Towards an IGAD Regional Flood Risk Profile

(2021)

This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region. (Document prepared for consultation with Member States)

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Background

The present report outlines the preliminary findings of the IGAD regional flood risk profile. This work was undertaken in partnership between IGAD-ICPAC, UNDRR, WFP, with support from the Government of Sweden and scientific support from the CIMA Research Foundation. In Phase II of the project (2021-2022), consultations with Member States willtake place with the aim to review and validate the findings.

This risk profile focuses on floods, which is a priority hazard for the IGAD Disaster operations Center. The regional risk assessment aims to present estimates of present and future flood impacts across different exposure categories. In the region, floods are the most prominent disasters events together with drought. Based on historical records, disasters caused by drought, floods and landslides are currently the main drivers of displacement in Djibouti, Kenya and Uganda. In 2019 alone, an estimated 1,753,000 people were displaced by disasters, mostly in Somalia, Kenya and Ethiopia.

Previously, regional flood risk information was available through the ATLAS of Climate Risk and Food security for the Horn of Africa Region (https://www.icpac.net/publications/greater-horn-africa-climate-and-food-security-atlas/). The Atlas tool has guided IGAD Member Stats in their adaptation planning and programme design, but it has also serves a wide range of stakeholders, including communities, governments, agencies and humanitarian actors in making communities resilient to food insecurity. The Atlas is based on historical/observed data, but does not include predictive information of flood risk. This presented some limitations for its application in support of humanitarian planning and action; particularly when considering the already evident consequences of climate change as well as the project increase in magnitude and frequency of weather related events.

Initially conceived as a continuation of the Atlas, the process of developing the IGAD Regional Flood Risk Profile focused on a forward looking methodology, one which allows for the inclusion of possible hazard and impact scenarios to come. In this respect, it explicitly include climate change in the quantitative assessment of flood risk.

The Horn of Africa Partnership for Early Warning and Early Action (referred as the HOA Partnership) was launched at the Stockholm High-Level event on "Addressing the Humanitarian Impact of Climate Change, Anticipate and Act" held in October 2020. The HOA Partnership promotes a multi-sectoral and inclusive approach to disaster risk reduction, that serves as a platform to develop risk knowledge products for the benefit of early warning and early action, with the aim of mitigating disasters and addressing persistent food security challenges in the Horn of Africa.

Risk Assessment is at the basis of many risk related activities. As such it needs to be based on scientific risk information that assesses vulnerability, hazard and exposure to estimate disaster impacts - quantifying population and economic losses across different regions and sectors.

As widely known, disasters' consequences depend not only on the socio-economic conditions of the affected communities but also on the institutional preparedness and capacity to manage such events. Thus, to be able to predict when events will happen, and which impacts are they likely to have on the ground is of extreme importance to build strong institutional responses.

Methodology

Science-based predictive tools are fundamental for climate adaptation, enabling disaster prediction and supporting risk management efforts. This is the reason why the new regional risk profile has followed a predictive-probabilistic methodology (see next section): using GloFAS (Global Flood Awareness System, link - https://www.globalfloods.eu/), a modelling suit developed by the Joint Research Centre of the European Commission (link) this project developed thousands of flood risk scenarios which were analyzed and interpreted, relating their possible consequences on different exposure categories, such as population, grazing land, infrastructure and crops affected. The analytical process was developed under both current and future climate conditions, considering the IPCC scenario RCP 8.5 which foresees an increase in the global temperature between 1,5°C and 4°C by 2100.

Several methodologies exist for the development of a risk assessment and often there is not a better or worse methodology. They are intimately linked with the application they are intended to be used for. However, some methodologies have a higher information content and allow for more flexibility in their practical use. One of these is the probabilistic risk assessment approach, which was used in this study. This approach has been used by UNDRR and other DRR stakeholders to develop quantitative risk profiles at the national and sub-national level.

The added value of a Probabilistic Risk Assessment (PRA) is often misunderstood, as audiences tend to view it as a highly technical method that is difficult to apply or understand. These difficulties represent a challenge for communicating risk results.

A probabilistic disaster risk profile should be seen as a risk diagnosis instrument, as it provides indications on possible hazardous events and their impacts. Both past and probable future events have been taken into consideration in a comprehensive risk assessment exercis

Probabilistic disaster risk profiles consider all possible risk scenarios in a certain geographical area. This means that both low frequency, high loss impact events, as well as high frequency, lower loss impact events are calculated. Included is their probability of occurrence, and all elements of the risk equation (risk = hazard X exposure X vulnerability / capacity), their variability and uncertainty ranges.

$$Risk = \frac{Hazard \times Exposure \times Vulnerability}{Capacity}$$

Events which have never been historically recorded but might occur in projected climate conditions are also considered in the risk analysis. This feature is particularly useful in the context of climate change which is dramatically increasing uncertainty about future hazard patterns. Thus, societies need to calculate their “worst” possible impacts in order to be prepared. Under this lens, there is no valid alternative to a probabilistic analysis to address this uncertainty in a usable, quantitative way.

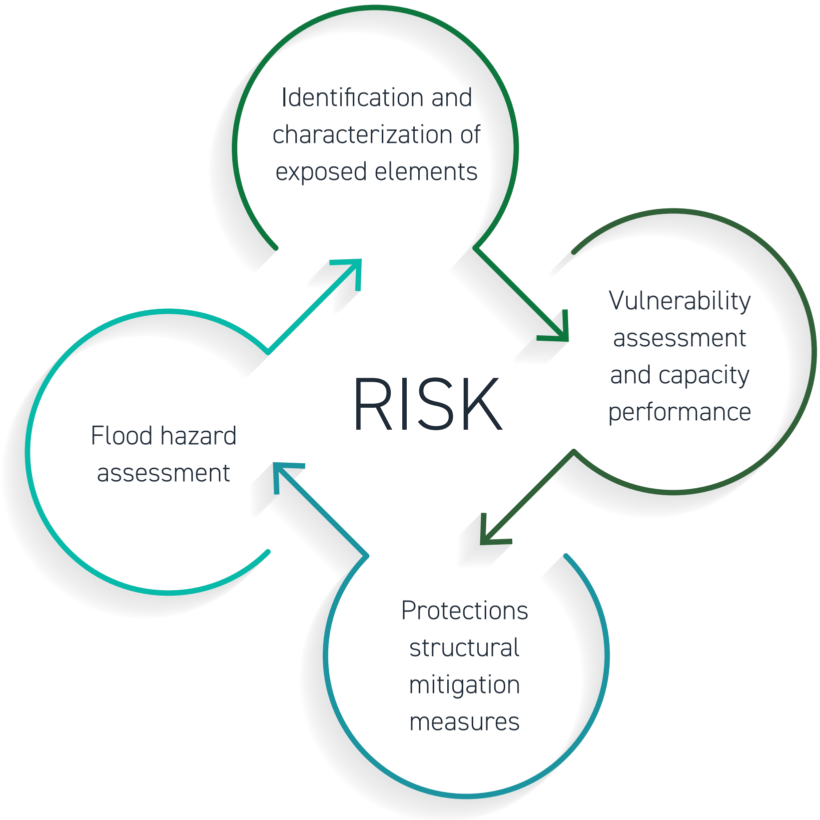
By assigning a probability of occurrence to each event magnitude, a probabilistic risk profile quantifies the expected direct impacts of disasters through economic metrics and affected population, both at aggregated and at disaggregated levels (ex. affected children, women and people with disabilities, different regions and development sectors). As this risk information is framed within return periods as a conventional probability measure, a PRA approach provides a clear vision of the risk trends.

This risk information is expressed as annual average loss (AAL) and a probable maximum loss curve (PML). It is calculated both at a national scale, as well as by sector and by region, which allows for a geographic and quantitative comparison of disaster losses, both within a country and/or between countries. These analyses and comparison exercises are an important step of the risk awareness processes, key in pushing for risk reduction, risk adaptation and risk management mechanisms to be put in place.

Flood risk assessment involves four main steps:

- flood hazard assessment;
- identification and characterization of exposed elements;
- vulnerability assessment and capacity / performance of flood;
- protection/structural mitigation measures in lowering flood damaging conditions.

From the combination of these four steps into a flood model we are able to determine risk.



Different procedures and methodologies to determine flood risk are used worldwide through a variety of models and approaches. Their common aim is to understand the probability that different magnitudes of damaging flood characteristics - considering flood depth, horizontal flood extent, flood velocity and flood duration - will occur over an extended period of time. These estimates can be calculated both in current and projected climate conditions through a consistent analysis of meteorological, geological, hydrological, hydraulic and topographic properties of the watershed, channels, and floodplains, resulting in detailed hazard maps.

In this risk profile two different climate scenarios were considered:

- under current climate conditions: with disaster risk assessed using the observed climate conditions in the 1980 - 2018 period;
- under projected climate conditions: with disaster risk being assessed under projected climate conditions (projected period 2050 - 2100), considering the IPCC scenario RCP 8.5 which foresees an increase in the global temperature between 1,5°C and 4°C by 2100, and assuming that further risk mitigation measures will not be put in place.

In the case of this study, we have utilized the modelling suit developed by the Joint Research Centre of the European Commission (JRC) called GloFAS (Global Flood Awareness System) validated and adapted using hydrologic data from the region. The modelling suit includes Hydrologic simulations in present and future climate for all the regions as well as the related hazard maps determined by a 2-dimensional hydraulic model mimicking the water behavior in the flood plain.

The obtained Hazard maps are then combined with the reproduction of past events patterns, derived from the joint analysis of multiple simulated streamflow time series. This procedure is replicated for simulations of the projected future events. Information on the performance capacity of flood protection measures is finally added to the analysis, this was done considering the local GDP distribution as a proxy for the flood defence in the area. This workflow allows for the estimation of the "expected" water depth for a certain location and/or individual infrastructures, for a set of reference scenarios. From this step on, it is possible to explore the full frequency distribution of events and the consequent damage to exposed assets, taking into consideration their different levels of vulnerability.

The probability of a given flood magnitude is expressed in terms of the "return period" (or recurrence interval). Return period is the average time interval, in years, separating two consecutive events equal or exceeding the given flood magnitude. The damage assessment is converted into economic metrics through the computation of the average annual loss - the expected loss per year, averaged over many years - and the probable maximum loss - a relationship describing all the potential losses with a certain probability range.

Achieved outputs, represented through maps and graphs, aim not only at providing the Greater Horn of Africa region with updated and predictive flood risk information - so to better prepare for future climate conditions - but also to foster the integration of such information with other possible disasters' cascading effects - such as food security, population displacement, disease outbreaks and conflicts. In this first phase, the regional flood risk profile outputs were linked with the strategic goals of the Word Food Program – to support countries to achieve zero hunger - and to those of IGAD, committed to build stronger regional emergency response interventions.

Choosing the risk Indicators

One of the main objectives of this project was to start looking on how the information produced within the Regional Risk Profile could inform the Food Security policies and actions in the field. In its first phase, the development of the IGAD regional flood risk profile focused on a set of risk indicators. These reflect the following needs and constraints:

- Availability of homogeneous and reliable exposure indicators in the GHoA region or in the IGAD region to be used for the risk indicators definition
- Relevance of the exposure layers and related risk indicators for early warning and early action in the DRM domain and specifically in the Food Security domain
- Feasibility of deriving reliable metrics given the technical and time constraints in developing the Regional Risk Profile

THE FOLLOWING SET OF RISK INDICATORS CONNECTED TO FOOD SECURITY ISSUES WERE THEREFORE SELECTED

People likely to be affected / rendered vulnerable / displaced

Number of people likely to be affected based on flood extent and duration. People who were affected during the floods as well as People who were displaced during the floods may increase vulnerability to food insecurity.

Crop production loss

Number of hectares of crops within the flood zone and likely to be submerged depending on flood extent and duration of inundation leading to loss of production.

Loss of grazing land

Number of hectares of livestock grazing land likely to be inundated and cut off from access, depending on extent and duration of inundation leading to hindered access to grazing lands.

Implications on infrastructure/facilities that directly/indirectly influence food & nutrition security

- Structural damage to roads and rails during flood event
- Markets affected by flood events
- Schools affected by flood events
- Health facilities affected by flood events

TEXTUAL EXPLANATION OF THE PROPOSED DEPENDENCIES OF RISK INDICATORS FOR WFP STRATEGIC OBJECTIVES AND RESULTS AND IGAD RELATED KEY PRIORITY AREAS

People likely to be affected / rendered vulnerable / displaced

People affected by flood events

OUTPUT
Average annual number of people affected by flood events at regional / Admin0 and Amin1 level.

CONNECTION WITH FOOD SECURITY
Affected people could suffer nutrition problems because of food shortages, in particular young children will suffer the highest impact on nutritional health. This information is particularly relevant for Properness and Responses to Food and Nutrition Crises and can also support IGAD in focusing agricultural enhancement in those areas to reduce the negative consequences on nutrition that these areas are likely to facing due to recurrent floods.

People displaced due to flood events may increase the vulnerability to food insecurity

OUTPUT
Average annual number of people displaced by flood events at regional / Admin0 and Amin1 level.

CONNECTION WITH FOOD SECURITY
People displaced are likely to have lost their houses and/or have their properties damages and their food stocks in the houses destroyed. As such their livelihood might have been severely menaced. Those people are prone to food insecurity.

Crop production loss

GDP produced in flood affected area

OUTPUT
GDP in flood affected areas in terms of AAL at Admin0 and Admin1, as a proxy of loss of income.

CONNECTION WITH FOOD SECURITY
GDP is used as a proxy for loss of income, this reduces the smallholder productivity and can worsen food insecurity. The smallholder households rely on their production for food security, nutrition and generating incomes through sale of surplus produce to buy other necessary foods that they don't produce.
Small-scale holders also supply markets with the surplus produce which allows people who rely on markets to access food. Hence, floods through their impact on smallholder impacts on food availability for the producing households and also access to food for market dependent households. This has direct and indirect influence on nutrition.
Similarly, the smallholder producing households are part of the food system by contributing to food production and supply to markets, which ensures food availability to others.

Hectares of croplands destroyed

OUTPUT
Annual average number of cropland hectares affected at regional/Admin0 and Admin1 level.

CONNECTION WITH FOOD SECURITY
The estimation of hectares of land affected by the flood with associated potential crops destroyed by flooding/waterlogging or potential production lost when people do not cultivate due to floods when considered in relation to known yield per hectare, is crucially linked to food availability.

Loss of grazing land

Death of animals from drowning

OUTPUT
Average annual affected livestock by flood events at regional/Admin0.

CONNECTION WITH FOOD SECURITY
Livestock production is a major source of food and nutrition security for many pastoral and agropastoral households through milk and incomes from selling livestock: therefore this indicator is strictly linked to food availability.

Loss of grazing land

OUTPUT
Annual average number of hectares of livestock grazing land affected at regional/Admin0.

CONNECTION WITH FOOD SECURITY
Grazing lands are important for maintaining Livestock production. Most riverine areas have traditionally been used for grazing during the dry season due to availability of water and pastures. However, extended duration of flooding and high-level inundation is a challenge to this production system by limiting livestock access to such resources. This is linked to food availability in the l mid and long term.

Implications on infrastructure/facilities that directly/indirectly influence food & nutrition security

Structural damage to roads and rails during flood event

OUTPUT
Average annual km of local roads involved in flood events at regional and Admin 0 and Admin 1 level.

CONNECTION WITH FOOD SECURITY
Roads and rails infrastructure are key to food and nutrition security by allowing for transportation of food and nutrition supplies to places where they are needed. Because of destruction of infrastructures (or simply because they are rendered unusable) during floods, the supply mechanism is affected curtailing availability and physical access to food. Equally, households depend on roads to reach markets to purchase food. When cut out due to floods, the market dependent households are affected through limited or no supplies which pushes the prices of market commodities' up such that poor households are unable to meet adequate quantities for consumption. This is a major driver for food and nutrition insecurity in some areas in the IGAD region such as South Sudan, Somalia unless food stocking/prepositioning is done before floods occur.

Schools affected by flood events

OUTPUT
Average annual number of schools involved in flood events at regional and Admin0 level and Admin 1 level.

CONNECTION WITH FOOD SECURITY
Schools affected by flood can have a direct impact on nutrition through the impossibility of delivering school meals programs. Furthermore, if the affected schools are not reconstructed in short times also more indirect consequences could be expected, reducing improvements in productivity and incomes.

Health facilities affected by flood events

OUTPUT
Average annual number of health facilities involved in flood events at regional and Admin0 level.

CONNECTION WITH FOOD SECURITY
Health facilities are used for the delivery of essential health services including nutrition interventions. Health facilities allow for disease control and access to essential vaccinations which in turn lead to good health that facilitates effective food utilization.

Results

Probabilistic disaster risk profiles consider all possible loss/impact scenarios in a certain geographical area. This means that both low frequency, high loss/impact events, as well as high frequency, lower loss impact events are included in the calculation.

Annual Average Losses and Probable Maximum Losses are the risk metrics that summarise the risk findings of the probabilistic risk assessment. In particular, the AAL is the expected loss per year, averaged over many years. While there may actually be little or no loss over a short period of time, AAL also accounts for much larger losses that occur less frequently. As such, AAL represents the funds which are required annually in order to cumulatively cover the average disaster loss over time.

On the other hand, the PML curve shows the likelihood of a certain scenario producing an estimated amount of losses. It is expressed in terms of annual probability of exceedance or its reciprocal, the return period. Typically, PML is relevant to define the size of reserves which, insurance companies or a government should have available to manage losses.

Risk results in terms of annual average loss and probable maximum loss curves were calculated for several indicators at different spatial levels of aggregation.

In Figure 1, a summary of all the results in terms of annual average loss at GHoA level is provided for current climate conditions.

Approximately 2 million of people are affected on average every year by flood events. This accounts for 0.5% of the total population in the GHoA posing serious attention to the problem of recurrent floods in the area.

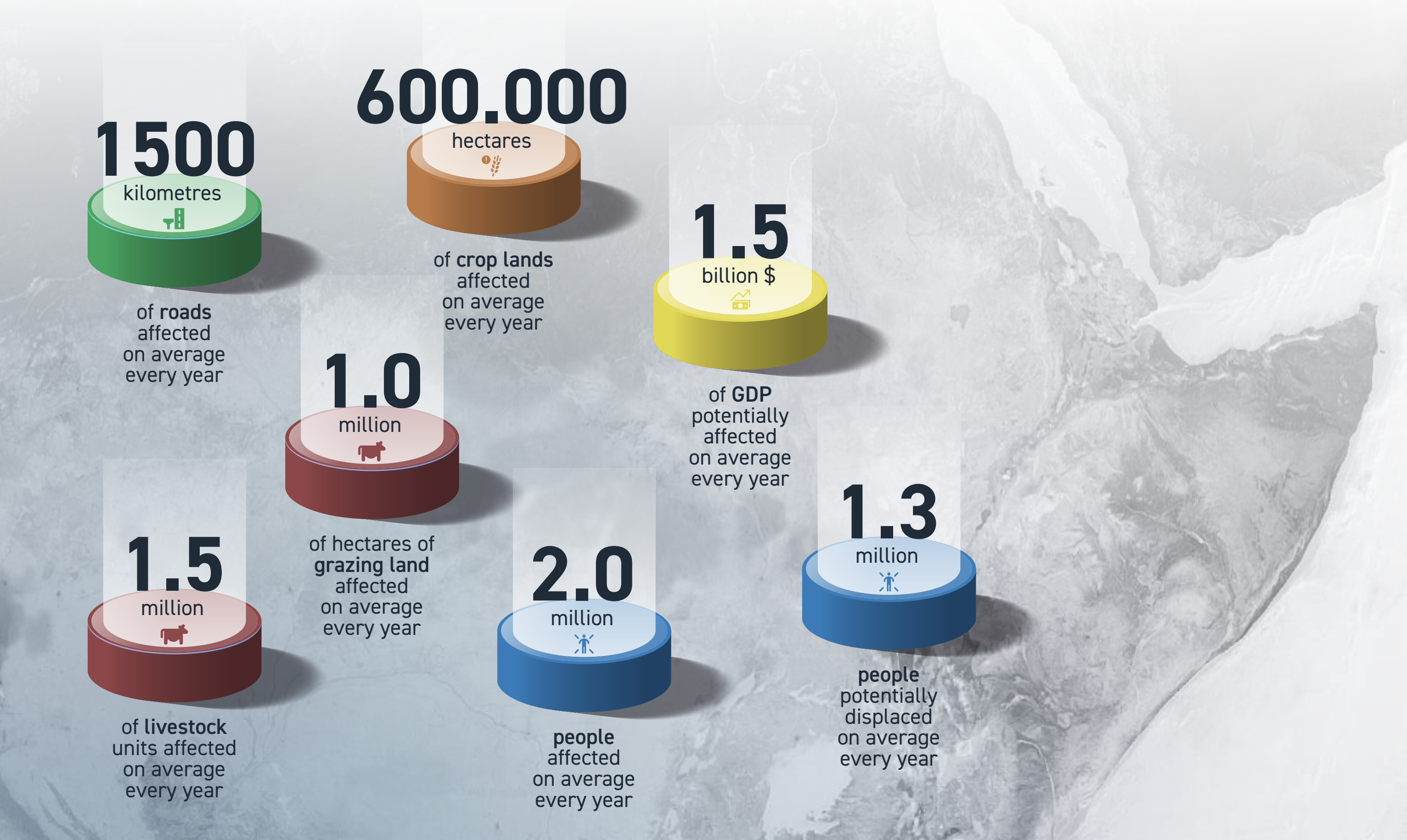
More than 50% of these affected people, 1.3 million, are potentially displaced due to the severe consequences of the floods. This makes floods the most prominent disaster together with droughts in inducing displacement in the Region. From Historical records Disasters caused by drought, floods and landslides are currently the main drivers of displacement in Djibouti, Kenya and Uganda. In 2019 alone, an estimated 1,753,000 people were displaced by disasters, mostly in Somalia, Kenya and Ethiopia. When these climate factors merge with conflicts and instability the situation exacerbate calling for immediate attention from National, Regional and Continental authorities as well as from the international community.

Directly connected with the displacement issue, but more broadly with food security and therefore with sustainable livelihood in the sub-Saharan region some other numbers should be noted. IGAD is home to 68 million of livestock units, including nearly half of sub-Saharan cattle, sheep and goat population. This accounts for 15% of the whole GDP in the IGAD region. This critical resource is heavily impacted on an annual basis by floods as 1.5 million livestock units are affected each year risking death by floods. In addition, 1 million hectares of grazing land are flooded every year causing persistent effects of floods.

Livelihood in the IGAD Region and more specifically food security is intimately linked with agricultural production. Every year 600 thousand hectares of cropland are affected on average by flood events, severely impacting the rural communities.

Consequences of flood events can be seen also on infrastructures: 1500 km of primary and secondary roads are impacted on average every year.

Risk results at GHoA level for the different indicators assessed in the analysis - Figure. 1



People affected

The same indicators were assessed at national and provincial or county level. Their spatial distribution has been computed in present and possible future climate conditions. In the case of population affected, the future population distribution, including the projections of population density has been also considered to estimate the separate contribution to risk change of climate change and changes in exposure.

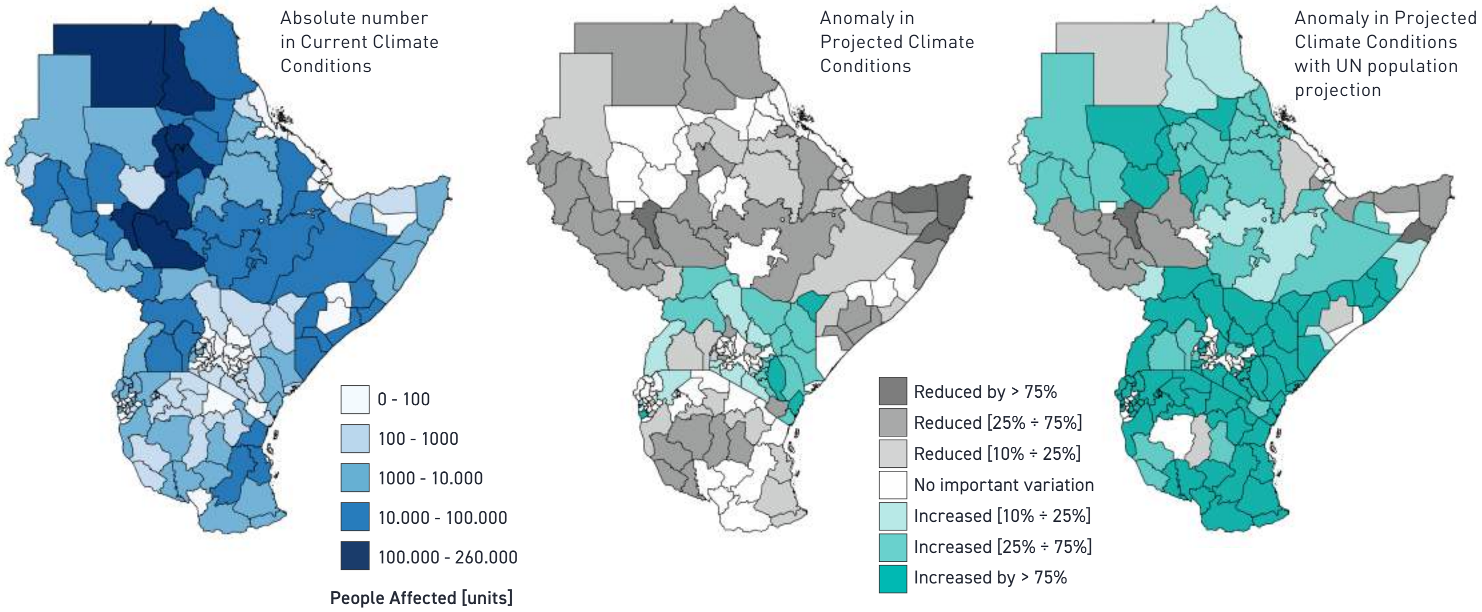
In the following picture it is possible to observe the spatial distribution of the population affected on average every year by flood events under current climate conditions, under projected climate conditions (in terms of anomaly) and under projected climate conditions taking UN population projection for 2050 into account (in terms of anomaly).

In absolute terms and considering current climatic conditions, the northern part of Sudan and the eastern part of South Sudan are the ones suffering the highest consequences. Other hotspots can be identified on major river system such as the Nile and where exposure concentrations are evident.

Under projected climate conditions, a decrease of the population affected can be seen almost everywhere in the Region except than in Kenya and Uganda. This can be traced back to the overall reduction in rainfall predicted by climate models. As usual, when climate change is analysed, the large uncertainty associated with those estimates need to be accounted for especially when results are used in a quantitative manner.

