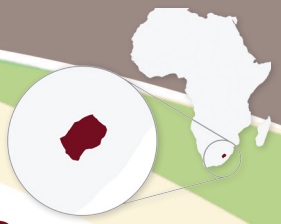


Climate-Smart Agriculture in Lesotho

Climate-smart agriculture (CSA) considerations

A P Although agriculture accounts for just six percent of Lesotho's Gross Domestic Product (GDP), the sector is important for the livelihoods of 80 percent of the country's population.

A P The cereal (maize and wheat) mono-cropping system, as well as the rearing of goats and sheep for mohair and wool dominate the country's agricultural sector. The sector is greatly affected by low soil fertility; land degradation, especially soil erosion; and high vulnerability to droughts coupled with high food price fluctuations and reliance on imports to meet local food needs.

A M I Conservation agriculture (CA) is the most widely promoted climate-smart agriculture (CSA) practice, although other practices such as keyhole gardens, small-scale irrigation, organic manure application and the use of tunnels (greenhouses) are common. Traditional CSA practices such as Likoti and Machobane also exist and have potential to be integrated into modern CSA practices, hence improving acceptability among rural households.

A M I Lesotho is heavily deforested with forests now covering just 1.5% of the country's land area. There is a need to scale up agroforestry in meeting the country's goals related to improving forest cover, while at the same time enhancing the food security, nutrition and resilience of households. The integration of stone fruits (peaches and nectarines) and other fruit trees into existing cropping systems could be an option.

A M I For livestock production, the main climate-smart practices include fodder production, as well as rangeland rehabilitation and management. Given the country's energy needs, particularly in off grid rural communities, biogas energy development using livestock manure could be an option. The adoption of improved (including both heat- and cold-tolerant) breeds of cattle, goats and merino sheep will also be important for improving the resilience and productivity of the local production of meat, milk, wool and mohair, while reducing greenhouse gas emissions per unit of produce. At present, the country imports most of its meat and support to a low carbon, more productive and highly resilient meat industry in Lesotho is required. Animal health management and improved veterinary services will also be crucial to improve production quality and enhance resilience of the livestock sector.

P Although CA and other climate-smart practices have been promoted in Lesotho for many years; the term climate-smart agriculture itself is fairly new and has not been integrated into Lesotho's policies and programs. In addition, the country's climate policy environment is limited. This is set to change once the draft National Climate Change Policy, which highlights the need for climate-smart practices, is finalized and endorsed.

$ At present there is limited information on the costs of adaptation and mitigation initiatives in the agricultural sector, and a detailed assessment to determine these needs will support better long-term planning of climate-smart agriculture finance for the country.

$ The main funders of climate-smart agriculture related programs and projects in the country include the World Bank and the African Development Bank (AfDB), as well as bilateral funding institutions such as USAID, DFID and the European Commission, while United Nations agencies such as FAO, UNDP and UNEP have also contributed financially and technically. The country has however, not yet accessed some of the major international climate finance instruments such as the Green Climate Fund (GCF) and the Adaptation Fund (AF), and more could be done to ensure access to these two instruments. Funding for forestry-related initiatives is also severely limited.

I $ There is limited capacity for agricultural climate change adaptation and mitigation in Lesotho and there is a great need for extensive awareness raising, sensitization and capacity building for climate-smart agriculture.

I CSA research in Lesotho needs to be enhanced in partnership with government, private sector, international research institutes, development partners and the farmers themselves.

A Adaptation M Mitigation P Productivity I Institutions $ Finance

The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agricultural development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs); and require planning to address trade-offs and synergies between these three pillars: productivity, adaptation, and mitigation [1]. The priorities of different countries and stakeholders are reflected to achieve more efficient, effective, and equitable food systems that address challenges in environmental, social, and economic dimensions across productive landscapes. While the concept is new, and still evolving, many of the practices that make up CSA already exist worldwide and are used by farmers to cope with various production risks [2]. Mainstreaming CSA requires critical stocktaking of ongoing and promising practices for the future, and of institutional and financial enablers for CSA adoption. This country profile provides a snapshot of a developing baseline created to initiate discussion, both within countries and globally, about entry points for investing in CSA at scale.

UKaid from the British people
WORLD BANK GROUP
CGIAR
RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security
CCAFS
CIAT 1967-2017

National context

Economic relevance of agriculture

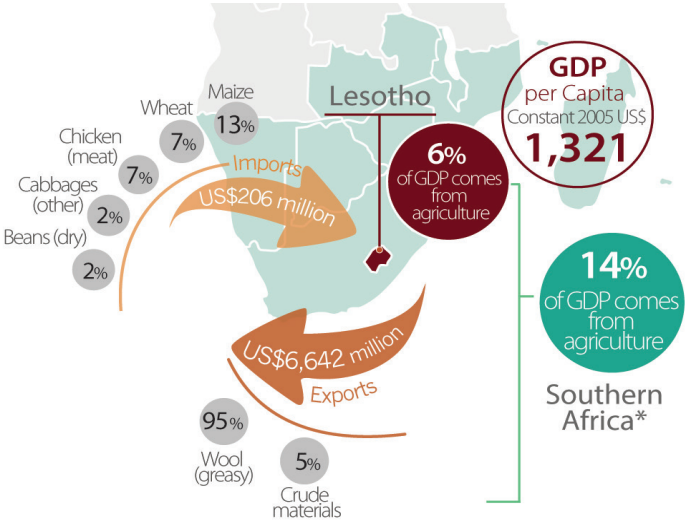
Agriculture[1] is relatively a small part of Lesotho's economy, contributing an average of 6 percent to the national Gross Domestic Product (GDP) over the period 2012 - 2016 [3]. Agriculture's share of the GDP has been declining since the 1960s, when the sector contributed over 80 percent, to below 20 percent in recent years[2]. Despite the low contribution to GDP, agriculture remains a major livelihood for the majority of the rural population, while revenue from products such as wool and mohair are important for the economy.

Maize, wheat, pulses and sorghum are the primary crops grown. Livestock comprise sheep and goats, which are key for the production of wool and mohair. Cattle on the other hand is mainly subsistence for household use such as draught power, milk, fuel (dung) and meat. Between 2009 and 2013, wool contributed about 55 percent to total agricultural exports on average; wheat flour 25 percent; and maize flour 11 percent. The value of total agricultural exports for crops and livestock on average over the period 2009-2013 was US$ 6.6million [3]. Lesotho is heavily reliant on food imports, which has led the government to focus on production of food staples to address food security concerns. While the agricultural sector accounts for 41 percent of employment, it is estimated that about 80 percent of the country is reliant on agriculture either directly or indirectly for a livelihood, particularly in the rural areas. There is a high dependence on remittances (especially from men, working in the mines in South Africa), and wages from casual labor (especially in the urban areas). Remittance and wages from casual work contribute about 40 percent and 43 percent respectively to household incomes [5].

The country has a population of approximately 2 million people (49 percent male, and 51 percent female), with 72 percent of this population living in rural areas[3]. More than half of the population has access to agricultural land [6] and some livestock, and production is largely rainfed, subsistence farming, with about 93 percent household agricultural fields planted for direct consumption purposes [7]. Both women and men participate in agriculture, with more than one third of rural women, and more than two thirds of rural men engaged in the agricultural sector[4].

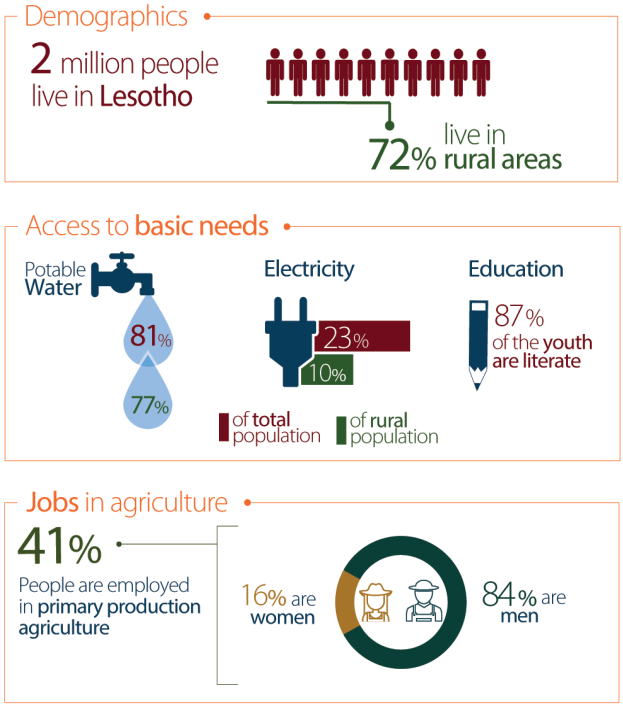
Poverty is not only high but also deep; and the depth has increased over time despite a lot of effort to create employment and better livelihoods [8]. The population on less than US$1.90 per day is 60 percent with 57 percent of the total population, and 61 percent of the rural population living below the national poverty line in 2010. Rural poverty in the country is highly associated with the low performance of the agricultural sector. The country scores very well on access to improved water resources with approximately 81 percent of the population having access; however, access to electricity is low at 23 percent of the population. The country has one of the highest literacy rates in Africa – youth literacy currently stands at 87 percent – due to high investment in social sectors over the years [3].

Economic relevance of agriculture in Lesotho [3, 4]



*Southern Africa: Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia - Excludes Angola due to lack of data

People, agriculture and livelihoods in Lesotho [3, 4, 9, 10, 11]

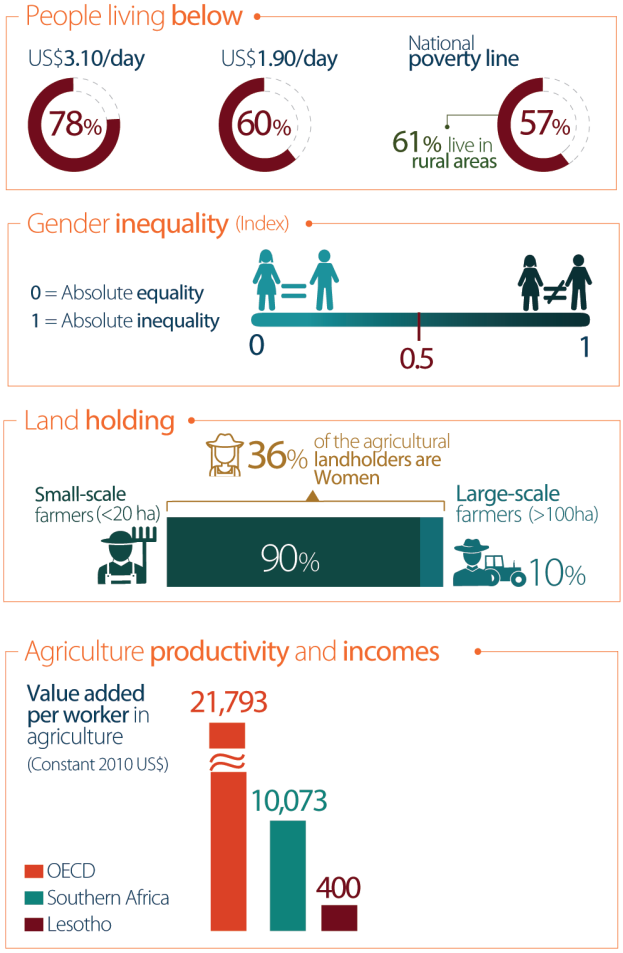


1 Agriculture for the context of this profile includes both

2 Details on this decline are available at: https://www.theglobaleconomy.com/Lesotho/Share_of_agriculture/

3 Recent census (from national sources) estimate urban population at 34 percent, peri-urban (first time it is included in the census) host 7.5 percent of the population. The rural areas currently host 58 percent of the population, an indication of significant rural-urban migration.

4 NAIP 2015-2020, Lesotho Agriculture and Food Security Investment Plan

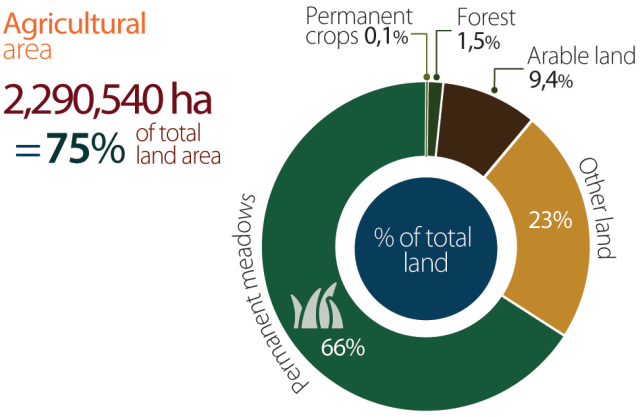


Land use

The Kingdom of Lesotho is a small, mountainous country that is completely enclaved by the Republic of South Africa, with an estimated land area 30,358 km^2 and a population density of 68 people per km^2. Approximately 75 percent of the total land area is suitable for agricultural production (including rangelands that occupy 60% of total land). The rangelands play a vital role in livestock production that is an integral part of the county's economy. Much of the land is however, hilly and affected by land degradation, especially soil erosion. The country's irrigation potential is approximately 12,500 ha, with just over 20 percent of this actually equipped for irrigation [12]. Of the total equipped area under irrigation, 175 ha are small schemes and 2,462 ha are under large schemes of greater than 100 ha each [13]. Water is a major natural resource that earns the country significant income. Its importance to the economy has attracted a number of donors (including the World Bank, African Development Bank, and European Investment Bank) to invest in the Lesotho Highlands Water Project (LHWP).

