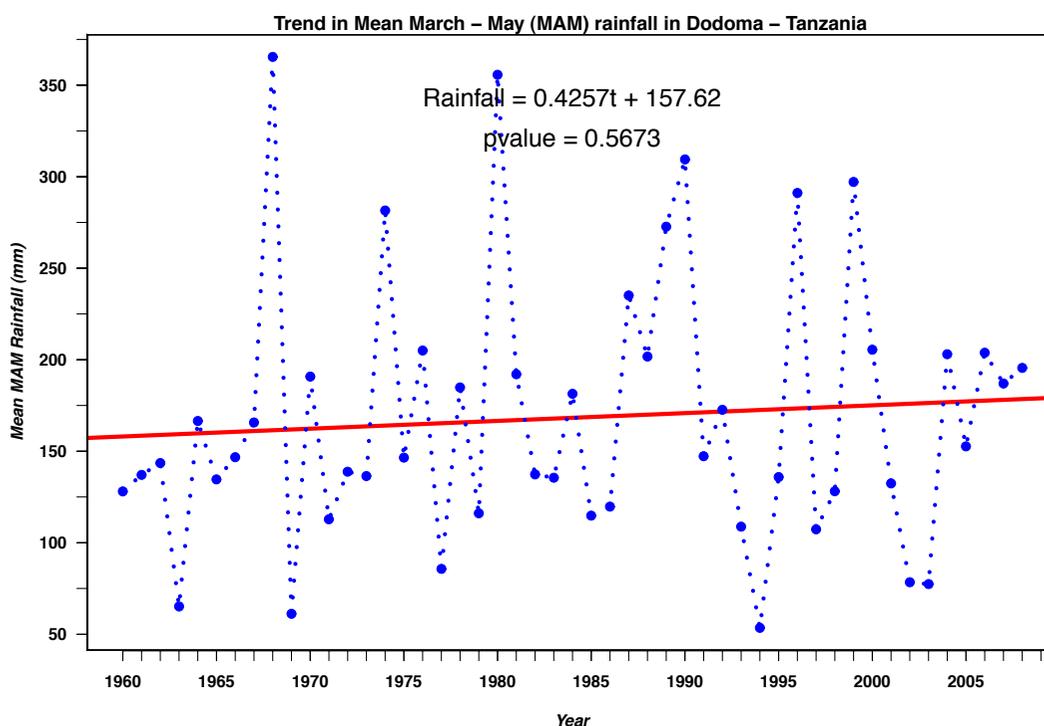
Rainfall trends

In most parts of Tanzania, rainfall has been characterised by stronger inter-annual variability (Chang'a et al., 2010; Kijazi and Reason, 2009; Zorita and Tilya, 2002). Figures 8 through 10 present a time series of MAM, OND and annual rainfall at Dodoma in Tanzania. MAM rainfall ranged from 53.5 mm to 365.4 mm, with a mean of 168.3 mm, while

OND rainfall ranged from 7.7 mm to 526.9 mm, with a mean of 153.4 mm.

