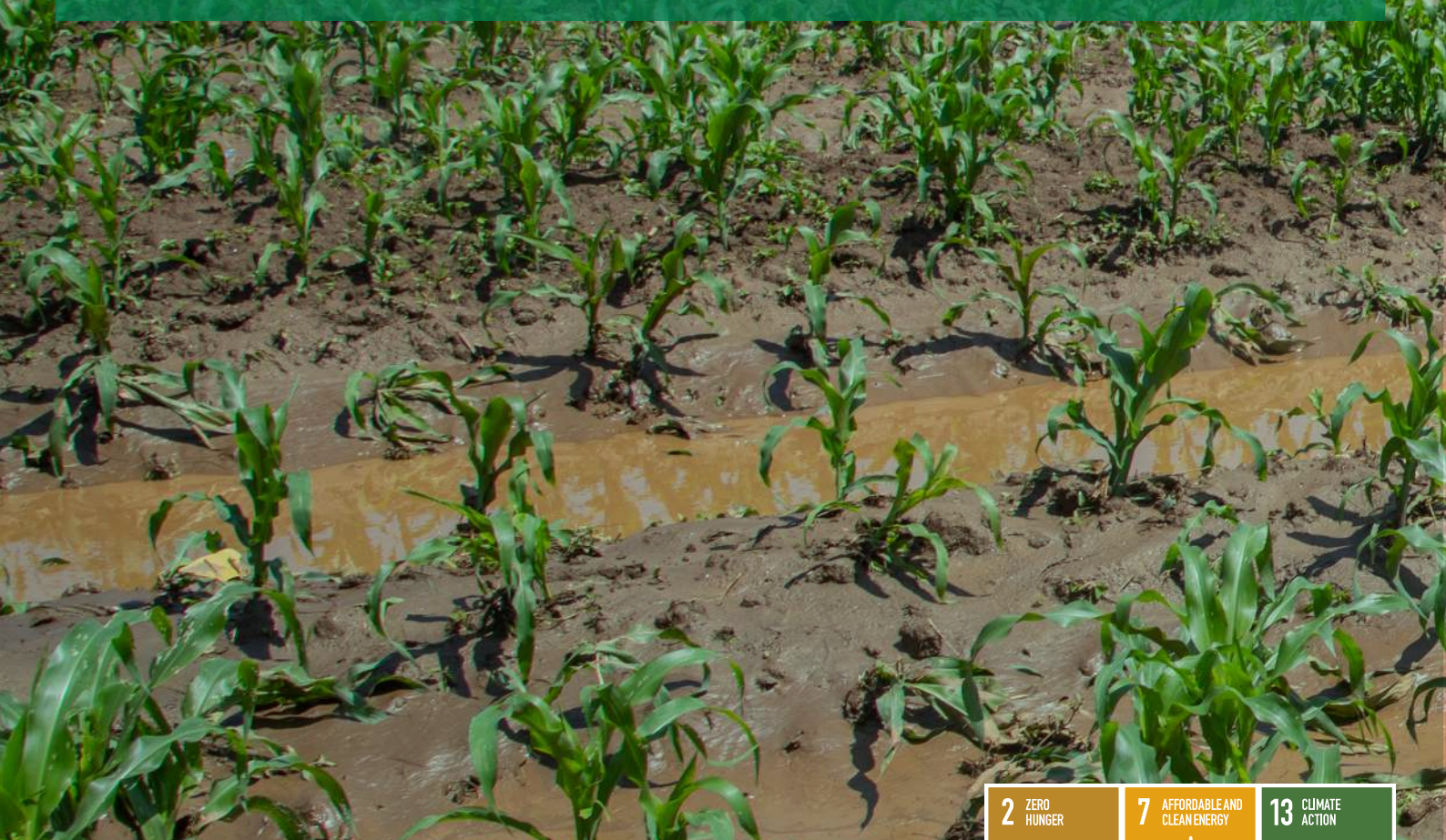


# POLICY BRIEF

## JANUARY 2023

CLIMATE RISK MAPPING AND MITIGATION MEASURES TO ORIENT PRIVATE SECTOR INVESTMENT IN RWANDAN AGRICULTURE.