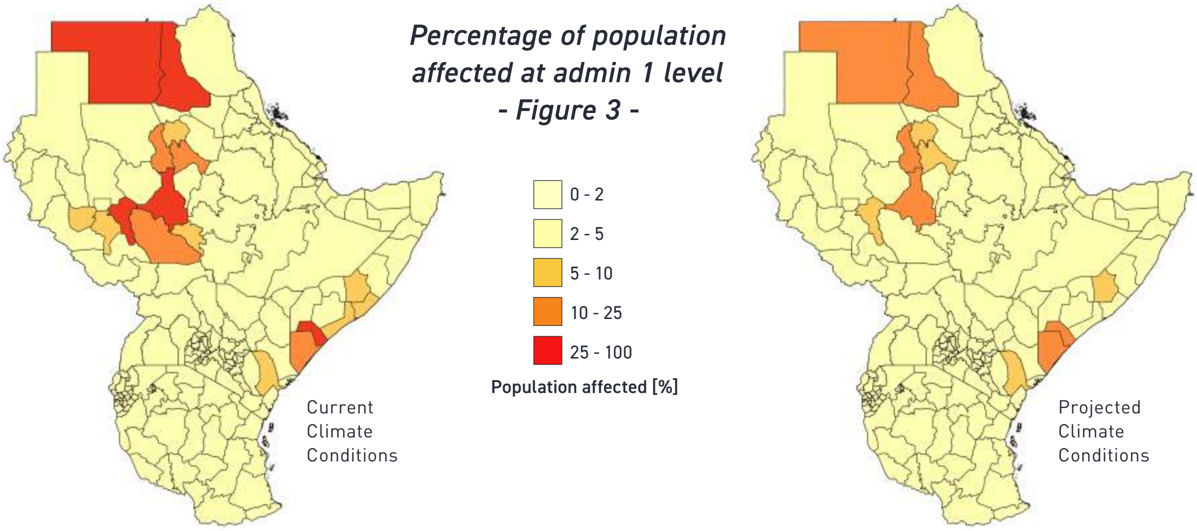
If population projections are coupled with climate projections, a reduction in terms of people affected can be seen only in the northern part of Sudan, in South Sudan and in the eastern part of Somalia. These results highlight the importance of taking socio-economic projections into account: their consequences in terms of risk cannot be neglected.

Annual Average Number of People Affected by flood events at province or county level - Figure 2



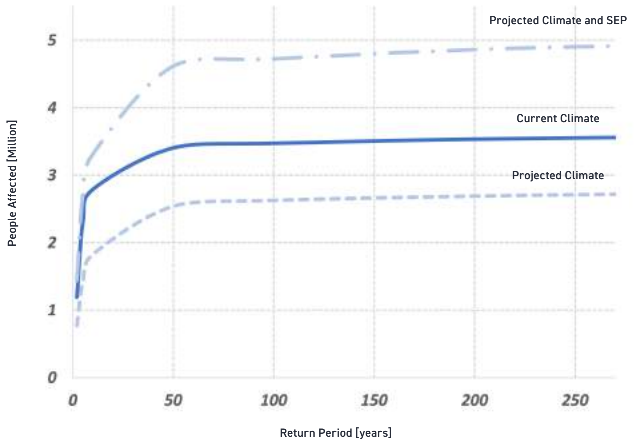
If results are analyzed in relative terms, calculating the percentage of people affected in respect of the total population at province or county (admin 1) level it is possible to highlight some hotspots in the northern part of Sudan, where the majority arable areas are along Nile river making them prone to flooding, and in the eastern part of South Sudan and in some coastal areas of Somalia and Kenya where more than 10% of the population is affected by floods every year (Figure 3).

Percentage of population affected at admin 1 level
- Figure 3 -

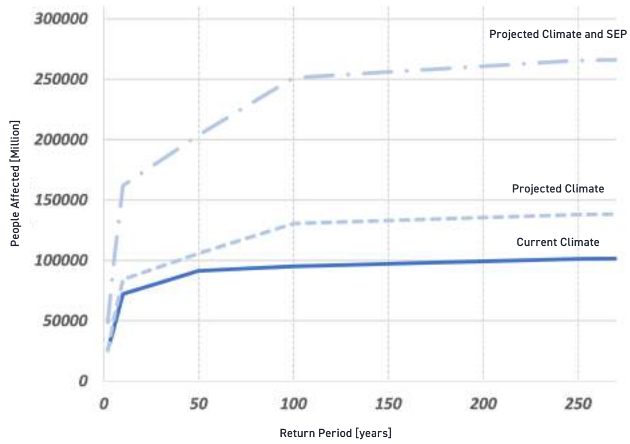


Another risk metric that was assessed during the project is the Probable Maximum Loss (PML) curve that describes how the risk parameter changes with the frequency of the events considered, from the more frequent ones to the rarest and more severe. PML curves for population affected at GHoA level is shown in Figure 4: it is possible to observe that, if projected climate conditions are coupled with the current population distribution, the number of people potentially affected by flood events for different return periods are fewer than the ones in current climate conditions. If, instead, projected climate conditions are coupled with UN population projection for 2050, the estimates of people affected for different return periods are higher than the current ones. This is in line with the results expressed in terms of annual average and confirms the importance that socio -economic projections have in risk assessment. A 50-year return period event in current climate affects more than 3 million people, while in future it might affect almost 5 million people. PML curves were calculated for all indicators at GHoA level and at country level.
The Figure 5 describes the PML curve for Kenya. Kenya is the only country where climate change exacerbates with consistency the flood risk. Both curves, the one considering climate change alone and the one considering socio-economic projection, are higher than the curve describing the present risk conditions for every type of events considered.

PML curves for population affected at GHoA level
- Figure 4 -



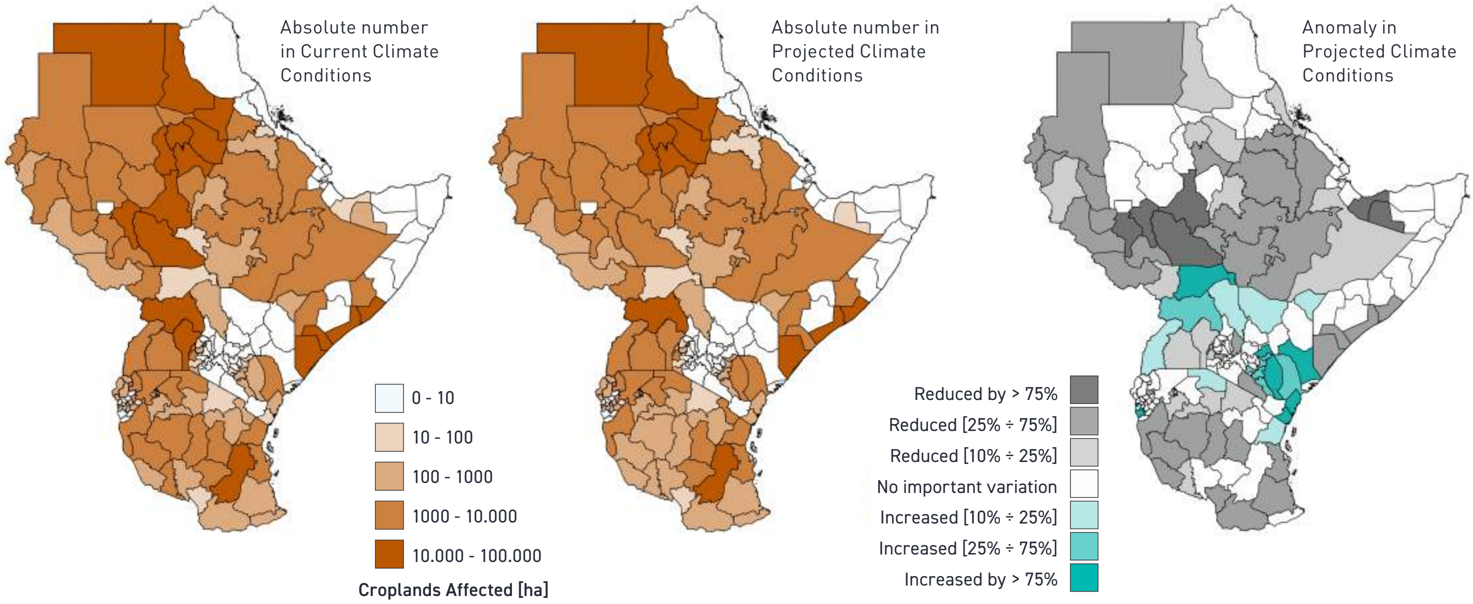
PML curves for population affected for Kenya
- Figure 5 -



Cropland affected

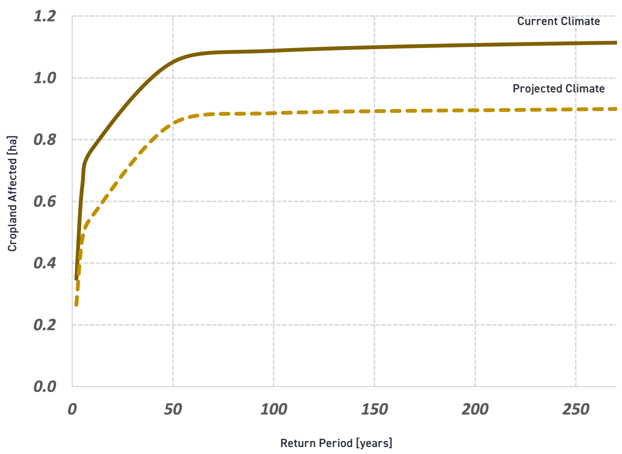
Approximately 600000 hectares of croplands are affected on average every year at GHoA level: in the following picture it is possible to observe the spatial distribution of the cropland affected at province or county level. In current climate conditions the highest number of hectares of cropland affected is in the in the northern and eastern part of Sudan and in South Sudan. Under projected climate conditions, a decrease of the cropland affected can be observed almost everywhere except than Kenya, Uganda and Burundi, mirroring the pattern observed for affected population.

Annual Average number of hectares of cropland affected by flood events at province or county level - Figure 6

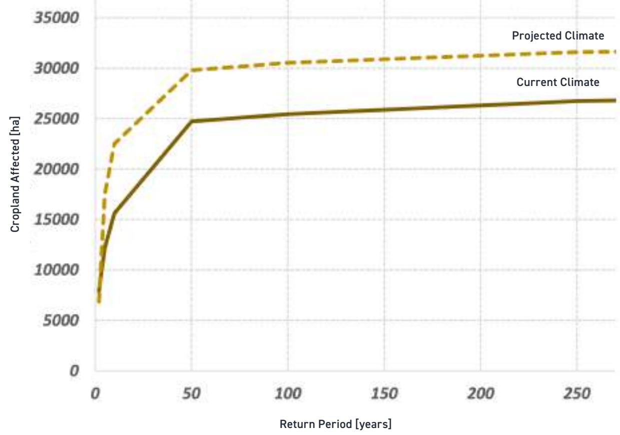


Similarly to population the PML curves were computes for all risk metrics considered. The PML curves for cropland affected at GHoA level is shown in Figure 7: it is possible to observe that in present climate conditions a relative frequent event (with a return period of less than 5 years) is expected to affect more than half a million hectares of cropland. This estimate doubles if a rare event is analysed (return period larger than 50 years). When climate change is considered the impact in all frequencies is reduced by at least 20%. This as a consequence of the overall reduction in precipitation in the GHoA, however if we consider specific areas in the IGAD region, such as Kenya, the situation reverses and we observe an exacerbation of the risk conditions in future climate (see Figure 8).

PML curves for cropland affected for GHoA - Figure 7

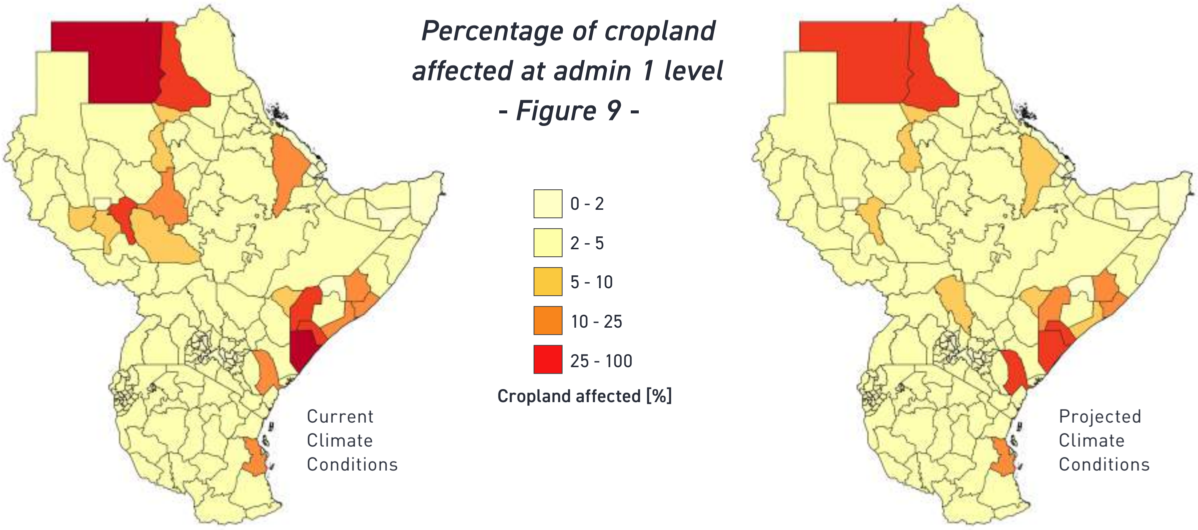


PML curves for cropland affected for Kenya - Figure 8



If results are analyzed in relative terms, calculating the percentage of cropland affected in respect of the total hectares of cropland at province or county (admin 1) level, it is possible to highlight the same hotspots in the northern and eastern part of Sudan, in South Sudan along the Nile river and, in addition, in the southern part of Somalia and some areas in Ethiopia (Figure 9).

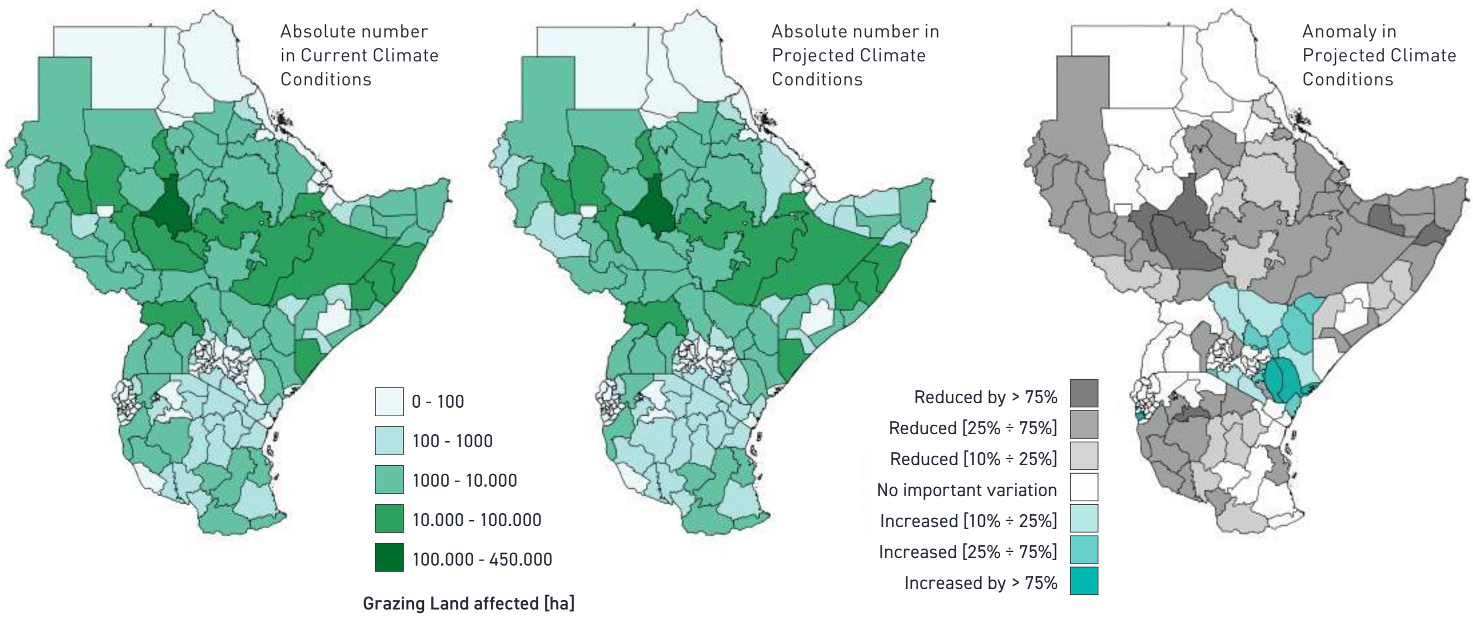
Percentage of cropland affected at admin 1 level - Figure 9 -



Grazing land affected

Figure 10 shows the spatial distribution of the grazing land affected at province or county level. In current climate conditions the highest numbers of hectares of grazing land affected are concentrated in South Sudan and Ethiopia. In projected climate conditions, it is possible to observe a decrease of the grazing land affected almost everywhere except than Kenya and Burundi.

Annual Average number of hectares of grazing land affected by flood events at province or county level - Figure 10

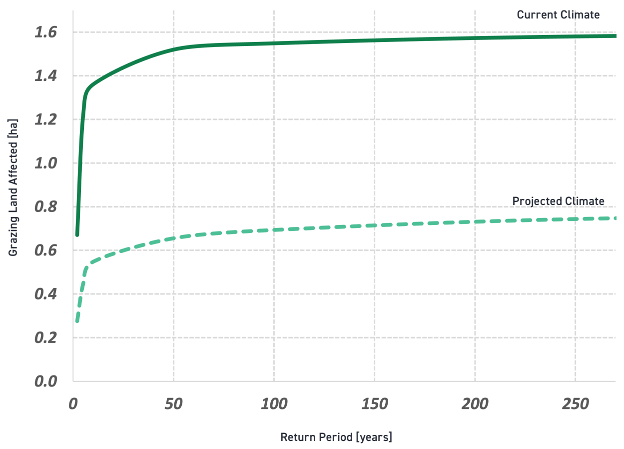


The PML curve for grazing land affected at GHoA level can be seen in Figure 11. The curve rises steep in the first part reaching more than 1 million hectares of grazing land affected for very frequent event. Such an impact is often creating food insecure conditions in the mid-term, forcing agropastoral communities to move and setting the grounds for tensions and conflict outbreak.

When climate change is considered the impact in all frequencies is reduced by at least 50% changing the risk-scape significantly.

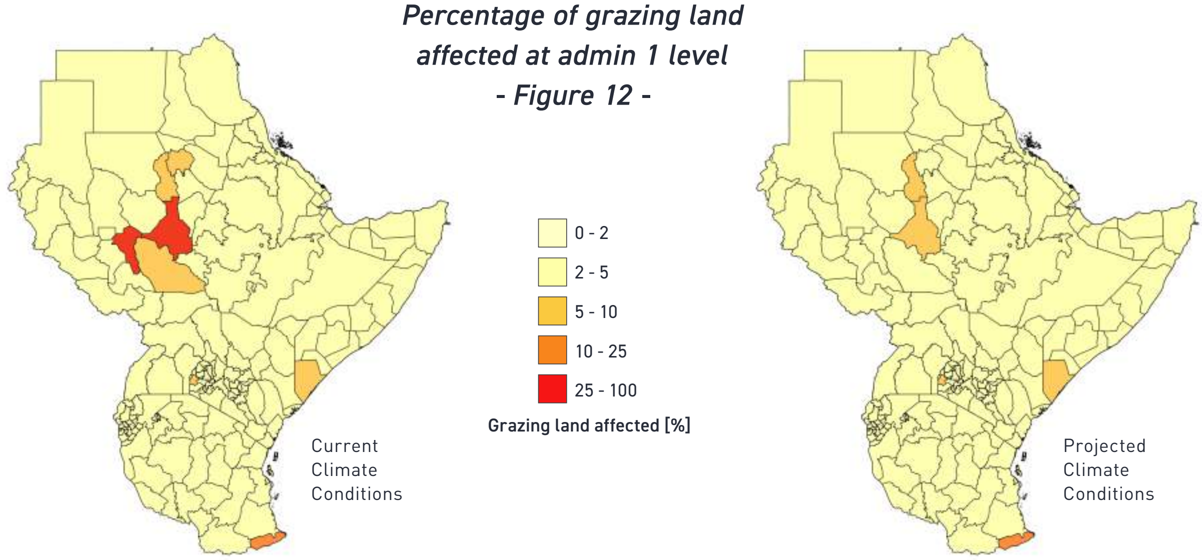
However, this needs to be analysed locally, as some areas will suffer exacerbation of losses in future climate.

PML curves for grazing land affected for GHoA
- Figure 11 -



If results are analyzed in relative terms, calculating the percentage of grazing land affected in respect of the total hectares of grazing land at province or county (admin 1) level, it is possible to highlight hotspots in South Sudan and, in addition, the southern part of Tanzania. The hotspot in Tanzania is also confirmed in projected climate conditions (Figure 12).

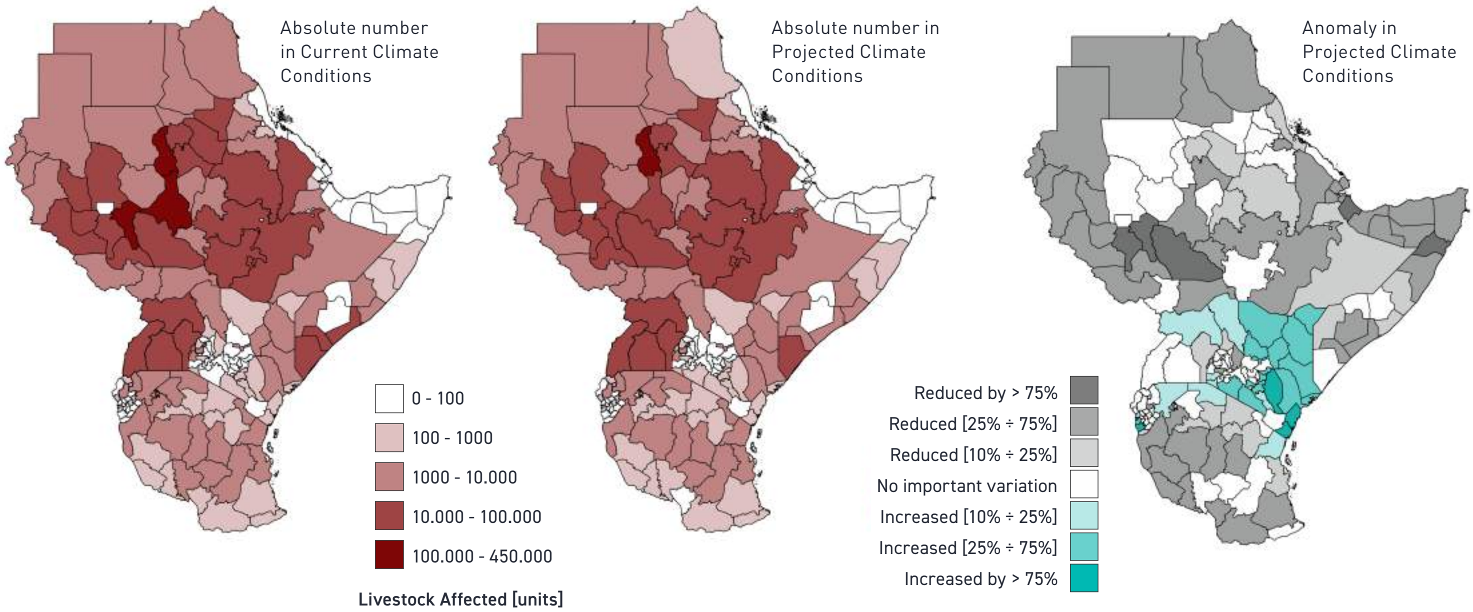
Percentage of grazing land affected at admin 1 level
- Figure 12 -



Livestock units affected

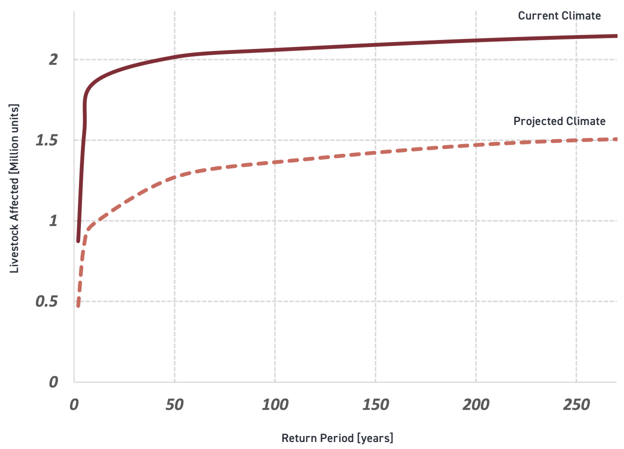
When the spatial distribution of the livestock affected at province or county level is considered in current climate conditions, the highest number of livestock affected in absolute terms is concentrated in South Sudan, Ethiopia, Uganda and the southern part of Somalia. Under projected climate conditions, a decrease of livestock units affected should be expected almost in all countries except than Kenya, Burundi, Uganda and northern part of Tanzania.

Annual Average number of livestock units affected by flood events at province or county level - Figure 13



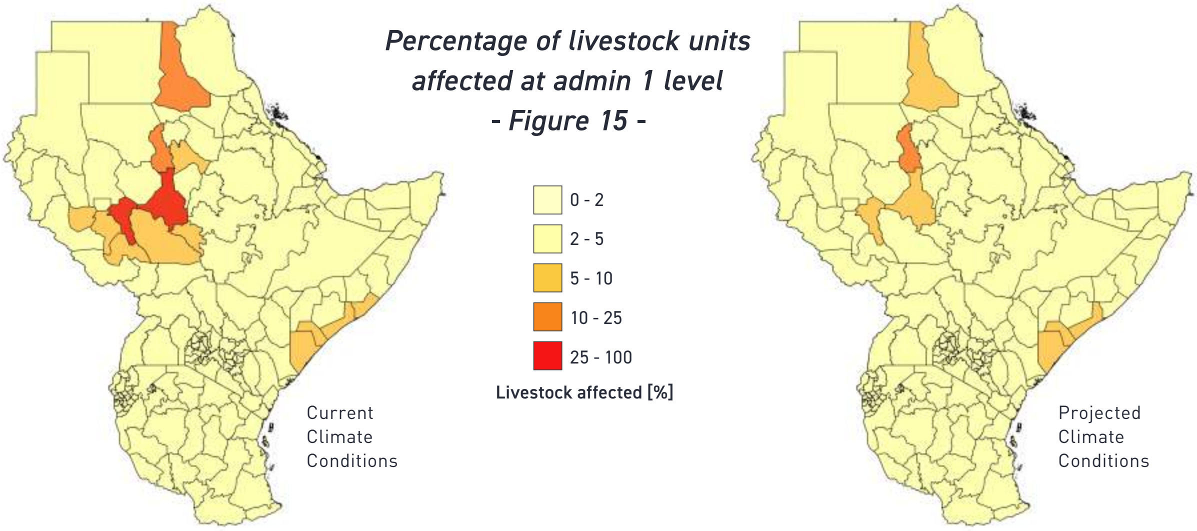
The PML curve for livestock affected at GHoA level can be consulted in Figure 14. The number of affected livestock units reaches 2 million already for events observed on average every 50 years, creating a resilience concern for the GoHA region that relies on this resource for its economy on different levels. Large impacts are observed also for frequent events. Again, when climate change is considered in the analysis the impact in all frequencies is reduced by at least 30% determining a very different picture in the region. However, this needs to be analysed locally, as some areas will suffer exacerbation of losses in future climate.

PML curves for livestock affected for GHoA - Figure 14



If results are analyzed in relative terms, calculating the percentage of livestock units affected in respect of the total livestock units at province or county (admin 1) level, it is possible to highlight hotspots in South Sudan, in the eastern part of Sudan and in the southern part of Somalia. The same hotspots, even if we a decreased percentage, can be seen also under projected climate conditions (Figure 15).