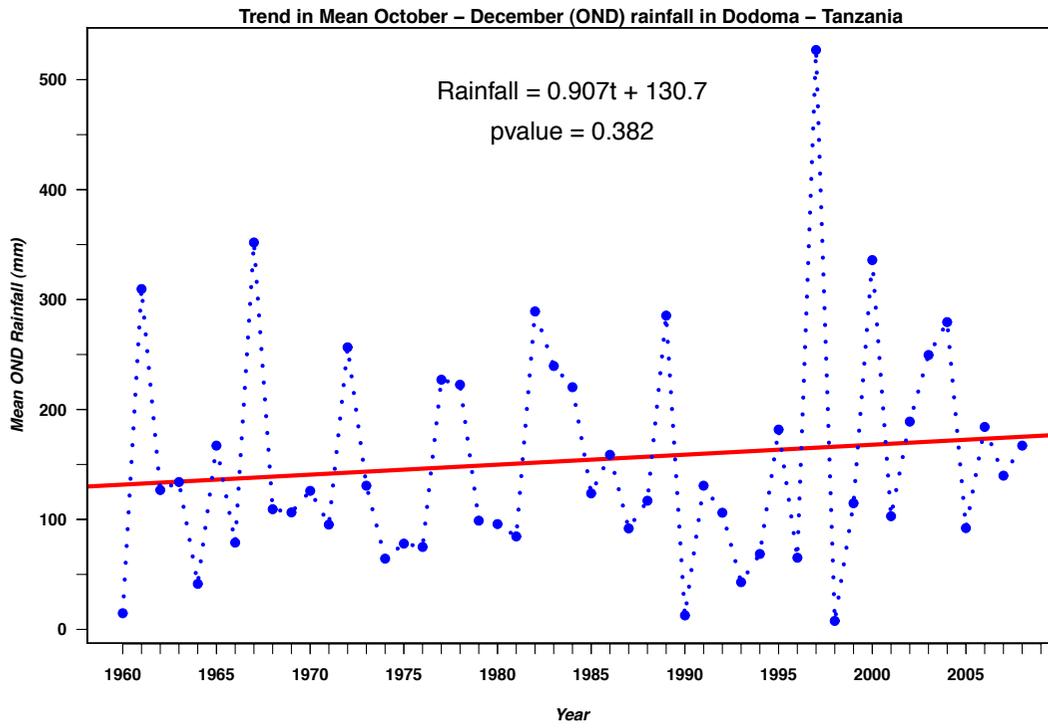
Annual rainfall in Dodoma ranged from 283 mm to 863.7 mm, with a mean of 572 mm. These results indicate a high intra-seasonal and inter-annual variability of rainfall in Dodoma. Trend analysis results indicate no significant discernible linear trend in MAM, OND and annual rainfall in Dodoma. The slight positive trends Figures 8 through 10 depict are not statistically significant, underlining the nature of uncertainty associated with rainfall patterns.

Figure 8: Trend in mean March-April-May (MAM) rainfall in Dodoma



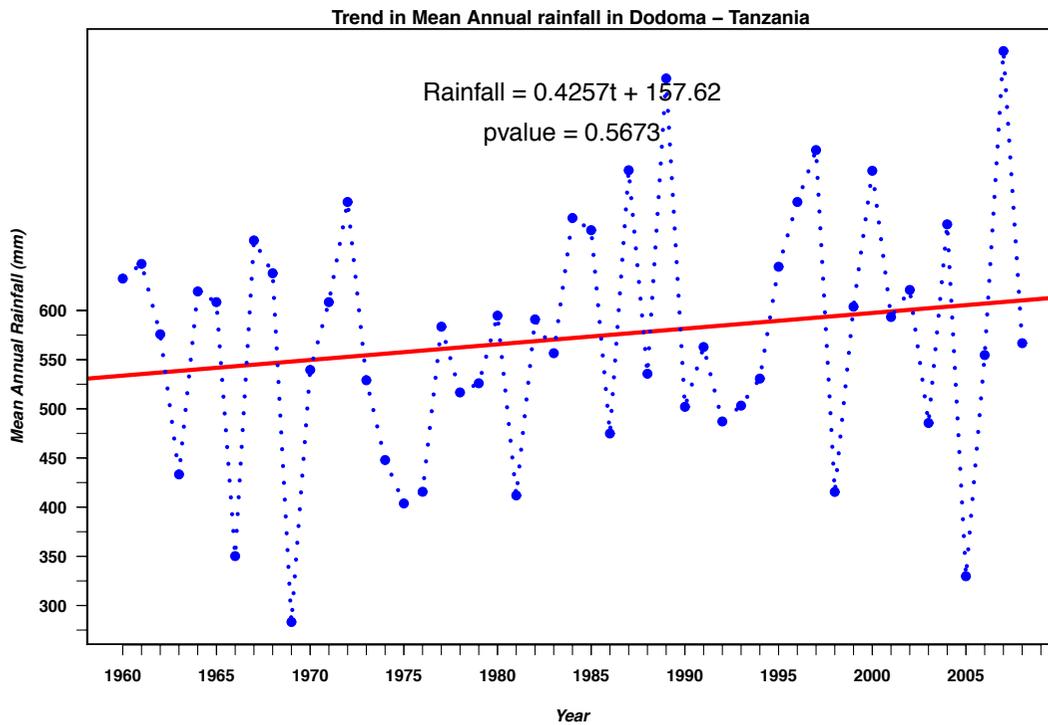
Source: TMA data analysis (2014).