Forests cover 49,585 ha [14], just 1.5 percent of the country's land area, and is severely affected by deforestation and forest degradation, largely due to the use of wood as a main household cooking and heating energy source.

Land use in Lesotho [12]



Agricultural production systems

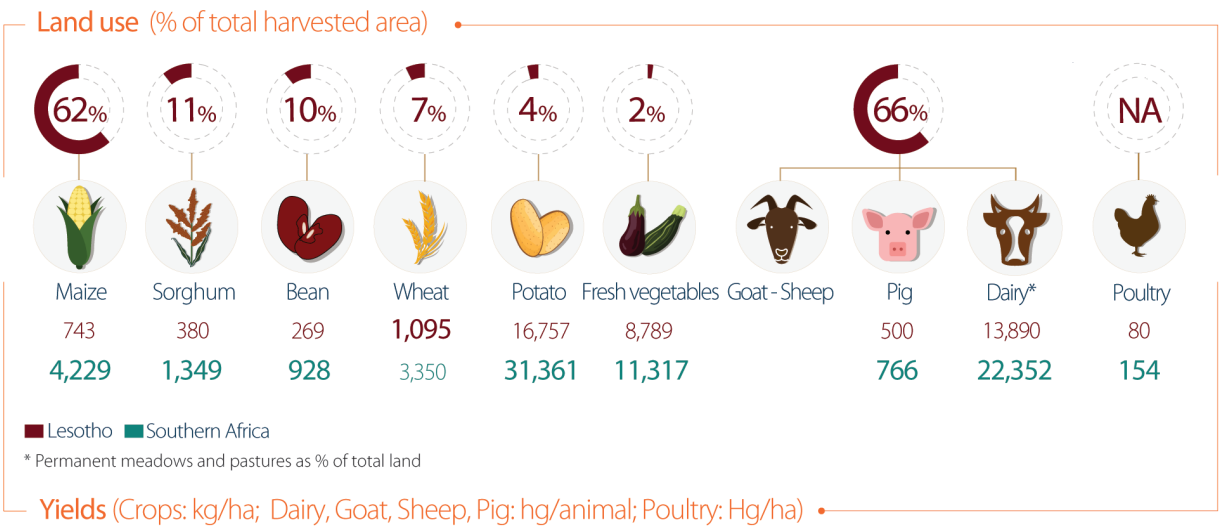
Agriculture in Lesotho is predominantly small-scale, characterized by rainfed cereal production and extensive animal grazing; with the contribution of the livestock subsector roughly double that of the crop subsector. The country is classified into four agro-ecological zones (AEZs): the Lowlands (17 percent), the Foothills (15 percent), the Senqu River Valley (9 percent), and the mountains (59 percent) based on rainfall patterns, altitude, soil and water holding capacity, growing seasons and physiological features. The majority of the between 75 percent and 80 percent of the population that depend on agriculture in the country reside in the Lowlands and Foothills where most of the arable land is found. There are both medium-scale (often using rented land) and smaller scale farmers. Important crops in the country are maize, wheat, sorghum, potato, beans and peas, fruit trees and fresh vegetables such as cabbage and tomatoes, while sheep and goat (mostly for wool and mohair), cattle, and pigs are the major livestock. Wool and mohair form an integral part of the economy, supporting approximately 50 percent of the rural households particularly in the mountain districts. Sheep and goats are mostly kept under an extensive livestock production system. Cattle and other animals such as donkeys and horses play a major role in crop production since they are used for ploughing and transporting produce to markets. The short cycle stock (chicken and pigs), especially kept by women contribute significantly to household food security. Rearing of small ruminants and poultry under intensive management systems is common in the urban areas. Cattle are reared under an extensive system for subsistence milk and meat production. However, beef production is limited and the country relies heavily on beef imports from neighboring South Africa.

The following infographic shows a selection of agricultural production systems considered key for food security in Lesotho. The selection is based on the production system's contribution to economic, productivity and nutrition indicators. For more information on the methodology for the production system selection, see Annex 1.

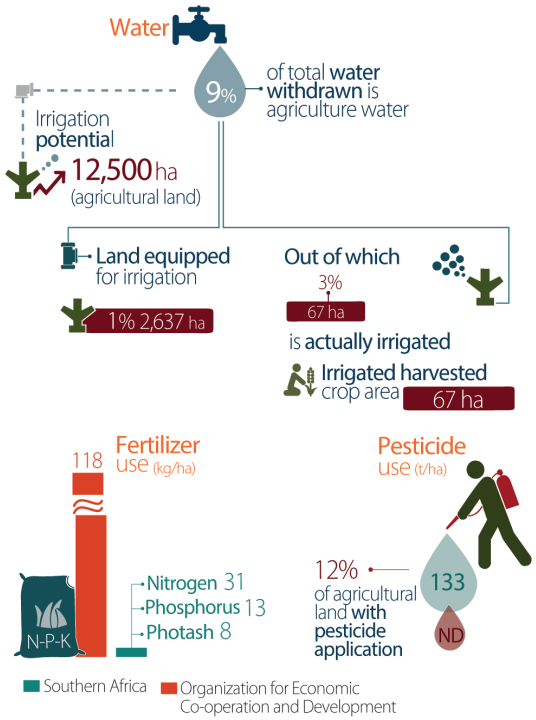
The most common production system in the country is the wheat-maize mono-cropping system, which despite its prevalence is unsustainable and insufficient to feed the country's population. Home gardening is also an important source of horticultural produce, with an estimated 70 percent of rural households producing vegetables. Most home gardens are rainfed, supplemented with irrigation from household and/or community domestic water supplies. The produce from home gardens is mainly for self-consumption, with limited quantities for the local markets.

Agricultural yields achieved in various projects range from 1.9 to 3.6 tonnes/ha for maize, between 3.5 and 13.5 tonnes/ha for potatoes, and from 2 to 11.5 tonnes/ha for onions [12][5]. Low productivity is partly due to the use of open pollinated seed varieties with only farmers in the northern lowlands, especially commercial producers, utilizing hybrid seed. Utilization of chemical fertilizers varies from district to district and farmers in high potential cereal production areas of the northern lowlands (Leribe, Butha-Buthe, Maseru and Berea) use more chemical fertilizers compared to the low potential mountain areas of the south. Although manure use is still not significant in the south, the government together with development partners has been subsidizing fertilizer to promote utilization.

Production Systems Key for Food Security in Lesotho (4)



Agricultural input use in Lesotho (3, 4, 12)



Food security and nutrition

Lesotho is confronted with chronic poverty, food insecurity and high rates of malnutrition (33 percent of children below five years of age are stunted). Erratic weather patterns, land degradation and severe El Niño weather events are the major causes of household food insecurity. In 2017, over 200,000 people were in need of humanitarian assistance; the largest number (725,519) was recorded in 2012/2013 [15] (see annex 7 for trends of people requiring food assistance). The country can only meet 30 percent of its annual cereal requirements. The remaining 70 percent is offset by imports mostly from South Africa . Maize forms the bulk of the imports among the cereals [4]. Other factors contributing to food insecurity include falling production of cereals and increases in food prices. HIV/AIDS prevalence at 25 percent (59% females, 41% males), one of the highest rates in the world, also contributes to a reduction in household productivity and income, exacerbating the need for better diets and more nutritious food.

5 http://www.fao.org/nr/water/aquastat/countries_regions/LSO/LSO-CP_eng.pdf

6 http://documents.wfp.org/stellent/groups/public/documents/ena/wfp284541.pdf?iframe

Food security, nutrition and health in Lesotho

[3, 4, 16, 17, 18, 19, 20, 21]

Food security

Score 0-100*

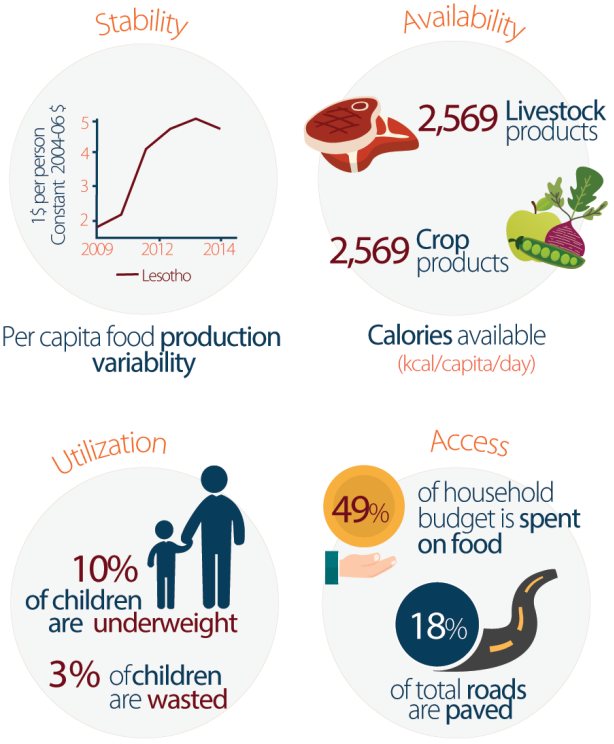
Global** 57

Lesotho No data

Sub-Saharan Africa 37

* Takes into account aspects of affordability, availability, and quality
** Refers to the 113 countries included in the Index

Food security indicators (selection)



Food aid (2012)

17,865 metric tons

(cereals 93%)

Emergency 7,935 mt

Project aid 9,930 mt

Changes in total food aid (from 2012 to 2011) 48%

Health

Access to clean energy sources

30% of the population has access to clean energy sources (non-solid fuels) for cooking

Child Mortality rate

Under-five mortality rate (per 1,000 live births): 97

Adolescent fertility rate

92 births per 1,000 women, ages 15-19

Prevalence of HIV infections

25% people infected with HIV

59 % are women (age 15+)

Agricultural greenhouse gas emissions

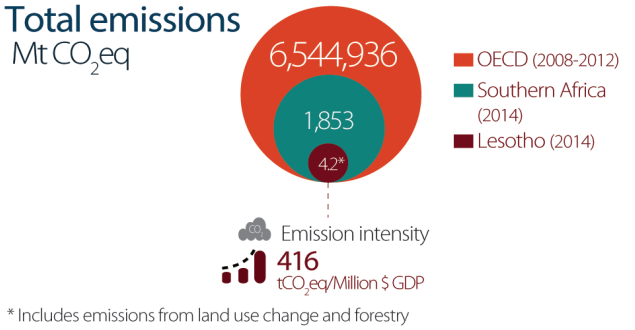
The total annual greenhouse gas emissions (GHG) for Lesotho, including emissions from land use, land-use change and forestry (LULUCF) is 4.17 Mt CO2 equivalent (CO2e) [22]. The agricultural sector is the second largest emitter in the country accounting for 34.7 percent of national emissions, while energy (64 percent of national emissions) is the largest emitter. Within the agricultural sector, livestock overwhelmingly accounts for the majority of emissions at 93.9 percent of agricultural emissions with cropping accounting for just 6.1 percent of agricultural emissions. This is particularly concerning given that the country is still highly dependent on meat exports from neighboring South Africa and only wool and mohair make significant contribution to exports and national incomes. Within the livestock subsector, enteric fermentation (52.2 percent of agricultural emissions) and manure left on pastures (38.5 percent) are key GHG emitters, while in the crop subsector, savannah burning for agricultural purposes (4.7 percent) is the largest emitter.

Although the country's Nationally Determined Contribution (NDC) highlights agriculture as a main GHG emitter, it does not highlight agriculture among its main mitigation actions, rather focusing on energy, waste management and forestry. Within the forestry sub-sector however, there is some mitigation potential to be gained from reforestation as well as reduction in reliance on wood fuel through provision of sustainable and renewable energy particularly hydropower, as well as through adoption of fuel efficient stoves. The implementation of the reforestation option and the efficient cook stoves initiatives are both conditional on availability of finance, with reforestation estimated to cost US$24 million between 2015 and 2030. The reforestation option is aimed at raising the country's forest cover from the current 1.5 percent of total land area to 5 percent [14]. The NDC commits to a 10 percent unconditional reduction in GHG emissions by 2030 compared to the business-as-usual (BAU) scenario, with the unconditional target being

35 percent below the BAU scenario [14]. The intersection between forestry, energy and agricultural production will need clear elaboration and analysis in order to achieve these goals. The clear costing of the targets and activities will also be crucial as at present this is lacking.