Republic of Rwanda  
Ministry of Agriculture  
and Animal Resources





## INTRODUCTION

Climate change has a direct impact on the assets and resources needed to earn a living. The destruction of homes and infrastructure, degradation of ecological resources, loss of biodiversity and environmental damage severely harm livelihoods that are climate-sensitive, including agriculture and fishing (WSR, 2020).

For instance, it is reported that more than 2 billion people are living in countries under water stress and 3.6 billion people face inadequate access to water at least one month per year. Meanwhile, water-related hazards have increased in frequency for the past 20 years. Since 2000, flood-related disasters have increased by 134%, and the number and duration of droughts also increased by 29%. Also, it is projected that climate change will push up to 130 million people into poverty over the next 10 years unravelling hard-won development gains and could cause over 200 million people to migrate within their own countries by 2050 (WMO, 2021).



# JUSTIFICATION

The increasing incidence of drought and famine, particularly, in sub-Saharan Africa are of critical concern, as low-input and small-scale mixed cropping systems predominate in this region. In addition, small-scale farmers in the region are particularly vulnerable to climate change (Thornton and Herrero, 2015; Thierfelder et al., 2017).

In Rwanda, like other countries in the region, climate change remains a big challenge in terms of ecosystem degradation and its negative effects in food security. It is therefore in this context that a climate risk assessment and vulnerability mapping for major value chain crops and livestock was conducted by the Ministry of Agriculture and Animal Resources in partnership with UNDP to develop mitigation measures to orient private investment in climate resilient agriculture.

The study focussed on 11 value chain commodities: Banana, Beans, Cassava, Chili pepper, Maize, Rice, Soybean, Irish potatoes and Wheat, Dairy value chain and Poultry, to provide more light on climate change risks and mitigations measures.

This policy brief presents the findings from climate risk mapping and proposed measures to orient private sector investment in agriculture.

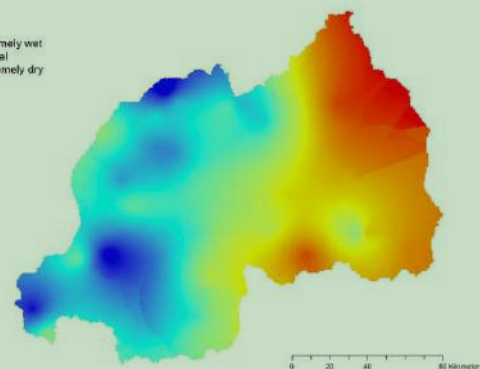
# KEYS FINDINGS

## Future drought pattern in Rwanda



By 2050, it is projected that the country mean increase for minimum and maximum temperature will be 1.7°C and 1.6°C respectively while the highest annual mean rainfall increase of 21.8mm and 23.6mm will be recorded at Kanombe and Gitega stations respectively and the lowest annual mean rainfall increase ranging from 1.5 mm to 5 mm will be observed at Kawangire, Rubengera, Byumba and Kamembe stations; while the moderate annual mean rainfall increase of around 10 mm will be observed at Byimana, Busogo and Nyagatare stations.

Legend  
SPI  
Extremely wet  
Normal  
Extremely dry



The important parts of the Rwanda especially in Eastern savanna, Eastern Ridge and plateau, Mayaga and Bugesera are in a negative water balance zone (about 40%), experiencing water deficit/rain shortage during crop production cycle.