Figure 9: Trend in mean October-November-December (OND) rainfall in Dodoma



Source: TMA data analysis (2014).

Figure 10: Trend in mean annual rainfall in Dodoma



Source: TMA data analysis (2014).

Generally, as Table 2 illustrates, there have been shifts in rainfall patterns in Tanzania. This conclusion is based on the results of an analysis of rainfall performance over the past three decades (1975-1984, 1985-1994 and 1995-2004) in the Tanzania Agro-Ecological Zones.

As Table 2 illustrates, rainfall shifts in some regions from a unimodality to a bimodality rainfall regime and vice versa have been largely attributed to climate change. For example,

Manyara region, which is mainly bordered by the unimodal ASAL regions of Dodoma and Singida as well as the transition region of Morogoro, has largely converted from a bimodal tendency to a unimodality (Ntika, 2007).

Also, Morogoro and Kigoma regions, which have been either wholly or partially conceptualised with transition features, are increasingly transforming to unimodal tendencies. Conversely, Mbeya and Shinyanga

regions, which have traditionally been unimodal, are gradually developing into bimodality tendencies. In general, however, all ASAL zones reflect negative sloping trends implying falling rainfall availability overtime (see Table 2). In view of this, there is a need to adapt to these projected rainfall shortages, possibly by adopting water-conserving technologies and climate-smart agriculture.

Table 2: Analysis of rainfall performance over the 1975-1984, 1985-1994 and 1995-2004 periods in the Tanzania Agro-Ecological Zones

AEZ	Study area	Estimated model
AEZ-I	Coastal	$y = -7.52x^2 + 26.367x + 92.463$
AEZ-II	Arid land– Dodoma:	$y = -0.8475x^2 + 7.235x + 37.722$
AEZ-III	Semi-arid lands – Shinyanga	$y = -37.203x^2 + 183.09x - 145.89$
AEZ-IV	Plateau – Mbeya	$y = -7.268x^2 + 33.288x + 48.086$
AEZ-V	South-Western Highlands– Mbeya	$y = -7.268x^2 + 33.288x + 48.086$
AEZ-VI	Northern Highlands – Kilimanjaro	$y = 1.4033x^2 - 10.47x + 87.756$
AEZ-VII	Alluvial – Morogoro	$y = 4.2733x^2 - 18.018x + 86.64$

Source: Ntika (2007).

Temperature trends

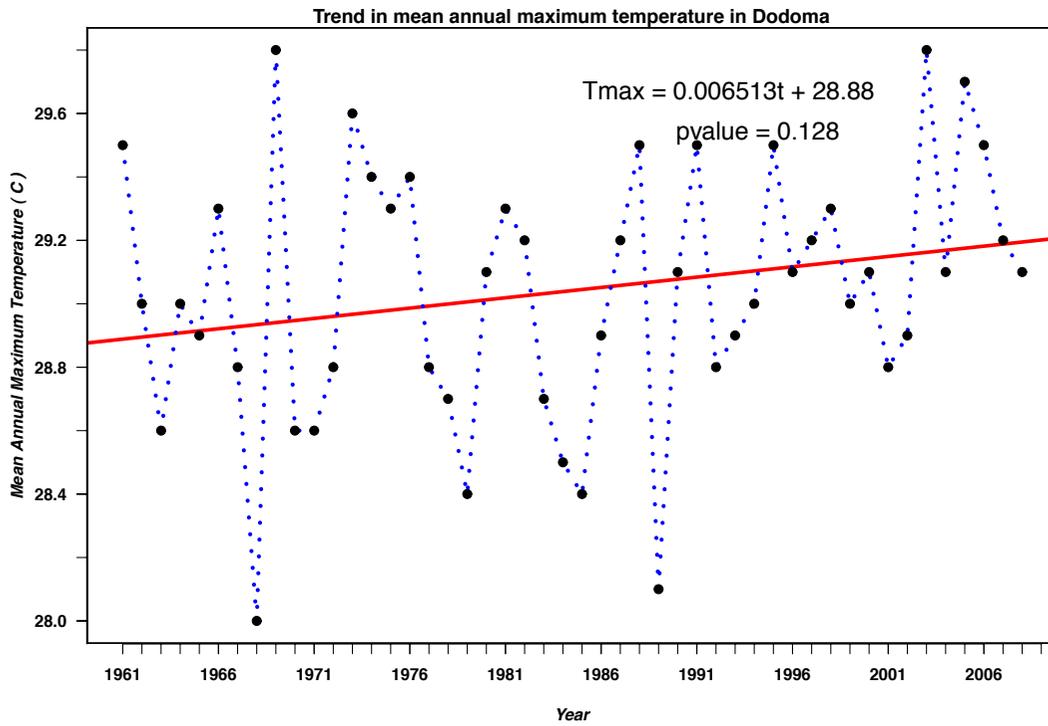
Time series analysis of both mean annual maximum and minimum temperatures has revealed a significant increase in temperature trends in a large part of Tanzania (Schreck and Semazzi, 2003; Shongwe et al., 2011). Trend analysis for mean annual maximum and minimum temperatures for

