Lesotho
Climate-Smart Agriculture Investment Plan

Opportunities for transitioning to more productive, climate-resilient, and low carbon agriculture

KHOTSO PULA NALA

WORLD BANK GROUP

Executive Summary

1. **The objective of this report is to fill knowledge gaps and identify investments to transform Lesotho's agriculture to a productive, resilient, and low-emissions sector.** The report identifies climate-smart agriculture (CSA) strategies to mitigate and adapt to climate vulnerability and evaluates the costs and benefits of investments to implement the strategies. CSA is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. CSA comprises three pillars: increasing productivity, enhancing resilience and adaptation, and reducing greenhouse gas emissions from the agriculture sector compared to past trends. A CSA strategy refers to a plan of actions to achieve CSA goals and targets for a country. Apart from climate change, Lesotho's agriculture sector is confronted with several endogenous and exogenous risk factors that make the country heavily dependent on food imports to meet domestic consumption needs.

2. **Lesotho's agricultural productivity challenges include small landholding of less than 1 ha for most households, outdated farm technologies and farm management practices, limited technical expertise, suboptimal use of inputs by most farmers, lack of an adequate irrigation and drainage system, weak rural infrastructure, a rudimentary rural advisory system, and limited access to credit and investment capital.** In addition, severe land degradation and climate variability with regular cycles of drought and intense rainfall have contributed to massive soil erosion, loss of scarce agricultural land, and rural poverty.

Climate change and agricultural vulnerability

3. **Climate is a major determinant of crop yield variability in Lesotho.** Very dry conditions can suppress yields, leading to low productivity. The variability of yield and thus production from year to year can be extreme and are primarily due to rainfall deficits leading to soil moisture stress and reduced rangeland productivity. The El Niño-Southern Oscillation (ENSO) phenomenon particularly affects climate variation in Lesotho. High intraseasonal and

interannual rainfall variability, with frequent droughts, has often resulted in delayed planting or farmers not planting at all, reduced seed germination due to hardened soil and lack of water, crop failures, deterioration of rangelands and pastures, water scarcity for livestock, and increased food prices.

4. **Increasing agricultural productivity, enhancing its resilience to climate change, and reducing the emissions that come from the agricultural sector are, therefore, triple imperatives that require alternative sets of practices.** CSA seeks to increase productivity in an environmentally and socially sustainable way, strengthen farmers' resilience to climate change, and reduce agriculture's contribution to climate change by reducing greenhouse gas (GHG) emissions and sequestering carbon.[1]

Climate smart agriculture investment plan (CSAIP) analytical approach

5. **The CSAIP analytical approach began with a stakeholder process that identified the vision and goals for Lesotho's agriculture sector.** Five CSA targets were developed that focus on increasing agricultural productivity, enhancing resilience, and reducing emissions. All five targets address productivity, the central goal of most agricultural policies, while two targets each focus on enhancing climate resilience and mitigation (table ES.1). A number of strategies were identified for achieving the specified targets. A CSA strategy refers to a plan of actions to achieve CSA goals and targets for the country. A CSA strategy typically includes techniques to managing climate risks, understanding and planning for adaptive transitions that may be needed for example into new farming systems or livelihoods, and exploiting opportunities for reducing GHG emissions. The strategies are clustered into three groups: climate resilience and nutrition security, commercialization, and capacity development strategies (table ES.2).

6. **The CSAIP analytical approach also includes scenario development that helps define specific pathways to achieve the proposed targets.** It was also a stakeholder-driven process to test the plausibility of identified agriculture sector goals and served as a "reality check" to the outcomes given future uncertainties and other constraints. Two major drivers that may influence agricultural development in Lesotho—agricultural trade and sustainable landscape management—were used to formulate land-use scenarios for 2010 to 2050. The scenarios developed were Current Trends, Commercialization, and Resilient Landscape (figure ES.1).

7. **The Current Trends (CT) scenario generally follows the current development pathway and ongoing tendency of market liberalization but with relatively low ambition toward sustainable landscape management.** A general

TABLE ES.1: LESOTHO CSA TARGETS

No.	Targets for long-term vision	CSA pillars addressed
1	Increase yields of major staples by a factor of 2.5.	P
2	Double income of smallholder farmers.	P, R
3	Increase agricultural exports by a factor of 2.5.	P, R
4	Reduce agricultural GHG emissions by 25%.	P, M
5	Reduce livestock emissions intensity by 25%.	P, M

Source: Authors based on stakeholder workshops
Note: P = productivity; R = resilience; and M = mitigation

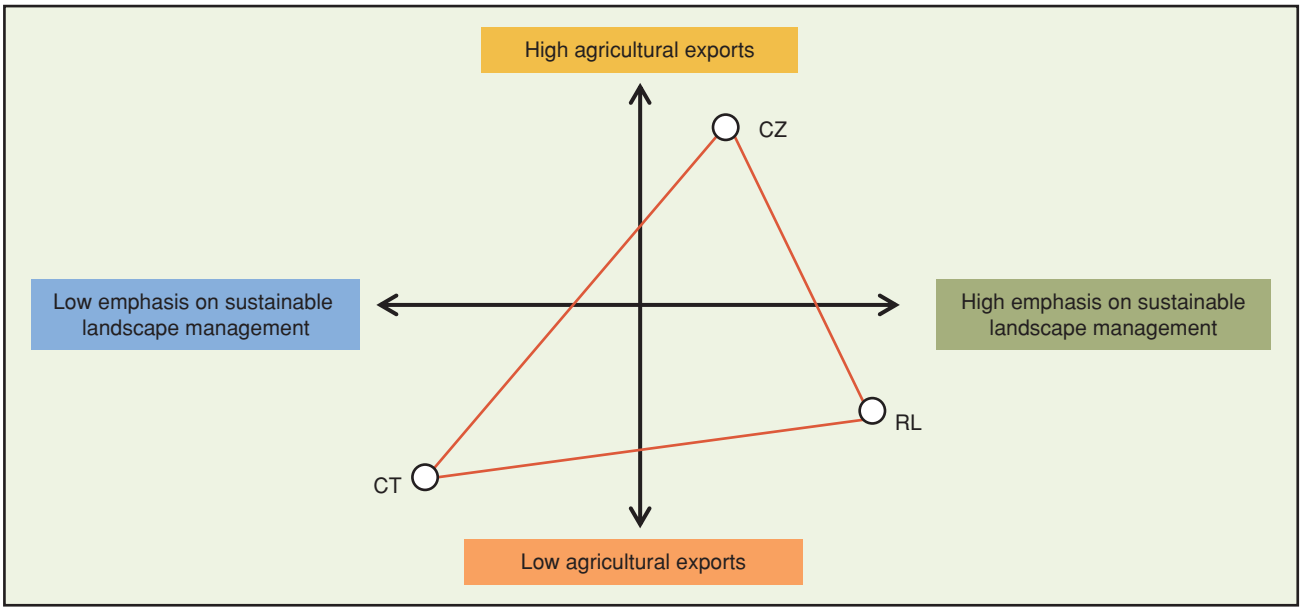
[1] Adaptation refers to adjustments in social and ecological systems, in response to actual or expected disturbances such as climatic impacts. Resilience on the other hand is the ability of social and ecological systems to absorb such disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change. Adaptation is the key factor for understanding how the resilience of social and ecological system changes over time. For simplicity, both terminologies are assumed to be synonyms in this report.

TABLE ES.2: STRATEGIES FOR ACHIEVING LESOTHO CSA GOALS

Climate resilience and nutrition security	Commercialization	Capacity development
Crop diversification	Agricultural value chain	Agricultural research and extension
Stress-tolerant crop and livestock breeds	Commodity standards	Knowledge development
Biofortified crops	Warehouse receipt system	Integrated weather and market advisories using Big Data and information and communication technology (ICT)
CSA practices at the farm level[2]	Greenhouse agriculture	—
Landscape approaches[3]	Market infrastructure development	—
Cost-effective irrigation	—	—

Source: Authors based on stakeholder workshops

FIGURE ES.1: POSITIONING OF SCENARIOS ON THE AXES OF DRIVERS OF AGRICULTURAL LAND CHANGE



Source: Authors

assumption under the CT scenario is for agricultural land under cultivation to grow through extensification and for production to keep pace with the current population growth rate. The CT scenario implies continued agricultural support for the dominant, unsustainable historical monoculture cropping system generally characterized by maize. To achieve this outcome, price support and subsidy must increase, implying an increasing social cost. In this scenario, maize, wheat, sorghum, and beans continue to be the primary crops, while sheep and goat production for wool and mohair remains vital. Agriculture continues to be dominated by small-scale rain-fed cereal production and extensive animal grazing.

[2] This includes integrated soil fertility management, conservation agriculture, agroforestry, improved feeding practices for livestock, animal health, and herd management.
[3] This includes rangeland rehabilitation and afforestation, terracing, soil erosion control, and flood management.

8. **The Commercialization (CZ) scenario prioritizes a high degree of market liberalization following trends in neighboring Republic of South Africa and takes into consideration agricultural commodities for which Lesotho has distinct comparative advantage.** The scenario assumes high ambitions for international cooperation, market liberalization, and increased agricultural exports as a main strategy to graduate from the United Nations (UN) ranking of least developed countries. The scenario implies a reduction in price support for field crops, notably maize, where deficits are assumed to be met by imports, supported through climate-smart agriculture investments in more profitable commodities, most notably potato, vegetables, and orchard products on the crops side and animal products on the livestock side of agriculture.

9. **The Resilient Landscape (RL) scenario assumes a lower priority to market liberalization but prioritizes a land management system that empowers smallholders with ambitions toward sustainability, socioeconomic resilience, and low ecological impact from economic growth.** The RL scenario focuses on integrating climate-smart, modern scientific knowledge like use of improved crop varieties and climate advisory services with the Machobane Farming System (MFS), a traditional farming practice that combines the use of crop rotation, relay cropping, and intercropping practices with the application of manure and plant ash to conserve soil moisture and replenish soil fertility. A main strategy to graduate from the least developed country status under the RL scenario is supporting smallholders, investing in sustainable landscape management, and building institutions to enhance landscape resilience.