Percentage of livestock units affected at admin 1 level - Figure 15 -

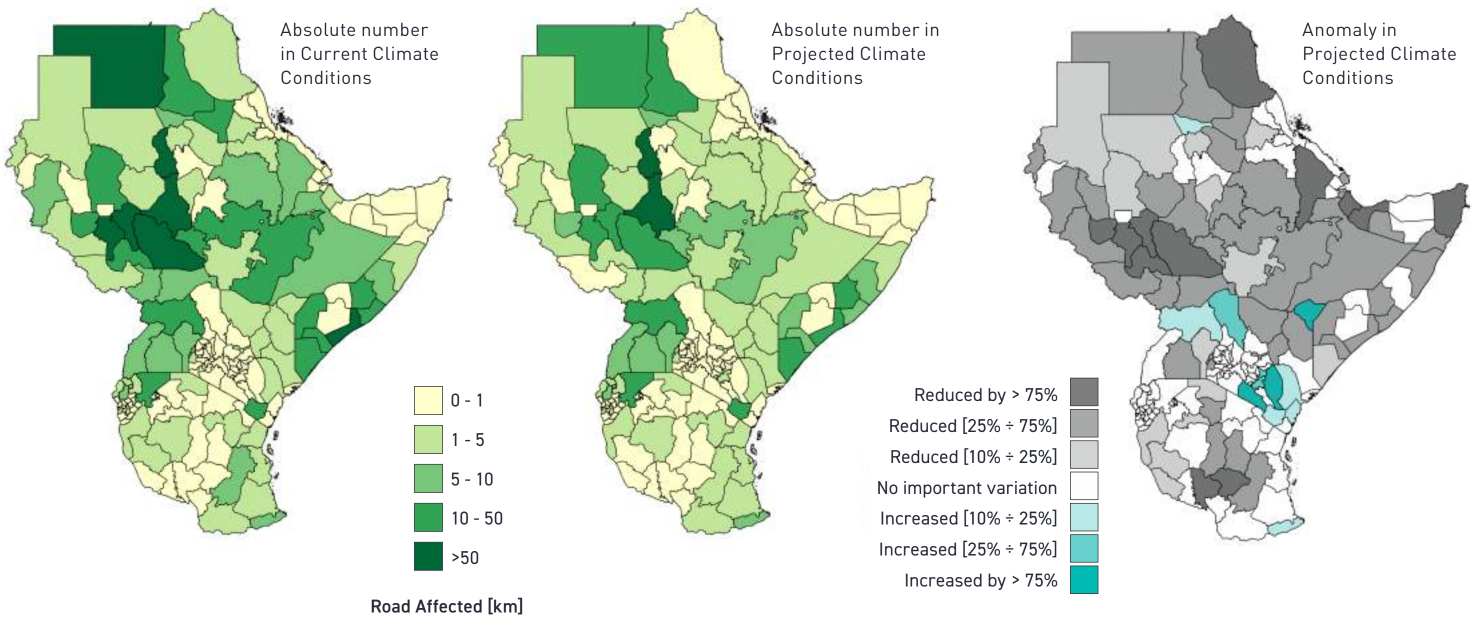


Kilometers of roads affected

Approximately 1500 km of primary and secondary roads are affected on average every year by flood events: in the following picture it is possible to observe the spatial distribution of the kilometres of roads affected at province or county level.

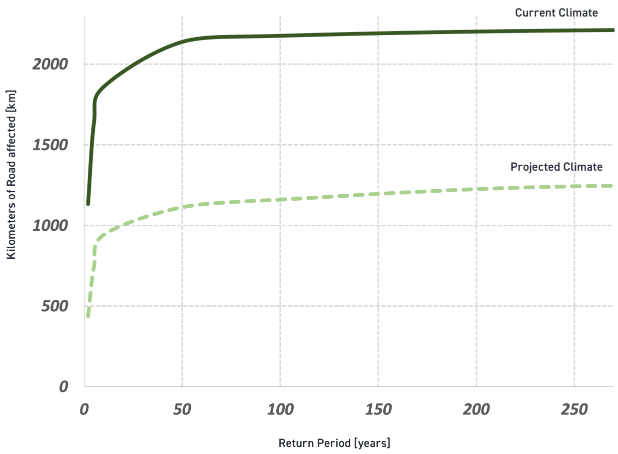
In current climate conditions the highest number of km of roads affected are concentrated in South Sudan, in the northern part of Sudan where the road connect the several cities and villages running along the Nile River, and in the southern part of Somalia. Under projected climate conditions, it is possible to observe a decrease of the roads affected almost everywhere except than Kenya, Uganda, southern part of Tanzania and in one province in Sudan.

Annual Average number of kilometers of roads affected by flood events at province or county level - Figure 16



The PML curve for roads affected at GHoA level can be seen in Figure 17. The number of affected main roads exceeds 2000 km for rare events (observed on average every 50 years), determining a potentially strong impact on one of the most critical infrastructures in the region. The impact on roads creates direct economic losses for their reparation, but chief and foremost creating even higher indirect loss due to the disruption of transport. As for the other risk metrics, large impacts are observed also for frequent events. Climate change will determine an overall reduction in the impacts. However, this needs to be analysed locally, as some areas will suffer an increase of losses in future climate.

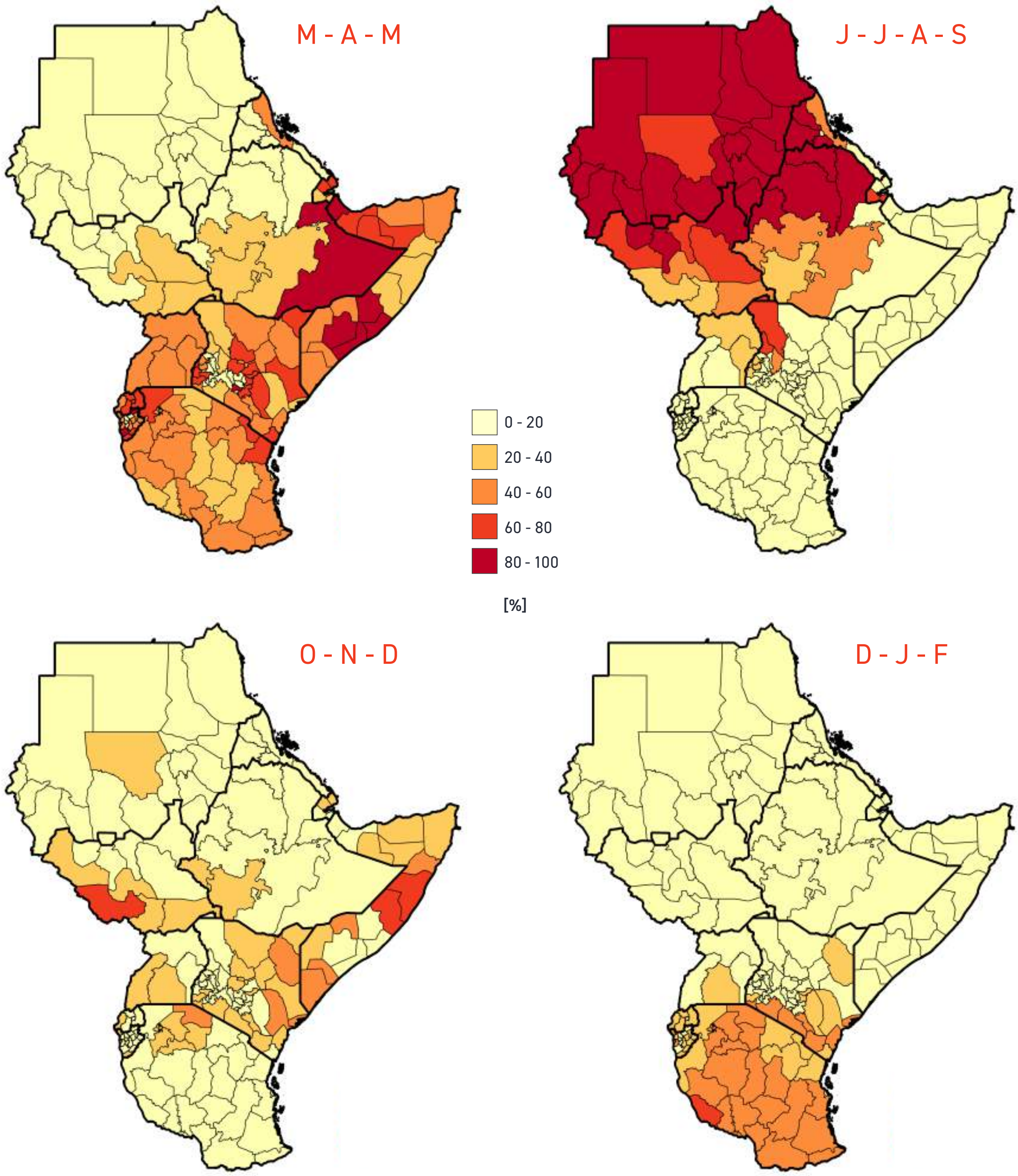
PML curves for roads affected for GHoA - Figure 17



Seasonality

Percentage of Flood events in the different season in respect to the annual number of floods (Current Climate)

Floods have a distinct seasonality in the GHOA region. MAM and JJAS are the seasons that report the highest number of floods on average during the years, OND is only significant along the Somali coast and the southern part of South Sudan, DJF is only significant for Tanzania.



Percentage of Flood events in current climate conditions in the different seasons, in respect to the annual number of floods: M-A-M March-April-May, J-J-A-S June-July-August-September, O-N-D October-November-December, D-J-F December-January-February • (Figure 18)

Recommendations

Mainstreaming and Communication

Disasters drain IGAD regional economy. Floods alone determine an average impact on people and critical sectors of economy that is difficult to sustain, often determining conditions that will cause an exacerbation of food insecurity. To consistently diminish such burden DRR investments need to be planned and DRR measures must be integrated across different sectors to obtain a resilient future region.

The government should therefore promote development actions that consider disaster and climate risks to reduce flood impacts across all sectors by mainstreaming the findings of the present risk assessment in all relevant policies. These recommendations assume higher urgency considering that these losses are predicted to increase with socio-economic development.

Among the sectors where this mainstreaming effort should focus first, the agricultural and pastural sector figures prominently. In fact, this sector is critical, not only because of the direct economic losses that it suffers, but also in consideration of the possible effects that reduced agricultural production can have on food security for the IGAD Region.

It is therefore recommended to pose even more attention into programs supporting sustainable agriculture in the IGAD Region.

Preparedness and Early Warning

Almost 1 million people are directly affected by floods every year in the Region. Climate change is going to exacerbate such behaviour in some hotspots and it will increase impacts in the entire region when combined with population growth. Following the current investment path, IGAD should keep in investing in Early Detection and Early Warning capability. The IGAD Disaster Operations Centre (DOC) centre is seen as a key component to increase resilience to disasters in the region. This will become even more effective when the present findings (risk knowledge) will be connected with early warning Standard Operating Procedures of the DOC and a routine impact forecast will be produced to assist Member states in their preparedness and early response actions.

- IGAD should therefore continue in investing in technology, knowledge and people dedicated to the early warning for early action (EW/EA). A solid legal and institutional framework should be consolidated that supports the DOC activities and its interconnections with the National systems on the one hand and with the Continental level on the other.
- Risk knowledge produced in this risk profile should also inform forecasts-based DRF actions e.g., through parametric insurance products supporting IGAD Member States.

DRR Strategy

It is one of the objectives of IGAD to substantially reduce the number of people potentially affected by floods in alignment with the Sendai Framework and the SDG targets. To accomplish that target the regional DRR Strategy needs to be duly implemented. This risk profile enhances the understanding of disaster risk by identifying and mapping areas that have a high exposure, thus enabling the prioritisation of DRR investments, such as climate smart agriculture, which is the main objective of a DRR Strategy. By jointly analysing the PML and AALs it is possible to quantify the resilience of countries at sub national level and to identify in the RDRRS focused measures on the most impacted sectors in order to increase such resilience. Specific attention should be placed on the Food Security issue.

It is therefore recommended that the preparation of DRR plans at any level in the region considers risk profiles as the basis for evidence to guide on strategies and guidelines to reduce the expected flood disaster impacts. The DRR plans should also consider the increased losses expected in future, foreseeing appropriate investments in DRR measures including early warning information generation and preparedness for response. The quantifications included in the risk profiles should inform resources mobilisation both at regional, government level and from the international community.

Awareness Raising and Education

The risk profile is a powerful way to visualise risk and therefore can be used to increase the awareness of risk at all levels. IGAD should conduct awareness programs at the regional level and support countries for similar campaigns at national level as an integral part of preparedness and emergency response mechanisms to disasters.

It is recommended to reinforce the disaster risk awareness and education programs and use the results in the risk profiles for flood as reference material.

Contingency Budget Allocation

Contingency funds cannot be considered as a stand-alone solution, but should be connected to the DRR investments; only in that way can allocation of contingency funding lead to reducing losses in the future..

The findings of this risk profile are highly relevant for the process of operationalising the IGAD Disaster Response fund. The contingency fund should be designed together with the competent public and private institutions and should consider also risk transfer options to guarantee a fast recovery of losses from floods for each sector. This should account for the fact that climate change impacts in some key sectors have a spillover effect to the other sectors. A first dimensioning of the needed resources to be stored for the most relevant sectors can be derived by the quantification of the impacts provided by the risk profiles. When these estimations are connected with the budget availability per sector, an optimal combination between contingency funds and risk transfer mechanisms can be also derived for each sector.

Towards an IGAD Regional Flood Risk Profile

(2021)

Annexes

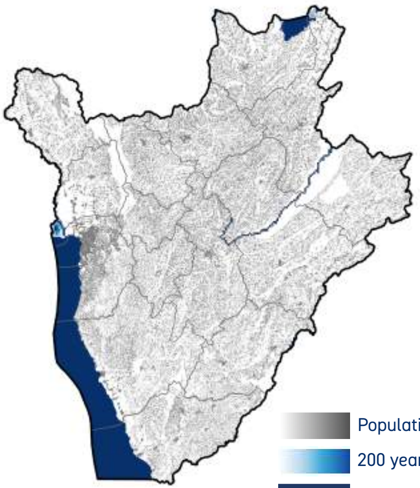
This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region. (Document prepared for consultation with Member States)

Towards an IGAD regional flood risk profile (2021): REPUBLIC OF BURUNDI

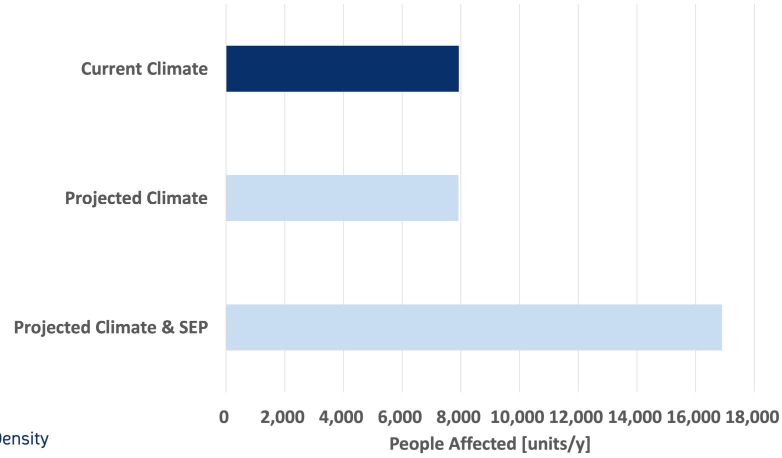
This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region.
(Document prepared for consultation with Member States)

Population Affected

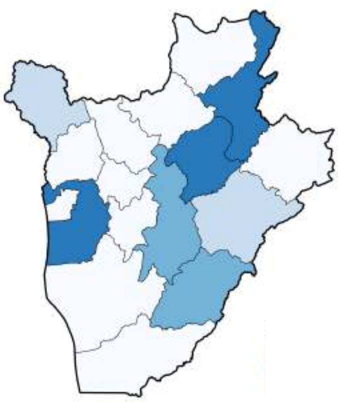
People Exposure



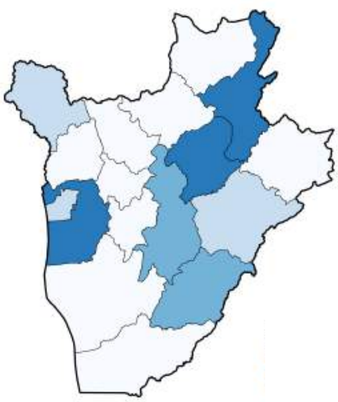
Annual Average Number of People Affected



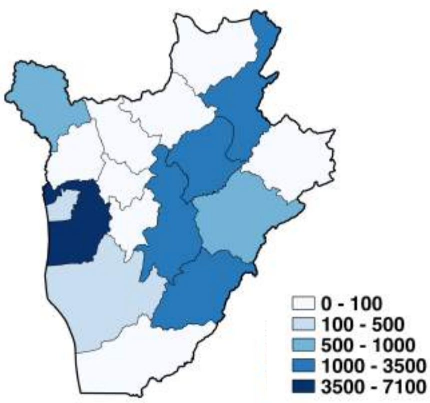
Absolute Number in Current Climate Conditions



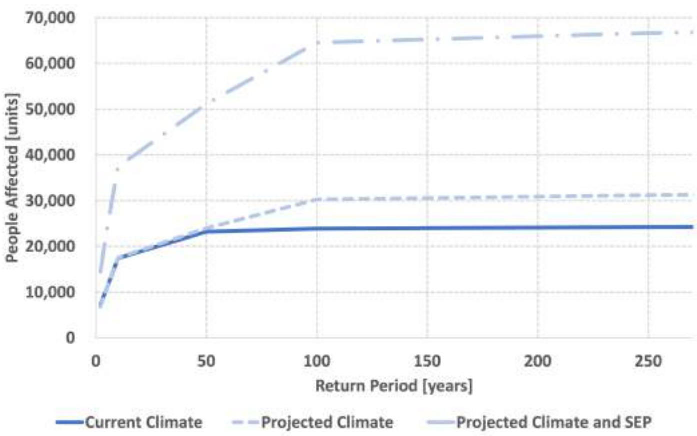
Absolute Number in Projected Climate Conditions