Dodoma, presented in Figures 11 and 12, respectively, reveal a significant (Pvalue < 0.05) increasing trend in minimum temperatures (Figure 12).

Figures 13 and 14 present the temperature trend for Tabora. A significant increasing temperature trend in both maximum and minimum temperatures is depicted. Generally, the increase in the

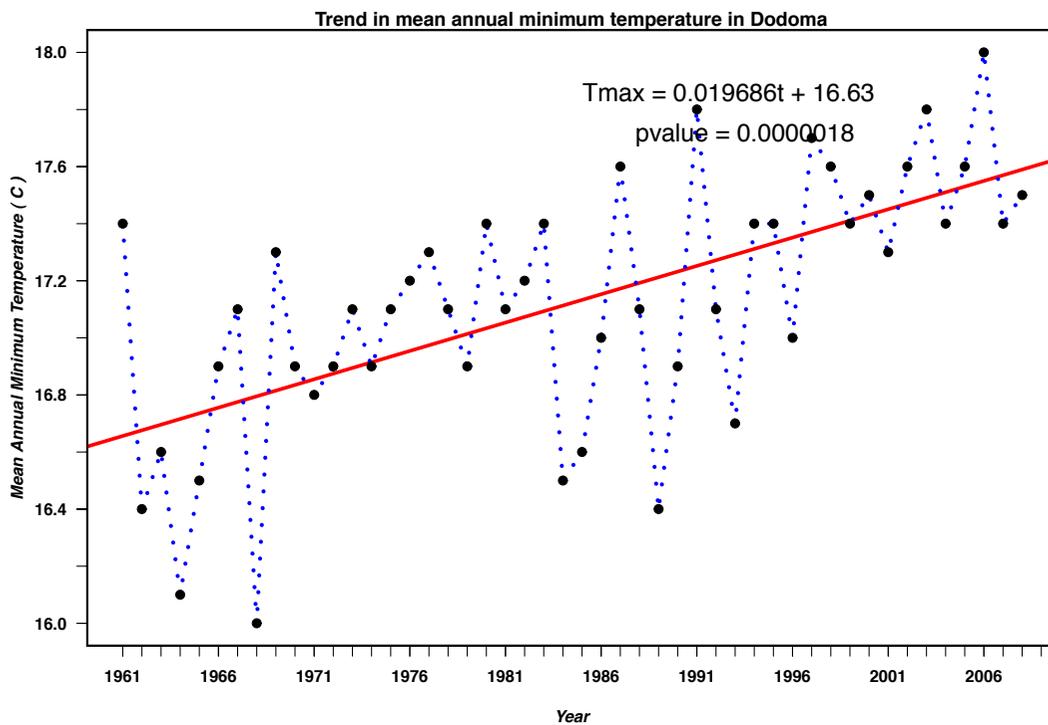
temperature trend is steeper and more pronounced in the mean annual minimum temperatures (Figures 12 and 14) as compared with the mean annual maximum temperatures (Figures 11 and 13). This is a typical observation across the region and globally (IPCC, 2013; URT, 2007).