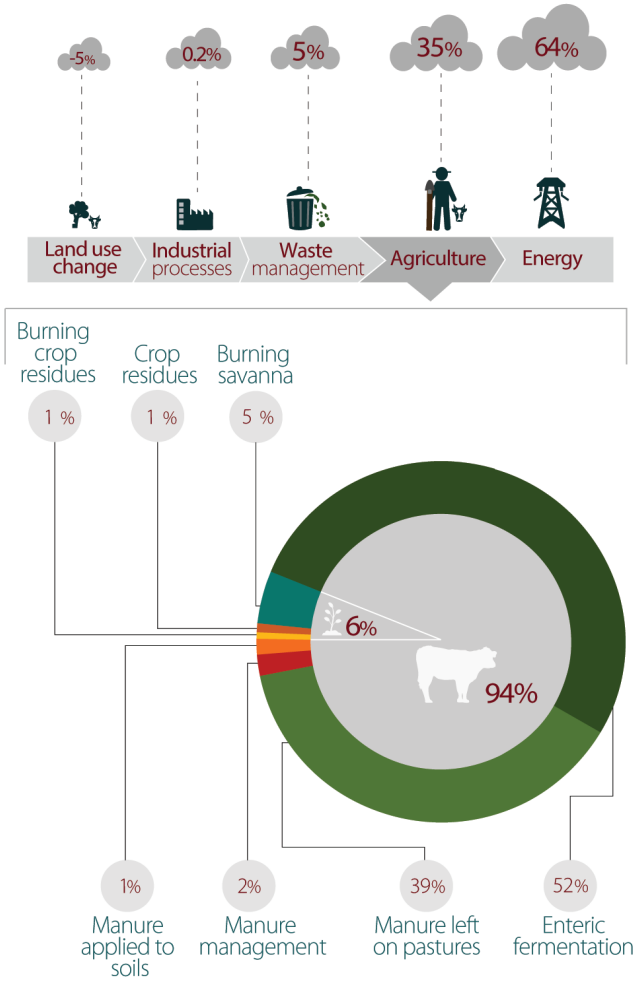
Mitigation of GHG emissions from Lesotho's agricultural sector could be targeted at scaling up conservation agriculture, improved livestock feed, improved rangeland management, and improved efficiency of production through small-scale irrigation. These could be linked to other mitigation priorities such as sustainable energy and reforestation.

Greenhouse gas emissions in Lesotho (3, 4, 22)



* Includes emissions from land use change and forestry

Sectoral emissions (2014)



Challenges for the agricultural sector

The agricultural sector in Lesotho is challenged by severe land degradation, use of traditional agronomic practices, overgrazing and high climate variability. The climate conditions in the country favor livestock production. However, several challenges such as poor organization of the different livestock value chain actors (which makes rearing livestock as a business challenging) and rearing of poor quality livestock breeds (resulting in low productivity) hinder realization of the full potential of the sub-sector. Crop production is a major agricultural activity for the people of Lesotho, where maize and sorghum occupy more than 60 percent and 10 percent of the cultivated land, respectively [4]. Maize and sorghum are the most important staple food crops, with maize often receiving policy and financing support, for example through maize input subsidies. This is notwithstanding the fact that maize, despite being a staple food crop, is not suitable for production across much of the Lesotho's agro-ecology, and the cost of production in the country is higher compared to the cost of importing from South Africa. Vulnerability to climate risks has reduced the productivity of the sector since the farmers have very little capacity to cushion themselves from the climate shocks. Time series data for Lesotho shows that drought and floods are the major causes of crop failure in the country[7]. Cognizant of the risks, the Government of Lesotho has set in place among other frameworks, a Resilience Strategic Framework to guide and coordinate efforts to address weather risks.

Adoption of modern agricultural practices by the farmers is relatively low. Unsustainable agricultural practices such as mono-cropping and overgrazing, and unregulated firewood extraction result in land degradation. Interviews with key informants and workshop participants showed that lack of knowledge about improved agricultural practices for crop and livestock production, high poverty levels that make most of the adaptation practices unaffordable to farmers, the mountainous topography of the country, unfavorable tenure system and cultural factors are the major impediments to adoption of climate-smart technologies. Poor access to financial services and low integration into supply chains[8] makes the sector uncompetitive, especially when compared to neighboring South Africa. Access to markets is limited, with the major challenge being low prices for producers, especially for raw produce such as milk, mostly due to minimal value addition.

Agricultural labor productivity in the country is low, mostly due to the burden from diseases such as HIV/AIDS. This results in low adoption of labor-intensive practices such as CA. The situation is worsened by migration of young people to South Africa to seek jobs in other sectors.

The above factors need to be urgently addressed to improve the performance of the agricultural sector. Funding for agricultural research also needs to increase.

7 http://lesotho.opendataforafrica.org/uqitsce/agriculture-lesotho

8 More details available at: https://www.wto.org/english/tratop_e/tpr_e/s324-01_e.pdf

Agricultural research is mostly led by the Department of Agricultural Research of the Ministry of Agriculture, and the Faculty of Agriculture at the National University of Lesotho. This has made coordination of agricultural research in the country problematic. Involvement of the private sector in research through consultations and proper dissemination of research results to the private sector and other users to increase investment in the sector.

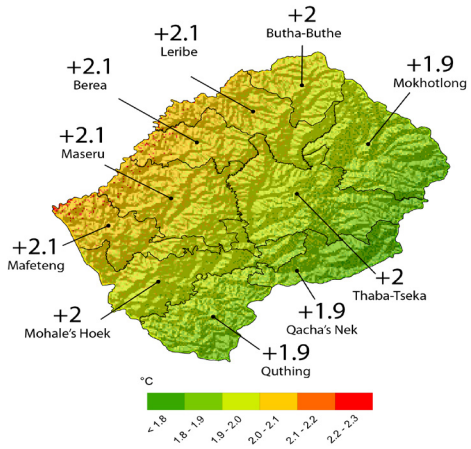
Agriculture and climate change

Lesotho is highly vulnerable to climate change, the most significant hazards being drought, high temperatures and heat waves, floods, hail, and frost. This vulnerability is compounded by poverty as well as land degradation, soil erosion and the hilly topography that hamper agricultural production. Droughts are of particular concern. For instance, the country experienced a prolonged drought between 1991-1996 [23], the period considered the longest for occurrence of drought in the country's history, while the 2015-2016 El Nino induced drought was one of the worst experienced in the country placing over 534,000 people at risk of food insecurity [15, 24]. Climate hazards in the country often result in delayed planting (or farmers not planting at all); reduced seed germination due to hardened soils and lack of water; crop failures; deterioration of rangelands and pasture; water scarcity for livestock; livestock emaciation and sometimes death; and increased food prices particularly of staple grains such as maize. In 2018 the country was affected by another climate related hazard, described as "golf-ball sized" hailstone, which resulted in animal deaths[9].

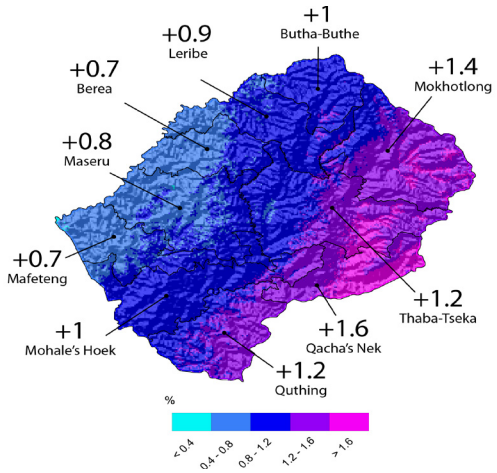
Analysis of precipitation and temperature trends in Lesotho over the period 1981-2012, indicate a decrease in precipitation and an increase in temperature [25, 26]. GCMs used to model climate projections for the country suggest that temperatures are likely to increase by an average of 2°C by 2050 and up to 2.4°C by 2070. The largest increase is expected to occur along the northwestern border of the country, which largely comprises the country's lowlands. The eastern and central parts of the country, including the mountain livelihood zone and part of Senqu River valley, are expected to experience a slightly lower increase in ambient temperatures than the northeastern parts of the country. In contrast to the past trend of reduced rainfall, projections indicate the possibility of a very slight increase in the country's rainfall (up to 1.6 percent) by 2070 [27, 28, 29]. However, the projected changes in rainfall are not uniform throughout the year, with winter rainfall projected to decrease strongly,

Projected change in Temperature and Precipitation in Lesotho by 2050 [27, 28, 29]

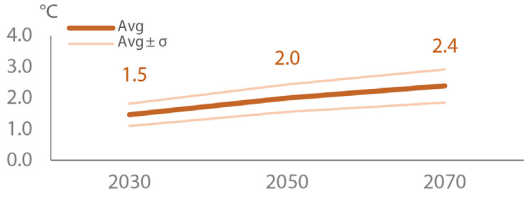
Changes in annual mean temperature (°C)



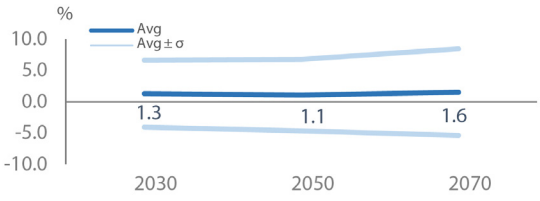
Changes in total precipitation (%)



Average temperature (°C)



Average precipitation (%)



9 https://reliefweb.int/report/lesotho/lesotho-flash-update-01-hailstorms-and-flash-floods-4-april-2018

summer and autumn rainfall expected to experience no significant change, and spring rainfall expected to gradually increase [25]. Spatially, the western districts of the country, where temperature is likely to increase the most, are likely to experience the lowest increase in rainfall (0.7 percent increase by 2050), with impacts on water availability for crop and livestock production. On the other hand, the eastern parts of the country are expected to have the largest increase in rainfall (up to 1.6 percent by 2050). Changes in rainfall are likely to undermine food security, particularly due to the country's high reliance on rainfed agriculture. Flooding may also become more frequent and severe in some parts of the country with dire impacts on agricultural production as well as marketing infrastructure and rural livelihoods as a whole. In addition, increased rainfall variability across the country can be expected to have impacts on water availability for crop and livestock production. Overall, the results indicate the foothill livelihoods and the low land (northern and southern) zones of the country as being most vulnerable to climate change, given the projected higher temperatures and minimal increase in precipitation. However, increases in temperature in the colder frost-affected parts of the country, may result in increased yield of crops such as maize.

Though different global circulation models (GCMs) have been used in the analyses, there is consensus that Lesotho is likely to experience higher temperatures, increased climate variability, and an increased frequency and intensity of extreme weather events all with impacts of crop and livestock production, water security, and rural infrastructure.

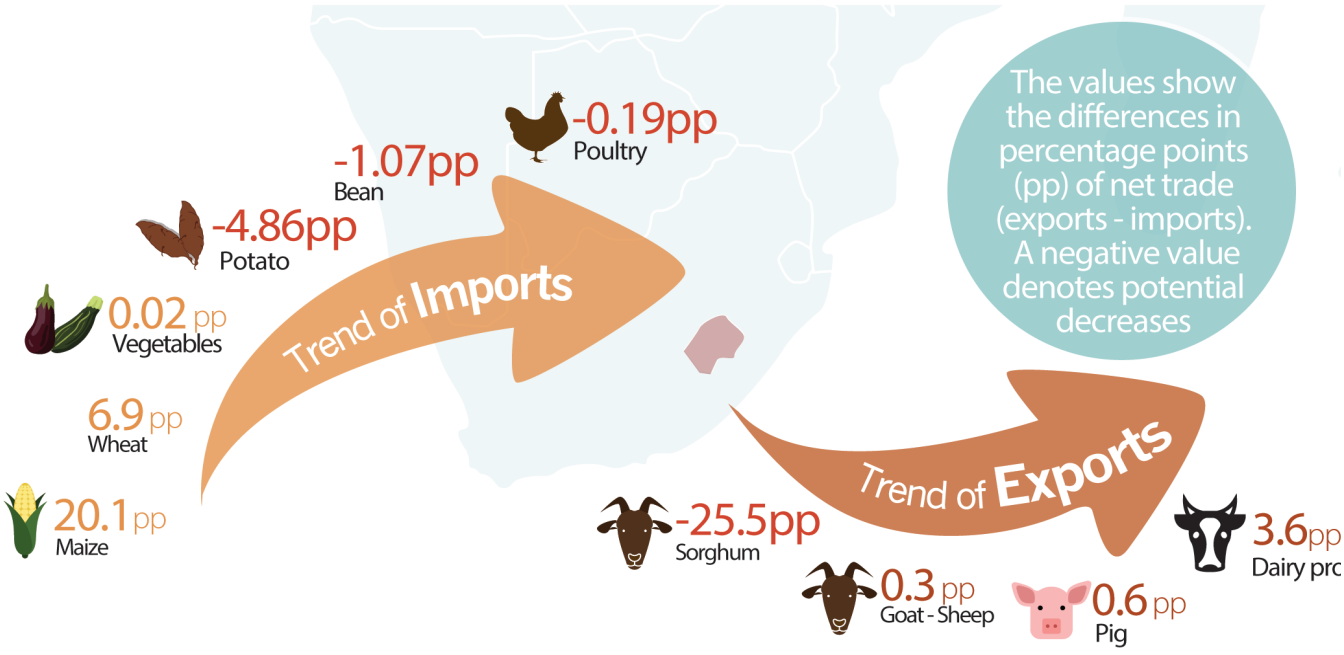
Potential economic impacts of climate change

The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) was used to analyze the effects of climate change on agriculture in Lesotho over the period 2020-2050[10] [30]. This assessment considered three parameters, namely net trade[11], crop area (or livestock numbers), and yields[12], for scenarios with and without climate change (CC and NoCC). All commodities were assessed individually except for sheep and goats, which were assessed as a group since the production systems are not significantly different, and vegetables.