Absolute Number in Projected Climate Conditions with UN Population Projection

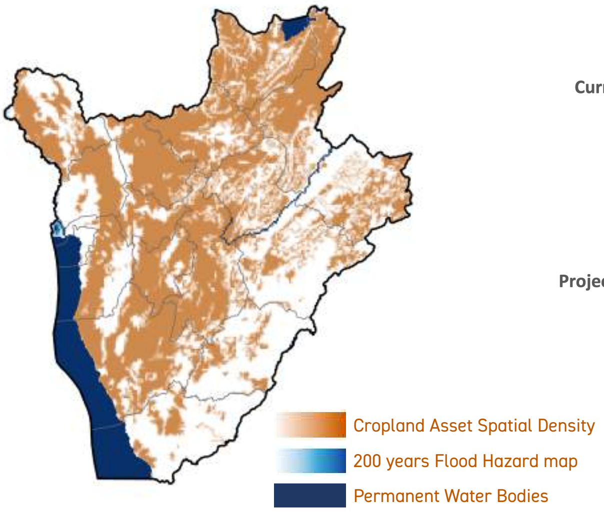


PML Curve - People Affected

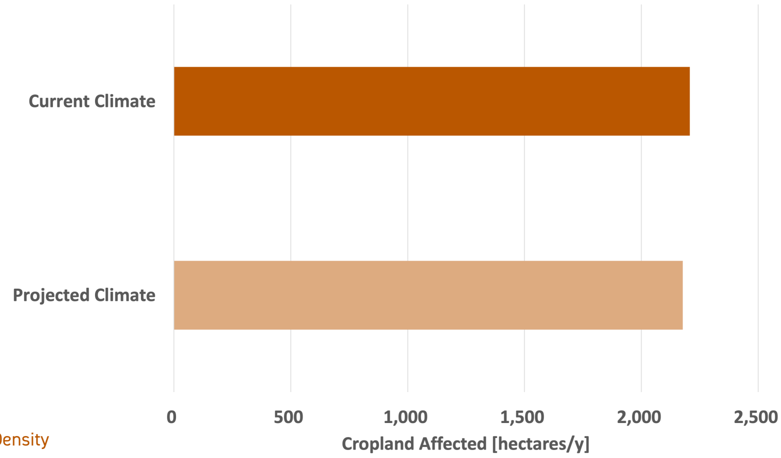


Cropland Affected

Cropland Exposure

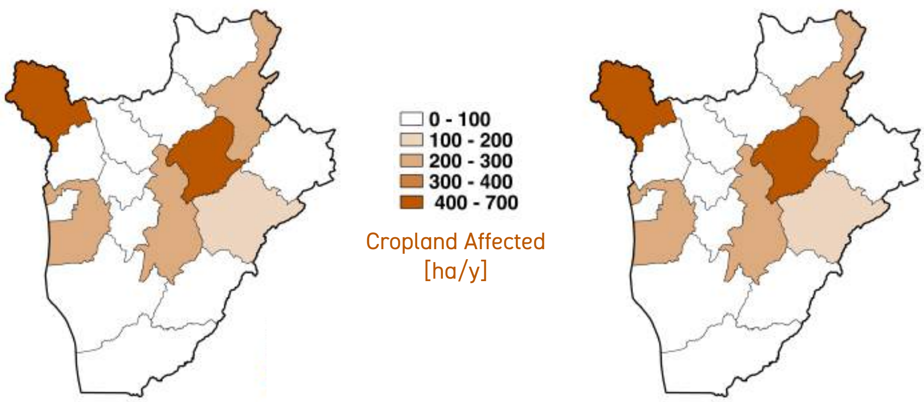


Annual Average Cropland Affected

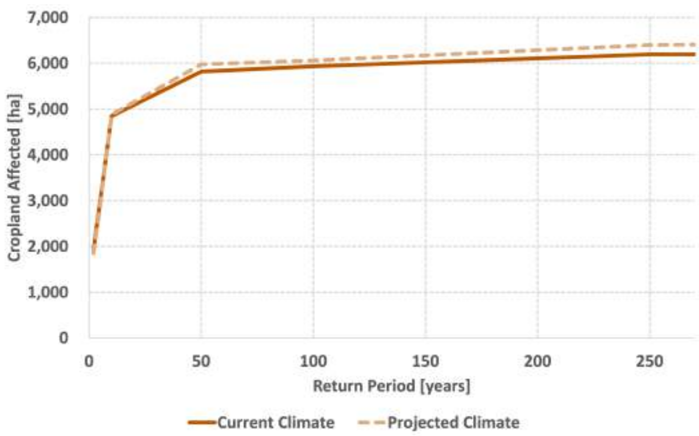


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

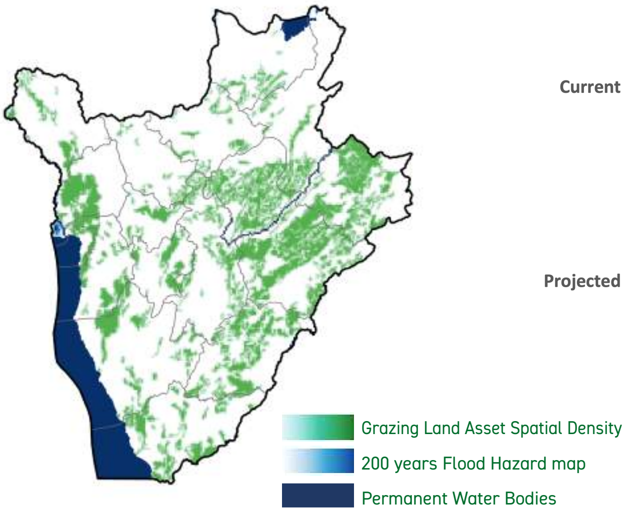


PML Curve - Cropland Affected

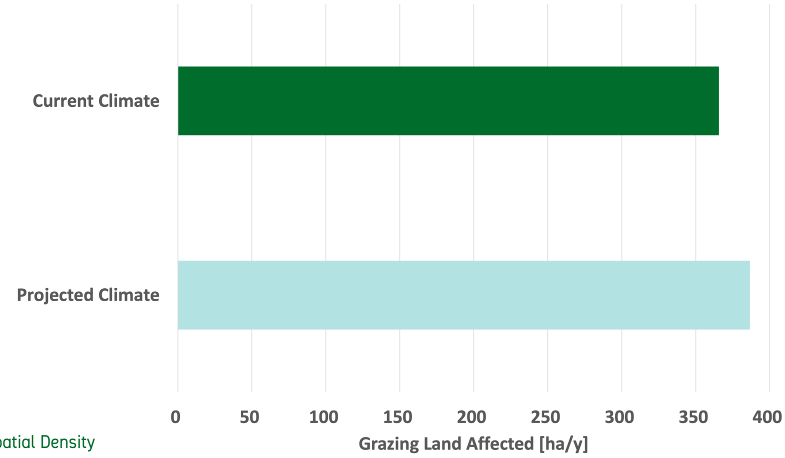


Grazing Land Affected

Grazing Land Exposure

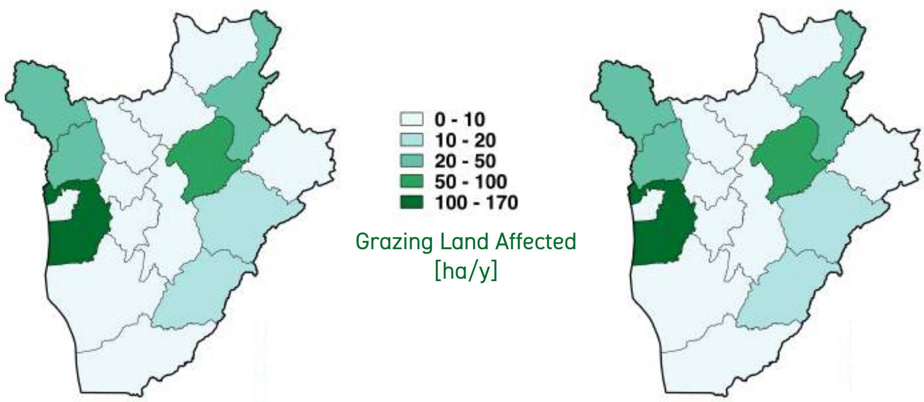


Annual Average Grazing Land Affected

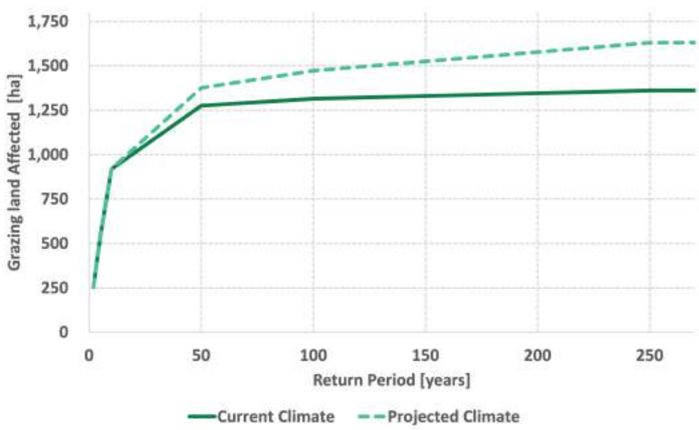


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

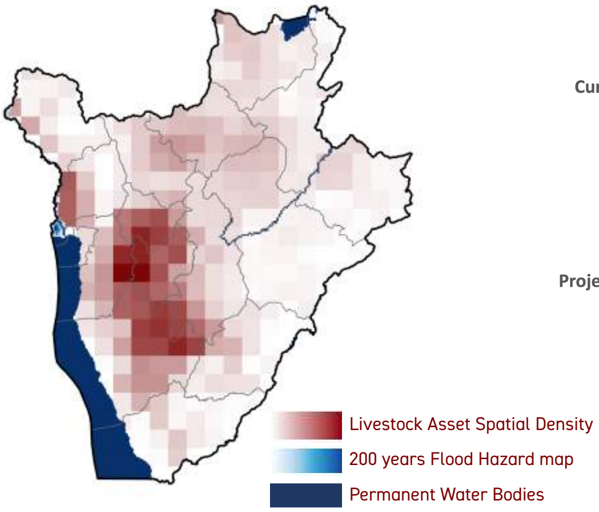


PML Curve - Grazing Land Affected

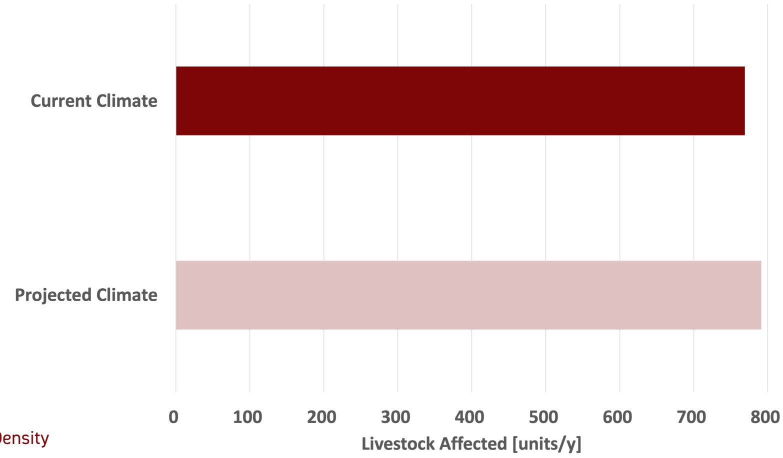


Livestock Affected

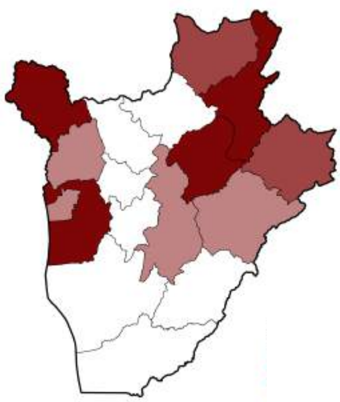
Livestock Exposure

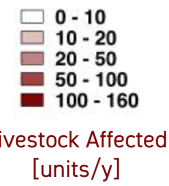


Annual Average Number of Livestock Affected

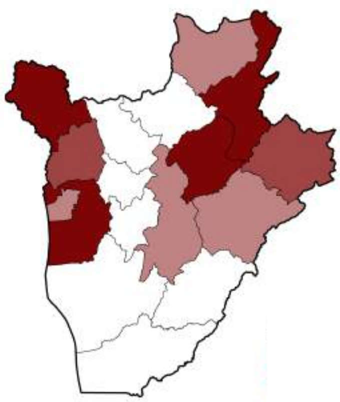


Absolute Number in Current Climate Conditions

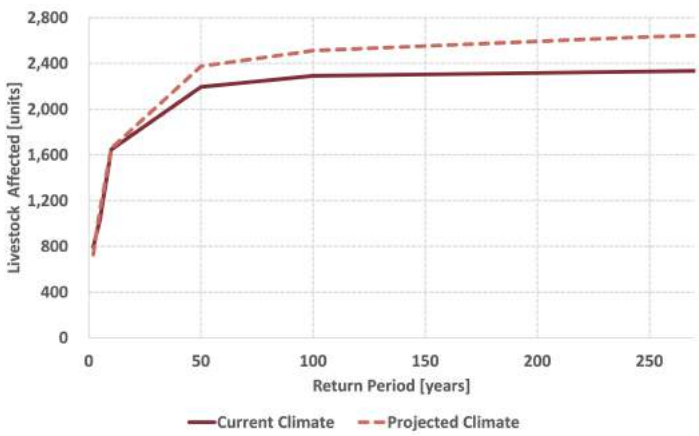




Absolute Number in Projected Climate Conditions

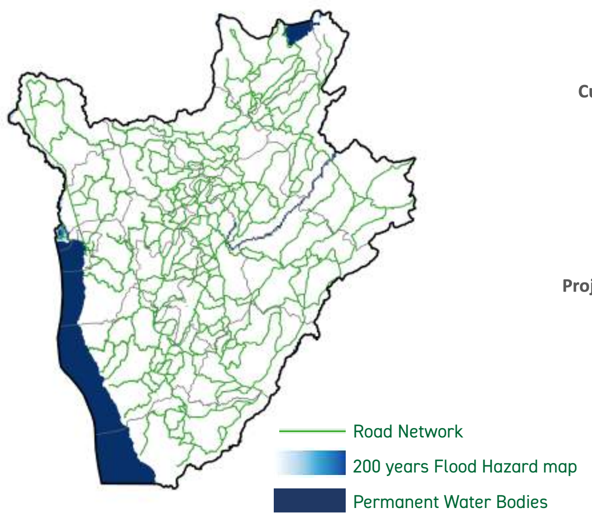


PML Curve - Livestock Affected

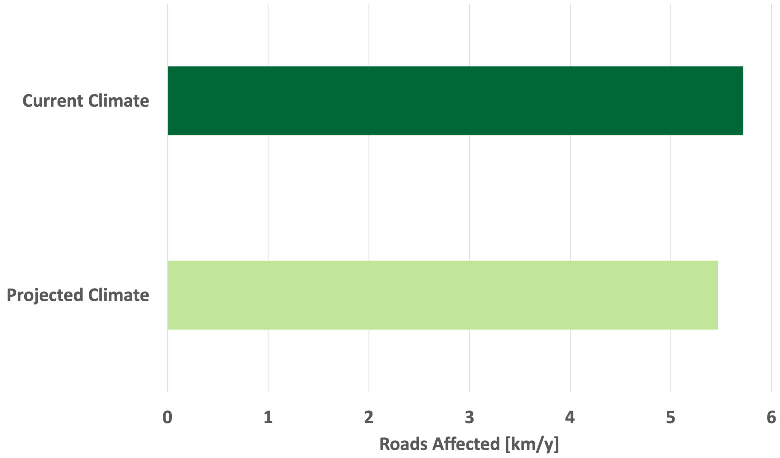


Road Network Affected

Road Network Exposure

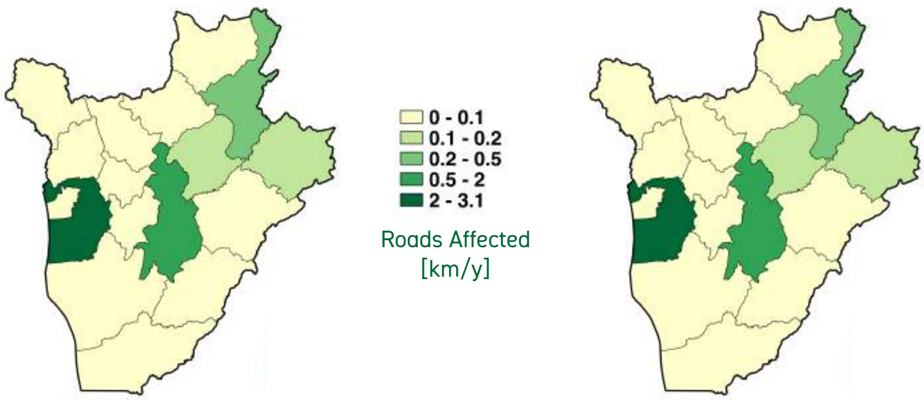


Annual Average Number of Km Affected

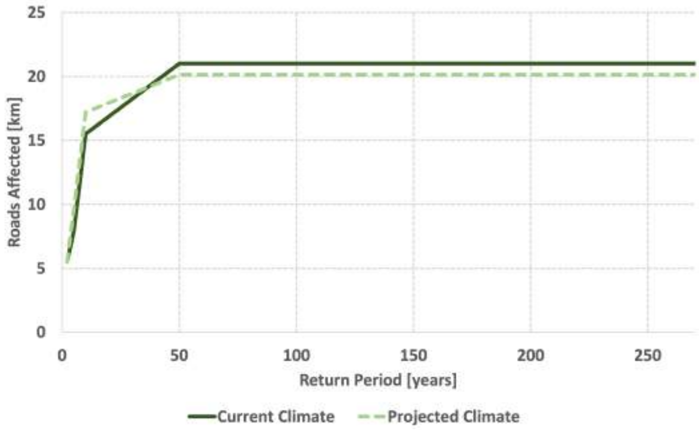


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

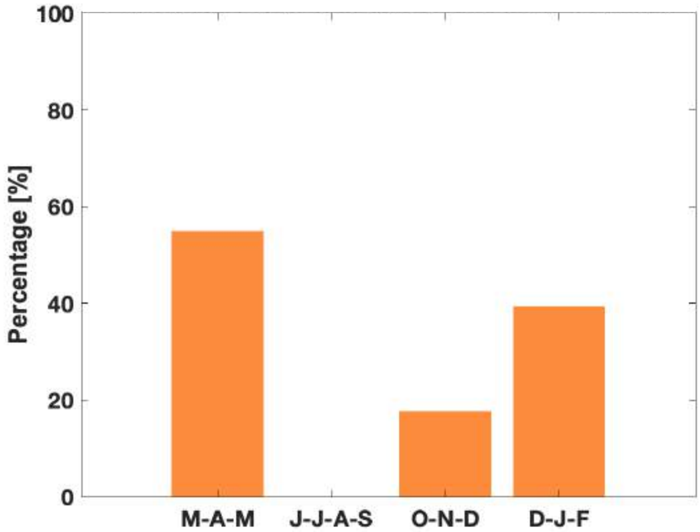


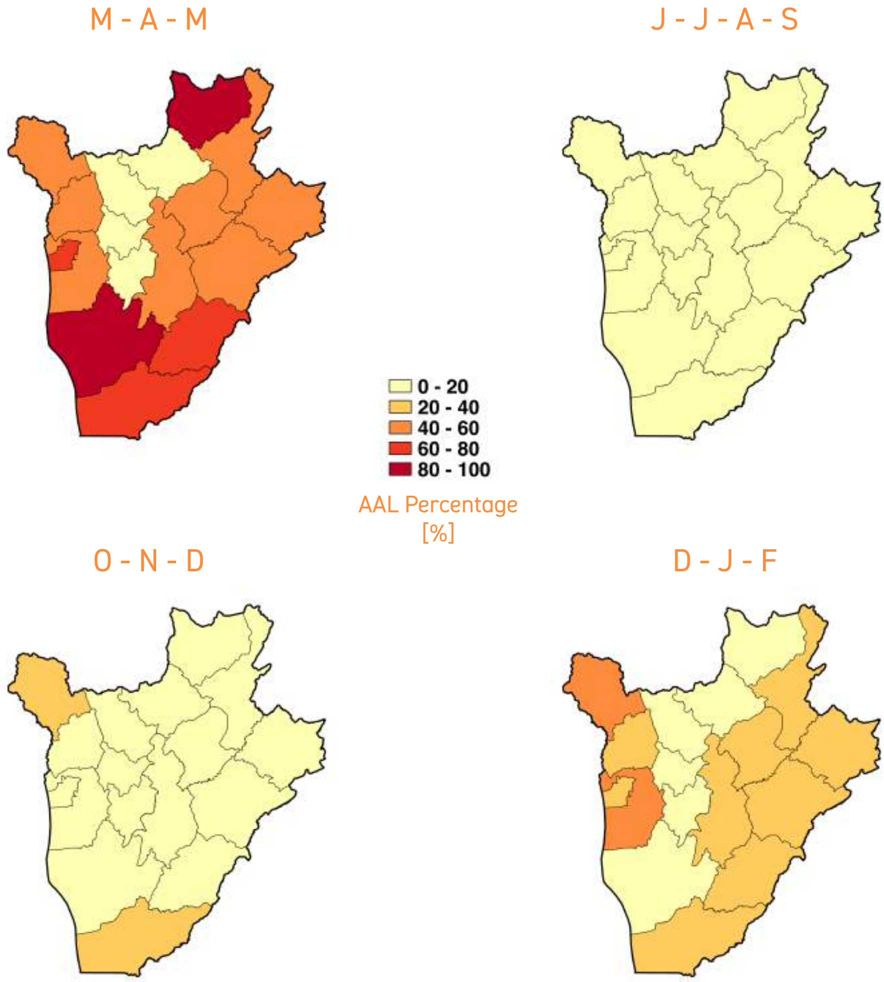
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





Towards an IGAD regional flood risk profile (2021): REPUBLIC OF DJIBOUTI

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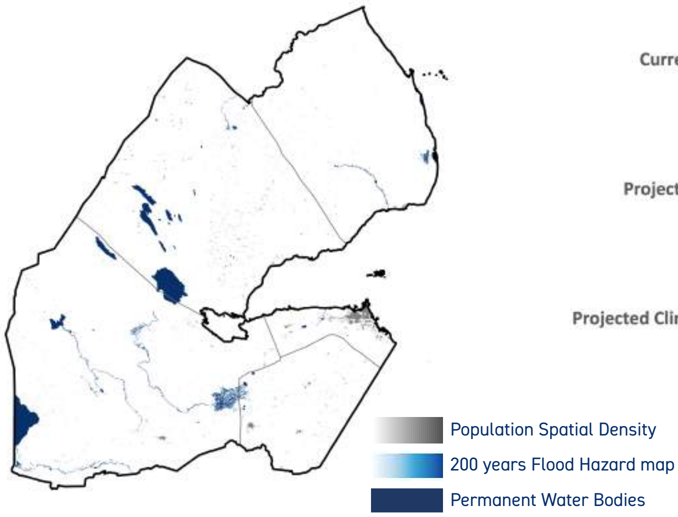
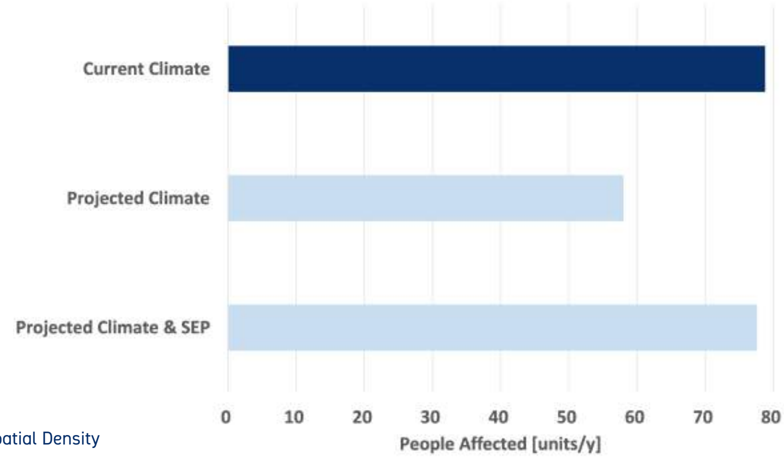
(Document prepared for consultation with Member States)

Population Affected

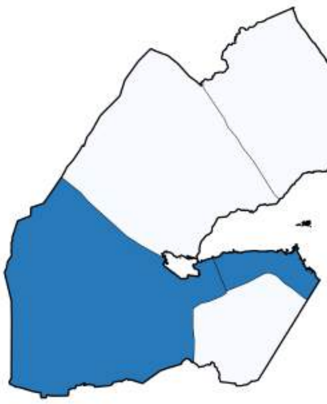
People Exposure



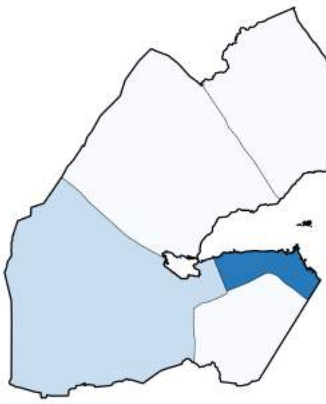
Annual Average Number of People Affected



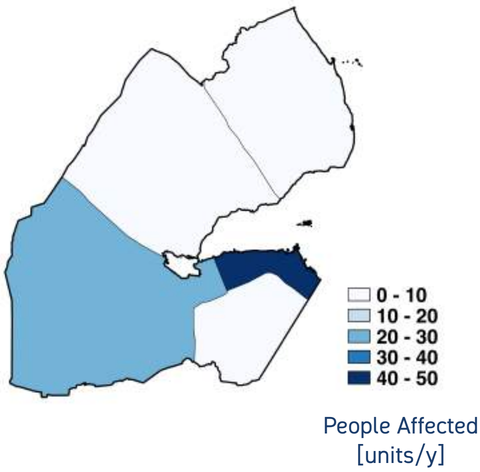
Absolute Number in Current Climate Conditions



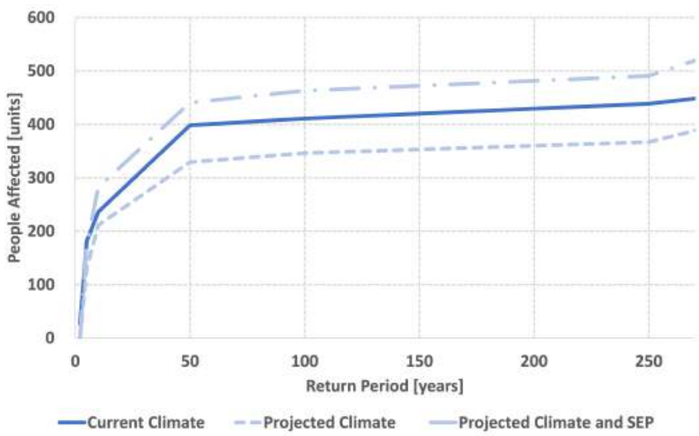
Absolute Number in Projected Climate Conditions



Absolute Number in Projected Climate Conditions with UN Population Projection

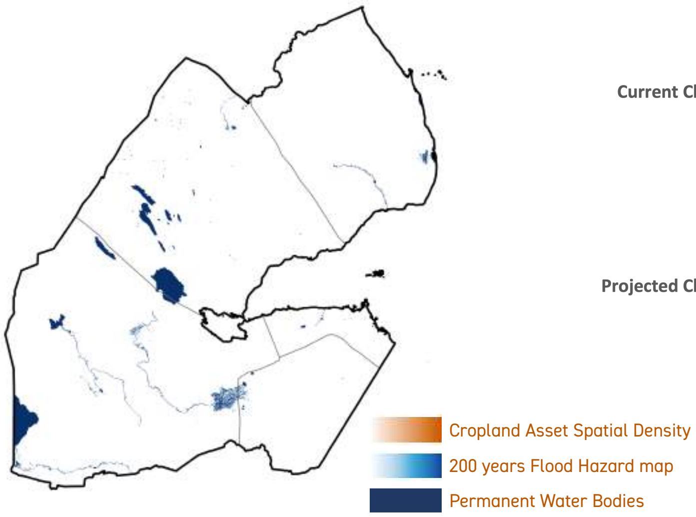


PML Curve - People Affected

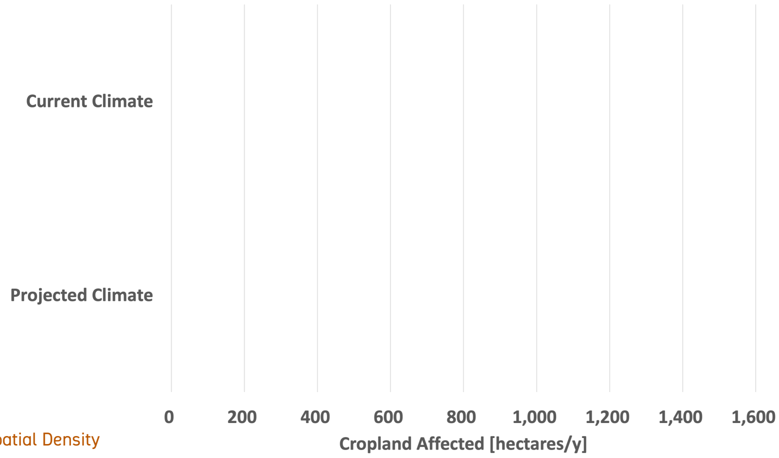


Cropland Affected

Cropland Exposure

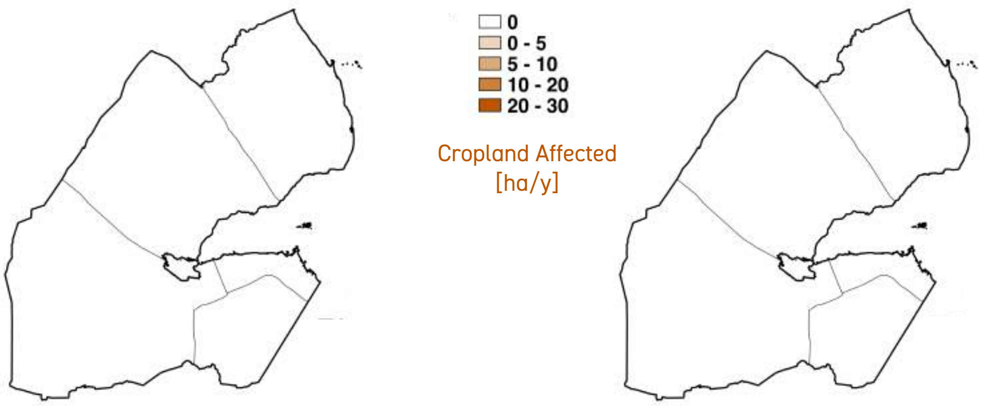


Annual Average Cropland Affected

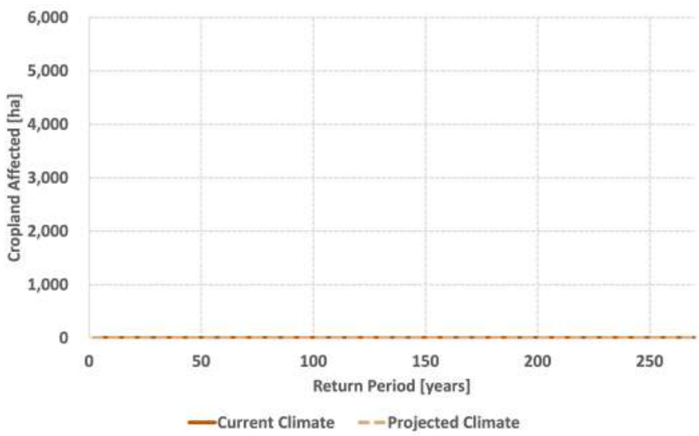


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

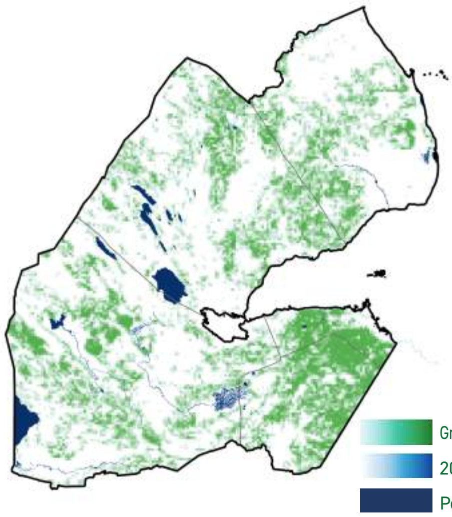


PML Curve - Cropland Affected

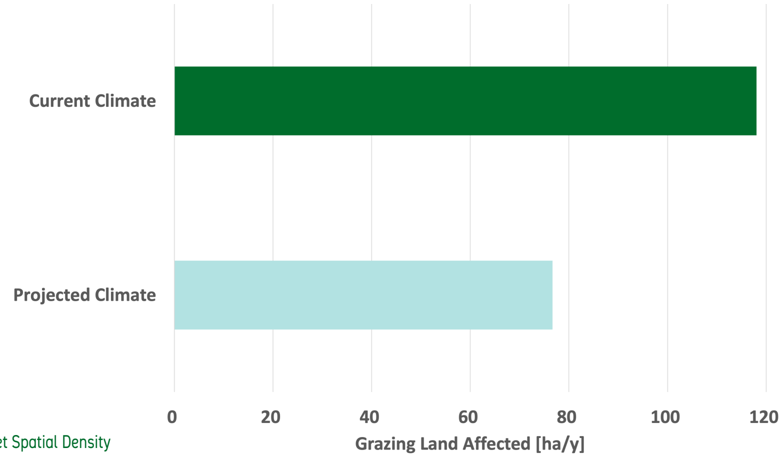


Grazing Land Affected

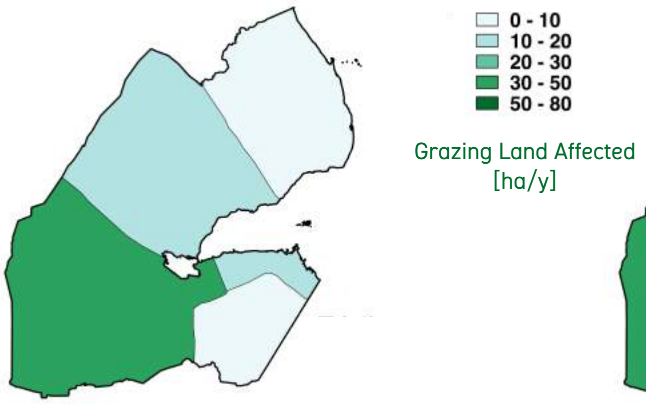
Grazing Land Exposure



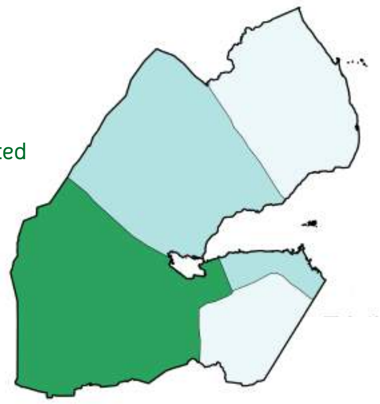
Annual Average Grazing Land Affected



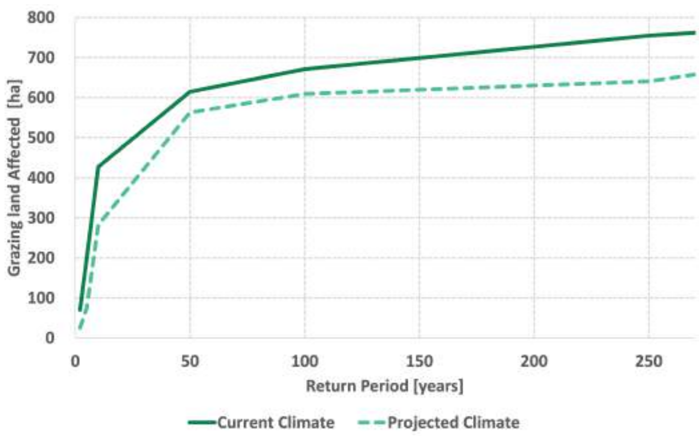
Absolute Number in Current Climate Conditions