Figure 11: Trend in mean annual maximum temperatures in Dodoma



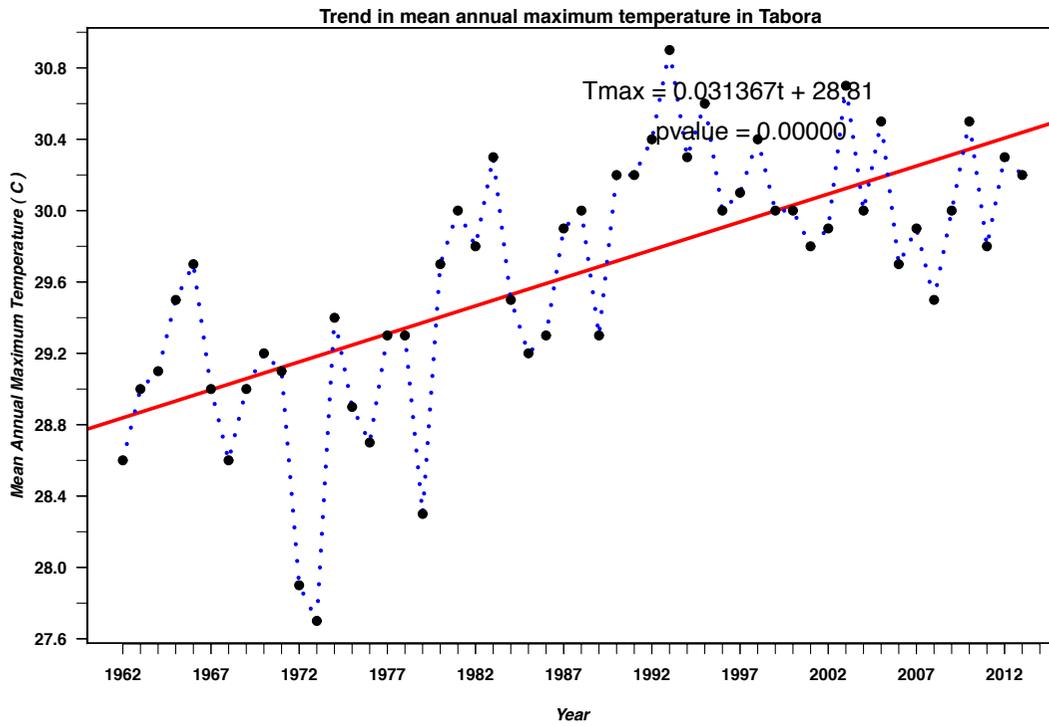
Source: TMA data analysis (2014).

Figure 12: Trend in mean annual minimum temperatures in Dodoma



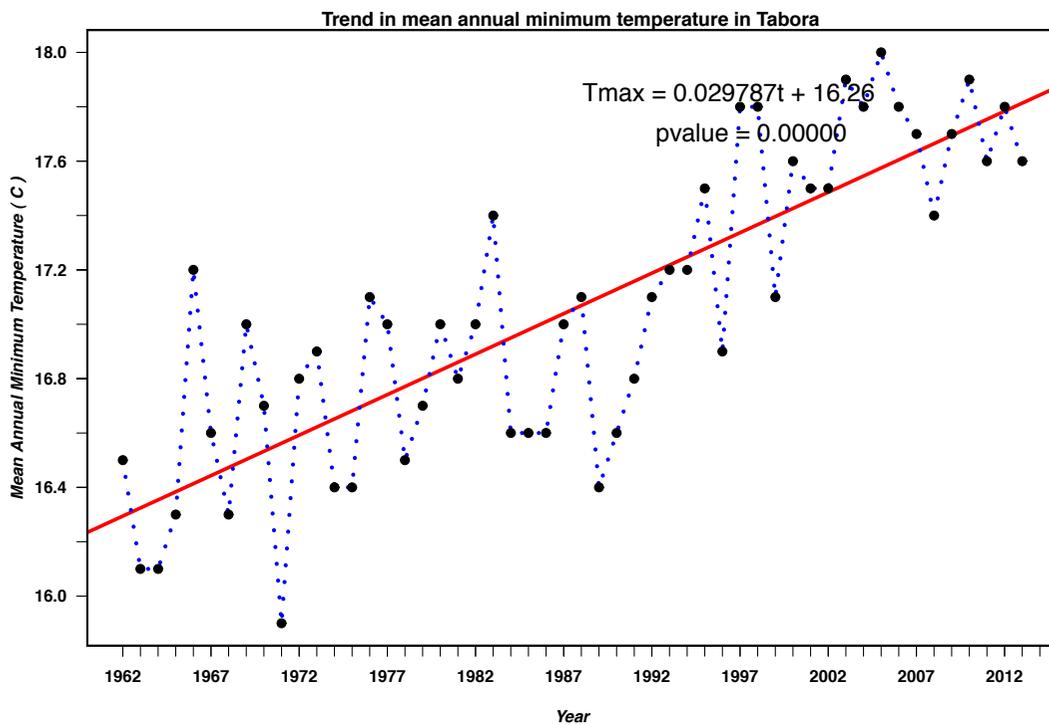
Source: TMA data analysis (2014).