Independent of climate change, results suggest that Lesotho may become more dependent on imports of most food commodities, and will continue to be a net importer of most agricultural commodities. In particular, results indicate the following:

- The country is expected to continue to be a net importer

The impact of climate change on net trade in Lesotho (2020-2050)

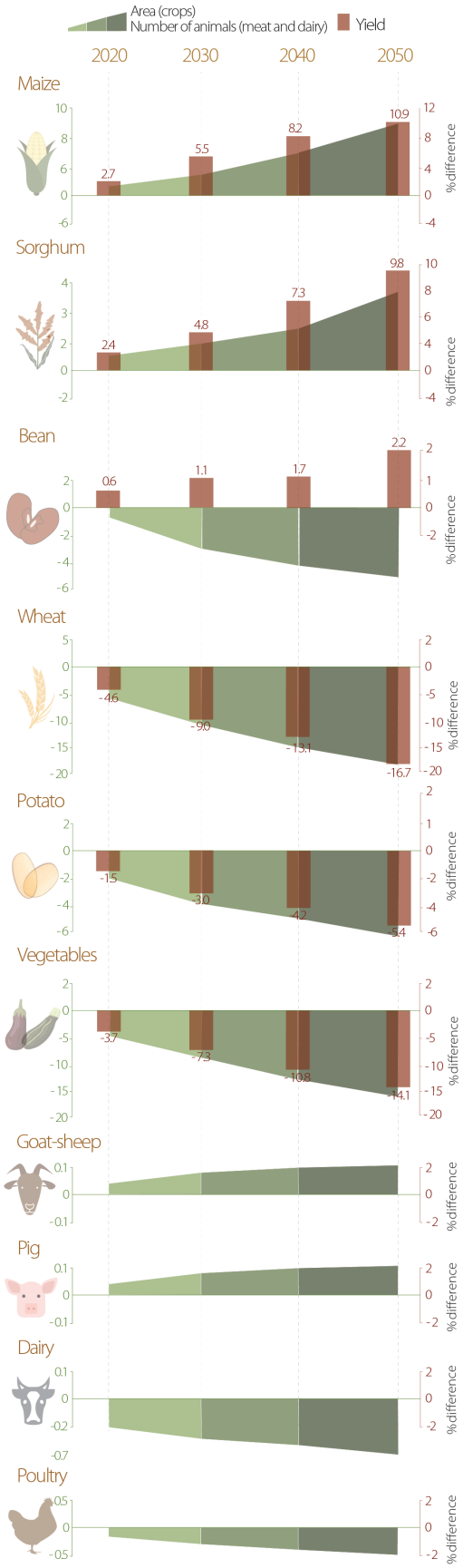


10 The IMPACT Model was parameterized by the Second Shared Socioeconomic Pathway (SSP2), a conservative scenario that is typically considered "business-as-usual"

11 A positive value for net trade indicates greater exports than imports while a negative value for net trade indicates greater imports than exports. Ideally, countries strive to have positive net trade of key agricultural commodities.

12 Measured in tonnes/ ha

Climate change impacts on yield, crop area and livestock numbers in Lesotho



*A negative value denotes potential decreases in area and yield expressed as percentage change in a climate change scenario vs. non climate change

of maize and wheat. However, net-trade for maize and wheat are likely to be 20.1 percentage points (pp) and 7pp higher respectively under CC compared to the NoCC scenario. These results give an impetus for more research on maize, considering that it is a staple crop for Lesotho.

- The country is expected to continue to be a net importer of potato, beans and poultry regardless of the scenario.
- Under both scenarios, the country may transition from being a net importer of dairy products and sorghum to being a net exporter. Net-trade is however, likely to be higher for dairy by 3.6pp and lower for sorghum by -25.5pp under the CC scenario as compared to the NoCC scenario.

- The country is likely to continue to increase exports of pork, and wool and mohair under both scenarios; the exports being slightly higher by 0.6pp and 0.3pp for pork, and wool and mohair respectively under the CC scenario as compared to the NoCC scenario.

Ultimately, changes in demand of agricultural commodities may be driven by several factors including population growth, national economic growth, incomes of individuals, commodity prices present in the global and national marketplace, consumer preferences, and national and international trade regulations.

Looking at the potential changes in yield and harvested area, several outcomes are possible. In terms of area under cultivation, the following changes are projected by 2050:

- The area under potato cultivation is projected to decrease under both scenarios; however, this decrease is projected to be more pronounced under CC by -4.1 percentage points (pp) compared to the NoCC scenario.

- The areas under beans, maize, sorghum and wheat cultivation are likely to increase under both scenarios. For maize and sorghum, the increases are projected to be 7.4pp and 4.5pp greater under the CC scenario as compared to the NoCC scenario. The areas under production for beans and wheat are likely to be 5pp and 18pp less respectively under CC compared to the NoCC scenario.

- The area under vegetables is expected to decrease under the CC scenario and increase under the NoCC scenario, with the with the production area being 13pp less under CC compared to the NoCC scenario.

In terms of yield projections up to 2050, the following can be expected:

- Yields for all the modelled commodities are likely to increase under both scenarios.

- However, the increase is projected to be 5.3pp, 13.5pp and 21.6pp less for potato, vegetables and wheat respectively under the CC scenario as compared to the NoCC scenario.

- The yields for beans, maize and sorghum are likely to be higher by 2.1pp, 11.8pp and 11.4pp respectively under the CC scenario compared to the NoCC scenario.

- The impact of climate change on animal numbers is not expected to be significant, with cattle, poultry, pig, sheep and goats having similar numbers under both the CC and NoCC scenarios.

In general, all production systems in Lesotho are projected to be at least somewhat adversely affected by climate change. The specific impacts depend on the production system in question, with wheat, potato and vegetables facing the most significant impacts. This will require innovations to counter yield reductions. Government policy can therefore focus on promoting the products the country has a competitive advantage in. Livestock also present a good opportunity given less effect from climate change, the high current and expected future dependence on imports, and positive impact on dairy exports for the country. However, the analysis only considered animal numbers; there is a need to consider other factors such as markets, range management and improvement of the breeding stock for realization of the full benefits.

CSA technologies and practices

CSA technologies and practices present opportunities for addressing climate change challenges, as well as for economic growth and development of the agricultural sector. For this profile, practices are considered CSA if they enhance productivity as well as contribute to at least one of the other objectives of CSA (adaptation and/or mitigation).

In Lesotho, some of the crop-based adaptation practices include CA, agroforestry, crop diversification, keyhole and trench gardens [31]. CA has been supported by several organizations such as the Food and Agriculture Organization of the United Nations (FAO), and has been the major focus of the government in terms of allocating resources through subsidies and formulation of agricultural production policies. Apart from a few studies [32], limited data exists on the current adoption rates as well as the costs and benefits of conservation agriculture in Lesotho. However, factors such as the labor intensiveness of the practice for both weeding and planting (especially given the use of a hoe for digging the planting basins promoted under the Likoti system), and lack of appropriate equipment (the hoe is primarily used rather than direct seeders and other CA equipment) have contributed to the low adoption of the technology. While the practice is considered more resilient to weather variability, and contributes to soil and water conservation, there is need to gather better evidence on the costs and benefits of CA under different agro-ecological conditions in Lesotho. Availability of CA technologies, credit and technical support are required to enhance the widespread adoption of the practice.

Key hole gardens are defined as "circular, raised-beds made up of layers of soil, ash, manure and other organic material that retains moisture and nourishes the soil, making it more productive than a conventional garden, even during dry or cold months" [33]. The gardens support nutrition and household incomes, as vegetables can be grown for consumption and the excess marketed. Irrigation is also promoted in Lesotho, particularly in conjunction with block farms, in which farmers cultivate individual blocks in a larger field, therefore providing an opportunity for gravity-fed irrigation. Continuous availability of water in Lesotho can be a problem. Prolonged and frequent dry spells resulting in low runoff and lowered water tables deprive crops and plants with a shallow rooting system of water despite the abundant water resources. This makes strategies that simultaneously conserve water and soil important considerations in designing irrigation interventions. Surface and sprinkler irrigation systems for vegetables and fruits have been applied at small scale, particularly in the dry spell prone lowlands of the country, leading to an increase in water use efficiency. Integrated (diversified) farms that combine crop, vegetable and fruit production with livestock rearing (chickens), and aquaculture have also been introduced in the country .These integrated and self-sufficient farms have some similarities to the Machobane Farming System that has long been practiced in Lesotho [34]. This farming system incorporates principles of crop rotation, organic fertilizer, and integrated pest and disease management to promote farm efficiency and self-sufficiency as well as improve resilience to climate change. Looking into the prospects of scaling up knowledge on such farming systems while integrating aspects of post-harvest processing (with involvement of the private sector), could be an option for the promotion of climate-smart practices in Lesotho.

In terms of livestock, improved breeds (including drought, heat and cold resistant) of cattle, merino sheep and angora goats are a priority for the country. There is some adoption of improved breeds as well as cross-breeding supported by international development partners such as the International Fund for Agricultural Development (IFAD) and research organizations such as ILRI, mostly with the aim of improving the quantity and quality of milk, wool and mohair. In addition, farmers practice rotational grazing, fodder production, stock size management and improved housing (particularly for poultry), as a means of adapting to weather variability and climate change but also as a means of reducing land degradation. As with most livestock-related resilience practices, provision of adequate health care and good animal hygiene play a key role in boosting livestock productivity, increasing efficiency of production, and enhancing resilience . Overall grassland management and rangeland rehabilitation remain key priorities for the country

13 https://www.farmersweekly.co.za/agri-business/empowerment/sustainable-farming-in-lesotho-thanks-to-thailand/

and should be considered when designing livestock-related programs.

Off-farm CSA-related practices include provision of improved climate services and early warning information related to droughts and floods. This is mostly provided by the Lesotho Meteorological Services (LESMET) with support from international partners such as the United Nations Environment Programme (UNEP). Weather index-based insurance is limited and could be an option for public-private sector partnerships for catalyzing adoption of climate-smart agricultural practices and technologies in the country. The private sector can also play a key role in extension services provision for new technologies and transfer of the technologies to smallholder farmers.

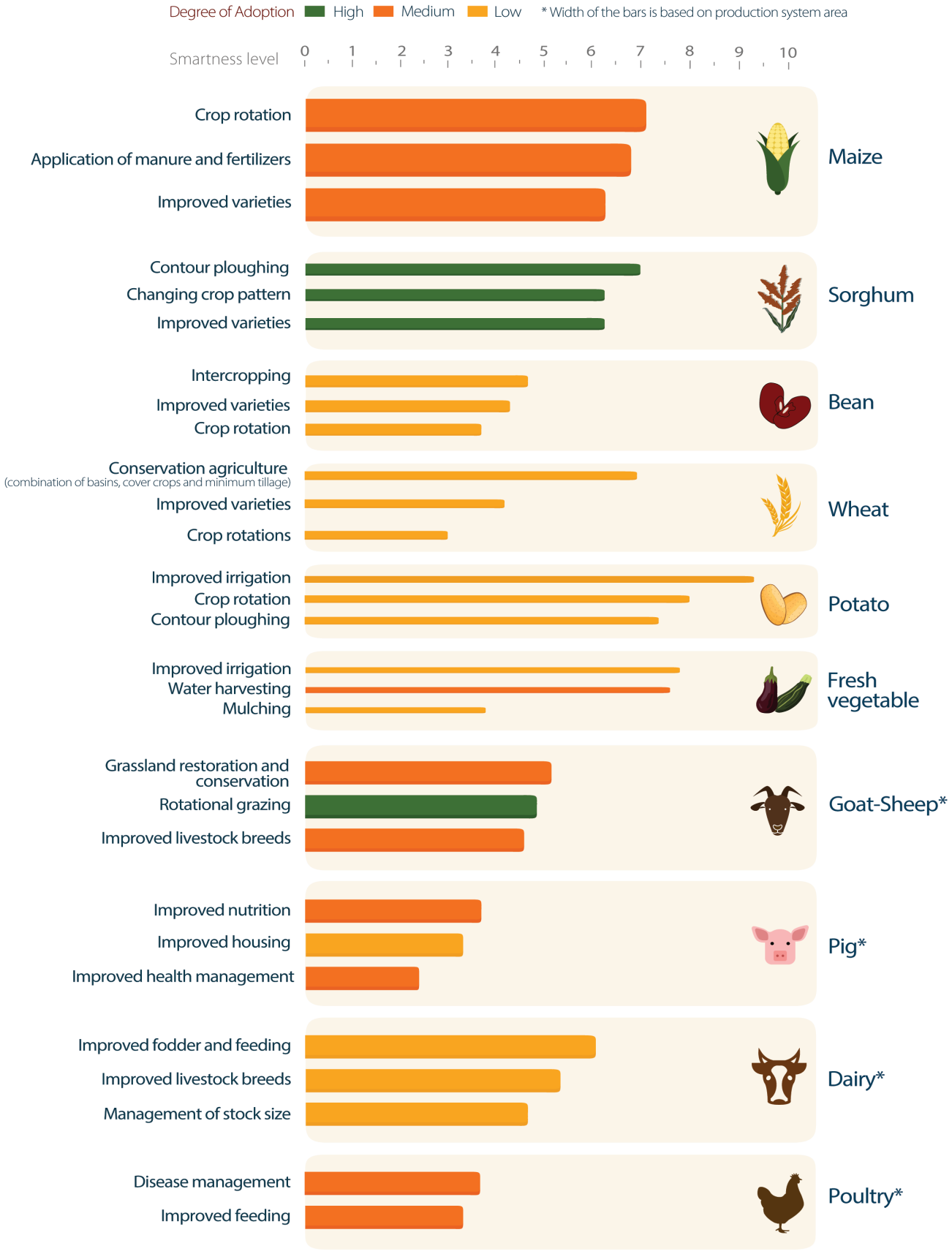
Many adaptation strategies have been suggested by NAPA (2007) including installation of greenhouses to protect against frosts, high temperatures and heat waves while improving agricultural productivity; promotion of water purification programs to cushion farmers against drought; rearing of livestock breeds that can withstand the extreme weather conditions; improvement of animal nutrition; and promotion of rangeland sharing within communities. However, Lesotho, like many other African countries lacks empirical evidence of the CSA impacts of various technologies and strategies promoted in the country.