Absolute Number in Projected Climate Conditions

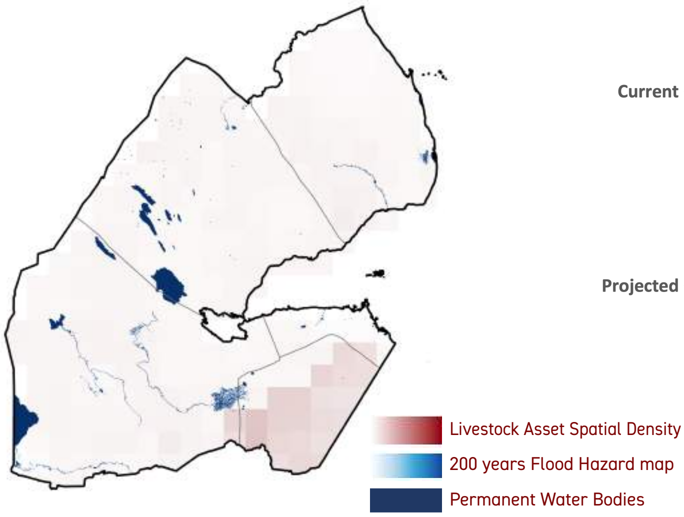


PML Curve - Grazing Land Affected

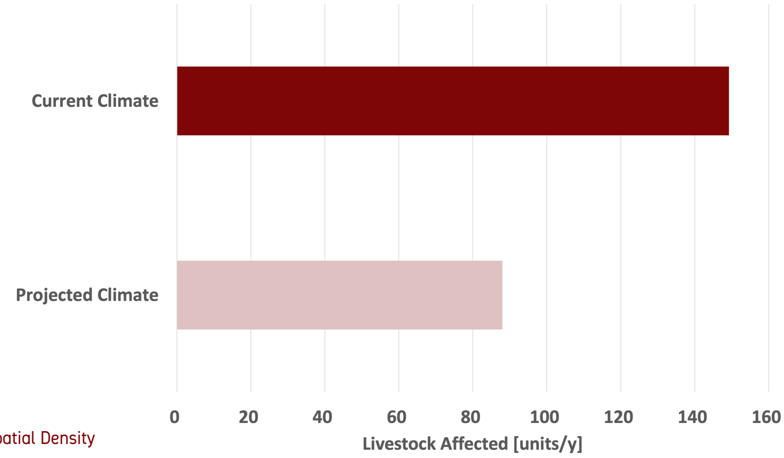


Livestock Affected

Livestock Exposure

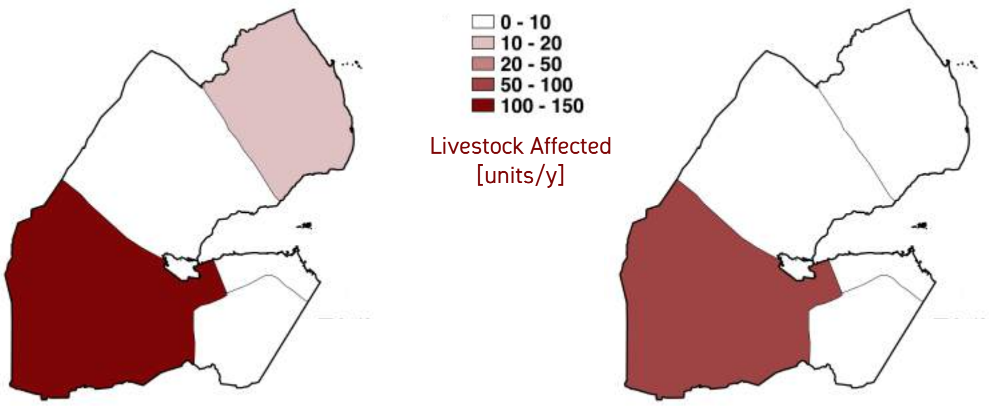


Annual Average Number of Livestock Affected

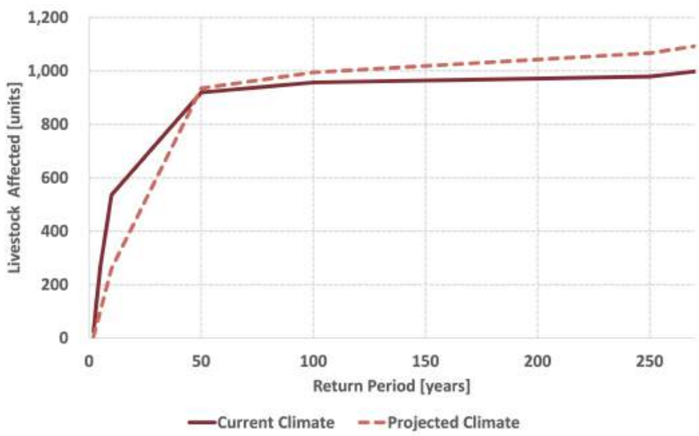


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

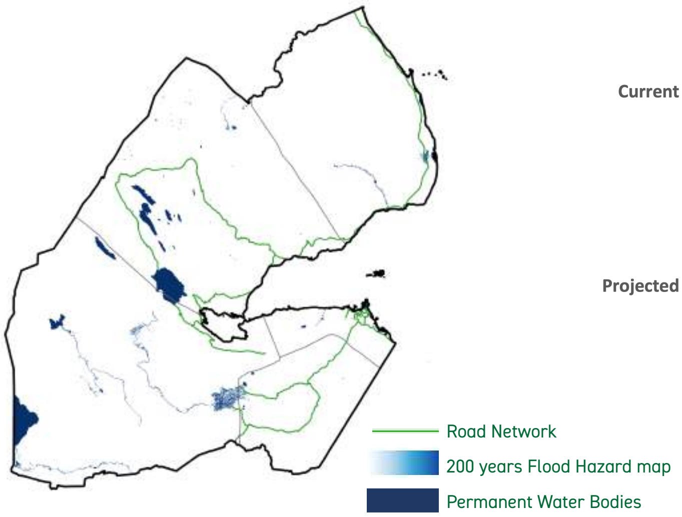


PML Curve - Livestock Affected

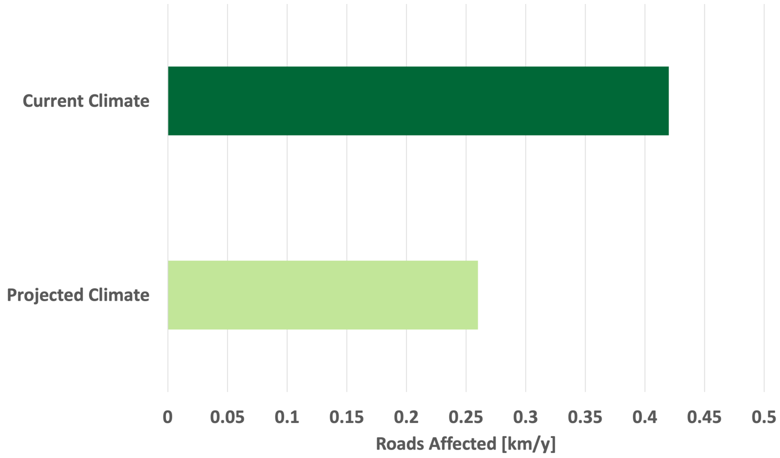


Road Network Affected

Road Network Exposure

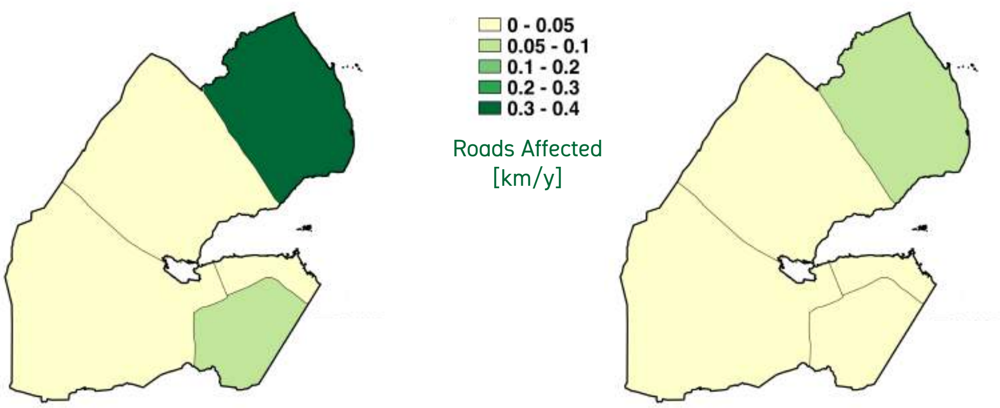


Annual Average Number of Km Affected

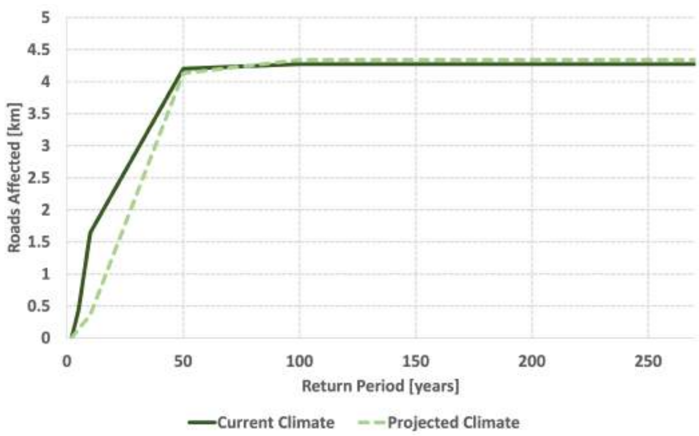


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

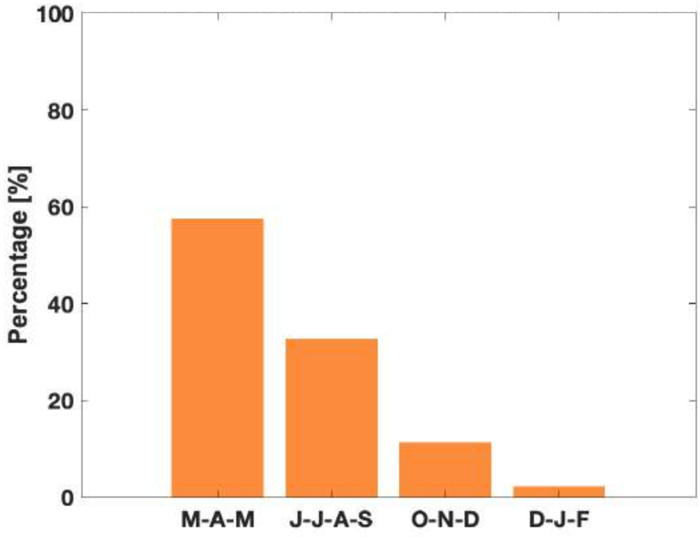


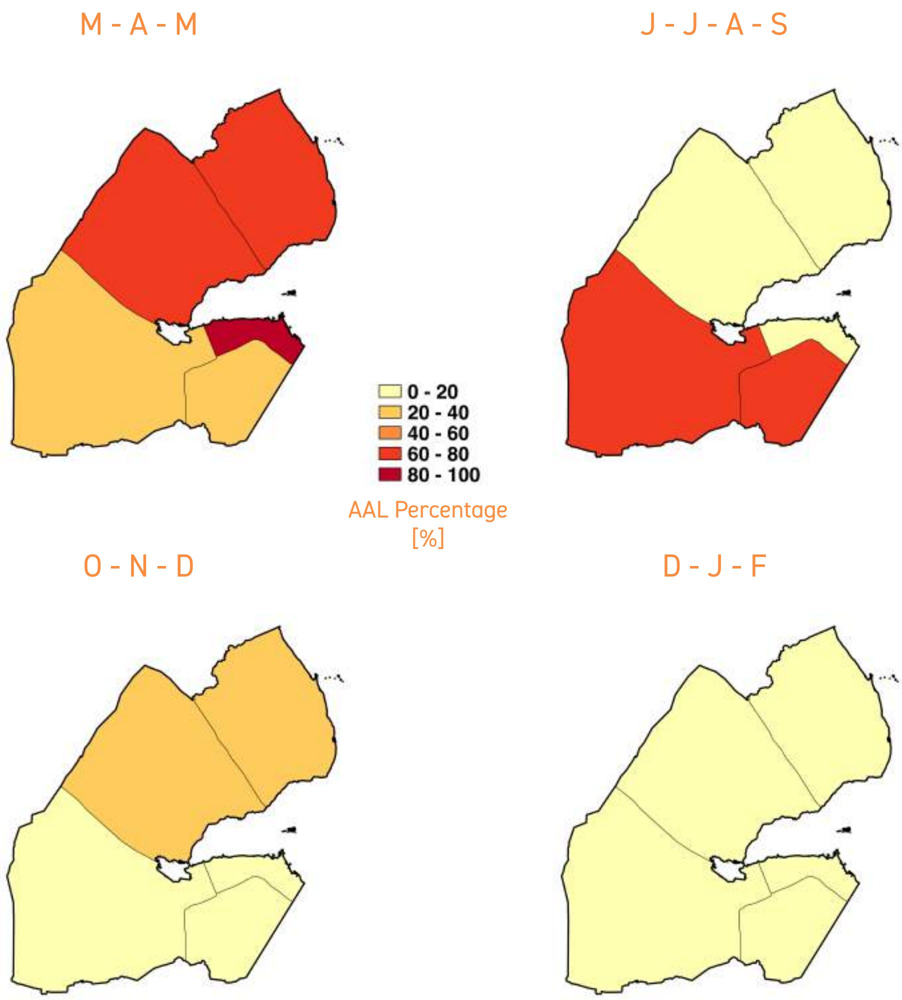
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





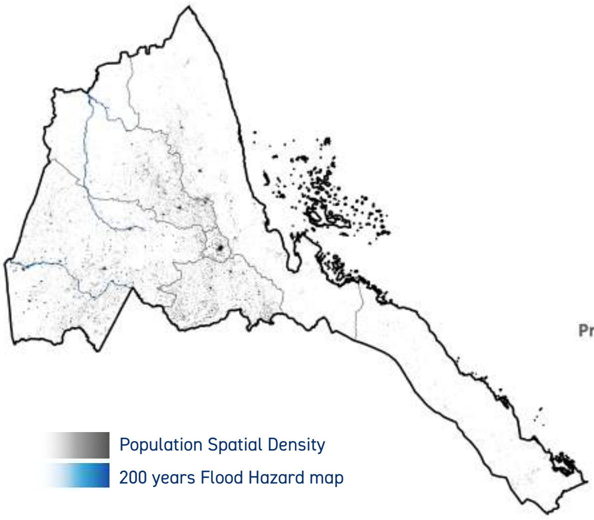
IGAD ICPAC | WFP World Food Programme | UNDRR UN Office for Disaster Risk Reduction | Regeringskansliet Ministry for Foreign Affairs Sweden | cima Research Foundation

Towards an IGAD regional flood risk profile (2021): STATE OF ERITREA

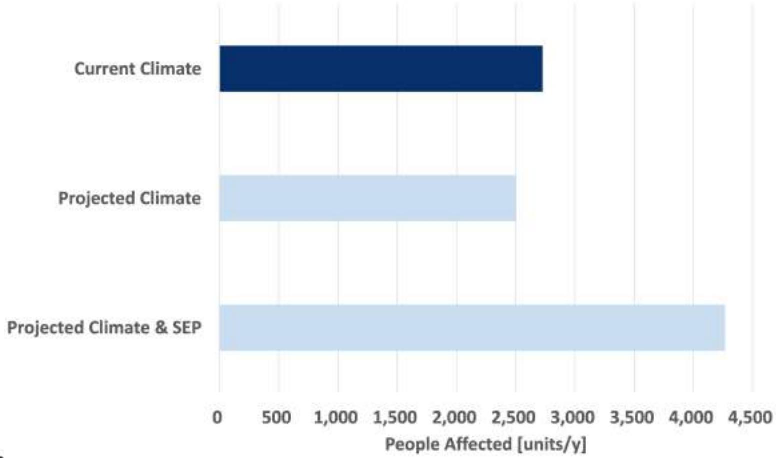
This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region.
(Document prepared for consultation with Member States)

Population Affected

People Exposure



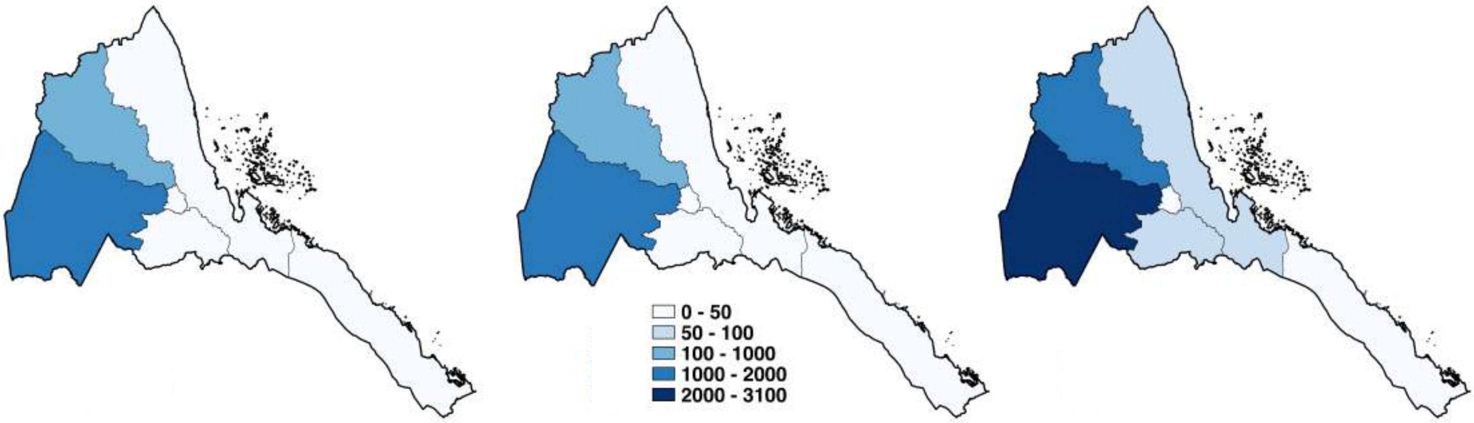
Annual Average Number of People Affected



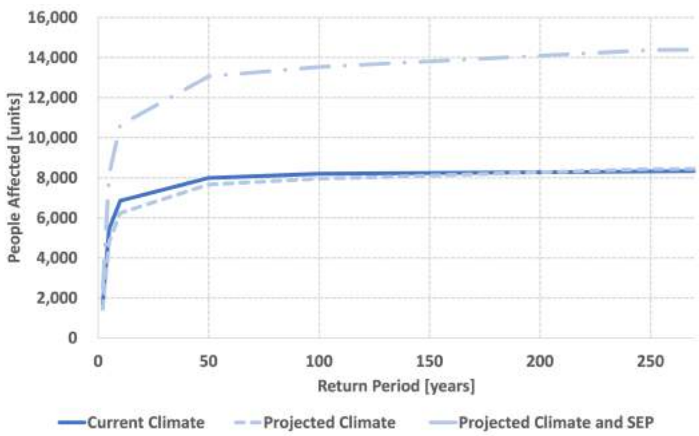
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