Figure 13: Trend in mean annual maximum temperatures in Tabora



Source: TMA data analysis (2014).

Figure 14: Trend in mean annual minimum temperatures in Tabora



Source: TMA data analysis (2014).

4.4 Socioeconomic impacts of climate change in Tanzania

Weather and climate account for over 70% of all natural disasters in the Eastern Africa region. Extreme weather events, such as drought and floods, have had significant impacts on both the people and the economy of the ASALs. The sectors that experience immediate impacts are agriculture, health, transport and water resources, among others. Severe droughts and floods have increasingly been felt in many parts

of the ASAL region, and they are expected to intensify over the coming decades, with negative consequences for, among others, food production and water scarcity. Droughts and floods have also seriously affected other vulnerable sectors such as forestry, fisheries, energy, health, tourism and services.

Over the past decade, several incidences of extreme climate events have occurred in various areas of semi-arid Tanzania, causing substantial and severe socioeconomic impacts including loss of human lives and destruction

of property and infrastructure (Table 3).

As a result, changing climate is expected to have multiple effects. Interactions between climate change-related trends and those of other drivers are becoming increasingly significant. Natural resource degradation, for instance, increases the vulnerability of socioeconomic activities to changes in rainfall, which has a multiplier effects on water availability (Fabricius et al., 2008).

Table 3: Recent extreme climate events and their socioeconomic impact in semi-arid areas of Tanzania

Event	Affected areas	Year	Impacts	Reference
Drought	Semi-arid regions of Tanzania, i.e. Dodoma, Arusha, some parts of Iringa, Kilimanjaro, Manyara, Shinyanga and Singida	2003/2005/2009	Death of animals, effects on agriculture, energy and business	Shayo (2013)
Floods	Morogoro (Kilosa) and Dodoma (Mpwapwa and Kongwa)	2009/2010	Devastation to humans, property and infrastructure	
Floods	Dar es Salaam	2011	Loss of lives (23 people left dead), loss of property and destruction of various infrastructure	Shingirirai (2013)
Floods	Dar es salaam	2012	Loss of lives (40 people left dead), loss of property and destruction of various infrastructure	Shayo (2013)

Source: author

5. Current adaptation knowledge, policies and strategies



5.1 Introduction

This report has reviewed Tanzania's key development plans and the role of ASALs in these. It has also shown how development plans are affected by climate change risks in the short-, medium- and long-term contexts and has analysed how communities in ASALs are dependent on sectors that are sensitive to climate conditions, such as agriculture, fisheries, forestry and tourism. Climatic trends in the form of rainfall and temperature patterns and their implications for socioeconomic development have been discussed. Finally, the report attempts to identify existing adaptation practices and knowledge that can form a benchmark for identifying adaptation strategies and that are therefore

worthy of further analysis through research and stakeholder engagement in order to inform policy- and decision-making processes for inclusive development pathways.

5.2 Adaptation knowledge, policies and strategies in agriculture

Agriculture remains an important sector for communities in ASALs. However, climate change is expected to trigger unprecedented effects on the growing conditions for crops and availability of water resources (Fabricius et al., 2008). Policy interventions should thus focus on the development of strategies for the sustainable management of land resources.