Lack of financial resources, scarce natural resources and long pay-off periods are some of the factors that contribute to the low adoption of some CSA practices. Competing needs, for instance, emergency drought relief versus long-term resilience building; or the need to retain residue on the soil versus the need to feed livestock also hamper adoption of some practices.

Farmers in the country have been undertaking risk management strategies to account for weather, market and other risks to varying degrees of success and within their own priorities for risk management. Promoting CSA practices that support longer-term adaptation to climate change (for example environmental management related interventions) will require a concerted effort to sensitize and change the mindset of farmers. Promoting a mix of shorter term CSA-related coping strategies and longer term adaptation and resilience building strategies will likely yield best results for farmers' adoption of some strategies; limiting foregone adaptive opportunities.

The following graphics present a selection of CSA practices with high climate-smartness scores according to expert evaluations. The average climate smartness score is calculated based on the practice's individual scores on eight climate smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, risks (adaptation); energy, carbon and nitrogen (mitigation). A practice can have a negative, positive or neutral impact on a selected CSA indicator, with ±10 indicating a 100% change (positive/negative) and 0 indicating no change. Practices in the graphics have been selected for each production system key for food security identified in the study. A detailed explanation of the methodology can be found in Annex 2.

Selected CSA practices and technologies for production systems key for food security in Lesotho



** Unidentified production system area

Case study 1: Climate-smart wool and mohair production and promotion

The Lesotho Wool and Mohair Promotion Project (WAMPP), is an International Fund for Agricultural Development (IFAD) funded project, coordinated by the Ministry of Agriculture and Food Security (MAFS) through the Department of Livestock Services (DLS). Other relevant ministries and government departments involved include the Ministry of Forestry and Land Reclamation (MFLR) through the Department of Range Resources Management (DRRM); and the Ministry of Energy, Meteorology and Water Affairs (MEMWA), which houses the Lesotho Meteorological Services (LMS). The project is funded through a US$5.8 million loan, another US$5.8 million IFAD debt sustainability framework grant and an additional US$7 million grant from IFAD's Adaptation for Smallholder Agriculture Programme (ASAP). The Government of Lesotho, and the Lesotho National Wool and Mohair Growers Association (LNWMA) are also contributing with co-financing, while project participants contribute in kind through labor on project infrastructure. The project will run for seven years focusing on three main components, namely: 1) climate-smart rangeland management; 2) improved production and management; and 3) wool and mohair processing and marketing.

Under component 1, a community-based approach is used to support delineation of grazing areas, establishing sustainable stocking rates, developing grazing plans and registration of community land rights. Investments to reduce erosion and land degradation (such as sack gabions, vegetative windbreaks, grassland reseeding) are also being made, thus contributing to more sustainable and climate-resilient rangelands with greater above- and below-ground carbon storage capacity. A new Rangeland Management Act is expected to be developed as part of the project, and collection of climate-information is to be enhanced through installation of 5 automatic weather stations and 200 rain gauges. Under component 2, the project is addressing three key issues, these being animal nutrition, animal breeding and animal health. Under the breeding sub-component, the project supports the revamping of two government livestock breeding centres for Merino Sheep and Angora Goats, and helping in improving the productivity and climate-resilience of the local livestock population. CSA-related activities within this component include establishment of 2,000 ha of forage (including support to intercropping of forage legumes with maize) and the training of 10,000 livestock producers on improved feeding and breeding practices. Livestock health management will be promoted, through training of paravets and development of risk assessment and vulnerability maps to predict the impacts of climate change on the epidemiology of livestock diseases. Under component 3, livestock owners are to be capacity built on a commercial and business approach to wool and mohair production, processing, marketing and sales. This includes development of climate-smart shearing sheds complete with solar panels, roof rainwater harvesting tanks and shelters; strengthening fiber handling and grading; and investing in feeder roads. The project also has a gender component to boost women's entrepreneurship skills and capacity.

The project is in its early stages and limited information is available on its impact. However, the value chain and landscape approaches to climate-smart wool and mohair production are expected to improve productivity and profitability, improve resilience to climate and market shocks, and reduce the negative impact of goats and sheep on the environment. Ultimately, the project is expected to reduce child malnutrition and increase climate-resilience for 250,000 households. These climate-smart practices included rangeland management, development of local facilities for breed improvement, construction of climate-resilient processing facilities, and capacity building of stakeholders and farmers on breed and feed improvements. This integrated approach to climate-smart agriculture could be applied to other important production systems in the country including maize, wheat, sorghum, fruits, and vegetables as well as meat and dairy (beef, pork and poultry).



Improved Merino Sheep and Stud Rams being showcased in Lesotho. Photos courtesy of the WAMPP

Case study adapted largely from: Wool and Mohair Promotion Project (WAMPP): Final project design report https://operations.ifad.org/documents/654016/6e480215-a284-4aaa-acc5-a60af49d1a66

Case study 2: Enhancing resilience through a joined up approach in promoting keyhole gardens

The pronounced winters and droughts throughout the year significantly reduce agricultural productivity in Lesotho. The high poverty and disease burden make it difficult for the small-scale farmers to adopt to the extreme weather. Redress of these challenges requires interventions that do not only touch on one sector but rather several sectors of the economy and involves all the key players in the relevant sector. Due to the limited scope of interventions, farmers' lack of capacity to adopt new practices and technologies, proper policies, and a collaborative effort from relevant institutions, the goal of holistically addressing the climate challenges on agriculture is rarely achieved.

In Lesotho, one of the significant interventions that has been used to have long lasting impacts that touch on several aspects of resilience and adaptive capacity is the keyhole gardens. Through a joined up approach, keyhole gardens have been promoted in Lesotho under the auspices of the Consortium for Southern Africa Food Security Emergency (C-Safe) project led by CARE International, World Vision and Catholic Relief Service (CRS); the project has since grown to include the Food and Agriculture Organization (FAO) and the World Food Programme (WFP). The program's main goal was to enhance food security, through better nutrition, improve climate resilience and increase incomes and savings targeting households affected by HIV and AIDS.

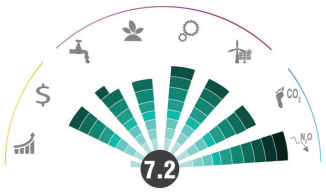
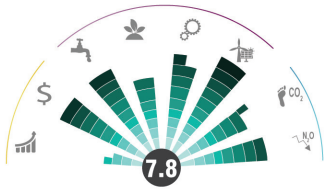
A keyhole garden is a raised bed measuring approximately 1m high and 2m in diameter; made from recycled materials such as ash, manure plus other organic matter; and surrounded by local brick, stones, cotton sacks, sorghum, maize and clay pots (see diagram). At the center is a hole that enables access and replenishment of the garden. The whole makes the whole structure look like a "key hole" from which the approach derives its name. The gardens are mostly used for growing vegetables. The garden enhances moisture retention and replenishment of organic matter, and can permit production in poor soils with little moisture. Keyhole gardens require little maintenance and can yield for up to 5 years before replenishment. Compared to conventional practices, keyhole gardens register higher yields since the system is resilient to both drought and low temperatures. The gardens permit all groups of people including the elderly and those who are sick to work on them. In addition, other than increasing yields, the keyhole gardens have promoted social ties, since people work in social groups (Matsema).

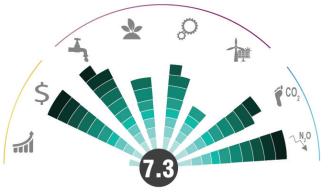
The Ministry of Agriculture and Food Security has helped in development of training manuals for the approach. FAO in collaboration with other partners such as the Unites States Agency for International Development (USAID) and the UK Government's Department for International Development (UKAid) has trained farmers on growing, improving yields, crop diversification through extension workers and schools. Local NGOs such as the Rural Self-Help Development Association and Good Shepherd Sisters are also involved in dissemination of the practice.

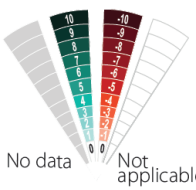
Since their inception, 23,150 keyhole gardens have been constructed, impacting approximately 115,590 people. The structures have enhanced year-round production of nutritious vegetables such as spinach, carrots and beetroot, and have enhanced income availability for other household expenses such as school fees. The success of keyhole gardens has led to their inclusion in the Food Policy of Lesotho. Keyhole gardens have continued to be widely adopted by farmers in the country, making the approach a viable CSA option that can be replicated not only at a micro level but also at national level.

Case study adapted from http://www.fao.org/news/story/en/item/340250/icode/, https://www.worldvision.org/wp-content/uploads/telling-our-stories-report.pdf and https://www.mrfcj.org/wp-content/uploads/2015/09/2013-04-16-Lesotho.pdf

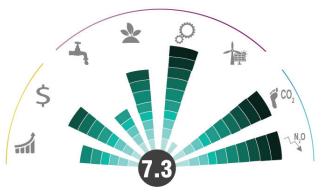
Table 1. Detailed smartness assessment for top ongoing CSA practices by production system as implemented in Lesotho.

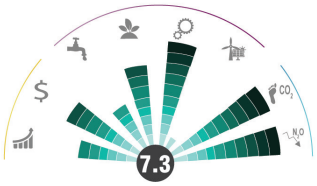
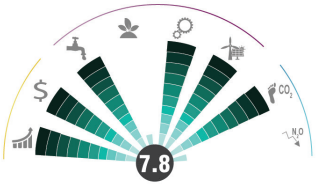
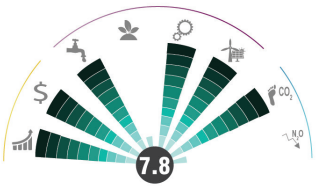
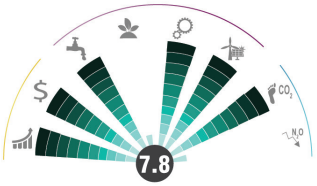
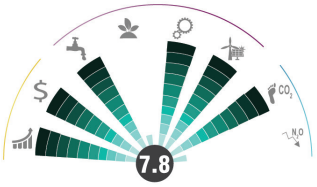
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Maize (62% of total harvested area)				
Application of manure	Southern region (Mafeteng, Mohale's Hoek, Quthing 30-60%	M		**Productivity** Increases yield and hence incomes and food availability. **Adaptation** Enhances soil water conservation. Easily practiced by both men and women. **Mitigation** Less use of mineral fertilizers hence lower emissions. Reduced methane emissions from manure left on pastures.
	Northern region (Berea, Butha-Buthe), Central (Maseru) 30-60%	M		
Crop rotations (with legumes and winter wheat)	Southern region (Mafeteng, Mohale's Hoek, Quthing 30-60%	S M		**Productivity** Improved yields, higher nutrient quality, and diversification of food and income sources. **Adaptation** Improved soil fertility when rotated with legumes, improved food availability and hence resilience to climate and market shocks. **Mitigation** Improved yearlong above- and below-ground biomass and hence CO2 storage. Improved efficiency of production.
	Northern region (Berea, Butha-Buthe), Central (Maseru) 30-60%	M		
Sorghum (11% of total harvested area)				
Crop rotations (relay cropping)	Southern region (Mafeteng, Mohale's Hoek, Quthing 30-60%	S M		**Productivity** Increases productivity due to reduced pest and disease incidence. Two or more crops from the same field. **Adaptation** Enhances food availability and soil fertility. Maximum use of available water resources. **Mitigation** Improved yearlong above- and below-ground biomass and hence CO_2 storage. Improved efficiency of production.
	Northern region (Berea, Butha-Buthe), Central (Maseru) 30-60%	S M		

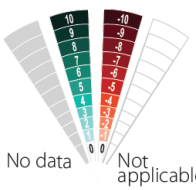
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Sorghum (11% of total harvested area)				
Contour ploughing	Southern region (Mafeteng, Mohale's Hoek, Quthing) >60%	S M		**Productivity** Increased yields due to accumulation of water and nutrients on contours and hence improved incomes. **Adaptation** Land management is made easier for women. Reduces soil erosion, improves soil quality and reduces use of fertilizer and water. Improves soil water storage. **Mitigation** Reduces emissions by maintaining soil structure.
	Northern region (Berea, Butha-Buthe), Central (Maseru) >60%	S M		
Wheat (7.2% of total harvested area)t				
Improved varieties	Thaba Tseka <30%	S		**Productivity** Improves soil fertility and structure thus improving productivity and profits. **Adaptation** Improved water retention in soils. Increased system resilience. **Mitigation** Reduce requirement of synthetic fertilizers, hence reduce nitrous oxide emissions.
	Highlands (Mokhotlong, Maseru Highlands, Linakeng, Mantsonyane <30%	S		
Conservation agriculture (combination of basins, cover crops and minimum tillage)	Thaba Tseka <30%	S		**Productivity** Increases yield over time. **Adaptation** Reduces land degradation, reduces soil erosion, conserves soil moisture for use by plants during dry spells and improves soil fertility. **Mitigation** Conserves biomass in the soil hence improving below ground carbon storage.
	Highlands (Mokhotlong, Maseru Highlands, Linakeng, Mantsonyane <30%	S		