Absolute Number in Projected Climate Conditions with UN Population Projection

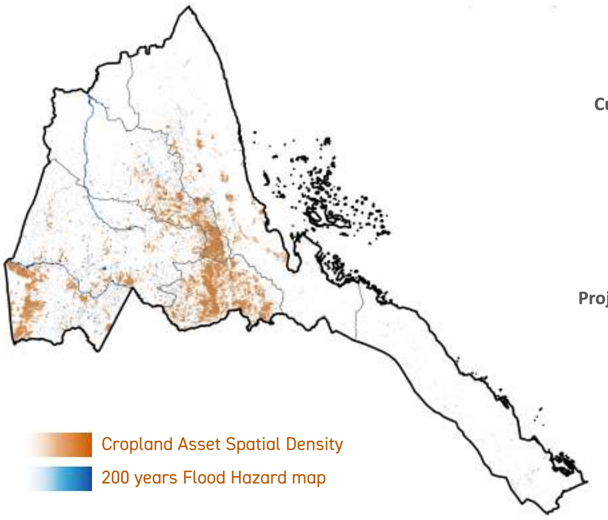


PML Curve - People Affected

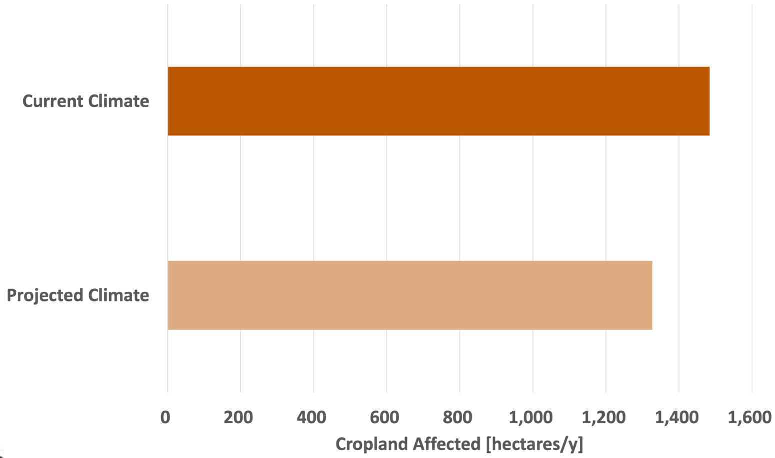


Cropland Affected

Cropland Exposure

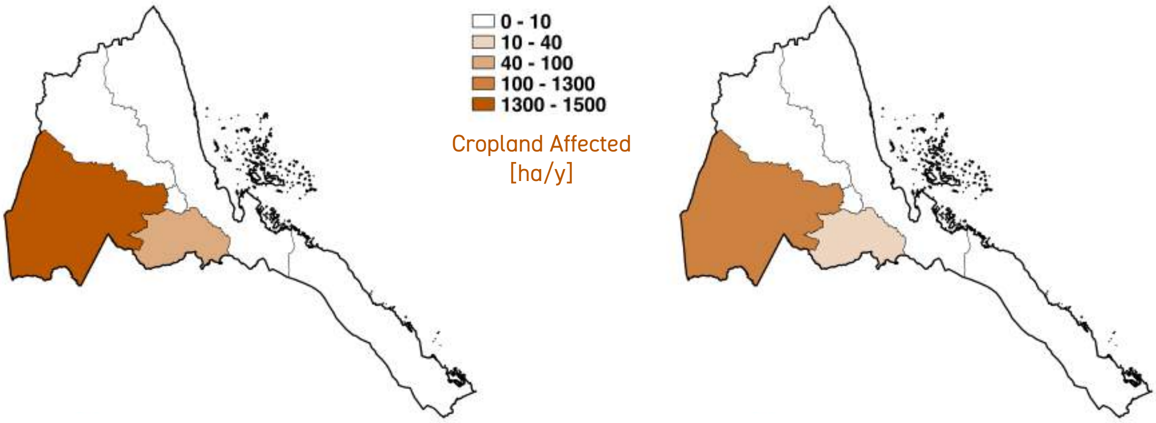


Annual Average Cropland Affected

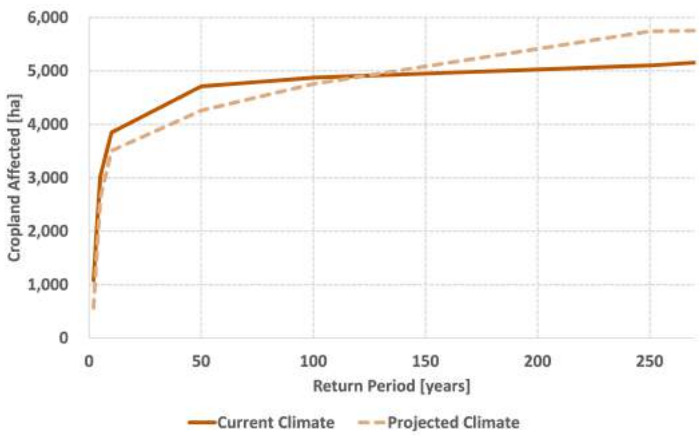


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

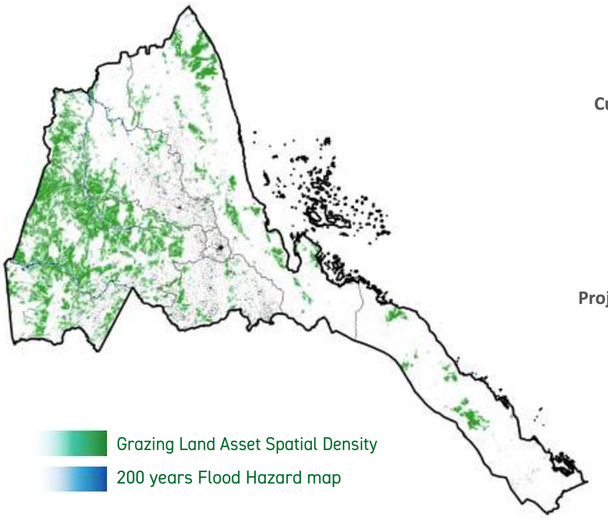


PML Curve - Cropland Affected

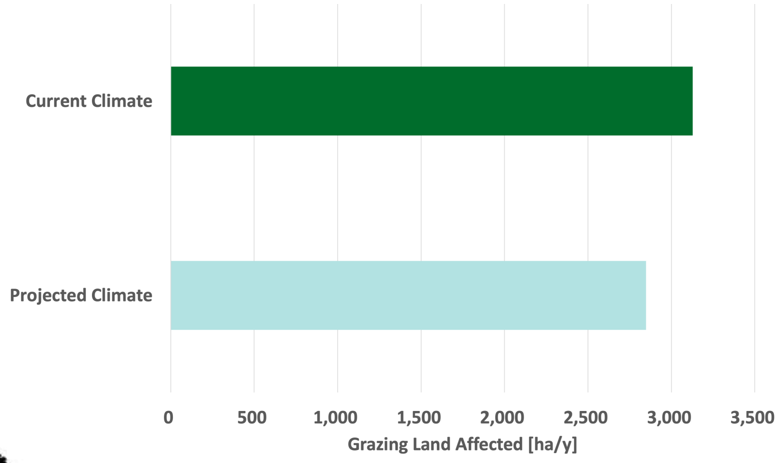


Grazing Land Affected

Grazing Land Exposure

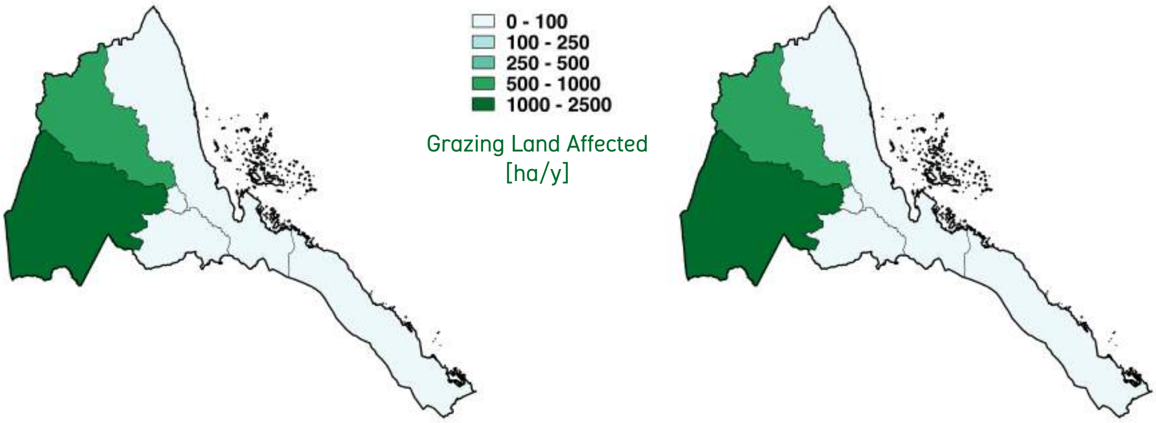


Annual Average Grazing Land Affected

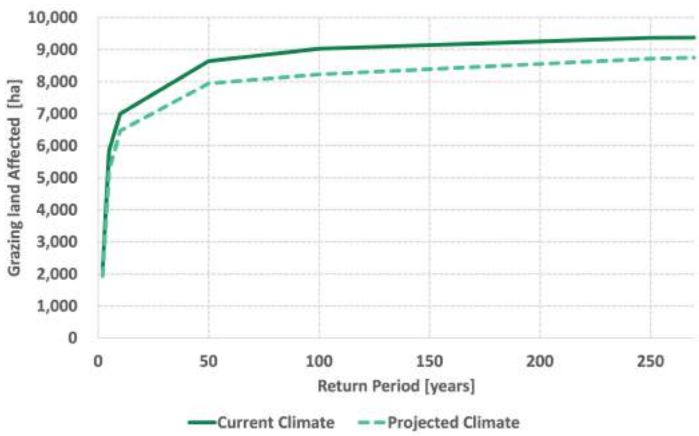


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

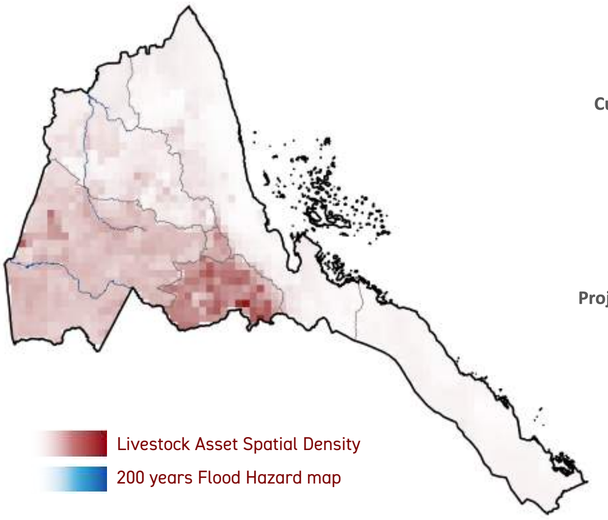


PML Curve - Grazing Land Affected

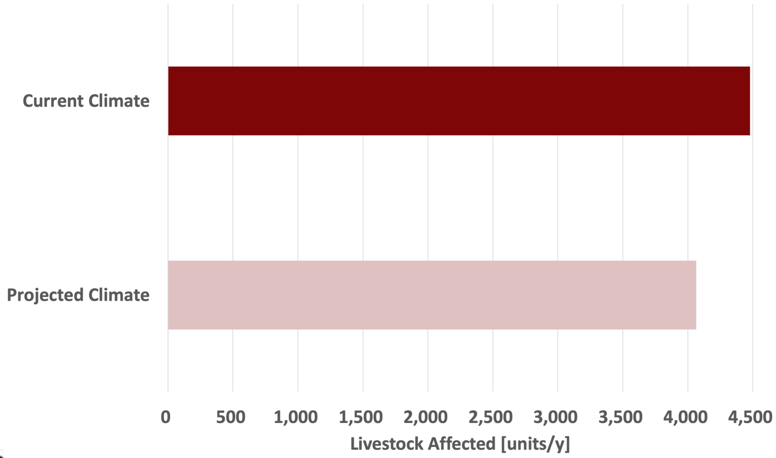


Livestock Affected

Livestock Exposure

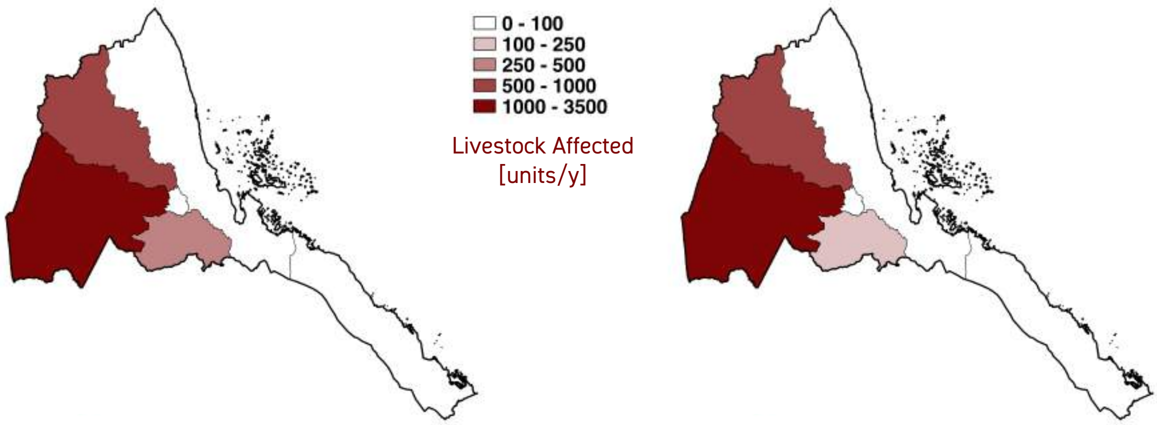


Annual Average Number of Livestock Affected

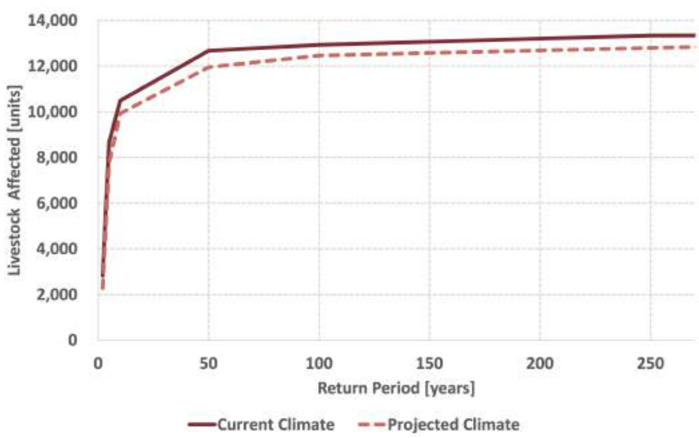


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

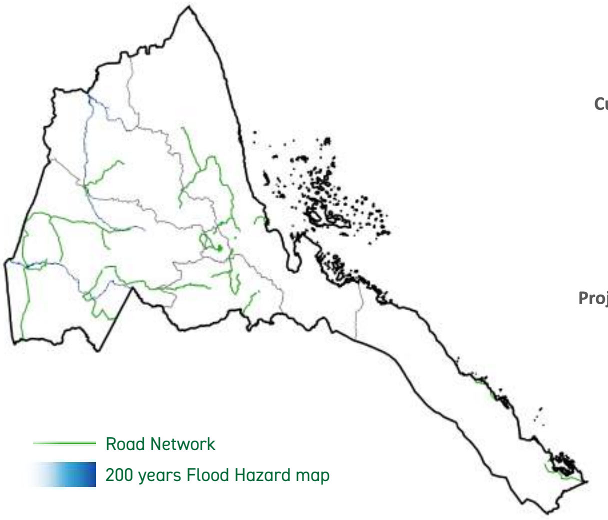


PML Curve - Livestock Affected

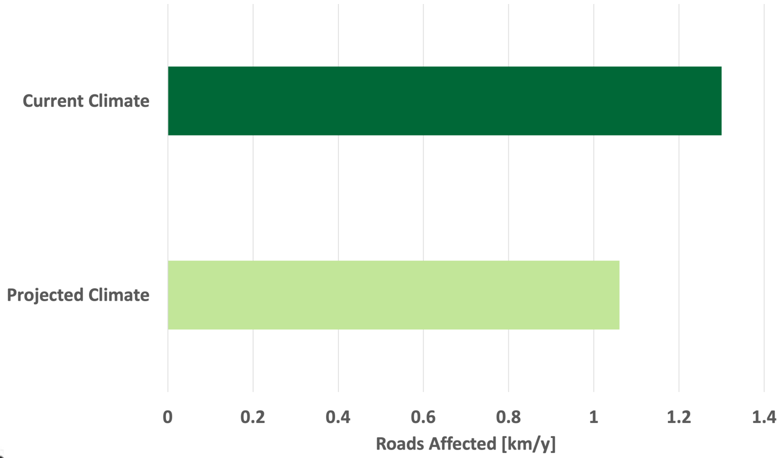


Road Network Affected

Road Network Exposure

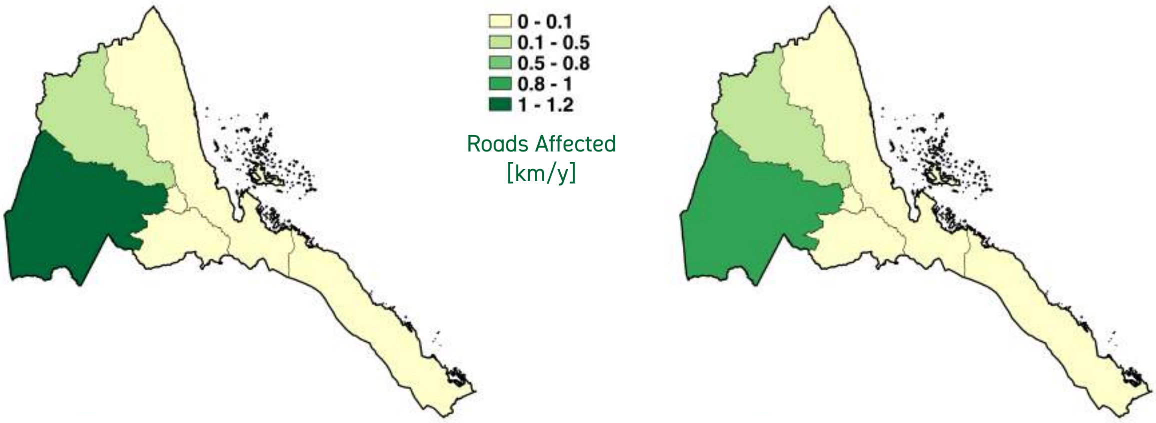


Annual Average Number of Km Affected

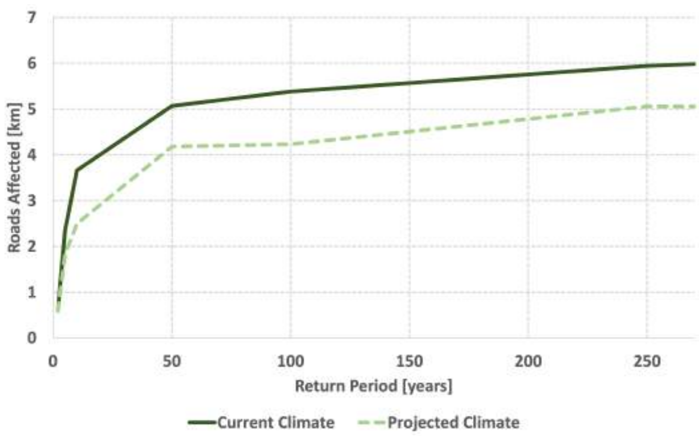


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

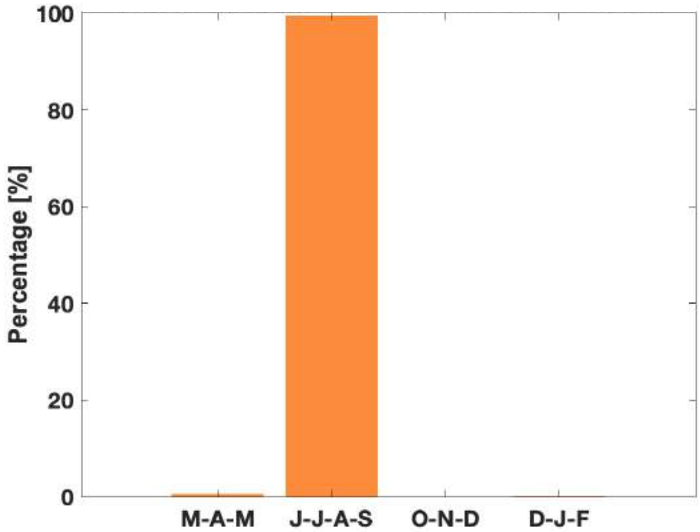


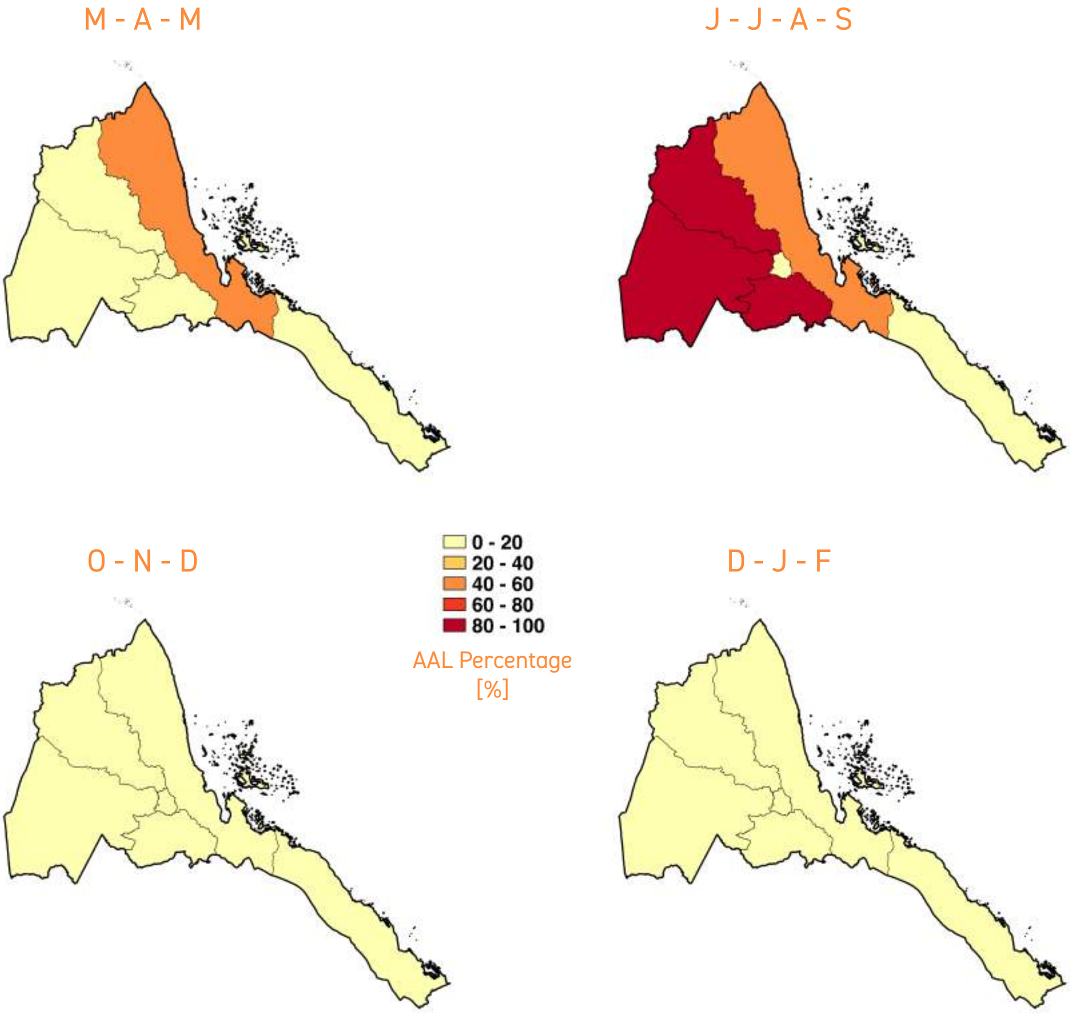
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





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REGERINGSKANSLIET Ministry for Foreign Affairs Sweden

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Towards an IGAD regional flood risk profile (2021): FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

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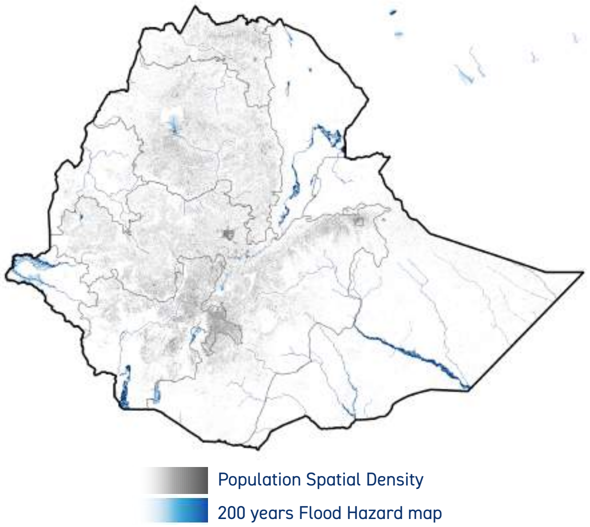
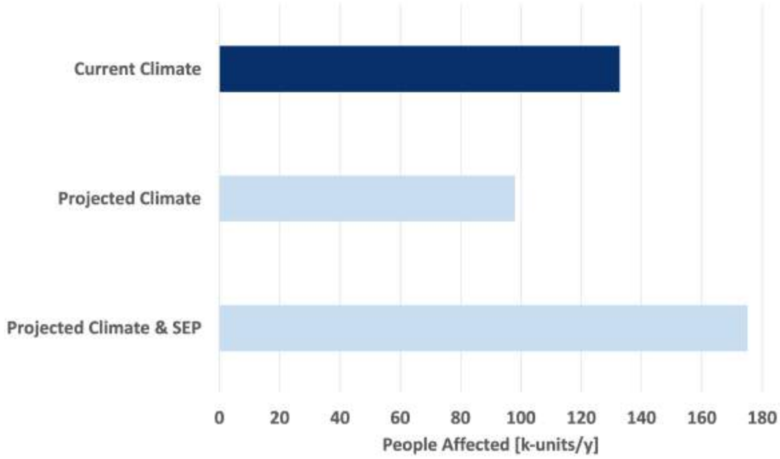
(Document prepared for consultation with Member States)

Population Affected

People Exposure



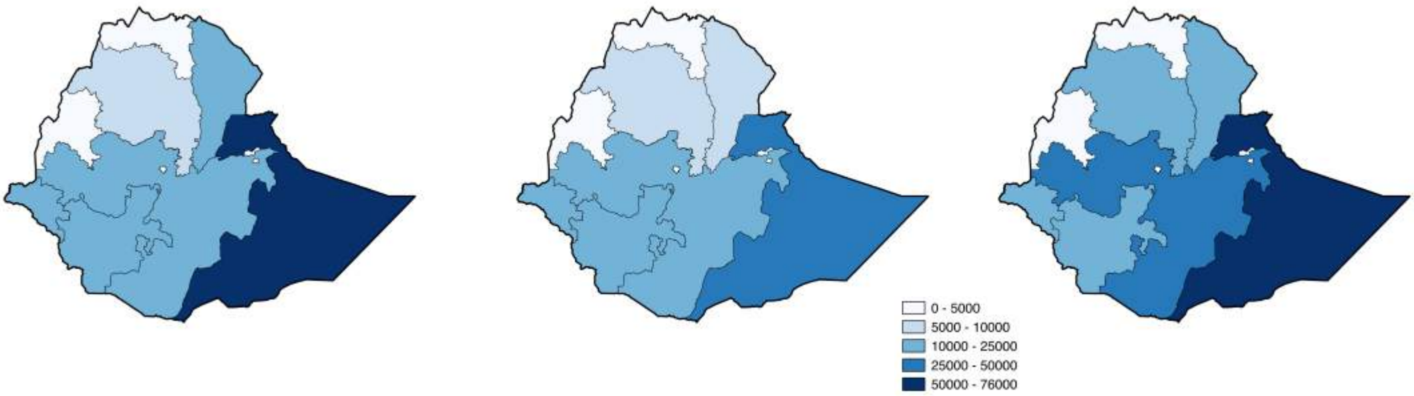
Annual Average Number of People Affected



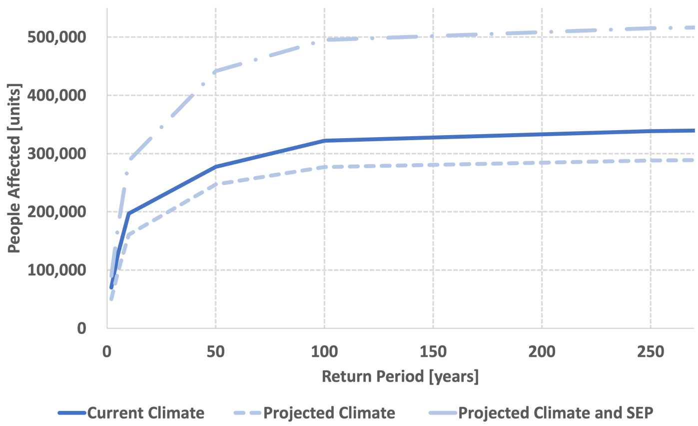
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

Absolute Number in Projected Climate Conditions with UN Population Projection

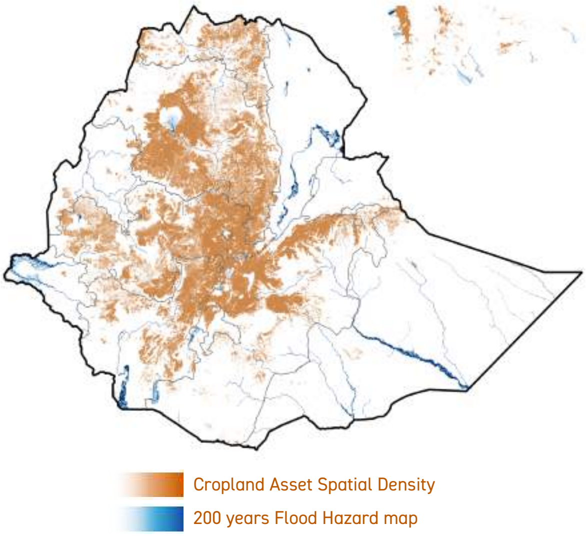


PML Curve - People Affected

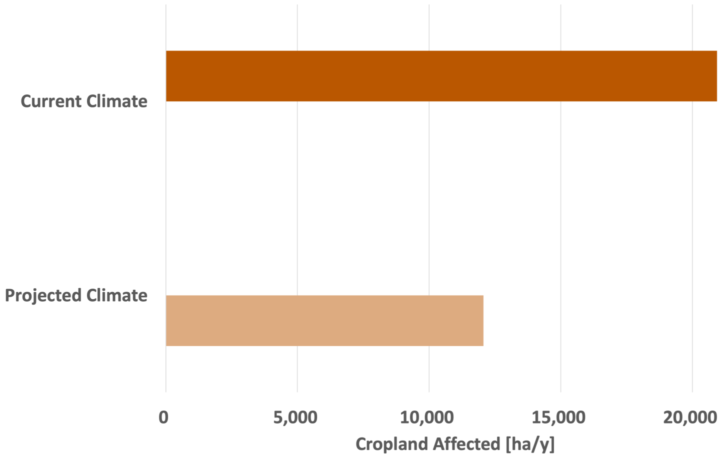


Cropland Affected

Cropland Exposure



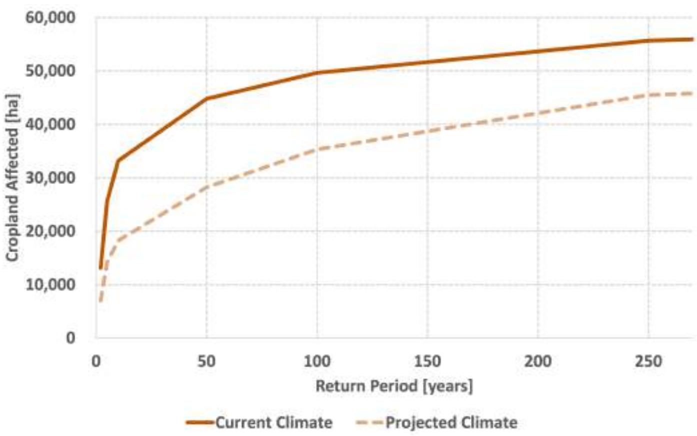
Annual Average Cropland Affected



Absolute Number in Current Climate Conditions

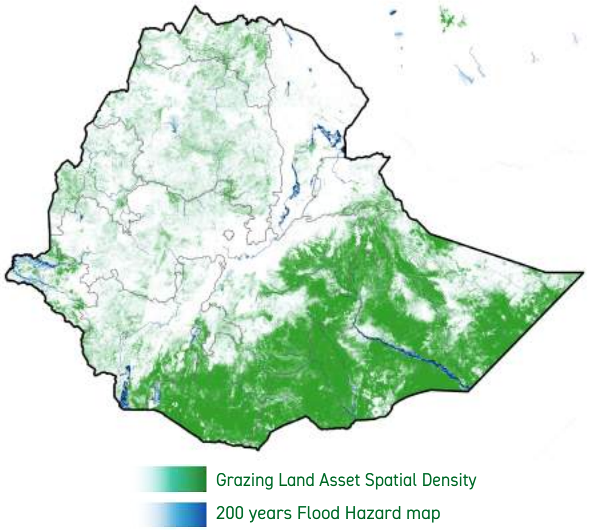
Absolute Number in Projected Climate Conditions