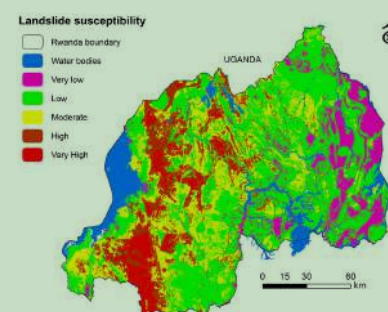
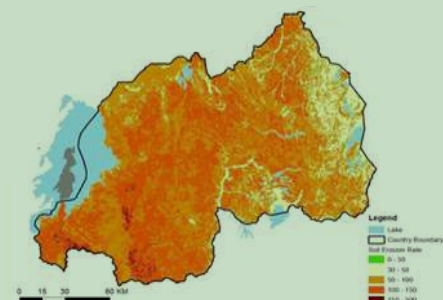
## Soil erosion map



A total of 595 million tons of soil is annually lost in Rwanda



Cropland expansion was found to be the major soil erosion causal agent. 26% of the total cropland located on a slope > 30% comprised 63% of the total soil lost from the cropland areas



## Flood prone areas in Rwanda



The eastern savanna and the central plateau are the most susceptible regions to flood risks. Lowland and relatively flat areas (very low slope values) are the most susceptible to flooding.



Increase in season variability will continue to be observed in agriculture calendar. Table below shows the projected rainfall onset and cessation mean dates for both March-May (MAM) rain season and September-December (SOND) rain season.

### Future projected onset and cessation dates

Station	March Mean	May Mean	Sep_Mean	Dec_Mean	Onset_MAM	Cess_MAM	Onset_SOND	Cess_SOND
GITEGA	139.8	160.4	300.3	76.6	11	31	13	18
KANOMBE	139.8	156.4	306.2	73.2	11	31	13	18
GIKONGORO	85.5	146.1	180.3	60.1	23	29	18	15
BYIMANA	107.1	173.1	177.5	61.5	17	32	18	15
RUBENGERA	122.7	140.8	176.6	72.4	14	29	18	17
GISENYI	117.8	109.9	189.7	66.3	15	25	18	16
KAMEMBE	108.0	141.6	247.6	94.4	17	29	15	21
BUSOGO	166.2	282.7	186.9	58.0	8	42	18	15
RUHENGERI	156.1	236.0	151.7	68.4	9	38	20	17
BYUMBA	129.9	122.1	208.3	45.6	12	27	17	13
NYAGATARE	104.5	158.9	166.4	74.2	18	31	19	18
KAWANGIRE	104.6	112.5	144.6	48.8	18	26	20	13
KIBUNGO	112.5	114.9	146.7	56.2	16	26	20	14
KARAMA	98.5	112.6	214.0	55.7	19	26	16	14
BUGARAMA	88.2	113.2	190.1	71.9	22	26	18	17



## Effects of climate change and variabilities on selected commodity value chains



- In most agricultural value chains, the production stage is the most vulnerable to climate variability and change effects. This is the case for all the 11 value chains selected for this study.
- Other vulnerable segments are: Harvesting, Post-harvest handling (mostly drying and storage) and Transport.
- The table below present most problematic climate risks for the 11 selected commodity value chains.

### Most problematic climate risks for 11 selected commodity value chains




Commodity	Drought	High Temp.	Heavy rain/ Flooding	Strong wind	Moisture	
Maize						
Wheat						
Rice						
Bean						
Soybean						
Banana						
Cassava						
Potato						
Chilli						
Poultry						
Dairy						