10. **To determine the impacts of CSA at sector and household levels, the CSAIP approach combined quantitative analysis and qualitative assessment.** Two innovative quantitative techniques were employed for the assessment. At the sector level, the Lesotho Agricultural Sector Model (LesAgMod) computer tool was purposefully developed to explore alternative agricultural pathways and investment priorities for Lesotho. The agricultural planning tool couples agricultural, water, soil nutrients, and land-use practices and climate change scenarios to assess key vulnerabilities of the agricultural sector and employs a profit maximization approach to estimate changes in land-use and cropping patterns over time. Each narrative scenario was run for a set of 10 future climate projections, resulting in 30 unique simulations. The climate projections are assumed to be an exogenous factor that has an influence on crop and livestock productivity.

11. **The second CSAIP quantitative technique includes a financial and economic analysis to determine the profitability of adopting CSA at the household and sector levels.** The analysis provided answers to two key questions:

    1) **What is the financial viability of CSA practices for a household?**

    2) **How do the anticipated costs needed to scale up CSA compare to the anticipated economic benefits?**

12. **While the first question helps in determining the incentive requirements for an average Lesotho household to adopt CSA, the second question assesses the economic and societal benefits of adopting CSA and establishes the economic rationale for the public sector to support farmers' adoption and scaling up of CSA.** For the Cost-Benefit Analyses, the CT scenario characterized by conventional farming practices was assumed to be the "without CSA investment scenario" or baseline scenario while the RL and CZ scenarios are the "with CSA investment scenarios."

CSA impacts at sector and household levels

Crop yield

13. **The projected changes in yield under climate change are summarized in figure ES.2 and table ES.3.** The minimum projected impact of climate change on yield is negative for wheat (15 percent decrease), maize (6 percent decrease), orchards (5 percent decrease), and beans (2 percent decrease). On average, potato has the largest positive

FIGURE ES.2: CHANGE IN CROP YIELDS DUE TO CLIMATE CHANGE

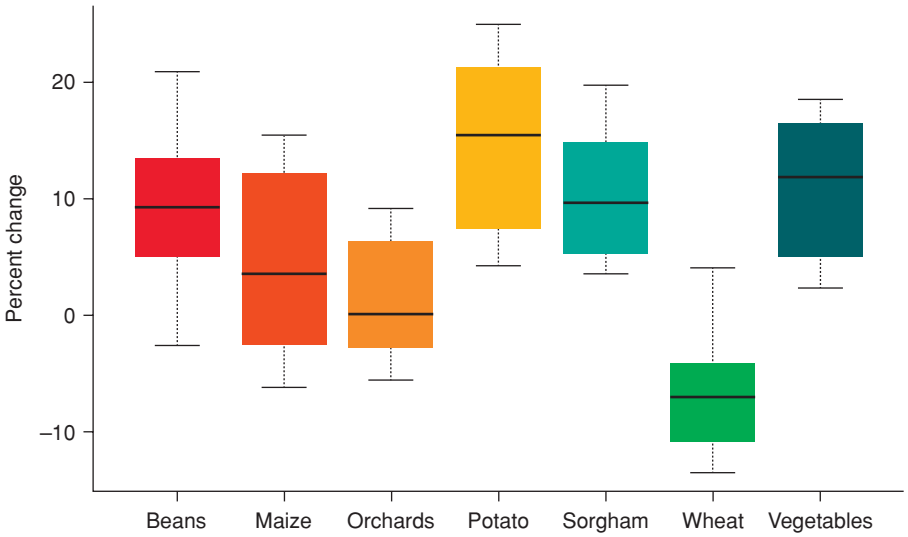


TABLE ES.3: PROJECTED IMPACTS OF CLIMATE CHANGE ON CROP YIELDS (%)

Crops	Minimum	First quartile	Median	Third quartile	Maximum
Beans	–2	5	9	13	21
Maize	–6	–2	3	12	15
Orchards	–5	–2	0	6	9
Potato	4	8	15	21	25
Sorghum	3	6	10	14	20
Wheat	–14	–11	–7	–4	4
Vegetables	2	6	12	15	18

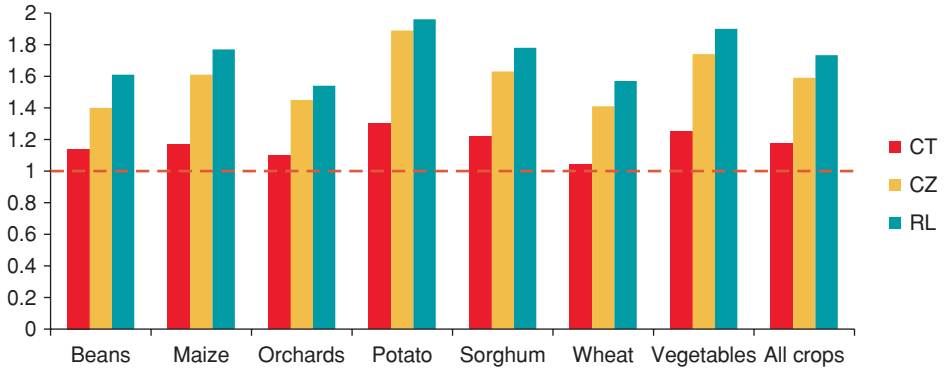
Negative Positive

Source: Authors

impact with 15 percent increase in yield, followed by vegetables (12 percent increase), sorghum (10 percent increase), and beans (9 percent increase), suggesting that crops would generally benefit from global warming in Lesotho. The warmer temperatures extend the growing season supported by mostly adequate moisture regimes. By extending the growing season, the period of successful pollination and initiation of kernel development in cereals that ends with physiological maturity of the kernels is maximized that may otherwise have been curtailed by cooler temperatures. Wheat is the exception, which shows a general decline, with reduced winter and spring soil moisture that results in suppressed yields. The maximum projected positive impact of climate change on yield ranges from 4 percent for wheat to 25 percent for potato.

14. **The RL and the CZ scenarios show the influence of CSA practices on yield, with the RL scenario resulting in higher yields compared with the CZ scenario.** Figure ES.3 indicates an increase in yield relative to historical for all scenarios under climate change. Relative to the CT scenario, the overall benefit of the CSA practices on yield under climate change is substantial. The variability of yields is primarily due to soil moisture deficits and heat stress. Potato and vegetables show the greatest increase in yield overall, benefiting from CSA practices, including the increase in application of nitrogen fertilizers.

FIGURE ES.3: RATIO OF CROP YIELDS UNDER CLIMATE CHANGE VERSUS HISTORICAL BY 2050

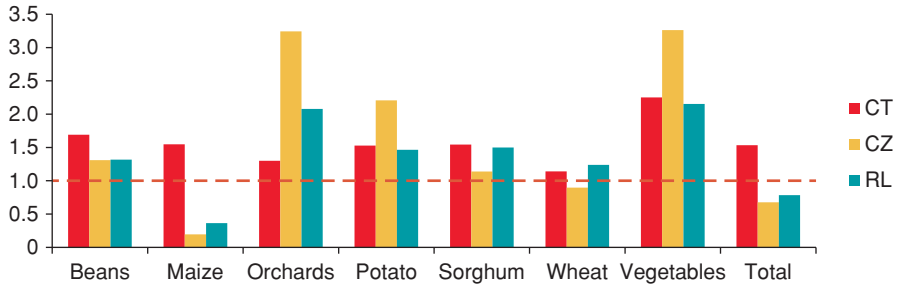


Source: Authors. Ratios above 1 show that relative to historical, crop yields will increase. On the other hand, ratios below 1 indicate that crop yields will decrease relative to historical.

Cropland expansion under climate change

15. **A major key to making agriculture climate-smart is increasing land-use efficiency through higher productivity, thereby reducing the need for clearing more land for agricultural production.** Relative to historical land use patterns, adoption of CSA leads to a reduction in the estimated cropland requirement by 20 percent for the RL scenario and 30 percent for the CZ scenario. On the other hand, the CT scenario shows cropland expansion by 50 percent (figure ES.4).

FIGURE ES.4: RATIO OF CROPLAND EXTENT UNDER CLIMATE CHANGE VERSUS HISTORICAL BY 2050



Source: Authors. Ratios above 1 show that relative to historical, cropland extent will increase. On the other hand, ratios below 1 indicate that cropland extent will decrease relative to historical.

Food production

16. **The estimated total production under climate change is 496,000 tons for CT, 590,000 tons for RL, and 742,000 tons for CZ.** Due to difference in cropping strategies under the scenarios described in paragraphs 7 to 9, the proportion of maize production decreases from 30 percent for CT to 3 percent for CZ. Potato is the most dominant crop accounting for 43 percent under CT, 54 percent under RL, and 62 percent under CZ scenario. The production of orchards under CZ doubles that of the CT scenario (table ES.4).

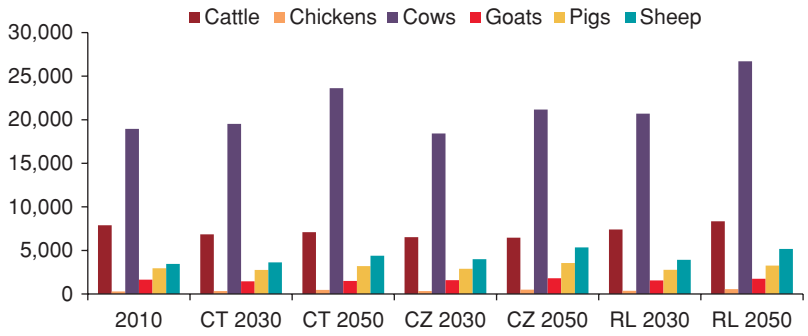
17. **While modeling results suggest steady increases of livestock over time, these changes are occasionally moderated by variability in climate and water supply (figure ES.5).** However, these effects are modest. The effects of climate and water supply reliability are more pronounced when looking at net production of livestock, because stresses caused by heat and scarcities of food and water have a larger influence on reducing the productivity of livestock than on increasing mortality.