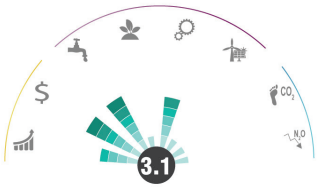
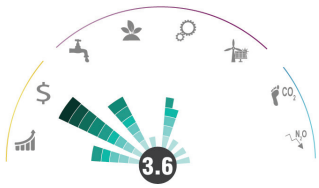
Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

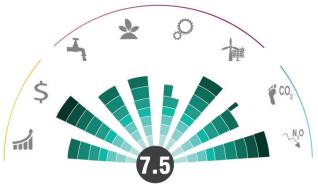
CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Beans (10% of total harvested area)				
Improved varieties	Berea <30%	S		**Productivity** Improves yields, and hence income. **Adaptation** Enhances high water use efficiency, promotes resistance to pests and diseases, and enhances availability and access to food **Mitigation** Increases biomass, and hence enhances carbon sequestration. May require more fertiliser.
	Northern Lowlands (Leribe, Berea), Butha-Bithe <30%	S		
Intercropping	Berea <30%	S		**Productivity** Increases yields hence income. Two crops can be grown at the same time. **Adaptation** Improves moisture conservation, reduces soil erosion, reduces pest and disease incidences, and enhances efficient fertilizer and water use. **Mitigation** Enhances carbon sequestration due to greater above- and below-ground biomass.
	Northern Lowlands (Leribe, Berea), Butha-Bithe <30%	M		
Potato (3.5% of total harvested area)				
Improved irrigation (drip or sprinkler)	Lowlands (Mafeteng, Monale's Hoek) <30%	S		**Productivity** Greatly increases yields. **Adaptation** Maintains yields in the face of drought and dry spells. **Mitigation** Enhances carbon sequestration as it ensures maximum vegetation cover. Improved productivity per unit of water used hence reducing emissions per unit of produce.
	Highlands and the Foothills (Semonkong, Marakabei) <30%	S		

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Potato (3.5% of total harvested area)				
Crop rotations	Lowlands (Mafeteng, Monale's Hoek) <30%	S		**Productivity** Increases yields. Multiple crops can be grown on the same field. Improves soil fertility when rotated with appropriate crops. **Adaptation** Improves soil texture, and helps prevent diseases and pests. **Mitigation** Enhances sequestration of carbon.
	Highlands and the Foothills (Semonkong, Marakabei) <30%	S		
Vegetables (2% of total harvested area)t				
Improved varieties	Southern region (Mafeteng, Mohale's Hoek) <30%	S		**Productivity** Greatly increases yields and incomes. Allows all year round production. Ensures all year round nutrition for men, women and children. **Adaptation** Maintains yields in the face of droughts and dry spells. Enhances physical health and resilience of men, women and children. **Mitigation** Reduces emissions since it maintains the integrity of the soil. Improves productivity per unit of water when appropriate irrigation technologies are used (e.g. drip irrigation).
	North region (Leribe, Botha-Buthe) <30%	S		
Water harvesting (underground)	Southern region (Mafeteng, Mohale's Hoek) 30-60%	S		**Productivity** Increases productivity hence incomes. Reduces runoff and loss of water for use in vegetable production. **Adaptation** Prevents soil erosion. Increases availability of water during dry spells and droughts. **Mitigation** Soil conservation through reduced erosion hence reduces emissions. Reduced loss of water as runoff results in reduced emissions.
	North region (Leribe, Botha-Buthe) 30-60%	S		



Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Sheep and goat (66% of total harvested area)				
Rotational grazing	Southern region (Mafeteng, Mohale's Hoek) 30-60%	S		**Productivity** Increases productivity due to better nutrition of animals. **Adaptation** Reduces soil erosion and land degradation. Healthy grazing land ecosystem and pastures help reduce impact of droughts and floods. **Mitigation** Enhances vegetation cover and facilitates carbon sequestration. Enhances regeneration of pastures hence allowing for improved carbon storage.
	North region (Leribe, Botha-Buthe) 30-60%	S		
Grassland restoration and conservation	Southern region (Mafeteng, Mohale's Hoek) 30-60%	S		**Productivity** Increases productivity due to improved nutrition of animals. **Adaptation** Reduces degradation of soils, reduces soil erosion and enhances vegetative cover and biodiversity. Healthy grazing land ecosystem and pastures help reduce impact of droughts and floods.. **Mitigation** Maintains and improves vegetative cover hence reduces greenhouse emissions.
	North region (Leribe, Botha-Buthe) 30-60%	S		
Pigs (66% of total harvested area)				
Improved housing	Mountains <30%	S		**Productivity** Increases meat production due to conducive environment for feeding and growth. **Adaptation** Protects the stock from extreme weather conditions such as heat waves, floods or extreme cold. **Mitigation** Enhances manure management hence reduced emissions.
	Lowlands and foothill <30%	S		

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Pigs (66% of total harvested area)				
Improved nutrition	Mountains 30-60%	S		**Productivity** Increases yields and quality of meat, ensures fast growth of animals. **Adaptation** Enhances adaptive capacity since healthy animals are more resilient. **Mitigation** Improves feed efficiency hence reduces emissions of methane and carbon dioxide.
	Lowlands and foothill 30-60%	S		
Dairy (66% of total harvested area)t				
Improved livestock breeds	Southern region (Mafeteng) <30%	S		**Productivity** Increases yield quantity and quality. **Adaptation** Enhances adoption of other strategies such as management of the stock; this reduces environmental degradation and wastage of feeds. Improved breeds may be more resilient to weather extremes. **Mitigation** Reduces feed requirements, hence reduction in the emissions. Greater production per unit of feed results in reduced emissions per unit of milk.
	Central region (Maseru) <30%	S		
Improved fodder and feeding	Southern region (Mafeteng) <30%	S		**Productivity** Increases milk production and income. Reduces production costs and hence increases profits. **Adaptation** Enhances availability of feeds, even during dry spells and droughts. Ensures healthy animals, which are more resilient to hazards. **Mitigation** Reduced emissions due to less land tillage using farm machinery. Greater production per unit of feed results in reduced emissions per unit of milk.
	Central region (Maseru) <30%	S		

Yield Income Water Soil Risk/Information Energy CO_2 Carbon N_2O Nutrient

CSA practice	Region and adoption rate (%) <30 30-60 60>	Predominant farm scale S: small scale M: medium scale L: large scale	Climate smartness	Impact on CSA Pillars
Poultry (66% of total harvested area)				
Disease management	Mountains <30%	S	3.8	**Productivity** Increases weight of live birds; increases laying rate. Reduces mortality and hence improves productivity and profitability. **Adaptation** Healthy poultry result in improved resilience to climate hazards **Mitigation** Slightly reduces emissions, though not significantly.
	Lowlands, Senqu river valley, Foothills 30-60%	S M	3.7	
Improved feeding	Mountains <30%	S	3.3	**Productivity** Increases weight of live birds; increases laying rate. **Adaptation** Reduces burden on women to look for feeds; creates jobs for women. Improves poultry health and hence resilience to hazards. **Mitigation** Reduces emissions due to enhanced feeding efficiency.
	Lowlands, Senqu river valley, Foothills 30-60%	S M	3.3	

Institutions and policies for CSA

Climate policy in Lesotho is formulated and implemented by the Ministry of Energy and Meteorology, which also acts as the country's National Designated Authority (NDA) for the Green Climate Fund (GCF). Within this ministry, the Lesotho Meteorological Service (LESMET) is responsible for the day-to-day climate change related activities. The Ministry of Tourism, Environment and Culture is the focal point for the United Nations Framework Convention on Climate Change (UNFCCC) including the Global Environment Fund (GEF).

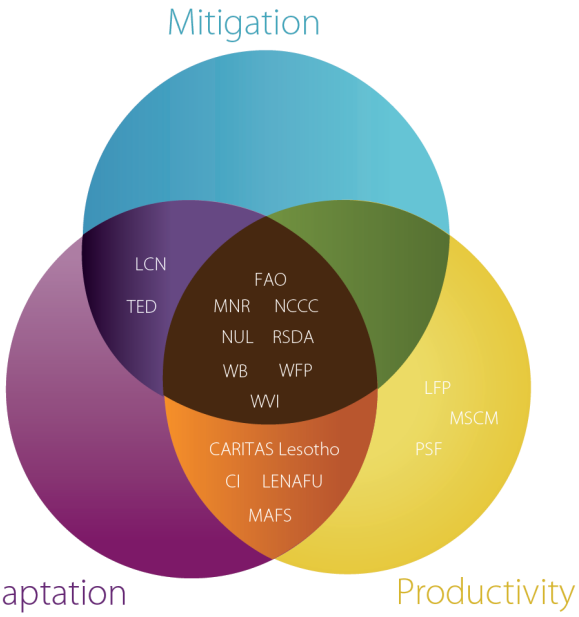
Government projects related to CSA include the Lesotho Renewable Energy-Based Rural Electrification Project that is being implemented as a pilot in three districts in the country. The project is co-financed by Government of Lesotho and the GEF through UNDP, and could have to support various climate-smart activities such as irrigation and agricultural processing. The GEF funded NAPA project "Improvement of early warning systems to reduce impacts of climate change and capacity building to integrate climate change into development plans" is being implemented through the United Nations Environment Programme (UNEP) in partnership with the Government of Lesotho (GoL). Through the UNDP coordinated GEF-Small Grants Program, a number of agriculture and climate change small community projects are being evaluated for financing[14].

The Food and Agriculture Organization of the United Nations (FAO) has supported in building the knowledge base for CSA through development and harmonization of visual training materials to be used in the promotion of CSA practices, mostly focusing on CA and keyhole gardens. This collective effort was coordinated and facilitated through the Resilience Strategy implemented by FAO and the GoL. The work also resulted in the establishment of the Lesotho National Conservation Agriculture Task Force (NCATF), which has been provided with support by FAO to develop and maintain a website[15], develop awareness raising materials, conduct trainings, and coordinate all actors involved in conservation agriculture promotion in the country. Other working groups supported include the Home Gardening and Nutrition Working Group, and the Sustainable Land Management Working Group. These working groups incorporate broad stakeholder involvement including civil society organizations (CSOs) that play an important role in CSA promotion. CSOs such as World Vision International (WVI) have been promoting CA across all ten districts of the country, in collaboration with organizations such as Caritas Lesotho and CARE International. A National Climate Change Committee (NCCC) established in 2013 also exists, as a multistakeholder, inter-ministerial committee serving as an advisory board to the Ministry of Energy and Meteorology.

In terms of research, the Ministry of Agriculture and Food Security (MAFS) has conducted CSA-related research across the four agro-ecological zones of Lesotho, analyzing the agronomic responses of maize under CA versus conventional approaches. MAFS is a key institution for CSA and is involved in many of the CSA-related initiatives in the country including CA promotion, keyhole gardens and irrigation development. The National University of Lesotho in partnership with the University of Tennessee (USA) has conducted CA research activities in Maphutseng, focusing on understanding the mitigation benefits of CA compared to conventional agriculture, as well as conducting research on locally appropriate cover crops. The National University of Lesotho conducts research and provides information on drought-tolerant, and pest- and disease- resistant crop varieties and livestock breeds, as well their nutritional value.

Cooperatives and the Lesotho National Farmers Federation (LENAFU) play an important role in agricultural production and marketing in the country. Capacity building efforts on CSA could be directed at these farmer-based institutions, while also building their business, financial management and negotiation skills.

Institutions for CSA in Lesotho



CI Care International **FAO** Food and Agriculture Organization of the United Nations **LCN** Lesotho Council of NGOs **LENAFU** Lesotho National Farmers Union **LFP** Litsoamobuny Fresh Produce **MAFS** Ministry of Agriculture and Food Security **MSCM** Ministry of Small Business Development, Cooperatives and Marketing **MNR** Ministry of Natural Resources **NCCC** National Climate Change Committee **NUL** National University of Lesotho **PSF** Private Sector Foundation **RSDA** Rural Self-Help Development Association **TED** Technologies for Economic Development **WB** The World Bank Group **WFP** World Food Programme **WVI** World Vision International

14 www.undp.org/content/dam/lesotho/docs/ProjectDocuments/AAPLesotho%20Prodoc.doc

15 https://www.lesothocsa.com/

In summary many of the institutions that have programs and projects related to climate change and agriculture have focused on the adaptation and productivity pillars of the CSA concept, with little focus placed on the mitigation pillar. Emergency response and relief aid has also been a focus due to the high vulnerability of the country to recurrent droughts. Knowledge of CSA remains low and there is need for enhanced awareness raising efforts, and capacity building on appropriate climate-smart practices for different agricultural commodities and different locations in the country.