PML Curve - Cropland Affected

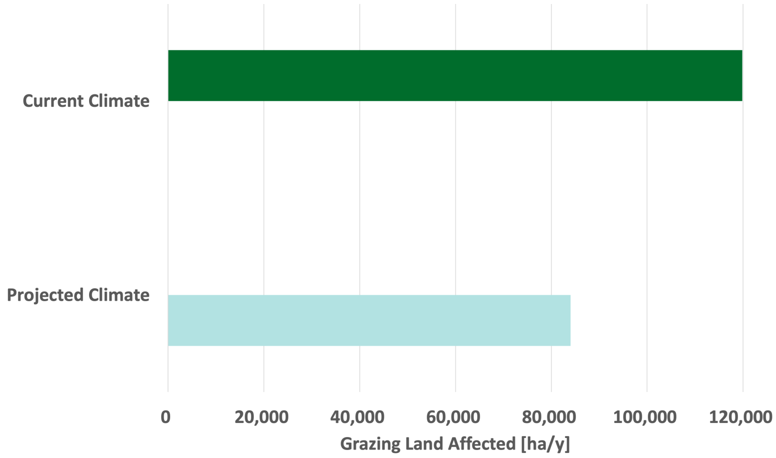


Grazing Land Affected

Grazing Land Exposure

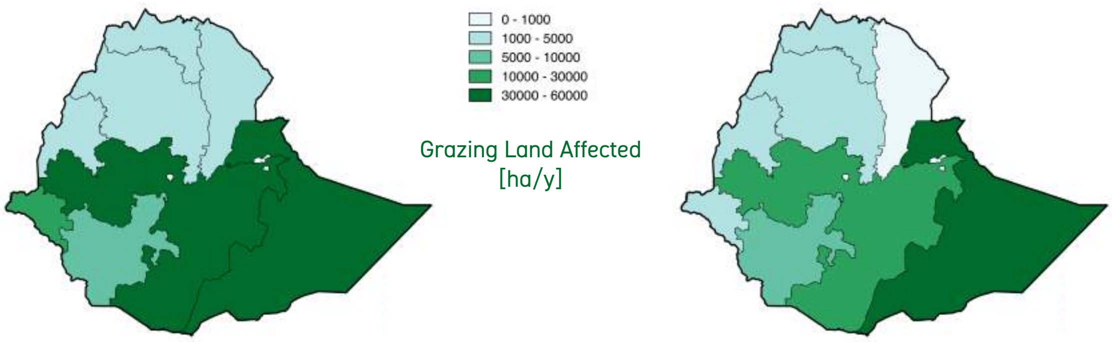


Annual Average Grazing Land Affected

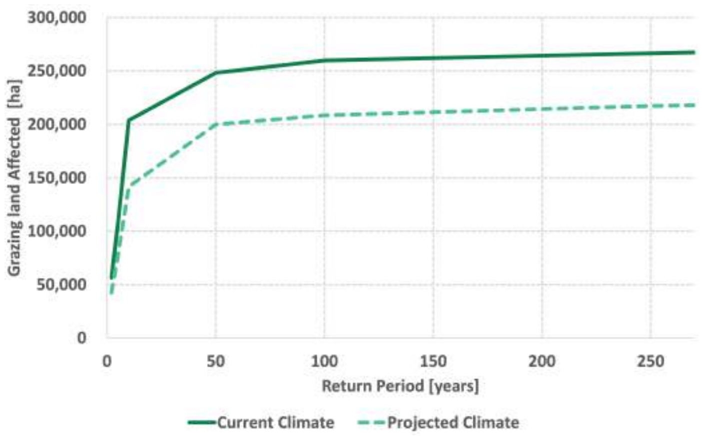


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

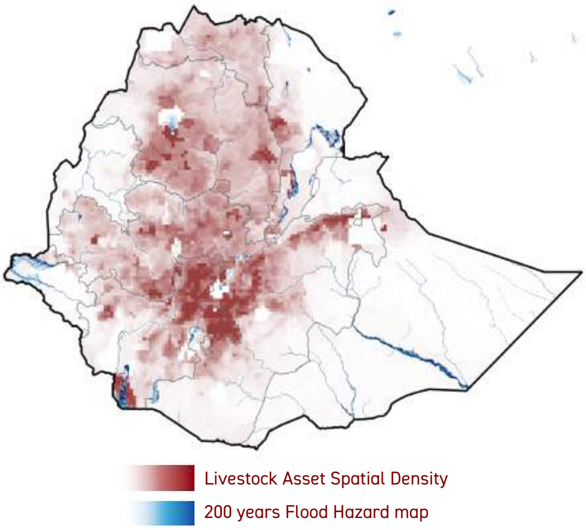


PML Curve - Grazing Land Affected

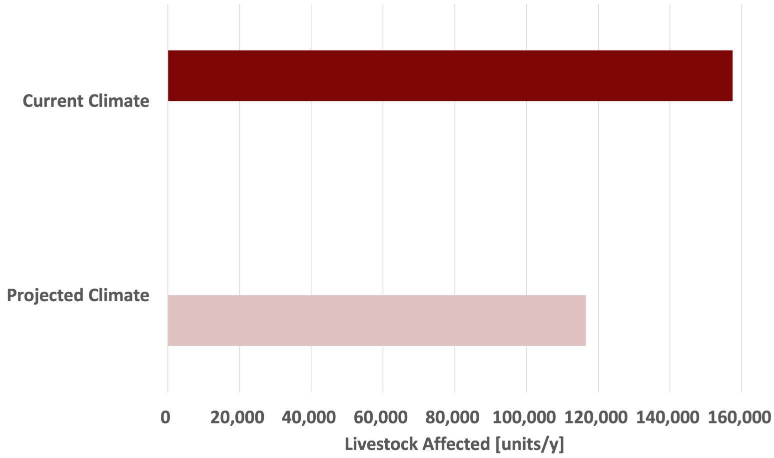


Livestock Affected

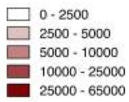
Livestock Exposure



Annual Average Number of Livestock Affected

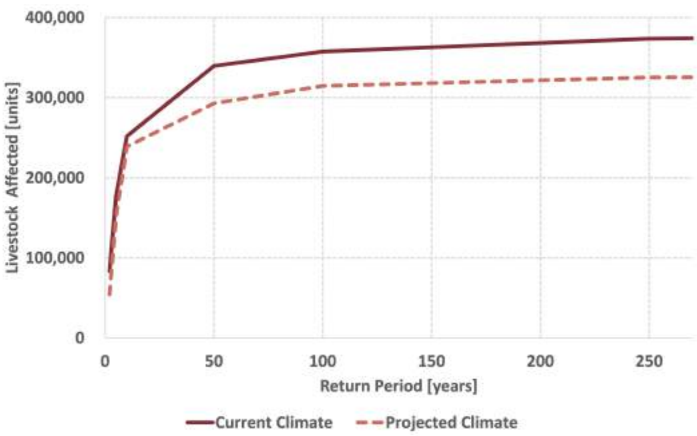


Absolute Number in Current Climate Conditions



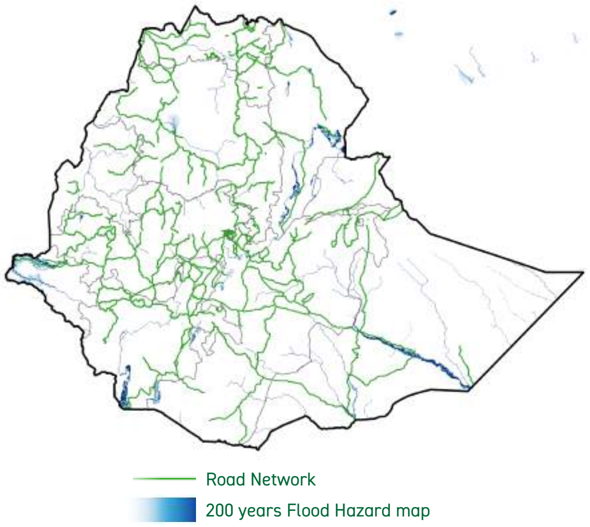
Absolute Number in Projected Climate Conditions

PML Curve - Livestock Affected

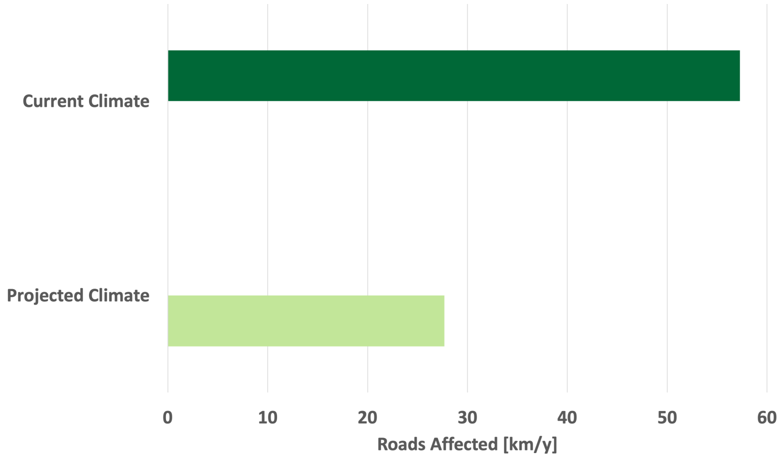


Road Network Affected

Road Network Exposure

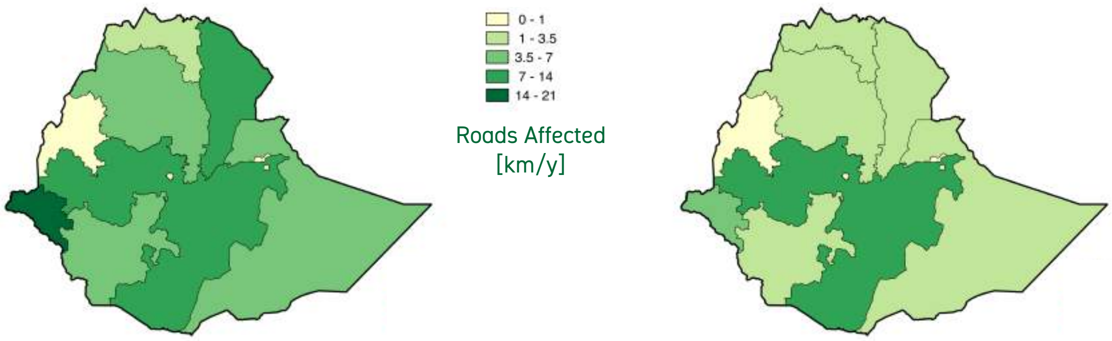


Annual Average Number of Km Affected

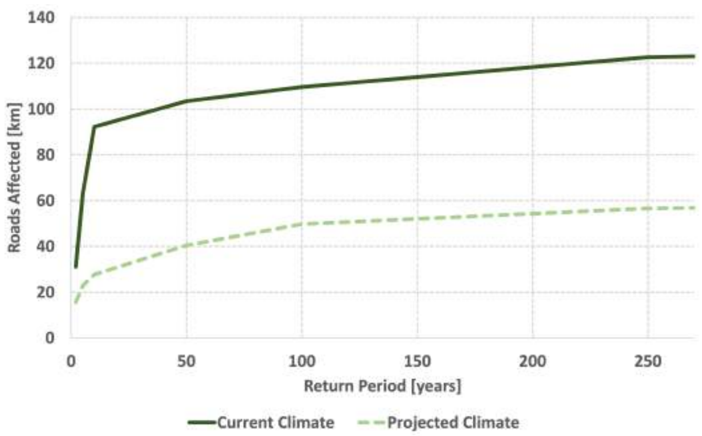


Absolute Number in Current Climate Conditions

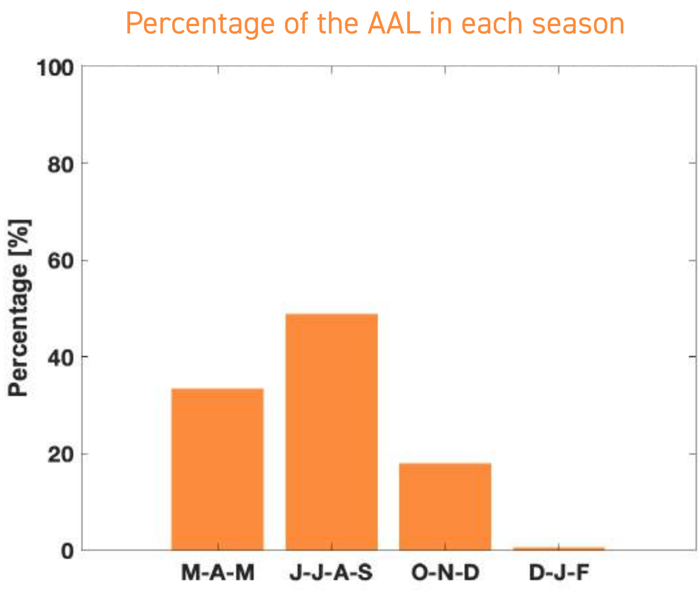
Absolute Number in Projected Climate Conditions

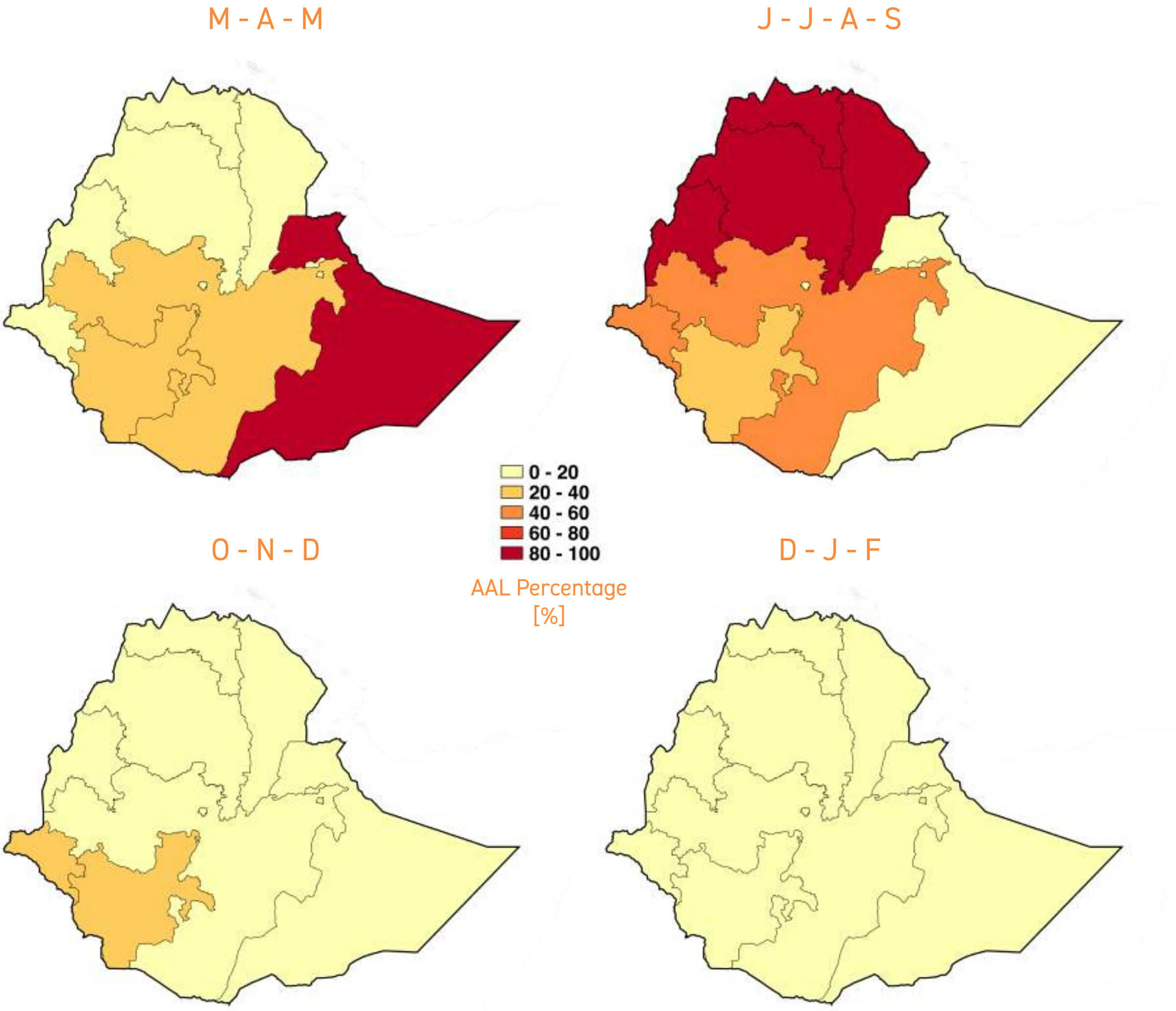


PML Curve - Km of Roads Affected



Seasonal Outlook





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Towards an IGAD regional flood risk profile (2021): **REPUBLIC OF KENYA**

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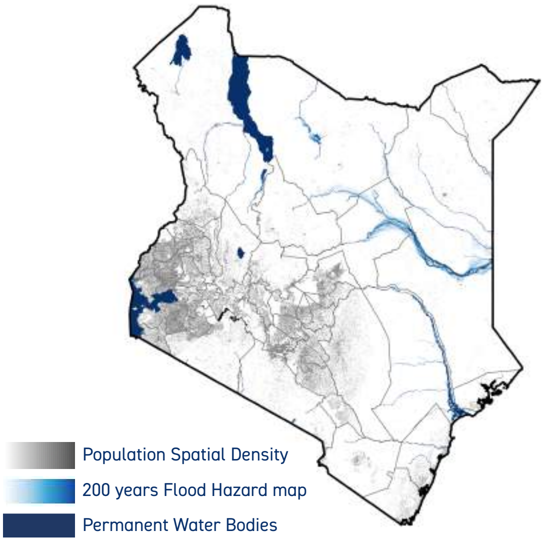
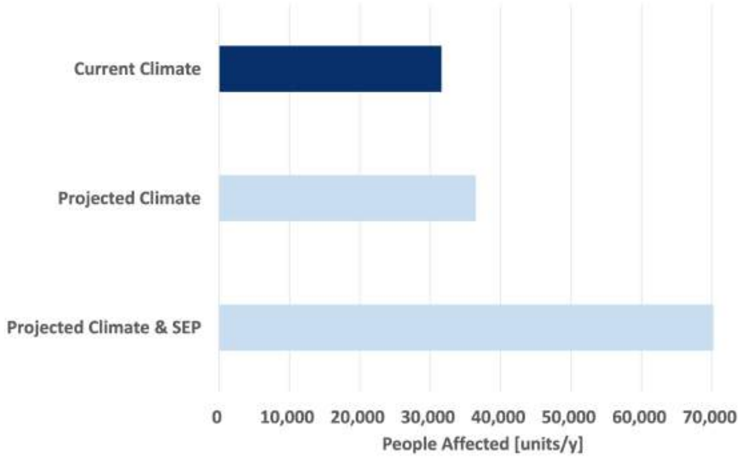
Population Affected

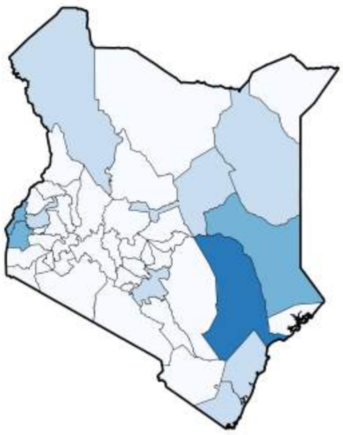
People Exposure



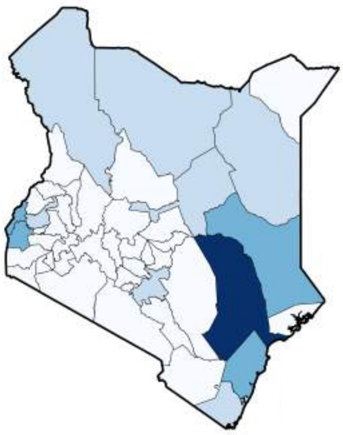
Annual Average Number of People Affected



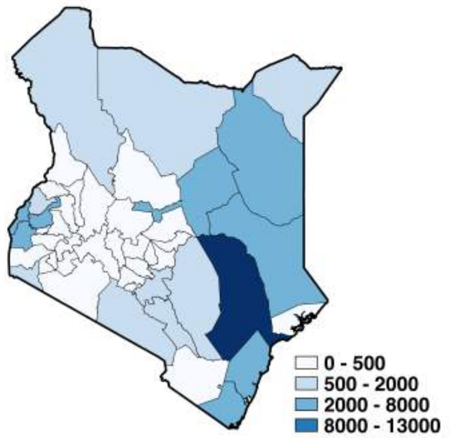
Absolute Number in Current Climate Conditions



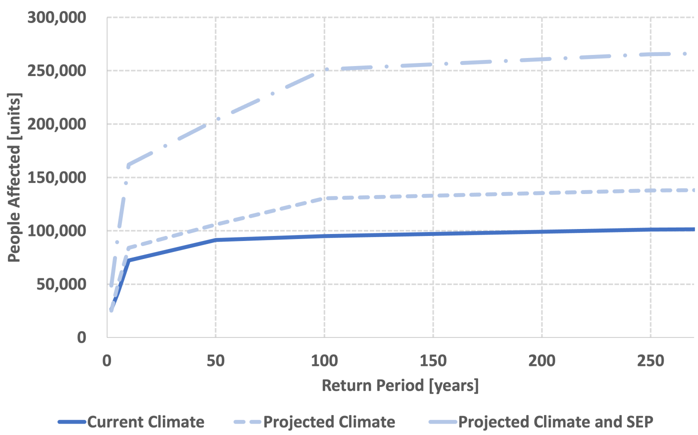
Absolute Number in Projected Climate Conditions