## CLIMATE RISKS AND PROPOSED MITIGATION MEASURES FOR 11 VALUE CHAINS


Value chain	Major effects due to climate risks	Mitigation measures/ solutions
<p><b>Maize</b></p> 	<ul style="list-style-type: none"> <li>- Reduced crop performance and yield</li> <li>- Increased prevalence of some pests and diseases (fall army worm, MLN),</li> <li>- Aflatoxin,</li> <li>- Limited access to market due to poor road conditions</li> </ul>	<ul style="list-style-type: none"> <li>- Promotion of early maturing varieties</li> <li>- Development of varieties that are tolerant/resistant to drought, pests &amp; diseases</li> <li>- Irrigation/Drainage; Erosion control measures</li> <li>- Improved access to post-harvest handling facilities</li> <li>- Development/optimization of climate agriculture smart technologies</li> <li>- Improve feeder road infrastructures</li> <li>- Improved early warning system to guide in farming operations</li> <li>- Enhance Maize insurance scheme</li> </ul>
<p><b>Rice</b></p> 	<ul style="list-style-type: none"> <li>- Reduced crop performance and yield</li> <li>- Increased prevalence of diseases (Yellow mottle virus, Pyriculariosis),</li> <li>- Limited access to market due to poor road conditions</li> </ul>	<ul style="list-style-type: none"> <li>- Promotion of fast maturing varieties</li> <li>- Development of varieties that are tolerant/resistant to flood, cold, pests &amp; diseases</li> <li>- Scale up drying and post-harvest facilities in production areas</li> <li>- Promotion of portable processing units</li> <li>- Promote water management practices</li> <li>- Development/optimization of climate agriculture smart technologies</li> <li>- Improve feeder road infrastructures</li> <li>- Improve early warning system to guide in farming operations</li> <li>- Enhance Rice insurance scheme</li> </ul>

Value chain	Major effects due to climate risks	Mitigation measures/ solutions
<p><b>Wheat</b></p> 	<ul style="list-style-type: none"> <li>- Stem lodging for long varieties</li> <li>- Disease outbreak (powdery mildew)</li> <li>- Increased post-harvest losses</li> <li>- Low quality of harvested grain</li> <li>- Reduced labor efficiency</li> <li>- Reduced crop performance and yield</li> </ul>	<ul style="list-style-type: none"> <li>- Promotion of varieties that are resistant/tolerant to lodging, drought and heat</li> <li>- Improve early warning system to guide in farming operations</li> <li>- Promote use of adequate post-harvest operations (mechanized threshers, use moisture free oxygen bags, etc)</li> <li>- Include Wheat in insurance scheme</li> </ul>
<p><b>Dry beans</b></p> 	<ul style="list-style-type: none"> <li>- Outbreak of diseases (anthracnosis)</li> <li>- Increased of storage pests/ rodents</li> <li>- Reduced crop performance and yield</li> </ul>	<ul style="list-style-type: none"> <li>- Promotion of varieties that are resistant/tolerant drought, pests and diseases</li> <li>- Promote climate smart agriculture technologies</li> <li>- Improve early warning system to guide in farming operations</li> <li>- Improve feeder road infrastructures</li> <li>- Promotion of mobile drying facilities and warehouses among cooperatives</li> <li>- Conduct research on efficient systems and structures</li> <li>- Include Beans in insurance scheme</li> </ul>
<p><b>Soybean</b></p> 	<ul style="list-style-type: none"> <li>- Increased pest and disease incidence</li> <li>- Reduced crop performance and yield (poor germination, stunting)</li> <li>- Increased storage pest and disease incidence</li> <li>- Poor yield quality</li> </ul>	<ul style="list-style-type: none"> <li>- Promotion of varieties that are resistant/tolerant drought, pests and diseases</li> <li>- Promote soil conservation practices (agroforestry, appropriate terraces, water retaining infrastructure)</li> <li>- Improve early warning system to guide in farming operations</li> <li>- Development/optimization of climate smart agriculture technologies (cover crops, intercropping, etc.)</li> <li>- Improve feeder road infrastructures</li> <li>- Include soybean in insurance scheme</li> </ul>