TABLE ES.4: CROP PRODUCTION AND THEIR PROPORTIONS FOR THE SCENARIOS UNDER CLIMATE CHANGE

	CT		CZ		RL	
	ton	%	ton	%	ton	%
Beans	10,075	2	10,169	1	12,020	2
Maize	146,770	30	24,536	3	51,172	9
Orchards	17,555	4	57,692	8	40,000	7
Potato	214,100	43	461,743	62	320,493	54
Sorghum	18,015	4	19,098	3	26,631	5
Wheat	18,418	4	21,160	3	32,125	5
Vegetables	70,881	14	147,415	20	107,993	18
Total	**495,815**	**100**	**741,813**	**100**	**590,433**	**100**

Source: Authors

FIGURE ES.5: LIVESTOCK PRODUCTION (TONS) FOR THE NARRATIVE SCENARIOS AVERAGED FOR ALL THE FUTURE CLIMATE PROJECTIONS



Source: Authors

18. **The potential for aquaculture development has recently increased and could represent an interesting investment for the private sector. Aquaculture helps to diversify food production, increase nutrition security, and enhance resilience.** The aquaculture model developed in the report refers to the most consolidated production system, that is, warm-water fish farming in the lowlands, where temperatures are relatively high. The model includes common carp production (trout), the main species being produced, and assesses the benefits to the individual fish farmer who has access to abundant water and exploit this for fish farming. Over a 5-year investment period, scaling up aquaculture to yield economic benefits of $8.2 million for the Resilient Landscape Scenario and $24.7 million for Commercialization Scenario.

Food availability and trade

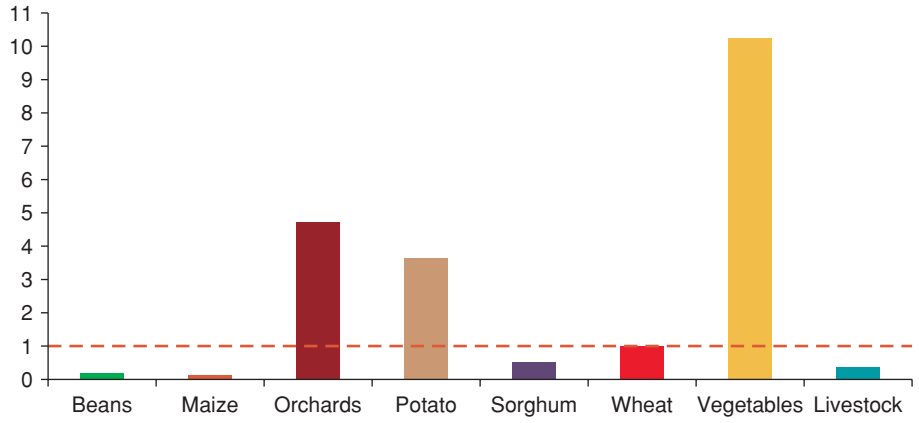
19. **Food calorie intake in Lesotho is about 2,450 kcal per capita per day, implying a calorie deficit of 11 percent compared to the recommended average of about 2,750 kcal per capita per day.** National food production contributes only 34 percent of Lesotho's per capita calorie intake (table ES.5) with more than half of per capita food calories derived from maize. While imports are 30 percent more than total national production, only about 2 percent of national production is exported. Per capita food rates have been modestly low and would benefit from increased production. Within the context of the CZ scenario, some nationally produced agricultural commodities—such as vegetables, orchards, and potato—could serve Lesotho's export market. Assuming population will grow to 3 million

TABLE ES.5: AVERAGE HISTORIC IMPORTS, EXPORTS, AND NATIONALLY PRODUCED CROP SUBSECTOR COMMODITIES AND THE KCAL PER CAPITA PER DAY PROVIDED BY EACH OF THOSE COMMODITIES FOR 2000–2010

	National production (ton)	Import (ton)	Export (ton)	Net (ton)	Calorie intake (kcal per capita per day)	National production as proportion of consumption (%)	Calorie (kcal per capita per day) from national production
Beans	17,000	83,000	2,000	98,000	370	17	64
Maize	96,000	213,000	2,000	307,000	1,350	31	422
Orchards	16,000	5,000	0	21,000	20	76	15
Potato	100,000	8,000	0	108,000	95	93	88
Sorghum	22,000	7,000	0	29,000	100	76	76
Wheat	17,000	83,000	2,000	98,000	370	17	64
Vegetables	26,000	17,000	0	43,000	12	60	7
Livestock	27,000	8,000	0	35,000	130	77	100
Total	**321,000**	**424,000**	**6,000**	**739,000**	**2,447**		**836**

Source: Based on FAOSTAT. Food items were converted to calories using Lesotho food composition table.

FIGURE ES.6: RATIOS OF CALORIES POTENTIALLY DERIVED FROM NATIONAL FOOD PRODUCTION BY 2050 UNDER CLIMATE CHANGE FOR THE CZ SCENARIO VERSUS CALORIES FROM HISTORICAL (2000–2010) NATIONAL PRODUCTION



Source: Authors. Orchards, potato, and vegetables can be prioritized for export. Ratios above 1 show that relative to historical, calories derived from national production will increase. On the other hand, ratios below 1 indicate that calories derived from national production will decrease relative to historical.

by 2050 and current food calorie shortfalls will be met through national production, figure ES.6 indicates that calories potentially derived from national production by 2050 could increase by a factor ranging from 3.6 for potato to 10.2 for vegetables.

20. **Potato production would grow to 462,000 tons by 2050, and Lesotho could target 200,000 tons for national consumption, doubling the historical requirement of 100,000 tons.** Thus, more than 260,000 tons could be available for export. Likewise, vegetable and orchard production are shown to grow at rates exceeding population growth rates and could also be used for exports, in addition to making food calorie intake grow to more acceptable standards of around 2,750 kcal per capita per day. To improve nutritional quality, Lesotho could also step up its biofortification efforts to cover beans, maize, wheat, and sorghum. Biofortification, a technique that uses conventional

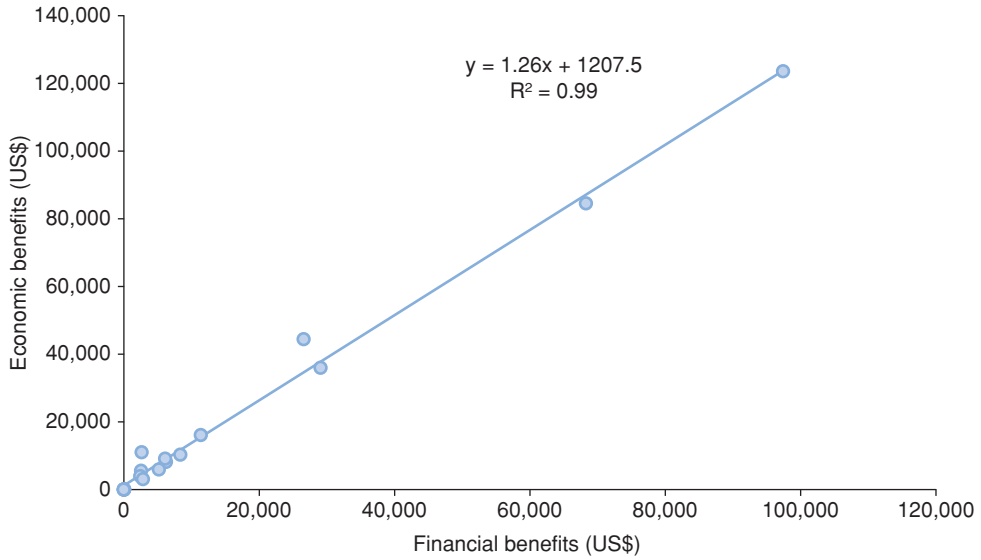
breeding methods to produce more nutritious crops—with a higher content of vitamin A, zinc, iron, or other micronutrients than standard crop varieties—could contribute to healthier diets in Lesotho.

Profitability of CSA

21. **Farm budget analyses reveal that climate-smart crop and livestock production are more profitable than conventional practices.** The annual net income of the representative farming household is about three times higher under the RL scenario, and about five times higher for the CZ scenario. Higher profitability of commercial farming results from increase in farm size, intensification of cereals production, and expansion of high-value crops: potato, vegetables, and fruits crops. Switching from a conventional to a commercial farming system is more profitable but requires more private investments, while switching from conventional to climate-resilient farming practices is less profitable but will be more affordable for the smallholders.

22. **Societal benefits of climate-smart crop production are higher than private benefits derived by individual farmers.** For every US$100 the farmer profits from CSA adoption, the society benefits an additional US$26 through transfer payments to producers (figure ES.7). CSA can also reduce soil erosion, generate carbon sequestration, conserve biodiversity, and provide other public goods that accrue to society but not to the farmers engaged in market transactions alone.

FIGURE ES.7: RELATIONSHIP BETWEEN ECONOMIC AND FINANCIAL BENEFITS OF CSA AT THE FARM LEVEL



Source: Authors

Carbon balance

23. **Table ES.6 indicates that relative to Current Trends, the RL scenario will generate a net carbon sink (that is, absorbs more carbon than it releases as carbon dioxide into the atmosphere) of 26 million tCO_2-eq, equivalent to 0.87 million tCO_2-eq per year, or 1.5 tCO_2-eq per ha per year.** Livestock activity is the major carbon emitter with 6 million tCO_2-eq, followed by inorganic fertilizers (1.9 million tCO_2-eq). However, improved grassland management helps to reduce most of these emissions with carbon sequestration of 21 million tCO_2-eq. Afforestation, switching from annuals to orchards, rangeland improvement, forest rehabilitation, and improved crop production all sequesters about 13.5 million tCO_2-eq. GHG dynamics for the CZ scenario are similar but generate considerably lower carbon sink of 2.5 million tCO_2-eq, equivalent to 84,000 tCO_2-eq per year, or 0.2 tCO_2-eq per ha per year. Livestock activity is also a

TABLE ES.6: CARBON BALANCE FROM CSA PRACTICES UNDER RL AND CZ SCENARIOS

Project activities	RL Scenario		CZ Scenario	
	Over the economic project lifetime of 30 years (tCO_2-eq)	Annual average (tCO_2-eq per year)	Over the economic project lifetime of 30 years (tCO_2-eq)	Annual average (tCO_2-eq per year)
	Net GHG emissions			
Afforestation	−6,517,278	−217,243	−2,281,062	−76,035
Annual crops to orchards	−18,223	−607	−174,423	−5,814
Rangeland improvement	−2,498,661	−83,289	−3,358,130	−111,938
Improved annual crop production	−1,954,768	−65,159	−1,213,410	−40,447
Improved orchards practices	−149,243	−4,975	−1,413,030	−47,101
Grassland management	−20,741,663	−691,389	−6,102,907	−203,430
Livestock management	6,236,615	207,887	7,055,693	235,190
Forest rehabilitation	−2,504,146	−83,472	–	–
Fertilizers and pesticides application	1,900,070	63,336	4,890,078	163,003
Aquaculture	18,804	627	75,215	2,507
Total	**−26,228,494**	**−874,283**	**−2,521,976**	**−84,066**
Per hectare	**−46**	**−1.5**	**−5**	**−0.2**

Source: Authors. The CT was assumed to be the "without project" scenario.