Other interventions should also be directed towards agro-ecological approaches for addressing poor production and food insecurity in ASALs (Fabricius et al., 2008; Reij and Steeds, 2003).

Fabricius et al. (2008) further indicate that, under semi-arid conditions with a variable rainfall regime and high and growing human population densities, successful interventions will include effective adoption of initially inappropriate external knowledge in soil and water conservation, including labour-intensive terrace farming and integrated livestock production; and adoption of indigenous self-help institutions to harness labour and capital. Others will include enhancing access to efficient

produce markets in urban centres and abroad for both educated and unskilled labour; and security of resource tenure for all, men and women, and strong social attachment to family land.

All these notwithstanding, some adaptation to the negative effects of climate change are being exercised across scales in different agro-ecological zones. For instance, the government in collaboration with other key stakeholders has been investing heavily in the production of cassava and potatoes, which are drought-tolerant crops (MAFSC, 2006). While potatoes and cassava have behaved quite well across scale in semi-arid lands of Tanzania, sorghum has not. This crop has historically been drought tolerant and equally has received government promotional efforts to ensure it grows well. This falling trend owes to the late Masika rains onset and the serious effects of

plant pests and diseases, especially in Dodoma, Shinyanga and Mwanza regions. Nevertheless, the reasons sorghum is performing badly in these areas needs investigation, so as to be able to pin-point what factors are contributing (Ntika, 2007).

Further, though maize is more vulnerable in drought-prone areas compared with sorghum and millet, the traditional low food status associated with consumption of sorghum and bulrush millet leaves out a strong sociocultural issue that remains unaddressed. This is probably one of the potential issues that need to be studied under climate change initiatives.

5.3 Adaptation knowledge, policies and strategies in livestock

Heavy dependence on traditional systems for livestock-keeping, mainly featured by large numbers of

herds (Jama and Zeila, 2005; Nori et al., 2008; Rowlinson et al., 2008), is compromising livelihood systems and consequently reducing the adaptive capacities of communities in the ASALs. The situation is also likely to be severe given the pace of unpredictable trends of climate change impacts on rangelands and other pastoral livelihood systems, and the likelihood of interacting with non-climatic factors such as poor governance of natural resources and dysfunctional institutional and policy frameworks to support this production sector. Therefore, improving the policy framework and enhancing modern pastoral production systems, such as through the establishment of rangelands, would enhance the resilience capacities of communities and contribute to socioeconomic development across scales.



5.4 Policies and strategies in wildlife conservation

As we have noted, policy interventions in terms of increasing wildlife conservation areas have also been a challenge to the livelihoods and natural resource management in ASALs (Sendalo, 2009). The need for conservation and increasing protected areas is reflected in the many policies developed and pieces of legislation enacted since the late 1990s. These documents include the Forest Policy (1998), the Forest Act (2002), the Environmental Management Act (2004), the Wildlife Policy (2007) and the Wildlife Act (2009).

Emerging participatory activities for wildlife management such as WMAs provide some scope for the diversification of livelihoods in the ASALs of Tanzania, especially in the north-east. Community-based tourism is also an emerging opportunities for the improvement of wildlife management and community livelihoods. These new arrangements for the management of wildlife resources in Tanzania may also address some key challenges associated with tenure, financing of wildlife management, infrastructure and markets for wildlife-related products.

5.5 Role of other drivers of economic growth in resilience-building in Tanzania

Markets and the private sector in ASALs

Tanzania shares similar constraints to other ASALs. Most parts of ASALs are water-scarce, and rural

areas have weak transport linkages to attract investments in the production of diverse farm products. The state has been promoting private sector development in recent years, with some success in the food-processing industries and textiles, and there are plans to develop the extractive industries and improve the productivity of agriculture. However, a majority of the population remains engaged in subsistence agriculture, with limited ability to engage with formal markets.

The lifestyle and economic strategy of people living in ASALs is traditionally characterised by their need to ensure adequate water supply and protection against food shortages. Moving with livestock in search of water and pasture resources is one of the main livelihood strategies (Gratzfeld, 2003).