Value chain	Major effects due to climate risks	Mitigation measures/ solutions
<p><b>Banana</b></p> 	<ul style="list-style-type: none"> <li>- Pest invasion (nematodes, weevils)</li> <li>- Prevalence of diseases (fusarium wilt, bunch top diseases, Xanthomonas wilt)</li> <li>- Banana leaves destroyed by hailstones which negatively affects yield,</li> <li>- Plant breakage/toppling,</li> <li>- Rotting of banana suckers in water logging conditions</li> <li>- Reduced crop performance and yield</li> </ul>	<ul style="list-style-type: none"> <li>- Improve feeder road infrastructures</li> <li>- Build the capacity of banana farmers and seed multipliers</li> <li>- Promote climate resilient varieties (tolerant to drought, etc)</li> <li>- Promote mulching to conserve soil moisture</li> <li>- Promotion of small-scale water harvesting and irrigation techniques</li> <li>- Promotion of staking methods</li> </ul>
<p><b>Cassava</b></p> 	<ul style="list-style-type: none"> <li>- Reduced crop performance and yield</li> <li>- Increased susceptibility to diseases</li> <li>- Outbreak of pests (green mites, scale insects, whitefly, ...) in dry period</li> <li>- Delayed harvesting or increased damage during harvesting due to hard soil in absence of rain,</li> </ul>	<ul style="list-style-type: none"> <li>- Promote climate resilient varieties</li> <li>- Promote climate smart agricultural technologies (mulching, irrigation, etc)</li> <li>- Promote mechanized farming operations (land preparation, harvesting, etc)</li> </ul>
<p><b>Potato</b></p> 	<ul style="list-style-type: none"> <li>- Increased incidence and severity of diseases (late blight),</li> <li>- Poor quality (pesticide residues) and quantity of harvested produce,</li> <li>- Reduced crop performance and yield (poor tuber formation, stunting)</li> <li>- Greening of tubers</li> </ul>	<ul style="list-style-type: none"> <li>- Improved access to early maturing varieties adapted to biotic and abiotic stresses, and with longer shelflife</li> <li>- Promote climate smart agricultural technologies (intercropping, crop rotation, etc)</li> <li>- Improve early warning system to guide in farming operations</li> <li>- Promote mechanized farming operations (land preparation, harvesting, etc)</li> <li>- Optimization of IPM techniques to reduce overuse of chemicals</li> <li>- Promote hydroponic farming for seed production</li> <li>- Enhance potato insurance scheme</li> </ul>

Value chain	Major effects due to climate risks	Mitigation measures/ solutions
<p><b>Chilli</b></p> 	<ul style="list-style-type: none"> <li>- Outbreak of pests (FCM, white-fly, thrips,...) and diseases (viruses)</li> <li>- Poor quality after harvest due to poor drying conditions in heavy rains,</li> <li>- Spoilage due to limited access to market due to poor road conditions during heavy rains</li> <li>- Temperature increase causes shorter storage time for banana bunches due to ripening.</li> <li>- Limited access to market due to poor road conditions in heavy rains</li> </ul>	<ul style="list-style-type: none"> <li>- Improve feeder road infrastructures</li> <li>- Promote climate resilient varieties</li> <li>- Enhance chilli insurance scheme</li> <li>- Optimization of post-harvest handling practices</li> <li>- Construction of drying, grading and collection facilities</li> <li>- Promote climate smart agricultural technologies (mulching, irrigation, etc)</li> <li>- Development/optimization of IPM options to manage various pests and diseases of chilli</li> <li>- Promotion of seed trays and construction of centers for multiplication of seeds and seedlings</li> <li>- Organization of the entire chilli value chain to minimize losses along different segments of the VC and enhance marketing.</li> </ul>
<p><b>Poultry</b></p> 	<ul style="list-style-type: none"> <li>- Feed shortage both in quality and quantity (raw material)</li> <li>- Outbreak of diseases (coccidiosis, etc) and flock mortality</li> <li>- Decreased egg production</li> <li>- Decreased performance of existing breeds</li> <li>- Increased perishability of poultry products (eggs, meat)</li> <li>- Vaccine instability</li> </ul>	<ul style="list-style-type: none"> <li>- Promote climate resilient breeds</li> <li>- Promote hydroponic feed production (eg. Spirulina),</li> <li>- Promote good husbandry practices</li> <li>- Promote cold chain for poultry meat and moisture free boxes for eggs</li> <li>- Promote/scale up the cultivation of local grains as ingredients for feeds</li> <li>- Promote alternative sources of proteins (eg. Black soldier fly, etc)</li> <li>- Promotion of thermostable vaccines</li> <li>- Enhance poultry insurance scheme</li> </ul>