TABLE ES.7: GHG EMISSION INTENSITIES FOR CROPS AND LIVESTOCK (tCO_2eq PER TON PRODUCT)

	Conventional	CSA	Difference
Crops			
Maize	2.2	−11.7	−13.8
Maize - CA		−8.2	−8.2
Other cereals	1.3	−6.1	−7.4
Legumes: beans and peas	8.4	−11.9	−20.4
Potato and vegetables	0.4	−0.7	−1.1
Livestock			
Dairy cattle	115.38	78.54	−32
Other cattle	316.61	245.57	−22
Sheep	3.38	3.34	−1
Pigs	0.18	0.12	−32
Goats	2.32	2.29	−1
Poultry	0.07	0.04	−37

Source: Authors

major carbon emitter (7 million tCO_2-eq), while application of fertilizers and pesticides emits about 4.9 million tCO_2-eq. Grassland management, conversion of annuals to orchards, afforestation, rangeland improvement, and improved practices in orchards are estimated to sequester about 8.4 million tCO_2-eq.

24. **Emissions intensity, defined as the quantity of GHG emitted per unit of produce declines following the implementation of CSA practices, therefore positively contributing to climate change mitigation.** For crops, the decline in emission intensity ranges from 1.1 tCO_2eq per ton of product for potato and vegetables to 20.4 tCO_2eq per ton of product for legumes. Switching to climate-smart livestock practices leads to a decline in livestock emission intensity, ranging from 1 percent for sheep and goats to 37 percent for poultry. The average decrease in livestock emissions intensity, estimated at 21 percent, is lower than the 25 percent CSA target for the country.

25. **In addition, CSA adoption could create jobs that will stimulate Lesotho's rural economy.** Shifting from low-value grain production to more labor-intensive and higher value-added crops like potato, orchards, and vegetables could generate 4,600 to 16,600 stable jobs (table ES.8). The CZ scenario will generate about 40 to 60 percent more jobs generated by the other two scenarios. However, unlocking the job creation potential of potato and horticulture subsectors will require Lesotho to strategically exploit its comparative advantage in the production of these commodities. The country can leverage research knowledge, export infrastructure, and market intelligence from its proximity to the Republic of South Africa (RSA). In addition, public-private partnership could be useful to take advantage of the abundant water resources required for commercial agriculture (World Bank Group 2018b).

TABLE ES.8: ESTIMATED NUMBER OF FARMING JOBS CREATED UNDER CLIMATE CHANGE OVER A 5-YEAR INVESTMENT PERIOD

	Coefficient (jobs/ha)	CT	RL	CZ
Beans	0.02	609	475	472
Maize	0.01	1,859	438	235
Orchards	1.30	6,658	10,643	16,599
Potato	0.30	3,194	3,060	4,614
Sorghum	0.05	2,013	1,956	1,486
Wheat	0.05	992	1,077	779
Vegetables	1.30	10,484	10,033	15,193
Total		**25,809**	**27,682**	**39,378**

Source: Data on number of jobs per ha for different cropping systems are modified from World Bank (2011, 2018a).

Prospect of meeting Lesotho's CSA targets

26. **The probability of Lesotho meeting its CSA targets vary from low for increasing productivity and agricultural exports to high for reducing agricultural emissions and livestock emissions intensity (table ES.9).** There are interdependencies in the prospect of meeting the targets; for instance, increasing agricultural productivity (target 1) is a prerequisite to doubling farmers' income (target 2), increasing exports (target 3), and to a lesser extent reducing agricultural emissions and livestock emissions intensity (targets 4 and 5). Thus, it is crucial that the CSAIP identifies an integrated solution that will address the potential constraints to meeting the targets, while synergistically delivering productivity and climate benefits to farmers.

TABLE ES.9: POTENTIAL OF MEETING LESOTHO'S CSA TARGETS

No.	Targets	Probability of meeting the target	Remarks
1	Increase yields of major staples by a factor of 2.5.	Low	Yield gap must be narrowed by introducing climate-ready, stress-tolerant species and cultivars adapted to Lesotho's context. Other constraints that must be addressed to effectively close the yield gap include weather-induced yield variability, soil fertility constraints, pest infestation, and market accessibility.
2	Double income of smallholder farmers.	Medium	Famers' income more than doubles for most CSA practices, but cost of adoption may be a barrier to meeting this target.
3	Increase agricultural exports by a factor of 2.5.	Low	The target can be met if Lesotho is able to narrow yield gap, prioritize horticulture and potato for exports, and create the enabling environment for higher levels of CSA adoption.
4	Reduce agricultural GHG emissions by 25%.	High	Target can be met following the adoption of climate-smart livestock practices under the RL scenario. Integrated catchment management will help reduce soil erosion and the associated loss of soil carbon. Better rangeland management will also help sequester carbon. Sustainable crop intensification will help reduce cropland expansion, and the associated carbon emission.
5	Reduce livestock emissions intensity by 25%.	High	This target has high probability of being met by stepping up the adoption of climate-smart livestock practices. More efforts are particularly required in lowering emission intensities from goat and sheep.

Source: Authors

Barriers to CSA implementation

27. **Even though CSA technologies can generate private and public benefits, their adoption faces many socioeconomic and institutional barriers.** Ranking of adoption constraints against CSA practices reveals that inadequate implementation capacity (75 percent) and access to inputs or finance (71 percent) are the most critical adoption barriers for all groups of CSA practices (table ES.10). Within crop management, the adoption of improved crop varieties (68 percent), postharvest management (68 percent), and Integrated Pest Management (65 percent) are influenced by the adoption factors the most. For climate-smart livestock management, animal health control (75 percent), grassland reseeding (73 percent), and improved animal breeds (73 percent) suffer from the adoption constraints the most. For integrated catchment management, afforestation/reforestation (69 percent), small-scale irrigation (69 percent), and gully control (63 percent) are mostly influenced by the adoption factors. Among CSA practice groups, livestock and grassland management are influenced the most, scoring highest across most of the adoption factors.

28. **Land tenure most influences agroforestry and fodder production (70 percent), terracing (73 percent), rotational grazing and grassland rehabilitation (78 percent), grassland reseeding (80 percent), and afforestation (88 percent).** Secure land tenure is critical to the sustainability of land use and CSA implementation. If land tenure cannot be protected effectively, farmers and commercial investors will be unwilling to invest, or will even give up long-term investments on farmland entirely. Inadequate research impacts post-harvest management (83 percent) and the adoption of climate-smart livestock practices the most, with stakeholders scoring improved animal breeds and feeding practices as the most critically impacted (85 and 80 percent, respectively).

TABLE ES.10: RELATIVE IMPORTANCE OF FACTORS FOR ADOPTION OF CSA PRACTICES IN LESOTHO

	Inadequate access to finance including inputs and credits	Inadequate access to markets	Limited implementation capacity (awareness, skill, training, and education)	Land tenure issues	Research	Inadequate access to infrastructure (roads, storage facilities, and ICT)	Public policy	Average
Crop management								
Minimum soil disturbance, residue retention	48	40	80	50	65	35	60	54
Crop rotation	58	50	60	53	58	38	55	53
Agroforestry	73	48	73	70	63	43	68	62
Judicious fertilizer application	73	48	60	35	55	35	55	51
Organic fertilization	58	45	60	28	58	43	53	49
Inorganic fertilizer	73	58	58	35	55	43	48	53
Improved crop varieties	80	80	70	48	73	63	60	68
Integrated Pest Management	75	55	73	53	73	50	75	65
Postharvest management	75	75	88	35	83	60	58	68
	68	**55**	**69**	**45**	**64**	**45**	**59**	**58**
Livestock and grassland management								
Rotational grazing	60	45	70	78	63	43	80	63
Fire management	50	25	68	53	55	28	78	51
Grassland reseeding	85	63	80	80	78	43	80	73
Fodder production	88	70	78	70	75	43	55	68
Livestock diversification	75	70	85	50	73	55	55	66
Improved animal breeds	88	75	85	45	85	68	68	73
Animal and herd management	68	50	68	68	63	53	68	62
Animal diseases and health control	88	80	80	55	75	70	78	75
Improved feeding practices	70	63	78	50	80	60	63	66
Manure management	58	40	70	38	60	58	60	55
	73	**58**	**76**	**59**	**71**	**52**	**68**	**65**

(continued)

TABLE ES.10: (Continued)

	Inadequate access to finance including inputs and credits	Inadequate access to markets	Limited implementation capacity (awareness, skill, training, and education)	Land tenure issues	Research	Inadequate access to infrastructure (roads, storage facilities, and ICT)	Public policy	Average
Integrated catchment management								
Small-scale irrigation	83	63	73	68	70	65	60	69
Rainwater harvesting	65	38	65	40	38	50	53	50
Terracing	40	20	83	73	58	48	53	53
Gully control	78	35	88	65	53	60	60	63
Flood control	68	25	73	60	50	63	60	57
Check dams	65	28	73	63	53	65	65	59
Afforestation/reforestation	73	40	88	88	60	68	70	69
Grassland rehabilitation	80	35	73	78	50	55	65	62
	69	**35**	**77**	**67**	**54**	**59**	**61**	**60**
Aquaculture								
Improved stocks	80	78	78	40	75	63	63	68
Production intensification	78	70	83	53	73	60	60	68
Better feeding practices	78	75	85	38	65	60	63	66
Improved water use efficiency and pond management	75	65	85	45	70	78	68	69
Diseases control	85	78	83	38	78	55	68	69
	79	**73**	**83**	**43**	**72**	**63**	**64**	**68**
Average	**71**	**54**	**75**	**54**	**65**	**54**	**63**	