The graphic in page 22 highlights key institutions whose main activities relate to at least one of the three CSA pillars (adaptation, productivity and mitigation). More information on the methodology is available in Annex 3.

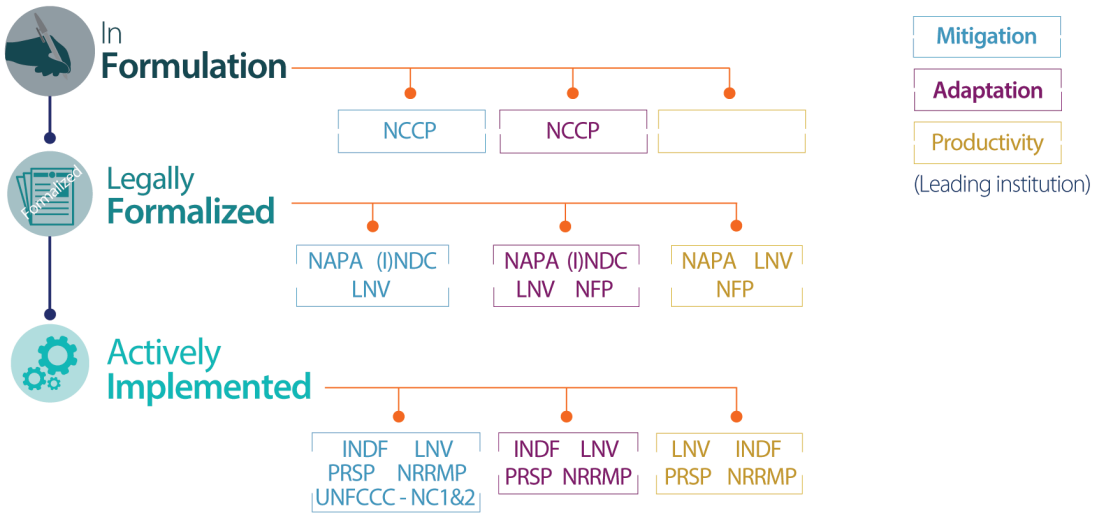
In terms of policy environment, the government of Lesotho acknowledges that climate change is a threat to national development. To show commitment to addressing climate change challenges, the country signed and ratified the UNFCCC and acceded to the Kyoto Protocol. The country submitted its First and Second National Communications to the UNFCCC in 2000 and 2013 respectively. The communications detail climate change impacts and adaptation options in eight sectors deemed vulnerable to climate change, including; water, agriculture, rangelands, forestry, soils, health, biodiversity, and Basotho culture [35]. In 2006, the country embarked on the preparation of a National Adaptation Program of Action (NAPA), which highlighted eleven priority adaptation areas including increasing livestock and crop production; securing water supply; enhancing food security; improving flood prone areas and wetlands; improving early warning climate disaster systems; and policy reform to integrate climate change into development [23]. Lesotho's NDC highlights agriculture as a focus area for adaptation, but does not mention the sector among its mitigation priorities even though the sector is a major GHG source in the country.

Lesotho's Agriculture and Food Security Policy (2006) indicates that agriculture is critically dependent on natural resources such as land, water, and forests. The policy highlights the need for soil fertility replenishment and increased use of high yielding crop varieties and improved livestock breeds. Key practices mentioned for this purpose are conservation agriculture, block farming, rangeland management and homestead gardens. The policy highlights that climate change has serious impacts on agriculture and livestock, emphasizing the need for adoption of climate-smart practices [34].

The National Environmental Policy (1998) provides the framework for water policy development in the country. The policy recognizes periodic prolonged drought, scarcity of water for agriculture, and pollution of land and water resources in its preamble; advocating for increased access to potable water [34].

Lesotho's National Forestry Policy (2008) encourages communities and individuals to participate in forestry

Policies for CSA in Lesotho



(I)NDC Intended Nationally Determined Contributions (2015) (LMS) **INDF** Interim National Development Framework (2008) (MDP) **LNV** Lesotho National Vision 2020 (2000) (MFDP) **NAPA** National Adaptation Programme of Action (2007) (MNR) **NCCP** National Climate Change Policy (2017 draft) (MEM) **NFP** Ministry of Forestry and Land Reclamation (2008) (MFLR) **NRRMP** National Range Resources Management Policy (2014) (MFLR) **PRSP** Poverty Reduction Strategy Paper (2004) (MDP) **UNFCCC - NC1&2** National Communications to the UNFCCC (1992) (MEM)

development and community plantation management to reduce deforestation[16], and protect against water and wind erosion [34]. Regionally, Lesotho is a participant of the SADC Reducing Emissions from Deforestation and Land Degradation (REDD +) program whose goal is to contribute to the sustainable management of the forests of the SADC region while contributing to poverty reduction, sustainable development and climate change mitigation [34].

The country has a National Gender and Development Policy (2003) which mentions the need for equitable access to land and other natural resources as a key requirement for the adoption of more resilient agricultural practices. The Disaster Management Act (1997) focuses on reducing vulnerability to disasters, particularly food security related vulnerability caused by climate hazards such as droughts and floods. Within the framework of this policy, the Lesotho Disaster Management Authority (DMA) undertakes annual vulnerability assessments throughout the country through a multi-sectoral and multidisciplinary committee called the Lesotho Vulnerability Assessment Committee (LVAC).

The critical state of agriculture and national development as well as the effects of climate change led the Government to prioritize agriculture and food security, with its goals in this regard outlined in Vision 2020 (2000) and the National Strategic Development Plan (NSDP, 2012). The NSDP focuses on creating employment, developing infrastructure, promoting technology adoption, reversing environmental degradation, and enhancing adaptation to climate change [36].

Recently, the country began the process of developing a National Climate Change Policy (NCCP) and a National Resilience Strategic Framework (NRSF). Both documents are currently in draft status. The NCCP specifically mentions the need for climate-smart practices, and marks a significant step in integrating CSA into the country's policies and programs. The latter outlines eleven pillars including strengthening preparedness for disaster and climate risks, environmental protection, sustainable natural resource management along which the country will mainstream resilience. The NRSF provides for different roles that various organizations will play in the actualization of the strategy. Through the Smallholder Agriculture Development Project (SADP), the country is in the process of finalizing development of an Irrigation Master Plan to guide and strengthen investment in irrigation and promote adoption of climate-smart practices by farmers[17]. The SADP aims at increasing smallholder agricultural productivity, supporting diversification into market oriented agriculture, and improving the enabling environment for agribusiness activities.

Lesotho has also embarked on the process of developing a National Adaptation Plan (NAP) with support from UNDP and FAO. The NAP is expected to incorporate some CSA practices. A Lesotho Sustainable Land and Water Management Strategic Investment Programme[18] (2014-2024) exists, and highlights the need for integrated land and (small scale) water management, focusing on practices such as conservation agriculture, agroforestry, various soil and water conservation methods (including "donga[19]" stabilization), and the restoration of seriously degraded wetlands.

Although the tenets of CSA are embedded in the country's food security policies and programs, Lesotho has few policies directly related to or mentioning CSA. Even though there are many climate-resilient practices mentioned in various policies, a greater effort is required to ensure that CSA is better mainstreamed in all national policies.

The graphic in page 23 shows a selection of policies, strategies and programs that relate to agriculture and climate change and are considered key enablers of CSA in the country. The policy cycle classification aims to show gaps and opportunities in policy-making, referring to the three main policy cycle stages: policy formulation (referring to a policy that is in an initial formulation stage/ consultation process), policy formalization (to indicate the presence of mechanisms for the policy implementation at national level), and policy implementation (to indicate visible progress toward achieving policy goals, through concrete strategies and action plans). For more information on the methodology, see Annex 4.

Financing CSA

Lesotho's NDC indicates that, "In the absence of an official national adaptation plan, the NAPA options remain the best indication of the nation's intentions for adaptation" [14]. The NAPA projects include a number of CSA-related initiatives including fodder production, crop rotations, agroforestry (fruit tree planting), water harvesting, improved early warning and climate information, and wetland management among others. The NAPA costs are estimated at approximately US$20 million, and although valuable in their right as projects, they are likely a gross underestimation of the scale of the adaptation needs in the country. For example, in 2016 donors contributed US$40.7 million for the country's El Nino related drought response alone[20]. On the other hand, the NDC indicates that for the period 2015 – 2020, the cost of implementing forestry-related mitigation actions are approximately US$24 million, with this being conditional on external financial support.

16 Deforestation is largely caused by the harvesting of wood for fuel and building materials.

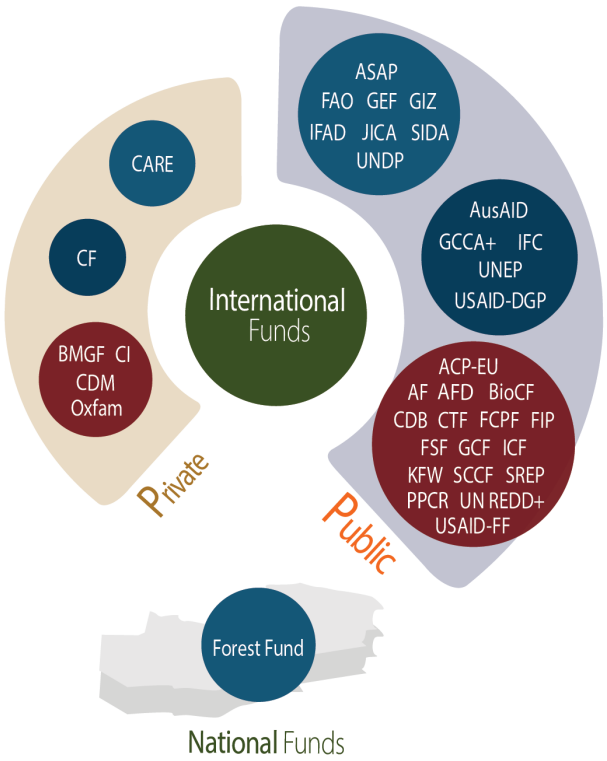
17 Examples of technologies likely to be supported include stress tolerant horticulture, conservation agriculture, small-scale irrigation and water harvesting, improved homestead gardening, and sustainable processing technologies.

18 http://terrafrica.org/wp-content/uploads/2013/downloadable-resources/SLM-LSIF-Pro-Doc_Final.pdf

19 Donga is a local name for a gulley

20 https://reliefweb.int/sites/reliefweb.int/files/resources/lesotho_cerf_allocations_overview_12may2017.pdf .

Financing opportunities for CSA in Lesotho



- Funds actually accessed by country for CSA purposes
- Funds actually accessed by country for purposes other than CSA
- Funds not accessed by the country

ACP-EU African, Caribbean and Pacific-European Union Energy Facility **AF** Adaptation Fund **AFD** French Development Agency **AusAID** Australian Agency for International Development **BioCF** World Bank BioCarbon Fund **BMGF** Bill and Melinda Gates Foundation **CARE** Cooperative for Assistance and Relief Everywhere **CDB** China Development Bank **CF** The Clinton Foundation **CI** Conservation International **CTF** Clean Technology Fund **FAO** Food and Agriculture Organization of the United Nations **FCPF** Forest Carbon Partnership Facility **FIP** Forest Investment Program **FSF** Japan's Fast-Start Financing **GCF** Green Climate Fund **GEF** Global Environment Facility **GIZ** German Society for International Cooperation **ICF** United Kingdom International Climate Fund **IFAD** International Fund for Agricultural Development **IFC** International Finance Corporation **JICA** Japan International Cooperation Agency **KfW** German Development Bank International Climate Initiative **PPCR** Pilot Program for Climate Resilience **SCCF** Special Climate Change Fund **SIDA** Swedish International Development Cooperation Agency **SREP** Scaling Up Renewable Energy in Low Income Countries Program **UNDP** United Nations Development Programme **UNEP** Unite Nations Environmental Programme **UN REDD** United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation

The country does however have a significant portfolio of agricultural climate change adaptation and mitigation related projects. The main sources of international climate financing for these projects include the GEF and multilateral development banks such as the World Bank and the African Development Bank (AfDB). The country has accessed US$15 million from the GEF for national projects[21] and a further US$27 million from the Least Developed Countries Fund (LDCF). These projects have included initiatives on strengthening climate services in the country, supporting integrated watershed management, improved rangeland management, and fodder production, all with a link to CSA without explicitly mentioning the CSA concept.

The World Bank being a major funder of agricultural development projects in the country has made a concerted effort to ensure the integration of climate-smart practices into their projects. For example, the World Bank - International Development Association funded Smallholder Agricultural Development Project that began in 2016, was in 2017 allocated an additional US $10 million to strengthen the integration of climate-smart and climate resilient practices into the project with focus on smallholder farmers. Some practices identified include stress-tolerant horticulture, conservation agriculture, small-scale irrigation and water harvesting, improved homestead gardening, and sustainable processing technologies[22]. The World Bank has also supported the Ministry of Energy and Meteorology (MEM) to develop a Scaling Renewable Energy Program (SREP) Investment Plan (IP)[23], which highlights the potential uses of different energy investments for agriculture for example through irrigation possibilities, flood and drought protection and possibilities for agricultural processing. The African Development Bank (AfDB), as part of its goal to increase its climate finance to US$5 billion annually by 2020, has been a major contributor to climate change adaptation work in Lesotho. The ADB cofinances (with the GEF) US$17 million of the US$21.4 million project on Climate Change Adaptation for Sustainable Rural Water Supply in Lowlands, which includes aspects of flood and drought management, water harvesting for humans consumption as well as for crops and livestock. These projects highlight multi-purpose development of water infrastructure as a key means of supporting agricultural productivity and resilience in the country.