Value chain	Major effects due to climate risks	Mitigation measures/ solutions
<p data-bbox="165 338 272 376"><b>Dairy</b></p> 	<ul style="list-style-type: none"> <li>- Feed shortage</li> <li>- Outbreak of diseases</li> <li>- Low milk quality and quantity</li> <li>- Water shortage</li> </ul>	<ul style="list-style-type: none"> <li>- Promote hydroponic fodder production</li> <li>- Promote cultivation of diversified fodder crops (cereals &amp; legume crops) that are climate resilient</li> <li>- Promotion of semi-intensive and zero-grazing systems</li> <li>- Promote good husbandry practices that are climate resilient</li> <li>- Organization of the entire dairy value chain to minimize losses VC and enhance marketing</li> <li>- Scale up capacity building</li> <li>- Improve feeder road infrastructures</li> <li>- Enhancing milk packaging and transport methods</li> <li>- Improve access to water &amp; promote water harvesting techniques</li> <li>- Facilitate access to forage harvesting and preservation tools and equipment</li> </ul>

# REFERENCES

- Heidlo, 2012. Strategic and investment plan to strengthen the poultry industry in Rwanda.
- Karenzi, E., Mashaku, A., Nshimiyimana, M.A., Munyanganizi, B., Thonart, P. 2013, Kivuguto, Traditional Fermented Milk and the Dairy industry in Rwanda. A review.
- Kathiresan, A. (2012). Strategies for Sustainable Crop Intensification in Rwanda.
- MINAGRI, 2012. Strategy & Investment plan to strengthen the poultry industry in Rwanda. Final Report.
- MINAGRI, 2013. Rwanda National Dairy Strategy. Final Report.
- MINAGRI, 2013. Strategic plan for the transformation of Agriculture in Rwanda, Phase III
- RAB, 2016. Increased Soybean Production and Productivity for Sustaining Markets in Rwanda, Feasibility study report.
- Ray, R.C. and Ravi, V. 2005. Postharvest spoilage of sweet potato in tropics and control measures. Crit. Rev. Food Sci. Nutr. 45:623-644.
- Reddy, V. R., and Ya A. Pachepsky. "Predicting crop yields under climate variability and/or change conditions from monthly GCM weather projections." Environmental Modelling & Software 15.1 (2000): 79-86.
- Rosenthal, David M., and Donald R. Ort. "Examining cassava's potential to enhance food security under climate variability and/or change ." Tropical Plant Biology 5.1 (2012): 30-38.
- Rushemuka, P. N., Bock, L. and Mowo, J. G. (2014). Soil science and agricultural development in Rwanda: state of the art . A review, 18(1), 142–154.
- Schmidhuber, J.; Tubiello, F.N. Global food security under climate variability and/or change . Proc. Natl. Acad. Sci. USA 2007, 104, 19703–19708.
- Senanayake, S., et al., A Review on Assessing and Mapping Soil Erosion Hazard Using Geo-Informatics Technology for Farming System Management. Remote Sensing, 2020. 12(24): p. 4063.
- Spratt, S., 2009. Assessing the Alternatives: Financing Climate variability and/or change Mitigation and adaptation in Developing Countries. The New Economics Foundation.
- Susanna Cocchini and Emily ter Steeg, (2019). Poultry Sector Analysis Rwanda
- World Bank, 2015. Rwanda Agricultural Sector Risk Assessment, Washington DC
- Yanling Song, Hans W. Linderholm, Yi Luo, Jinxia Xu and Guangsheng Zhou. 2020. Climatic Causes of Maize Production Loss under Global Warming in Northeast China.

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