Low High

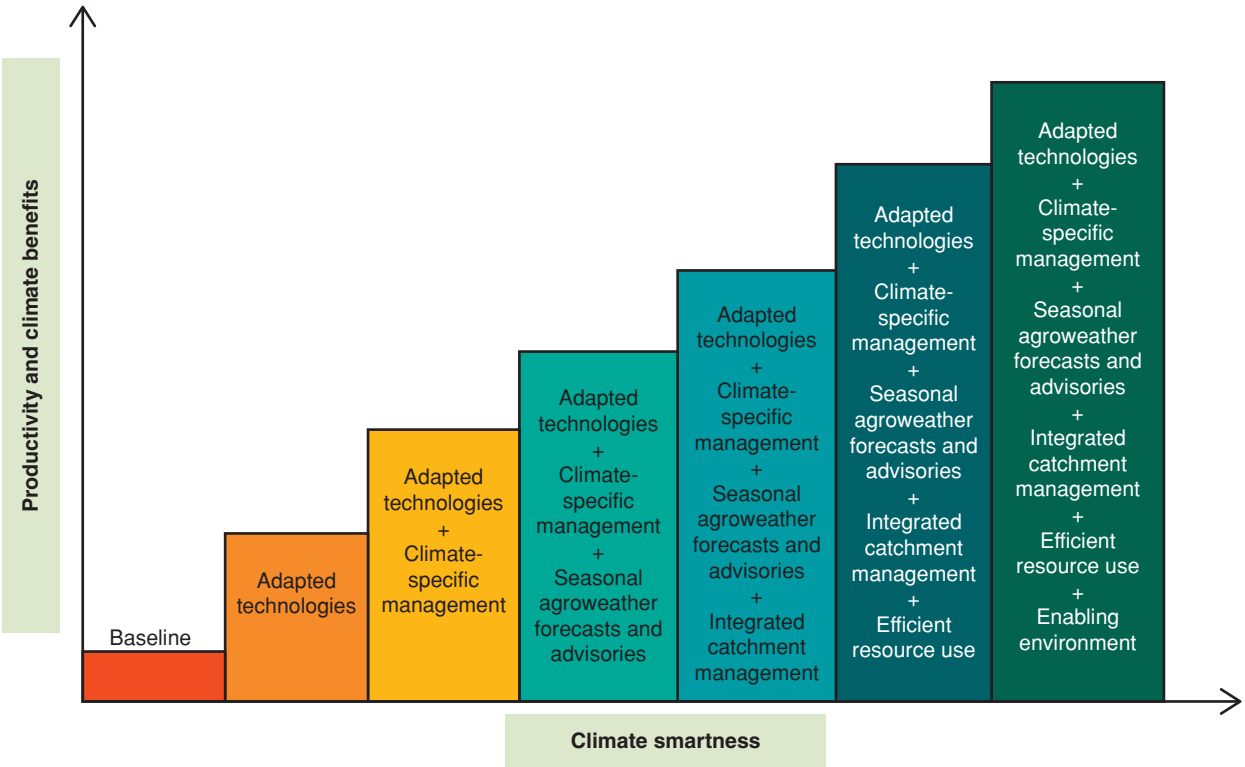
Source: Based on stakeholders' ranking.

Note: ICT = information and communication technology; IPM = integrated pest management. Importance of factors for adoption was first rated as 1 = Very low; 2 = Low; 3 = Moderate; 4 = High; and 5 = Very high. Thereafter, scores for each factor were averaged over the number of respondents and expressed as a percentage. Higher scores indicate that it is more critical and urgent to address a factor (or enabling condition) for effective CSA implementation in Lesotho.

CSA investment needs

29. **To determine Lesotho's CSA investment needs, emphasis was placed on integrating proven CSA technologies that will minimize trade-offs and capitalize on synergies between CSA pillars as exemplified in figure ES.8 where successive addition of CSA technologies leads to an overall increase in productivity and climate benefits derived from the agricultural system.** Climate modeling indicates that yield variability is primarily due to rainfall deficits, implying that there is need for stress-resistant, higher yielding crop varieties, and greater cropping intensity to meet food demand. Increasing cropping intensity implies that expanding efficient irrigation and agricultural water management technologies is a key part of the CSAIP in Lesotho. In addition to improved water use efficiency, strengthening the adaptive capacity of smallholder farmers to adjust and modify their production systems

FIGURE ES.8: RELATIONSHIP BETWEEN CSA BENEFITS AND CLIMATE SMARTNESS OF TECHNOLOGIES



Source: Modified from CCAFS (2014). This figure builds on the premise that CSA technologies are context-specific. Adapted technologies refer to those that are proven to be suitable to the local context. Climate-specific management comprises a set of practices that address the climate vulnerability of farming in the locality.

to minimize the potential future impacts from climate variability will require solutions that improve soil health, and increase farm productivity. Regional demand for fruit and vegetables is likely to increase as urban populations grow, incomes rise, and the popularity of healthy diets increases. Higher production and sales of high value crops would also deepen domestic agricultural markets, generate rural employment and improve nutrition. Lastly, implementation of sustainable landscape management encompassing interventions from the micro-catchment scale[4] managed largely by communities, to wider development among multiple sectors concerned with productive and nonproductive land uses will help optimize ecosystem functions and services.

30. **Given the above consideration, four thematic areas have been identified and validated with stakeholders as priority areas for the CSAIP investments (box ES.1).** They are:

- Improve water management in rainfed and irrigated agriculture;
- Scale up CSA technologies for crops, livestock, and aquaculture;
- Promote market access for farmers; and
- Support sustainable landscape and integrated catchment management.

31. **Total CSAIP financial costs for the RL scenario amount to about US$268 million over a 5-year investment period, corresponding to investment costs of about US$54 million per year.** For the CZ scenario, the total CSAIP costs are about US$208 million over the same period, or about US$42 million per year (table ES.11). The Internal Rate

[4] The within-field systems of water harvesting are called **micro-catchment** systems. A micro-catchment consists of small structures such as pits, holes, basins, and bunds formed for surface runoff water collection from within the cropped area.

BOX ES.1: BRIEF DESCRIPTION OF THE LESOTHO CSAIP COMPONENTS

Component 1: Improve Water Management in rainfed and irrigated agriculture.

Enhanced and efficient water management is a key factor for adaptation and increasing the efficiency of other CSA measures. The CSAIP will promote off- and on-farm investments in hydraulic infrastructure to restore and improve water distribution and reduce losses, improve water use efficiency, and increase and regulate water access management and governance for household consumption and agriculture production, particularly in areas of high agricultural potential. The CSAIP investment activities will include: sustainable water management practices such as micro-irrigation, water harvesting; modernization of hydraulic infrastructures, and strengthening institutions for effective agricultural water management.

Component 2: Scale up CSA technologies for crops, livestock, and aquaculture.

This CSAIP component will promote integrated soil fertility management; agroforestry; and conservation agriculture. For livestock, the CSAIP will finance three key interventions: improving access to better livestock breeds, improving animal nutrition, and improving access to animal health services. For aquaculture, the CSAIP will focus on improved stocks, production intensification, better feeding practices, and improved water use efficiency in the ponds.

Component 3: Promote market access for farmers.

Activities to be supported under this component include: development of Agriculture Clusters Service Enterprises; development of Market Hub Enterprises; aggregation of smallholder farmers into upgraded commodity value chains; piloting weather index insurance to manage risks; and promoting food quality standards. The component will also support the development of integrated climate information services through public private partnership.

Component 4: Support sustainable landscape and integrated catchment management.

This component will finance structural and vegetative measures of sustainable landscape management. The structural measures include terracing; gully control; flood control; and a check dam, a small, temporary dam constructed across waterways to reduce erosion by decreasing water flow velocity. The vegetative measures include afforestation/reforestation; and grassland rehabilitation. In addition, the component will finance the modernization of land administration through digital land registry and titling, spatial data infrastructure development, and capacity building for land administration.

TABLE ES.11: CSAIP INVESTMENT COSTS (US$, THOUSANDS PER YEAR)

Components	RL	CZ
1. Improve water management in rainfed and irrigated agriculture	14,944	18,382
2. Scale up CSA technologies for crops, livestock, and aquaculture	15,473	9,793
3. Promote market access for farmers	5,882	4,272
4. Support sustainable landscape and integrated catchment management	17,207	9,210
Total amount per year	**53,505**	**41,658**
Total over the complete investment period (5 years)	**267,525**	**208,288**

Source: Authors

of Return (IRR) for the RL scenario is 13 percent, increasing to 73 percent when carbon benefits are factored into the investment. For the CZ scenario, the investment rate of return is 32 percent but increases marginally to 34 percent with the inclusion of carbon benefits.

32. **Appropriate delivery methods are required for the CSAIP investment to support adoption and generate the desired benefits.** Six delivery methods that were considered with respect to the investment components and their roles in breaking key adoption barriers are indicated in table ES.12. All the delivery mechanisms focus on addressing implementation capacity which is the most critical CSA adoption barrier in the country. Except for agricultural research and innovation, the delivery mechanisms also address farmers' access to finance and

TABLE ES.12: ROLE OF DELIVERY MECHANISM IN ADDRESSING CONSTRAINTS TO CSA ADOPTION

Delivery mechanisms	Implementation capacity	Access to finance and markets	Inadequate research	Infrastructure	Land tenure
Efficient irrigation technologies and institutions	Establishment of irrigation institutions and strengthening their capacity through technical assistance and training	Higher and better agricultural produce from irrigation help to deepen agricultural markets		Investment in irrigation infrastructure will increase productivity and market access. This will, in turn, attract private investment, enhance job creation and stimulate growth.	
Pluralistic extension services and FFS	Increase the knowledge and skills of farmers, farmer aggregators, agro-processors, agro-dealers, and national and district level extension staff in proven CSA technologies.	Farmer aggregators and other service providers can help connect farmers to relevant markets.	Feedback from extension and FFS can stimulate further research and ameliorate yield-limiting constraints.		
Market linkages	Horizontal alliance helps to shift smallholder thinking from subsistence farming to agribusiness by training farmers to identify crops with potential for commercialization, grow them profitably, and establish relations with market agents.	Improved legal and regulatory framework for commercial agriculture helps improve access to market.	Public investment can be used to leverage private investment in agricultural research including developing improved seeds and seedlings, and IPM measures tailored to local conditions.	Public-private partnership can help address underinvestment, poor infrastructure, deficient services, low visibility, and insufficient funding.	