United Nations agencies such as FAO, UNDP and UNEP also support agriculture, forestry and natural resources related initiatives in the country. Regional organizations such as the Common Market for Eastern Africa (COMESA), through partners such as FAO, have funded conservation agriculture awareness raising and coordination in the country. Bilateral donors such as USAID, DFID, The Netherlands Development Agency and the European Commission fund various agriculture and climate change related initiatives.

Multi donor trust funds exist, particularly the United Nations Central Emergency Response Fund (CERF), designed to address the most urgent needs in food security, nutrition, agriculture, water and sanitation, and health. CERF has focused largely on drought response interventions such as seed and fertiliser distribution; however, organizations such as FAO have made a concerted effort to integrate climate-smart practices into their support by providing awareness

21 This does not include regional or multi-country projects to which Lesotho may be a part.

22 http://www.worldbank.org/en/news/press-release/2017/09/29/lesotho-to-direct-smallholders-towards-climate-smart-agriculture

23 https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/srep_18_4_investment_plan_lesotho_final_0.pdf

raising on conservation agriculture and other climate-smart practices to participating households. More could be done to mainstream CSA and long-term agricultural resilience building into the CERF and other emergency response funds in the country.

At the national level, there are limited funds available for agricultural climate change adaptation and mitigation initiatives in the country. A Forest Fund exists under the control of the Ministry of Agriculture, receiving voluntary contributions as well as fees and fines collected under the Forest Act. The funds are then used for forest management, forest research, reforestation initiatives and in some cases payments for community forest management[24].

Most funding has been toward agricultural productivity projects and there is a general lack of awareness of the diverse availability of international funding sources for agricultural climate change adaptation and mitigation. International funding for forestry is highly limited and the country has not accessed international funds for forestry related projects.

Potential Finance

Lesotho has not accessed many of the major sources of climate funding available including the Adaptation Fund and the Green Climate Fund. The country is yet to elaborate its National Adaptation Plan (NAP), which could give an updated and more realistic estimation of the costs of adaptation in the country, giving direction for donors on priority agricultural adaptation projects and their costs. Having a better understanding of the agricultural adaptation and mitigation options and costs would be a key requirement for long-term financial planning and resource mobilisation for CSA in the country.

Positively, the draft National Climate Change Policy, states that the Government of Lesotho will allocate a percentage of the national budget towards issues pertaining to climate change and will also advocate for private sector involvement in climate change adaptation through public-private partnerships, while government departments are encouraged to create an enabling environment for climate finance for all sources. Although no specific budget percentage is mentioned and neither are specific focus areas, it will be crucial to ensure that climate-smart practices are prioritised within national budgets, possibly through the National Agricultural Investment Plan (NAIP). Understanding the challenges and creating the enabling environment for private sector involvement in CSA will also be an important area of work and can be tackled by conducting a specific private sector engagement study to identify strategies to involve the private sector in CSA scaling up. Conducting sub-national climate risk profiling, commodity specific climate risk profiling and cost benefit analysis of different CSA technologies across different regions could facilitate private sector investment in agricultural value chains. The policy also indicates the need to leverage Green Bonds, which could be applied for the agricultural sector to promote climate-smart practices; this would however require the development of suitable eligibility criteria.

With the large number of smallholder farmers and relatively few large-scale commercial farmers, there is need to develop microfinance initiatives tailored to smallholder CSA investments. Similarly, with a large number of cooperatives in the country, greater effort could be made to sensitize these groups on CSA and support their access to public and private finance for CSA investments.

Outlook

There is an urgent need for finance to support agricultural adaptation and mitigation, as well as other related initiatives such as rural electrification, hydropower generation, and climate information provision. In addition, Lesotho requires greater support in terms of technology transfer for climate-smart practices as well as capacity building of farmers, cooperatives, development partners and extension agents. The three interlinked areas of finance, technology and capacity are mentioned in a number of climate change related documents including the country's NDC, and efforts to support these three aspects need to be well supported and coordinated through the relevant government Ministry.

Lesotho has a limited climate policy environment; however, this is set to change once the draft Climate Change Policy is adopted. Although the policy specifically mentions CSA as a key priority, there is need to ensure availability of finance (public and private, domestic and international), as well as build capacity of all the relevant stakeholders to implement the strategies identified. Greater awareness raising and sensitization of extension actors and farmers on climate-smart practices will be a key action.

Although various government documents, including the NDC, indicate agriculture as being one of the major GHG emitters in the country, little focus has been placed in these documents on identifying agricultural mitigation initiatives, while greatest focus has been placed on energy and forestry. A deeper analysis of the linkages between forestry, energy and agriculture, along with a concerted effort to identify mitigation opportunities linked to the agricultural adaptation priorities would be of benefit to the country's mitigation goals. Ensuring energy-related initiatives can be tailored to support the needs of smallholder farmers will be important in supporting the country to adopt some climate-smart practices (for example energy for irrigation, storage and processing of agricultural produce).

24 http://www.fao.org/docrep/003/x6821e/X6821E09.htm

Land degradation and natural resource management are major challenges, and locally appropriate CSA practices and investments are needed that improve the natural resource base. Soil based CSA practices could play a key role in ensuring food security in a declining natural resource base and a changing climate. Multi-purpose development of water-related infrastructure is a key investment for agricultural productivity as well as flood and drought management in the country.

At present, there is limited information on the costs of adaptation and mitigation initiatives in the agricultural sector, and a detailed assessment to determine these needs and costs will benefit better long term planning on CSA finance for the country. A greater focus on capturing data related to technology adoption rates, and on availability and ease of access to CSA technologies and inputs is needed. In the absence of a detailed analysis of these factors, current and future CSA-related investments need to have data collection and analyses integrated within them to provide a basis to inform policy decisions and guide CSA planning in the country.

Works cited

[1] FAO. 2010. "Climate-Smart" Agriculture. Policies, practices and financing for food security, adaptation and mitigation. Rome: Food and Agriculture Organization of the United Nations (FAO).

[2] FAO. 2013. Climate-smart agriculture sourcebook. Rome: FAO.

[3] World Bank. 2017. World Development Indicators: Lesotho. Washington, D.C.: World Bank (WB). **Available at:** http://data.worldbank.org/data-catalog/world-development-indicators

[4] FAO. 2017. Food and agriculture data (FAOSTAT). Rome: FAO. Available at: http://www.fao.org/faostat

[5] Government of Lesotho. 2013. Lesotho Sustainable land and Water Management Strategic Investment Programme 2014-2024.

[6] LVAC. 2017. Lesotho Vulnerability Assessment Committee. Annual Vulnerability Assessment and Analysis report. June 2017

[7] Government of Lesotho. 2015a. 2013/2014 agriculture production survey; crops.

[8] World Bank. 2015. Lesotho: Systematic Country Diagnostic

[9] UNDP. 2016. Human Development Report 2016. http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf

[10] Lesotho Bureau of Statistics. 2011. Lesotho Demographic Survey Report http://www.bos.gov.ls/New%20Folder/Copy%20of%20Demography/2011_Lesotho_Demographic_Survey_Report.pdf

[11] Government of Lesotho. 2014. Lesotho Agriculture and Food Security Investment Plan. NAIP 2015-2020.

[12] FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Available at: http://www.fao.org/nr/water/aquastat/data/query/results.html

[13] IFPRI. 2009. Measuring irrigation Performance in Africa. International Food Policy Research Institute. IFPRI Discussion Paper 00894. https://reliefweb.int/sites/reliefweb.int/files/resources/240F109982EEBCCD4925762C000A31F6-Full_Report.pdf

[14] Government of Lesotho. 2015b. Nationally Determined Contribution (NDC) of Lesotho to the United Nations Framework Convention on Climate Change (UNFCCC). Available at: http://www4.unfccc.int

[15] LVAC. 2016. Lesotho Vulnerability Assessment Committee. Annual Vulnerability Assessment and Analysis report. May 2016.

[16] EIU. 2016. Global Food Security Index. Economic Intelligence Unit (EIU). Available at: http://bit.ly/1nwKY4r

[17] WFP. 2016. Food Aid Information System. World Food Programme (WFP). Available at: http://bit.ly/1nwKY4r

[18] IFPRI. 2011. International Food Policy Research Institute. IFPRI Food Security Portal. http://www.foodsecurityportal.org/api/countries/fao-calorie-supply-p/lesotho

[19] Lesotho Bureau of Statistics. 2011. Budget Household Survey 2010-2011 http://www.bos.gov.ls/Downloads.htm

[20] AFDB. 2005. Multi-sector country gender profile: African Development Bank pp 25 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/lesotho.pdf

[21] IFPRI. 2017. International Food Policy Research Institute. IFPRI Global Hunger Index (GHI). http://www.globalhungerindex.org/results-2017/

[22] WRI. 2018. Climate Data Explorer. Washington, DC: World Resources Institute (WRI). Available at: http://cait.wri.org

[23] MNR. 2007. National Adaptation Programme of Action on Climate Change. Ministry of Natural Resources, Lesotho (MNR)

[24] FAO. 2016. El Nino- induced drought briefing- February 2016. Available at: http://www.fao.org/fileadmin/user_upload/emergencies/docs/FAOLesotho_ElNinoResponsePlanBriefing_February2016.pdf

[25] Dejene, A., Midgley, S., Marake, M. and Ramasamy, S. 2011. Experience and Lessons from Lesotho Strengthening Capacity for Climate Change Adaptation in Agriculture. http://www.fao.org/docrep/014/i2228e/i2228e00.pdf.

[26] World Bank. 2016. "Lesotho Water Security and Climate Change Assessment." World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO. Available at: https://www.gfdrr.org/sites/default/files/publication/lesotho-water-security-climate-change-assessment.pdf

[27] Collins M; Knutti R; Arblaster J; Dufresne JL; Fichefet T; Friedlingstein P; Gao X; Gutowski WJ; Johns T; Krinner G; Shongwe M; Tebaldi C; Weaver AJ; Wehner M. 2013. Long-term climate change: Projections, commitments and irreversibility. In: Climate change. The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Stocker TF; Qin D; Plattner GK; Tignor M; Allen SK; Boschung J; Nauels A; Xia Y; Bex V; Midgley PM. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. pp. 1029–1036. DOI: 10.1017/CBO9781107415324.024

[28] Ramírez J; Jarvis A. 2008. High-resolution statistically downscaled future climate surfaces. International Center for Tropical Agriculture (CIAT); CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Cali, Colombia.

[29] Ramírez-Villegas J; Thornton PK. 2015. Climate change impacts on African crop production. Working Paper No. 119. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. Available at: http://hdl.handle.net/10568/66560

[30] Robinson, S., Mason-D'Croz, D., Islam, S., Sulser, T., Gueneau, A., Pitois, G., and Rosegrant, M. W. 2015. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model description for version 3 (IFPRI Discussion Paper). Washington, D.C: International Food Policy Research Institute (IFPRI). Available at: http://ebrary.ifpri.org

[31] ATPS. 2013. Farmers' Response and Adaptation Strategies to Climate Change in Mafeteng District, Lesotho [Tsepo Stephen Tiisetso Sekaleli, Karabo Sebusi]. ATPS WORKING PAPER No. 74. African Technology Policy Studies Network.

[32] Silici, L. 2010. Conservation Agriculture and Sustainable Crop Intensification in Lesotho. Food and Agriculture Organization of the United Nations. FAO. Rome. www.fao.org/docrep/012/i1650e/i1650e00.pdf

[33] Billingsley, R., Mothunyane, M. and McLean, S. 2013. Lessons from Lesotho: how a 'joined-up' approach, centered on keyhole gardens, is tackling linked issues of hunger, nutrition and poverty. Paper for the Hunger, Nutrition, Climate and Justice Conference. 15-16 April 2013.

[34] Gwimbi, P; Likoetla, P; Thabane, K; Matebesi, P. 2014. A Comprehensive Scoping and Assessment Study of Climate Smart Agriculture (CSA) Policies in Lesotho. Food Agriculture, Natural Resources Policy Analysis Network (FANRPAN). https://www.fanrpan.org/archive/documents/d01756/Lesotho_Comprehensive_Scoping_Assessment_of_CSA_Policies.pdf

[35] MEMWA. 2013. Second National Communication of Lesotho to the UNFCCC; Ministry of Energy, Meteorology and Water Affairs, Lesotho (MEMWA). Available at: http://unfccc.int/resource/docs/natc/lsonc2.pdf

[36] South South North. 2017. Southern African Climate Finance Partnership: Lesotho Country Diagnostic. http://southsouthnorth.org/wp-content/uploads/Lesotho-diagnostic-2017.05.10.pdf

For further information and online versions of the Annexes

Annex 1: Selection of agricultural production systems key for food security in Lesotho (methodology)
Annex 2: Methodology for assessing climate-smartness of ongoing practices
Annex 3: Institutions for CSA in Lesotho (methodology)
Annex 4: Policies for CSA in Lesotho (methodology)
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Annex 7: Trends in food assistance requirements

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