The fact that these areas are regarded as not suitable for cultivation and that rainfall patterns are unpredictable and are subject to great fluctuations means people are not attracted to live in them. Therefore, human populations and investments in terms of communication, transportation and industry are not put in place.

Unlike the government of Kenya, which is ready to collaborate with different stakeholders in building capacities and enabling marginalised communities in its ASALs to break away from poverty, as stipulated in the government's Vision 2030 (Gratzfeld, 2003; Republic of Kenya, 2013), the government of Tanzania has done little to ensure its ASALs become productive and attract people, specifically investors. It has to be noted, however, that communities in these areas have lived within these constraints for centuries. They have existed on the

productivity provided locally and have used their knowledge to devise coping and adaptive strategies to build their resilience. When the situation becomes unbearable, they have used migration, both seasonal and permanent, as a survival strategy. However, it is still unclear how the dynamics of climatic conditions affect pastoral communities across scale and what the resulting policy implications are of human and livestock migration in the ASALs.

Human development and responses to climate risks in ASALs

Human development is not only a matter of expanding people's choices to be educated, to live long and healthy lives and to enjoy a decent standard of living. It is also about ensuring these choices are secure and sustainable. The majority of communities living in ASALs are denied life security because of the harsh conditions that they live in. Access to education in the ASALs of Tanzania is weak, and high illiteracy rates are a long-standing obstacle to economic development. The overall literacy rate in Monduli district, for example, is 45%, with noticeable differences across gender, poverty status and area of residence (Economic Development Initiatives, 2005). It is therefore important to enable communities in ASALs to withstand the shocks that emanate from the changing climate by increasing their resilience through education. There is strong evidence that countries that possess and cultivate human capital outperform other countries lacking human capital.

6. Conclusion and recommendations

6.1 Conclusion

This CSA set out to provide an initial assessment of the past and current climate in Tanzania and to identify solutions to the complex challenges of natural resource management, economic development, poverty alleviation and resilience-building in the context of climate change.

Analysis of the past and current climate in Tanzania, focusing on a few selected ASALs in terms of rainfall climatology for the 1960-1990 and 1971-2000 baseline periods, indicates a slight decrease in rainfall in the later climatological period. The results of the trend analysis indicate that, although there has been no significant trend in rainfall at ASAL stations, there has been a significant positive temperature trend in both maximum and minimum temperatures at the two stations observed in central Tanzania.

The trend in minimum temperature has been more pronounced and much faster compared with that in the maximum temperature. This result is consistent with the latest Intergovernmental Panel on Climate Change (IPCC) findings and other

observations in different parts of the globe. Nevertheless, it is important, and it will be more useful, to obtain more elaborate temperature and rainfall datasets from more ASALs in Tanzania to enable detailed and thorough analysis.

Furthermore, the socioeconomic assessment conducted with the aim of identifying solutions to the complex climate change challenges at the interface of natural resource management, economic development, poverty alleviation and resilience-building identified a number of development opportunities in ASALs. This CSA has presented the most important of these, including climate-smart agriculture, small-scale mining, sustainable pastoralism and community-based wildlife resource management. The roles of different actors in facilitating these opportunities will be the subject matter of future stakeholder engagements and research, which will aim at providing policy-makers with practical guidance on inclusive, climate-resilient development and supporting emerging good adaptation practices within the ASALs of Tanzania.

6.2 Policy recommendations

As seen earlier, many parts of the ASALs of Tanzania experience unreliable rainfall and water shortages. Rainwater harvesting and the promotion of water-efficient irrigation agriculture may be the most logical policy for the semi-arid areas of Tanzania. There is, however, no easy answer to the question of whether the focus of agricultural development in such areas should be on irrigated (blue water-based) or dryland (green water-based) agriculture. According to Senkondo et al. (2004), the focus should be on both types of agriculture.

Resilience in semi-arid areas can be further enhanced by implementing strategies to improve the productivity of the livestock sector through institutional and extension services (Nori et al., 2008; Rowlinson et al., 2008). Stakeholder engagement platforms as a basis for learning and integration of resilience strategies into sectoral plans and programmes are also recommended.

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