(*continued*)

TABLE ES.12: (Continued)

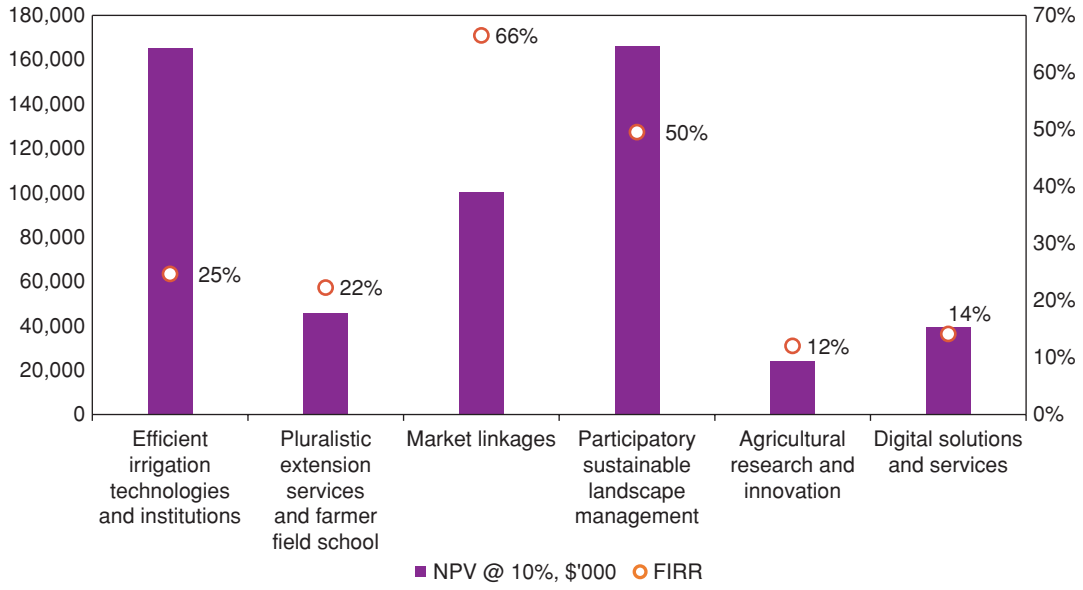
Delivery mechanisms	Implementation capacity	Access to finance and markets	Inadequate research	Infrastructure	Land tenure
SLM through participatory approaches	Participatory element of SLM and landscape approaches facilitates knowledge exchange between farmers and community members.	Large mitigation benefits from landscape restoration could open up opportunities from carbon finance.			The delivery method includes modernizing land titling and administration that helps to improve tenure security and proper land market functioning. Secure land tenure incentivizes CSA adoption.
Agricultural research and innovation	Combining agricultural research innovation with extension will help enhance farmers' capacity to implement integrated CSA solutions.		Improved crop and livestock breeding, increased yields, disease resistance, abiotic stress tolerance, and nutrition.		
Digital solutions and services	ICT-based agroweather, agronomic, and market advisories can be used to facilitate learning through feedback (bidirectional information flow) between farmers and advisories providers.	ICT tools can facilitate buyer—seller matching and market transactions for agricultural commodities. ICT also promotes financial inclusion. Market information systems will help reduce information costs.			Digitizing and documenting land rights in ways that are supported by local stakeholders enhances transparency and provides incentives for CSA adoption, sustainable land use, and intensification.

Source: Authors
Note: CSA = climate-smart agriculture; FFS = Farmer Field School; ICT = information and communication technology; SLM = sustainable land management.

markets. The application of digital technology can facilitate learning, market access, and regularization of land rights that will encourage CSA adoption.

33. **Figure ES.9 indicates that Net Present Values (NPVs) of the delivery methods are positive, suggesting that they all generate positive cashflow ranging from $24 million for agricultural research and innovation to $166 million for Participatory Sustainable Landscape Management.** This confirms the financial viability of investing in the delivery mechanisms. The costs of the delivery mechanisms are covered by the benefits, and there is an excess. The IRRs are above the discount rate of 10 percent, ranging from 12 percent for agricultural research and innovation to 66 percent for market linkages. The IRRs further provide confidence in the profitability of the delivery mechanisms.

FIGURE ES.9: NET PRESENT VALUE AND INTERNAL RATE OF RETURN OF LESOTHO CSAIP DELIVERY MECHANISMS



Source: Authors

Prioritization of scenarios and investment decision

34. **Prioritizing CSA practices that are adapted to a country's context is a key step toward optimizing the productivity and climate benefits of the practices.** Table ES.13 demonstrates that comparison over 13 indicators shows that the RL scenario performs better on 6 indicators (46 percent), while CZ performs better on 7 indicators (54 percent). Six important lessons emerge for effective scaling up of CSA in the country:

    - Though commercialization is more profitable, it requires larger farm size. It is more appropriate for medium-size, emerging farmers and requires strong market-oriented agricultural policies for it to be successful.
    - Furthermore, commercialization would require more private initiative and resources, for instance in developing the agricultural value chain and well-functioning land markets. This could constitute a serious barrier given Lesotho's nascent private sector.
    - Commercial agriculture generates more stable jobs but will also require a transformational shift in the farming systems and may be challenging given the current level of implementation capacity.
    - Though less profitable, climate-resilient agriculture delivers 10 times carbon benefits as commercial agriculture. Thus, climate-resilient agriculture could potentially benefit from climate finance. Climate-resilient agriculture is also more effective in controlling soil erosion.
    - Climate-resilient agriculture is 30 percent costlier for the public sector but is easier to implement and not affordable for small farmers. It is more tailored toward adapted technologies, landscape resilience and sustainable agricultural intensification that the average smallholder farmer can practice.

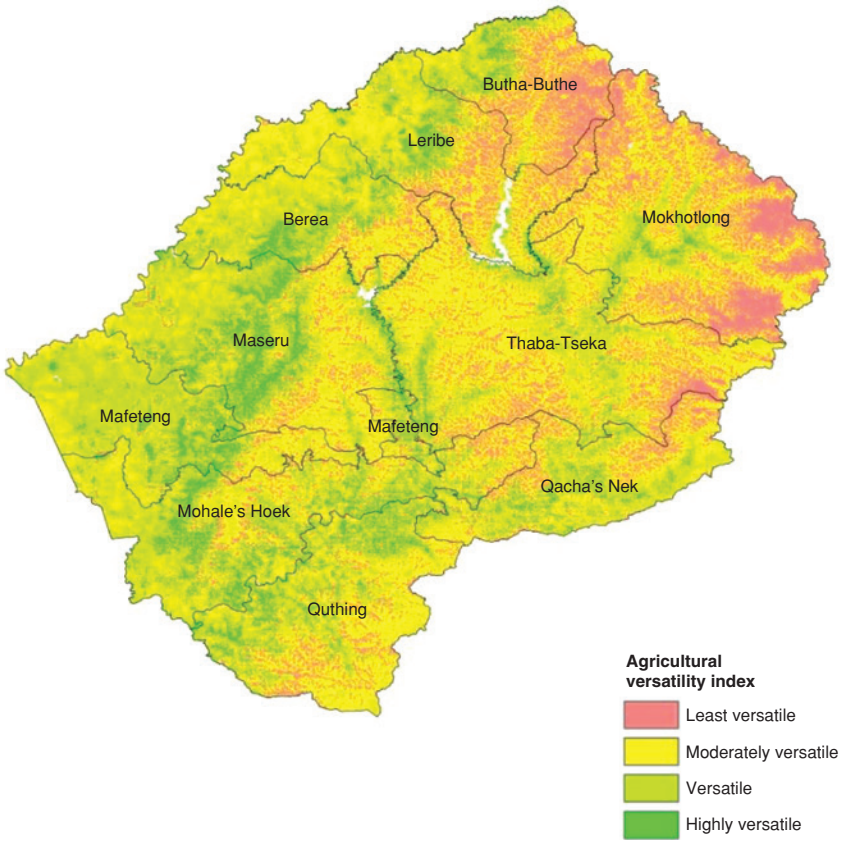
35. **Climate-resilient farming seems more feasible given the above considerations.** Alternatively, Lesotho may opt for climate-resilient farming and sustainable landscape management in zones more prone to soil erosion, suitable for afforestation and farmer-managed natural regeneration of vegetation, and where less fertile land needs restoration and replenishment. Commercial agriculture can be practiced in more fertile areas that are suitable for potato, orchards, and vegetables. Aquaculture development is more suitable to the lowlands due to warmer temperatures. In figure ES.10, the most productive lands in Lesotho are the versatile and the highly versatile land classes that can be preferentially allocated to commercial agriculture.

TABLE ES.13: COMPARISON OF INDICATORS UNDER THE TWO SCENARIOS

	Commercialization	Resilient Landscape
Net household income US$ per year	1,233	698
Increase in crop yields over historical (%)	60	70
Cropland area (ha)	132,247	153,482
Livestock production (ton)	38,849	45,765
Erosion control: gross erosion (Mt per year)	39	35
Food availability[5] (kcal/capita/day)	675	649
Export potential	moderate	none
GHG mitigation: carbon balance tCO_2-eq	−2,521,976	−26,228,494
Job creation	39,378	27,862
Economic internal rate of return (EIRR) %	32	13
Carbon benefits (US$ million)	2–17	36–282
EIRR % with carbon benefits	32–34	16–73
Financial cost (US$ million)	208	268

Source: Authors. Green color indicates that a scenario performs better; orange color indicates otherwise.

FIGURE ES.10: LESOTHO AGRICULTURAL VERSATILITY MAP



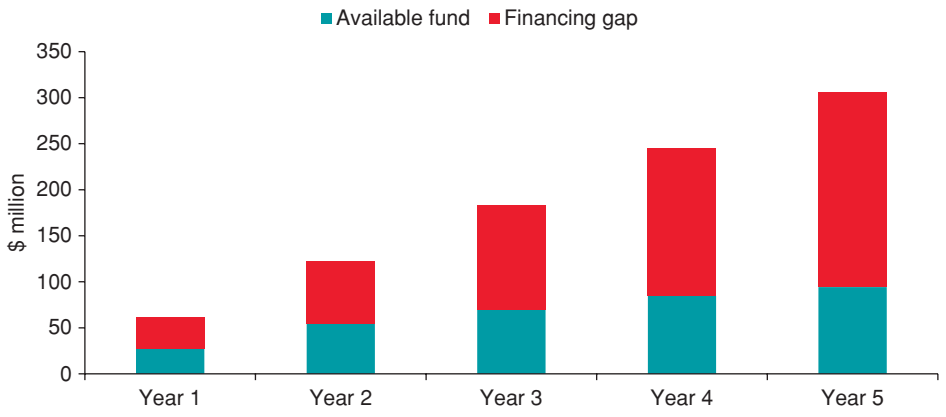
Source: Authors

[5] This measures food calories from national production.

Financing the investment plan

36. **Assuming Lesotho pursues the RL pathway, the cumulative financing gap amounts to US$34 million in year 1, increasing to US$211.5 million by year 5 (figure ES.11).** In estimating the CSAIP financing gap, the report considered existing agricultural projects with CSA-related expenditures and the duration of such projects.[6] The annual financing gap was then estimated as the difference between annual cost of CSAIP and available funds supporting CSA-related expenditures.

FIGURE ES.11: CUMULATIVE ANNUAL PROPORTION OF FUNDS UNDER EXISTING AGRICULTURAL PROJECTS AND CSAIP FINANCING GAP



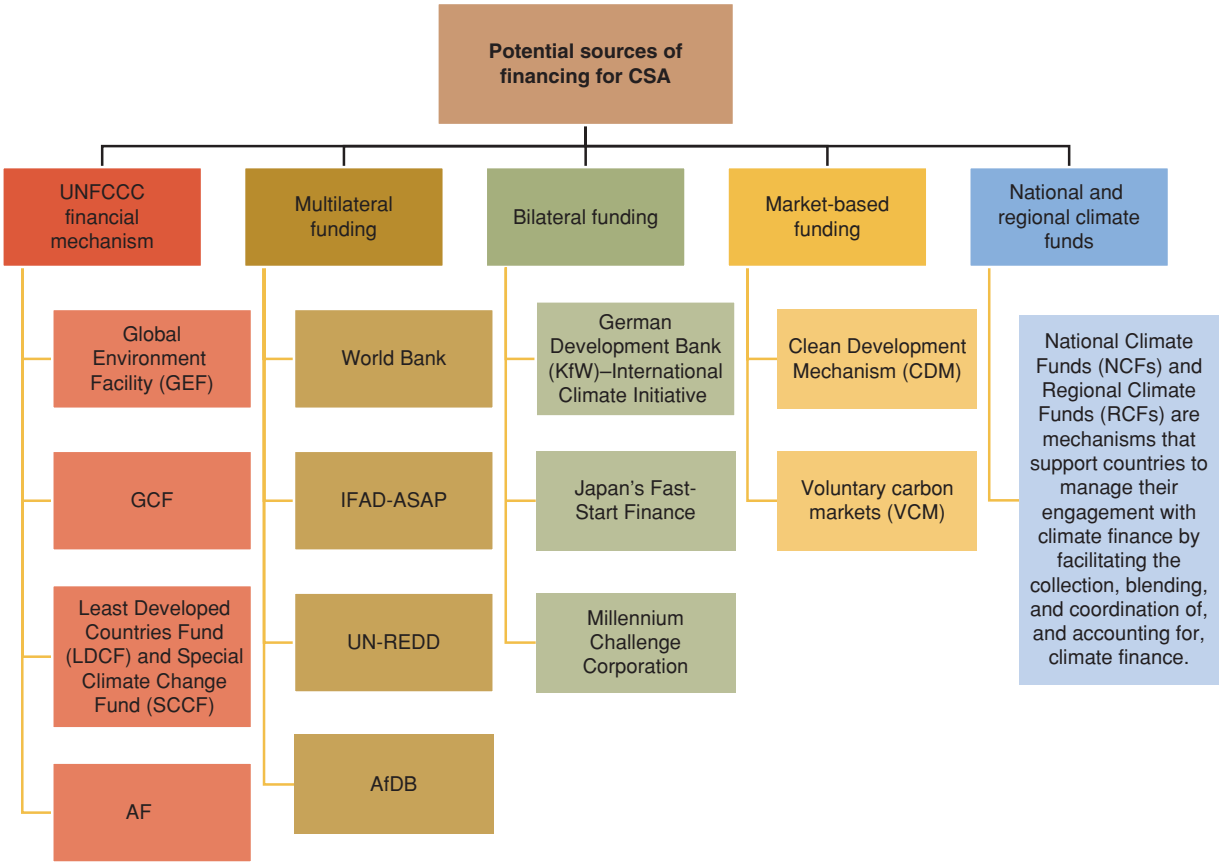
Source: Authors

37. **Lesotho can benefit from climate finance given its vulnerability to climate risks.** Climate finance refers to all financial flows that help achieve climate change adaptation and mitigation objectives. It can be instrumental in supporting Lesotho's agriculture sector in three main ways. The first way is meeting the gap in financing or increasing the attractiveness of an investment to leverage financing from other sources. The second way is reducing risks associated with an agriculture project either by reducing the overall financing requirement or through providing climate finance in the form of risk mitigation instruments, such as guarantees. The third way climate finance could support Lesotho's agriculture sector is using it to finance interventions that systematically reduce the transaction cost associated with CSA at the sector level. The sources of climate finance can be public, multilateral, bilateral or private (figure ES.12), but for climate finance to be effective in achieving its goals, strengthening the link between financial institutions and farmers is important.

38. **Lesotho CSAIP may benefit from the use of blended finance, that is, the use of public sector finance to crowd in or scale up private investment for the CSAIP (table ES.14).** Blended finance can be particularly effective in catalyzing investments in sectors where perceived risk is higher than actual risk, which is especially true for new sectors and projects with which investors are unfamiliar. Blended finance can also help deliver enhanced development impacts. In the case of the six delivery mechanisms, the following financing strategies are proposed.

[6] The total cost of existing projects is $142 million with about 42 percent funded by the World Bank.

FIGURE ES.12: SOURCES OF FINANCE FOR CSA IMPLEMENTATION



Source: Adapted from http://csa.guide.

Note: AF = Adaptation Fund; AfDB = African Development Bank; ASAP = Adaptation of Smallholder Agriculture Program; IFAD = International Fund for Agricultural Development; UNFCCC= United Nations Framework Convention on Climate Change; UN-REDD = United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation.

TABLE ES.14: POTENTIAL SOURCES OF FUNDING FOR CSAIP DELIVERY MECHANISMS

Delivery mechanisms	Possible sources of finance
Efficient irrigation technologies and institutions	IFAD, IFC, IDA, set up PPPs with assistance of development partners
Pluralistic extension services and FFS	IFAD, AfDB
Market linkages	IFC, MCC, set up PPPs with assistance of development partners, GCF, other climate funds
Participatory SLM	NDC Partnership, GEF, UNCCD, European Commission, GCF, UNDP
Agricultural research and innovation	BMG, AfDB, IDA
Digital solutions and services	GFDRR, IDA, set up PPPs with assistance of development partners

Source: Authors

Policy recommendations

39. **Scaling up CSA in Lesotho will require changes in policy and environment.** Policy actions to support effective delivery of CSA in Lesotho are outlined below.

    1) **Establish nationally owned CSA Program**

40. **CSA requires judicious policy management: proper coordination between agencies across different sectors at central and local levels.** CSA needs to shift beyond development practitioners to involve government agencies more often. Nationally owned climate-smart agricultural policies and action frameworks tend to increase the adoption of CSA technologies. Lesotho's national CSA program should also incorporate sustainable landscape management approaches for better management of agricultural production and ecosystem services. This will involve multidisciplinary teams from agriculture, forestry, soil conservation, water, and rangeland management.

2) **Improve knowledge management systems**

41. **Several climate-smart technologies are knowledge-intensive, and promoting their adoption will require well-designed, inclusive, and innovative knowledge management systems.** The priorities are to strengthen farmers' knowledge of CSA practices, facilitate sharing the techniques, and provide the greatest support to local and indigenous knowledge systems, such as the Machobane Farming System. This will result in more robust knowledge systems and farmer-led approaches. The use of co-learning and co-management strategies involving scientists and farmers is a way to do this. Scientific experts and farmers working closely together will, in turn, lead to mutual accountability.

3) **Foster equitable access to land**

42. **Secure land rights are necessary for climate-smart agriculture, providing incentives for local communities to manage land more sustainably.** Customary land rights and gender equality need to be recognized. Fast, effective, and low-cost approaches involving the use of satellite images, global position systems, and computerized data management technologies to access, register, and administer land rights are needed. Improving land governance—the way land rights are defined and administered—can be the missing link between land availability and sustainable agricultural development.

4) **Establish Strategic Food Reserve Agency**

43. **Lesotho could establish a Food Reserve Agency to support food security policies and social safety net mechanisms.** The Food Reserve Agency would help ensure a reliable supply and meet local shortfalls in the supply of agricultural commodities critical to food security. The Agency can also help the country meet food emergencies caused by drought, floods, hail, or any other natural disasters, manage food storage facilities, stabilize food prices, and provide relevant market information and agricultural credit facilities to small-scale farmers.

5) **Realign agricultural support to promote CSA**

44. **There is a need to realign agricultural support to break adoption barriers and promote CSA.** It is vital that government policies and investments address the demand and supply sides of agricultural input use. Reversing land degradation and improving soil health in Lesotho will require increased but targeted use of fertilizers and other inputs. This, in turn, will require building sustainable private sector-led input markets. However, progress in improving input distribution systems is likely to be unsustainable without strong, effective demand for the inputs. Effective demand can only be assured if farmers have access to reliable markets to sell their products at a profit. Thus, both demand- and supply-side interventions are needed to strategically break the adoption barriers associated with climate-smart practices. Examples of demand-side interventions are improving farmers' ability to purchase inputs and providing them with risk management tools. Examples of supply-side interventions include improving road and rural infrastructure to lower transport costs and developing market information system to reduce information cost.

6) **Strengthen agricultural research and extension**

45. **The goals of climate-smart agriculture cannot be met without policies and initiatives that encourage agricultural innovations and research, and establish stronger linkages between farmers, climate-smart supply chains, and markets.** There is need to strengthen research and establish partnership with CGIAR and other international research institutes to develop high-yielding, stress-tolerant, climate-ready varieties that are adapted to Lesotho's environment. Development of heat-tolerant varieties is of importance given the projected increase in

warming for Lesotho. Agricultural extension services should be upgraded to catalyze the agricultural innovation process and bring the actors together, coordinate and create networks, facilitate access to information, knowledge and expertise, and provide technical backstopping.

7) **Create enabling environment for private sector**

46. **Introducing policies and incentives that provide an enabling environment for private sector investment can increase overall investment.** Public investment can be used to leverage private investment in research and development, establish agroforestry, promote afforestation, and develop improved seeds and seedlings. Bundling agricultural credit and insurance together and providing different forms of risk management—such as climate information services, index-based weather insurance, or weather derivatives—are areas of private investment that can be encouraged through public policy and public-private partnerships.

8) **Build capacity to access climate finance**

47. **Lesotho faces a financing gap in the agriculture sector with low capacity to access climate finance.** Critical areas that need capacity development include identifying funding gaps and needs; assessing public and private financing options; developing payment for ecosystem services programs; developing bankable investment plans, project pipeline, and financing propositions; and developing financially viable opportunities for effective private sector engagement.

Table ES.15 provides information on specific measures under each policy option, responsible authorities, and time frame for implementing the measures.

CSA and the World Bank agenda in Lesotho

48. **Scaling up CSA has been a focus of the World Bank's work throughout much of the developing world, and many of the lessons gleaned from one region apply to others.** It is an integral part of development partners' larger agriculture work program in the country. This larger work program includes the Smallholder Agriculture Development Project (SADP) supported by the World Bank and the International Fund for Agricultural Development (IFAD) which is designed to enhance climate resilience and promote commercialization and nutrition diversity. SADP is also supporting the development of an irrigation master plan to assist the government in its efforts to define strategic priorities for improving the irrigation subsector. The Master Plan will identify a pipeline of high priority irrigation investments for support from government, private sector, and other development partners. The World Bank is also supporting the Agriculture Productivity Project for Southern Africa (APPSA) that seeks to increase the availability of CSA technologies to farmers in Lesotho in addition to establishing the Center of Excellence in horticulture in Southern Africa. IFAD is financing the Wool and Mohair Promotion Project (WAMPP) with the goal of boosting the economic and climate resilience of poor, smallholder wool and mohair producers to adverse effects of climate change in the Mountain and Foothill Regions of Lesotho. The European Union recently produced a set of reports for Integrated Catchment Management in Lesotho. The reports covered catchment development plans, institutional settings, and legal issues for effective catchment management. The Millennium Challenge Corporation (MCC) is also supporting Lesotho to build institutional capacity in the use, uptake and customization of data to enhance effective policy planning, coordination, and execution in different sectors including transport, irrigated agriculture, climate change, integrated catchment management, water, and health. The activities aim to build capacity in Lesotho's government agencies in cooperation with research centers, private sector and civil society organizations. The Private Sector Competitiveness and Economic Diversification Project (PSCED) supported by the World Bank is assisting Lesotho in building an enabling business environment, leveraging private investment support, providing access to finance to increase productivity, and increasing market opportunities in Lesotho's horticulture subsector. In addition, the World Bank has supported analytical work to identify strategies to unlock the potential of Lesotho's private sector in creating jobs and improving the competitiveness the horticulture subsector as well as another analytical work that specifically deals with linking smallholder vegetable farmers to markets. Another aspect of World Bank's work program is the Lesotho

TABLE ES.15: LESOTHO CSA POLICY MEASURES AND TIME FRAME FOR IMPLEMENTATION

	Time frame	Responsible authorities
Establish nationally owned CSA Program		
(i) Establish Lesotho CSA Program to guide implementation of CSA and landscape approaches, strategies, practices and technologies	Short	Department of Planning and Policy Analysis of the Ministry of Agriculture and Food Security; Ministry of Development Planning; Ministry of Forestry, Range, and Soil Conservation
(ii) Update irrigation policy and support policy planning for mainstreaming CSA	Medium	Department of Planning and Policy Analysis of the Ministry of Agriculture and Food Security
(iii) Introduce evidence-based policies and institutional strengthening for CSA	Short–Medium	Department of Planning and Policy Analysis of the Ministry of Agriculture and Food Security
Develop knowledge management system		
(i) Establish CSA Knowledge Portal	Medium–Long term	Department of Agricultural Research; Department of Crop Services; Department of Livestock all of the Ministry of Agriculture and Food Security; Lesotho Meteorological Services; National University of Lesotho
(ii) Promote inclusive Climate Information Services and Advisories Dissemination Platform	Medium–Long term	Department of Field Services; Lesotho Meteorological Services; Ministry of Science and Communications; ICT Service Providers
(iii) Document MFS practices and integrate with modern science	Short	Department of Field Services; Department of Agricultural Research; Machobane Agricultural Development Foundation; National University of Lesotho
Foster equitable access to land		
(i) Develop cost-effective approaches for managing land rights	Medium	Land Administration Authority
(ii) Document different types of land rights supported by stakeholders	Medium	Land Administration Authority
(iii) Identify opportunities for commercial farming	Short	Land Administration Authority; Department of Soil and Water Conservation; Lesotho National Development Corporation
(iv) Link land rights to land suitability, soil carbon and other key parameters of land use using satellite imageries	Medium	Land Administration Authority; Department of Soil and Water Conservation
Establish Strategic Food Reserve Agency		
(i) Set up Food Reserve Agency and define functions: administer the strategic food reserves, facilitate market development, and manage warehouse/ storage facilities	Medium	Ministry of Agriculture and Food Security; Ministry of Development Planning; Ministry of Finance; National Disaster Management Authority
(ii) Awareness building on the role of the Agency	Short	Ministry of Agriculture and Food Security; Ministry of Development Planning; Ministry of Finance; National Disaster Management Authority
(iii) Build and manage warehouses and storage facilities for national seed and grain reserve	Medium–Long	Ministry of Agriculture and Food Security; National Disaster Management Authority
(iv) Subsidize seed and grain storage for qualifying farmers	Long	Ministry of Agriculture and Food Security; Ministry of Development Planning; Ministry of Finance; National Disaster Management Authority

(*continued*)

TABLE ES.15: (Continued)

	Time frame	Responsible authorities
Realign agricultural support to promote CSA		
(i) Policy reform to align agricultural support to promote CSA	Short	Ministry of Agriculture and Food Security; Ministry of Planning; Ministry of Finance
(ii) Establish inputs e-voucher system	Short–Medium	Ministry of Agriculture and Food Security; Ministry of Planning; Ministry of Finance
(iii) Develop market information systems to reduce information costs	Short–Medium	Department of Field Services of the Ministry of Agriculture and Food Security; Ministry of Small Business Cooperatives and Marketing; Basotho Enterprise Development Corporation
Strengthen agricultural research and extension		
(i) Establish partnership with international research institutes and develop high-yielding, stress-tolerant, climate-ready varieties	Long term	Department of Agricultural Research, Department of Field Services, all of the Ministry of Agriculture and Food Security; Lesotho Agricultural College, Ministry of Agriculture and Food Security; National University of Lesotho
(ii) Upgrade agricultural extension services to facilitate access to information and improved technical backstopping	Short–Medium	Department of Field Services, Department of Agricultural Research, Ministry of Agriculture and Food Security
Create enabling environment for private sector		
(i) Introduce policies and incentives that provide an enabling environment for private sector investment	Short	Ministry of Agriculture and Food Security; Lesotho National Development Corporation; Ministry of Small Business Cooperatives and Marketing; Basotho Enterprise Development Corporation
(ii) Encourage private financial service providers to tailor instruments that enable farmers who adopt CSA practices to overcome adoption barriers	Medium	Ministry of Agriculture and Food Security; Lesotho National Development Corporation; Ministry of Small Business Cooperatives and Marketing; Basotho Enterprise Development Corporation
(iii) Promote PPP and design innovative risk management products (bundling credit and weather index insurance)	Medium–Long term	Ministry of Agriculture and Food Security; Lesotho National Development Corporation; Ministry of Small Business Cooperatives and Marketing; Basotho Enterprise Development Corporation
Build Capacity to Access Climate Finance		
(i) Build capacity to identify funding gaps and needs; assess public and private financing options	Long term	Ministry of Agriculture and Food Security; Ministry of Finance; Ministry of Development Planning
(ii) Develop financially viable opportunities for effective private sector engagement	Long term	Ministry of Agriculture and Food Security; Ministry of Finance; Ministry of Development Planning
(iii) Develop results-based financing/payment for ecosystem services programs	Long term	Ministry of Agriculture and Food Security; Ministry of Finance; Ministry of Development Planning

Source: Authors
Note: Short term = 1–2 years; Medium term = 2–5 years; Long term = greater than 5 years

Agriculture Public Expenditure Review designed to identify measures to improve the quality of public expenditures in agriculture. CSA through agroforestry, integrated soil fertility management, and conservation agriculture (CA) is a focus of an important World Bank partnership with the International Center for Tropical Agriculture (CIAT) and other partners to support the incorporation of CSA into national planning through the Lesotho CSA Profile. These together are part of the larger context of this work on the CSAIP in Lesotho.

WORLD BANK GROUP