Absolute Number in Projected Climate Conditions with UN Population Projection

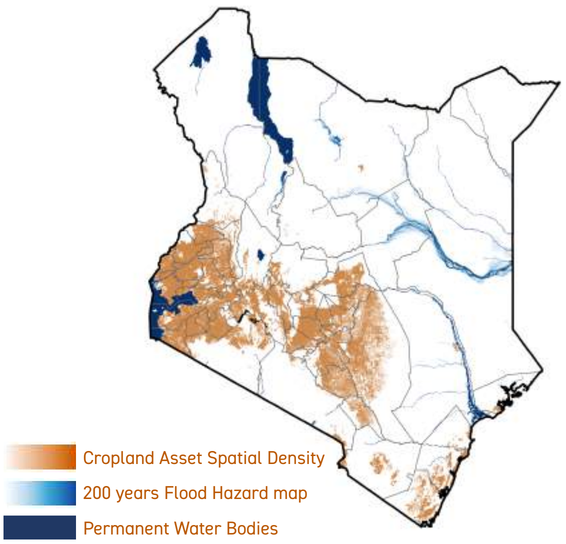


PML Curve - People Affected

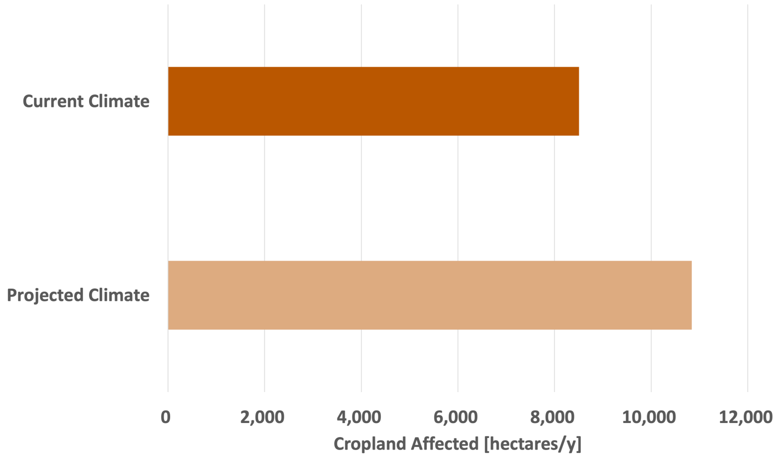


Cropland Affected

Cropland Exposure

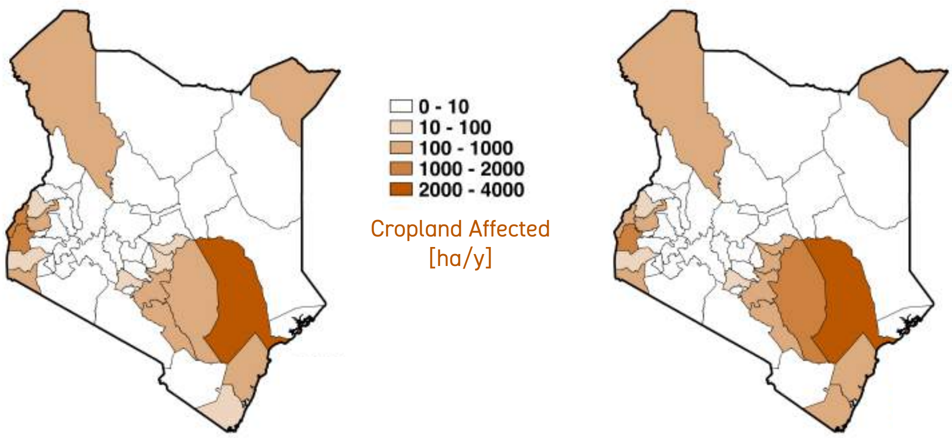


Annual Average Cropland Affected

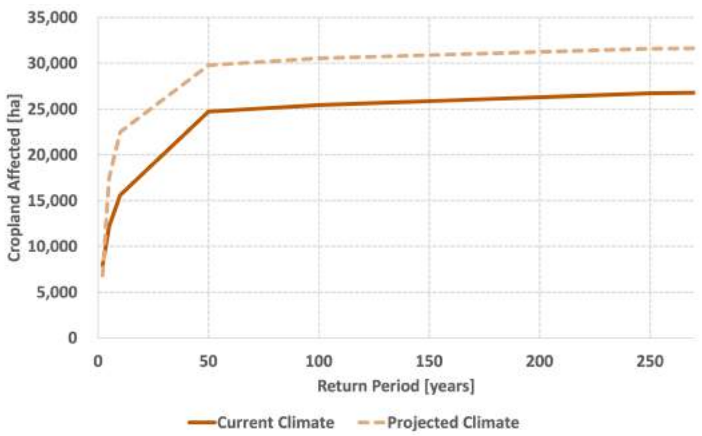


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

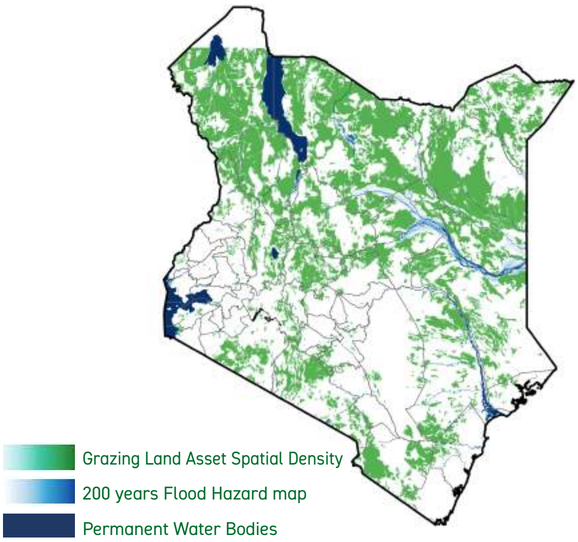


PML Curve - Cropland Affected

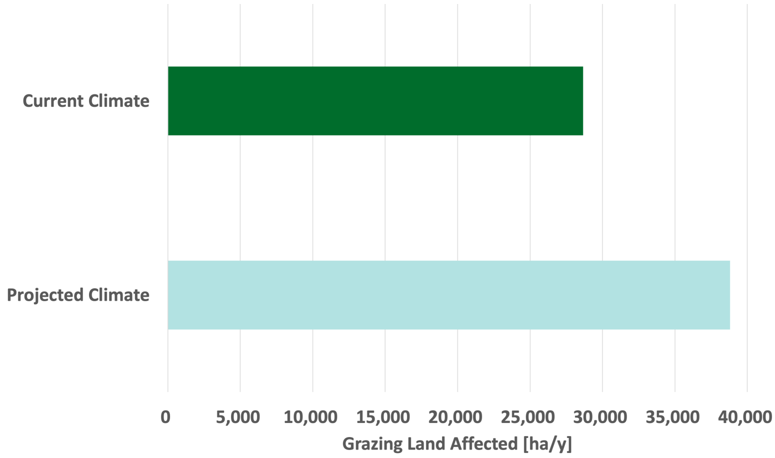


Grazing Land Affected

Grazing Land Exposure

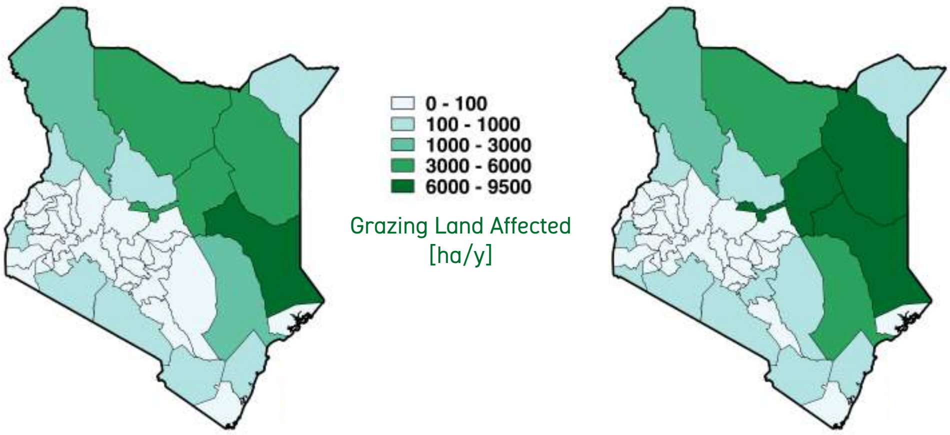


Annual Average Grazing Land Affected

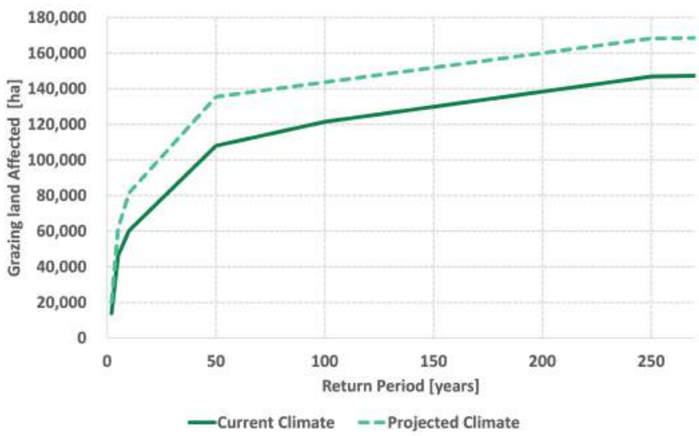


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

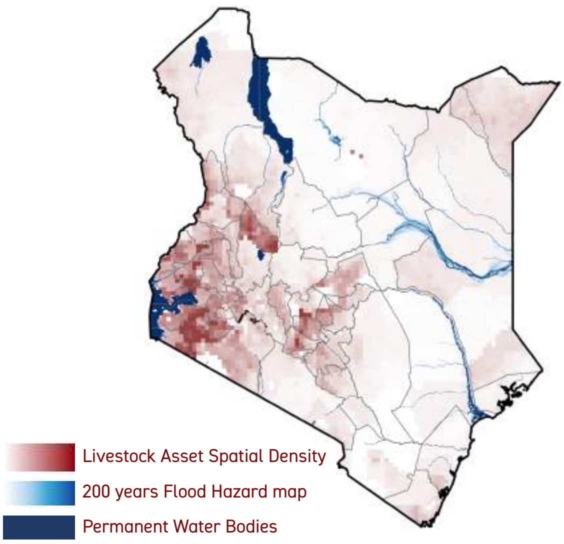


PML Curve - Grazing Land Affected

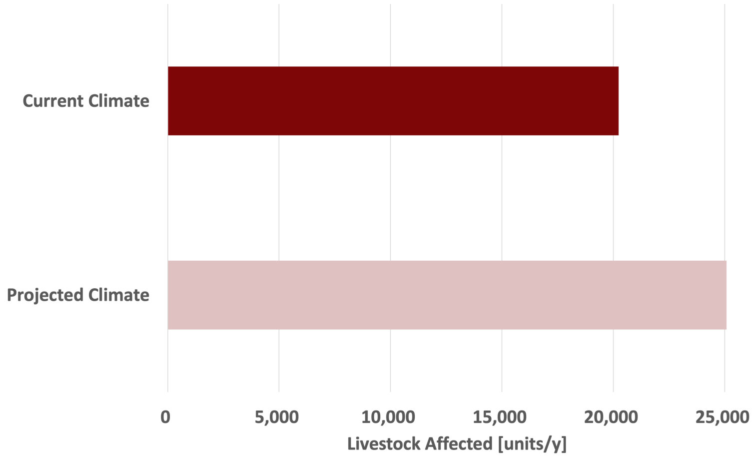


Livestock Affected

Livestock Exposure

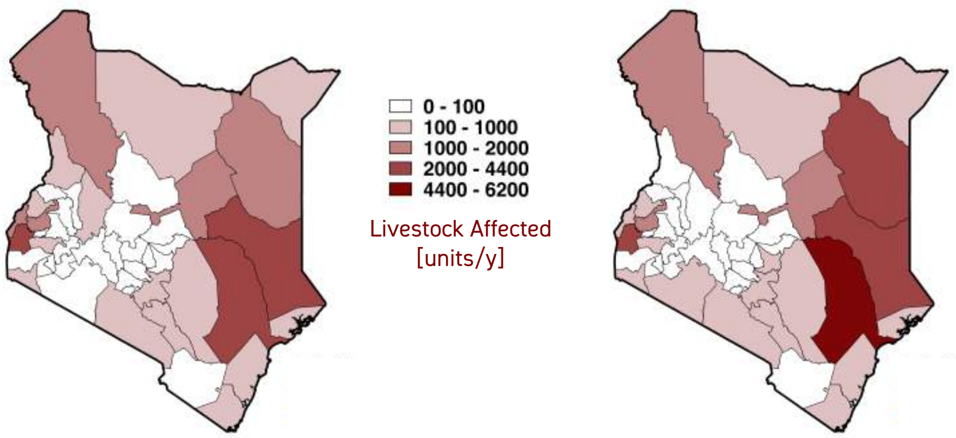


Annual Average Number of Livestock Affected

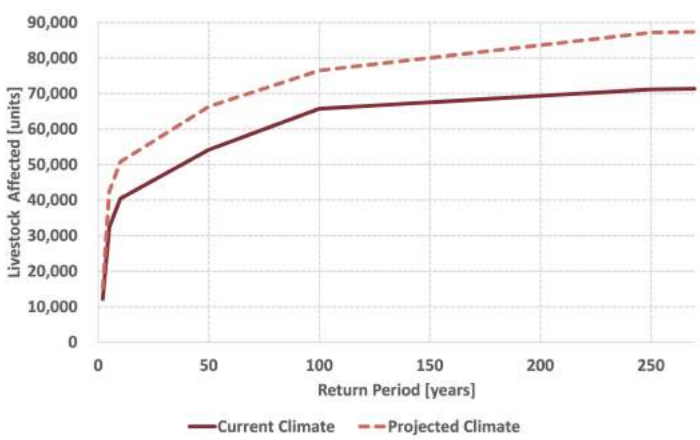


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

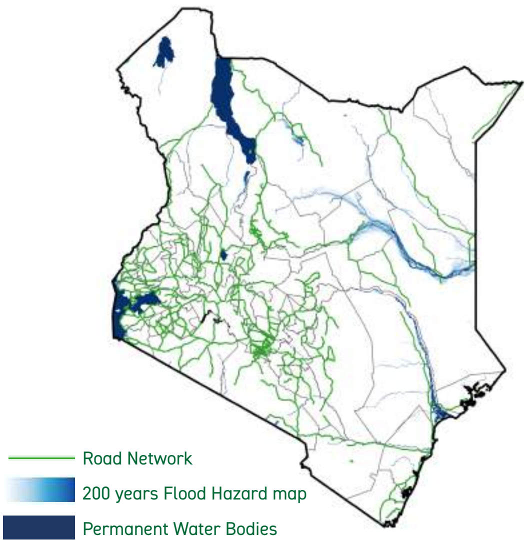


PML Curve - Livestock Affected

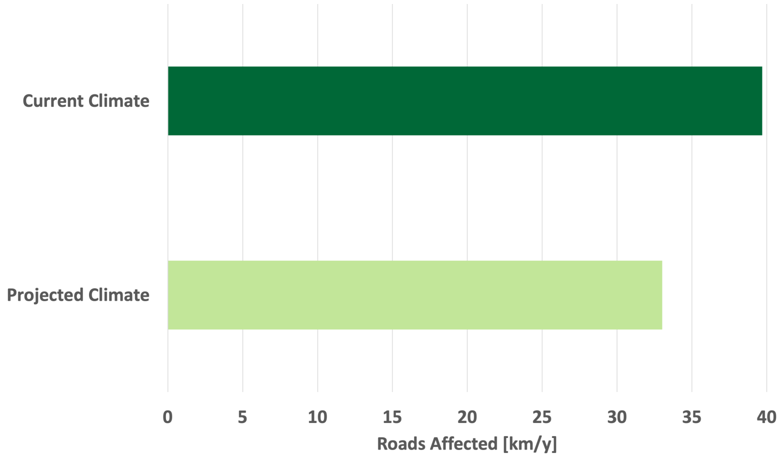


Road Network Affected

Road Network Exposure

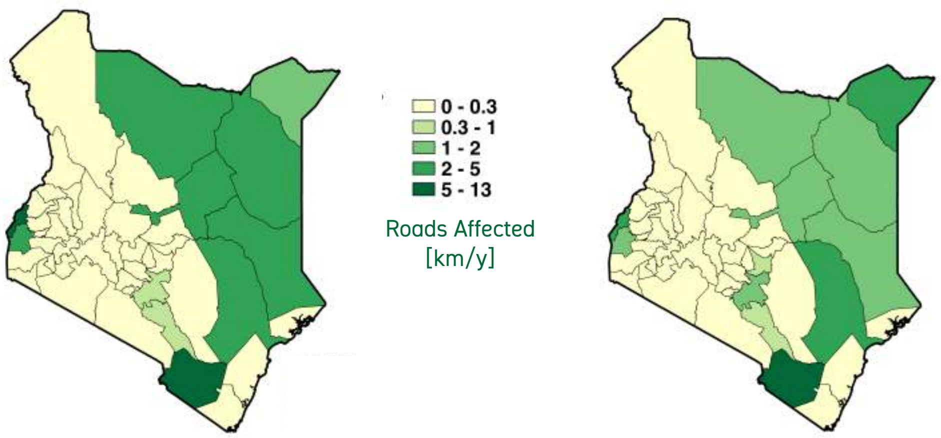


Annual Average Number of Km Affected

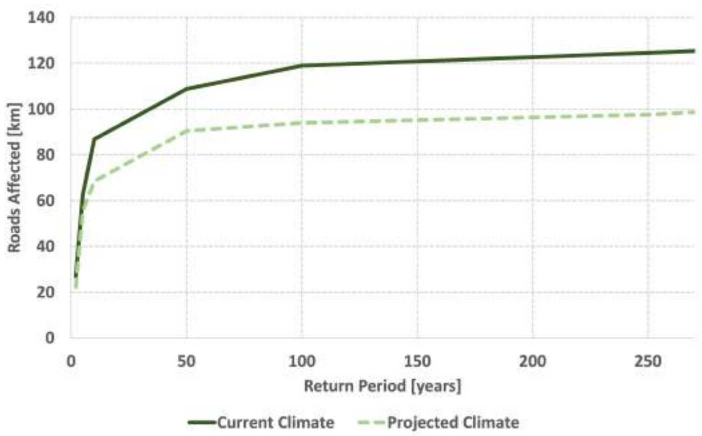


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

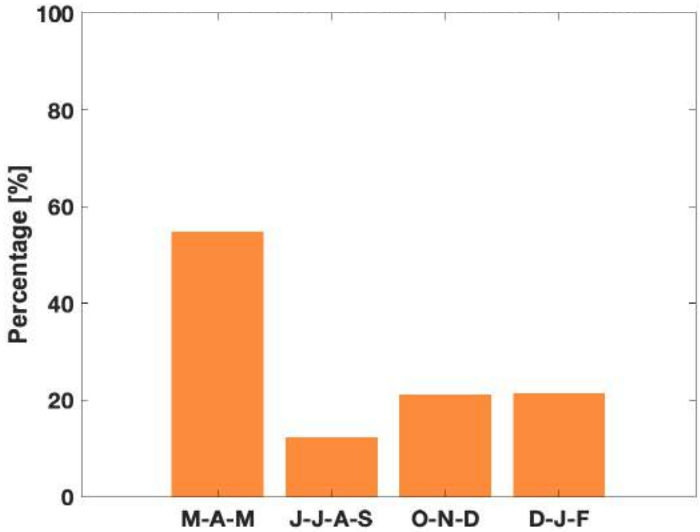


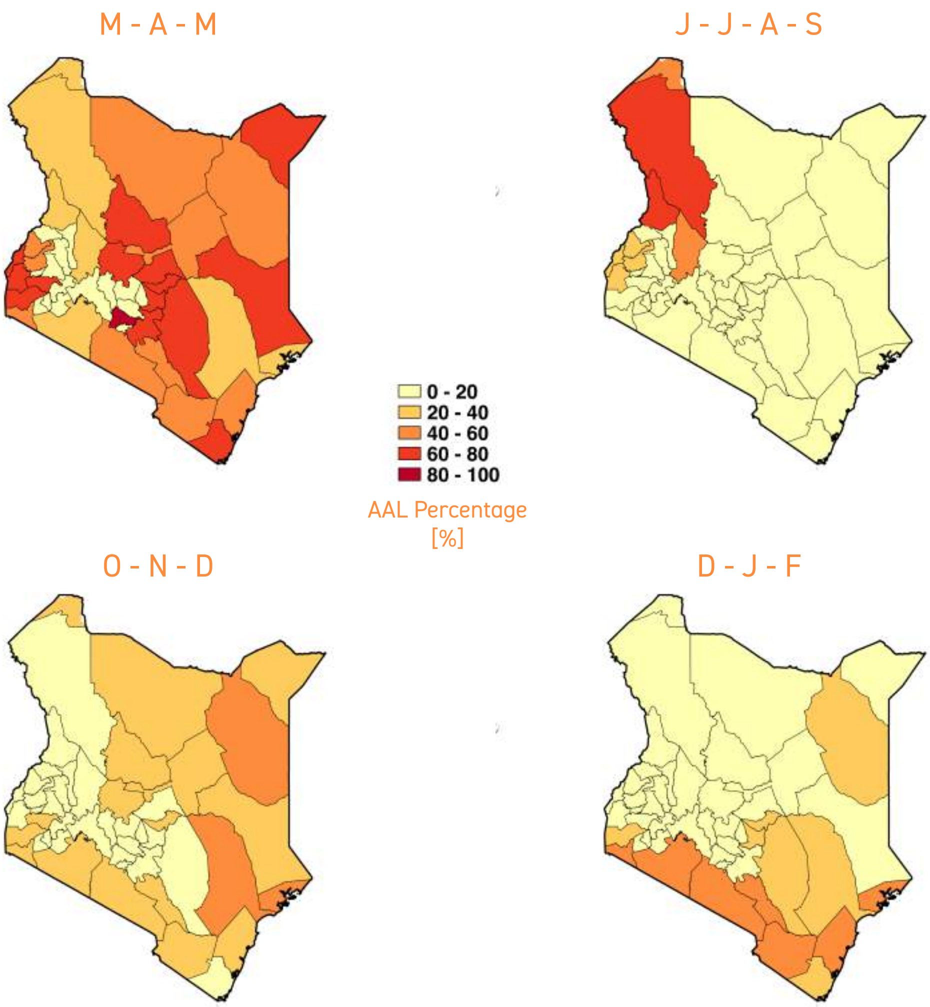
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season



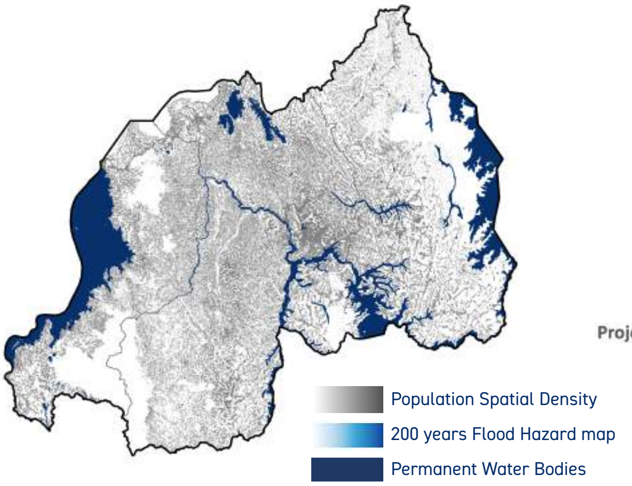


Towards an IGAD regional flood risk profile (2021): REPUBLIC OF RWANDA

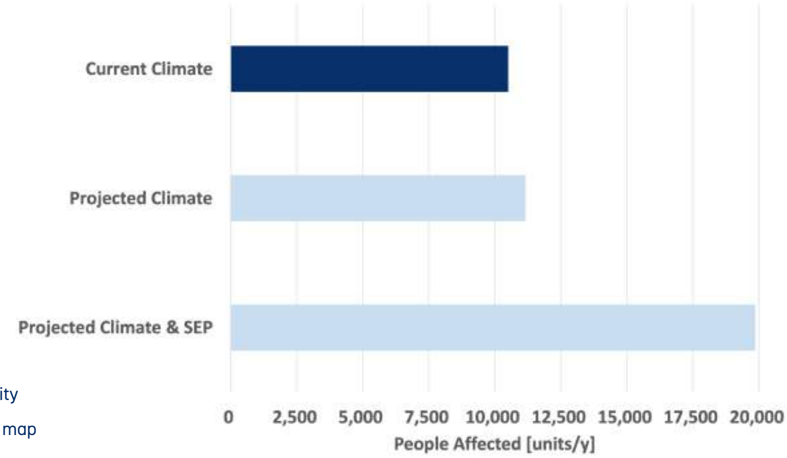
This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region.
(Document prepared for consultation with Member States)

Population Affected

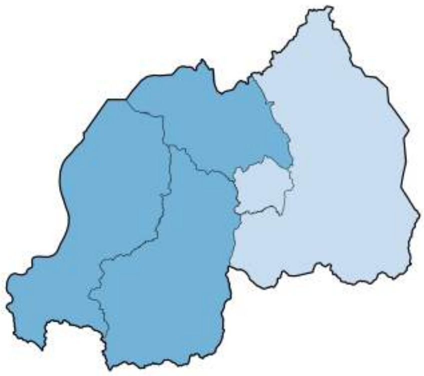
People Exposure



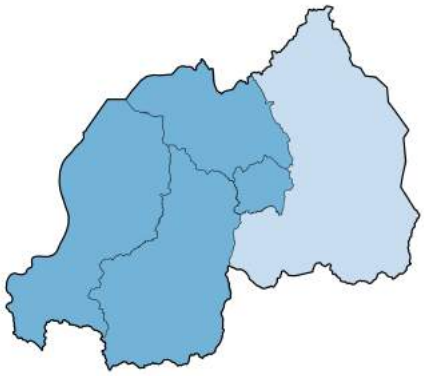
Annual Average Number of People Affected



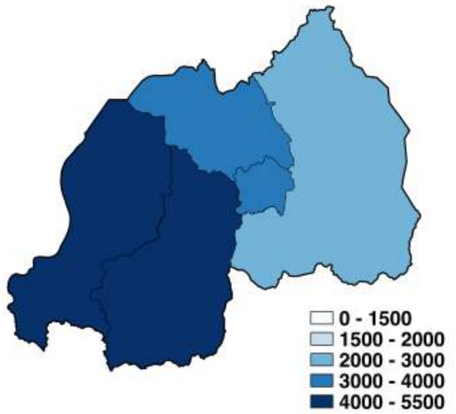
Absolute Number in Current Climate Conditions



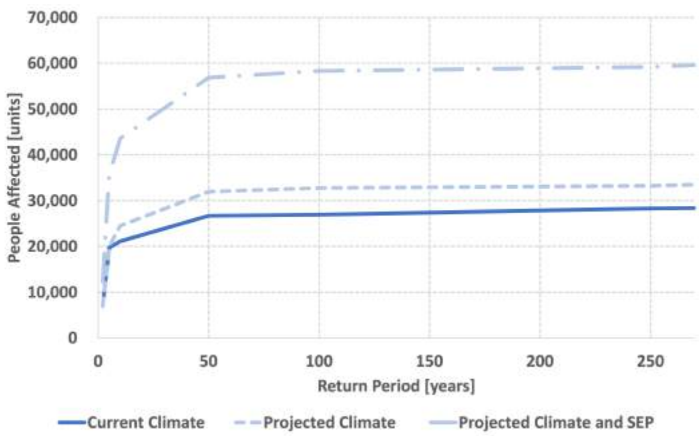
Absolute Number in Projected Climate Conditions



Absolute Number in Projected Climate Conditions with UN Population Projection

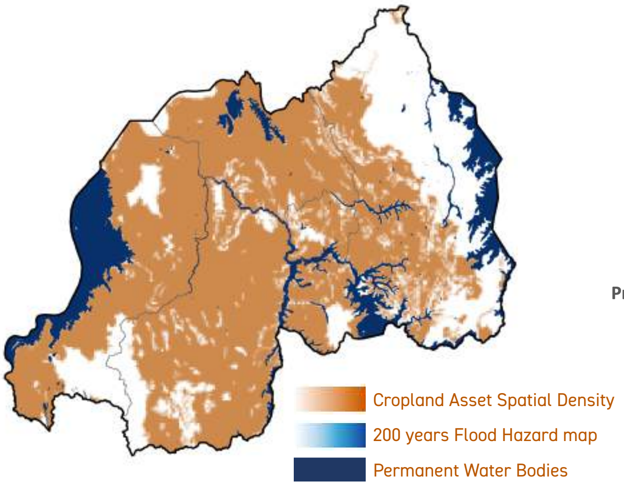


PML Curve - People Affected

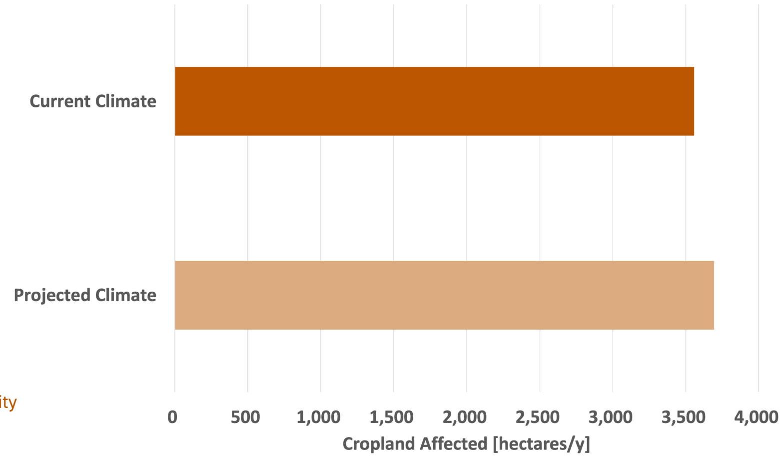


Cropland Affected

Cropland Exposure

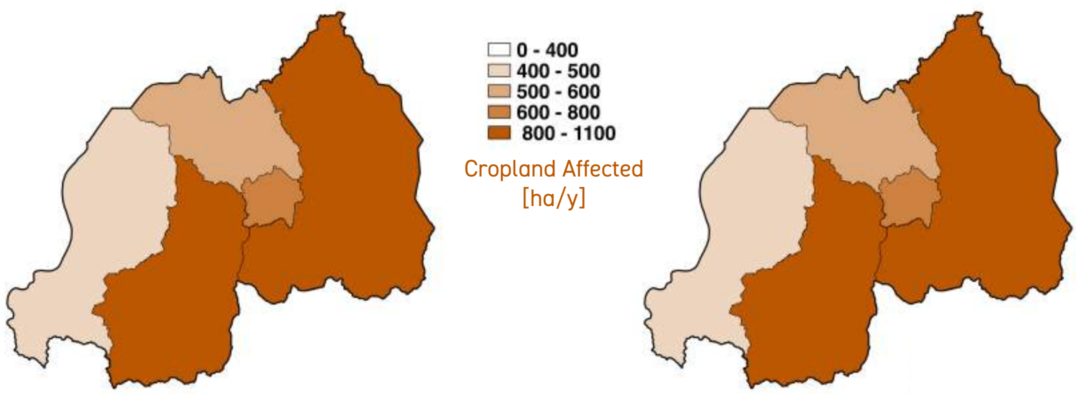


Annual Average Cropland Affected

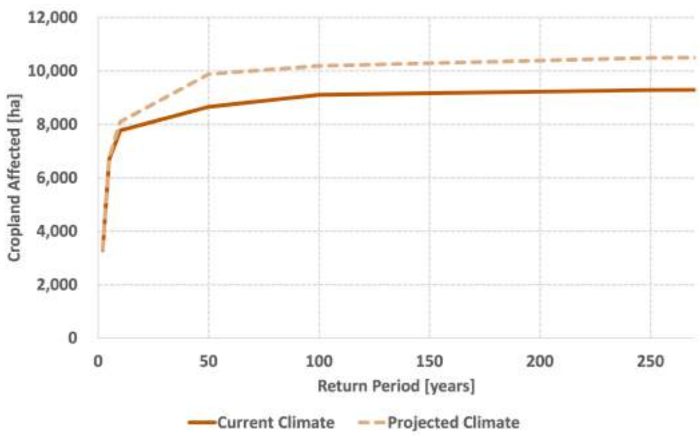


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

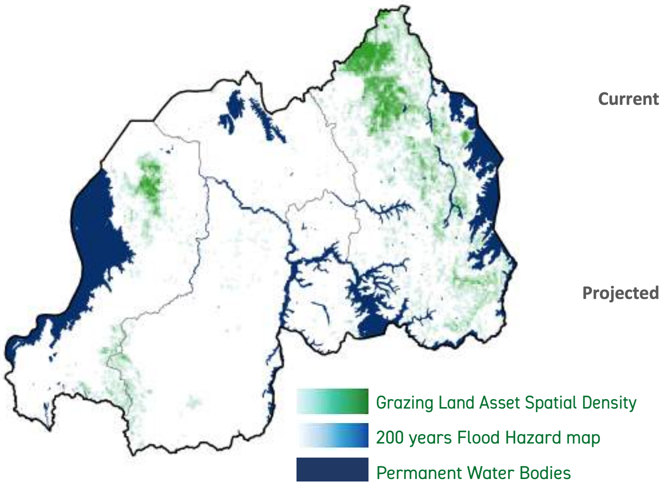


PML Curve - Cropland Affected

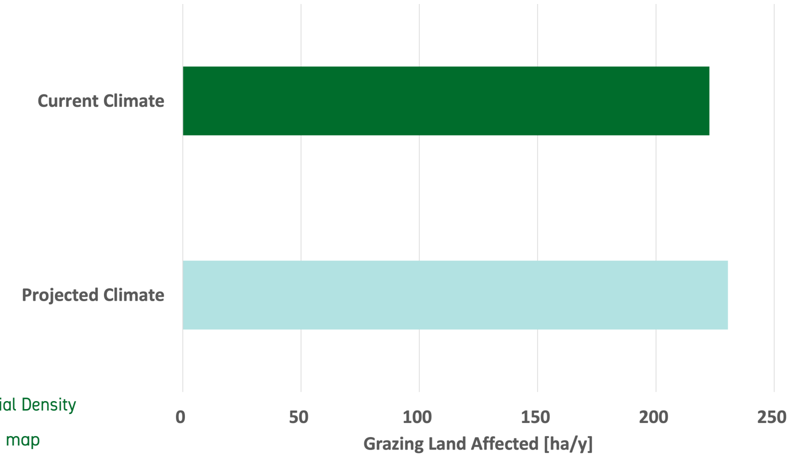


Grazing Land Affected

Grazing Land Exposure

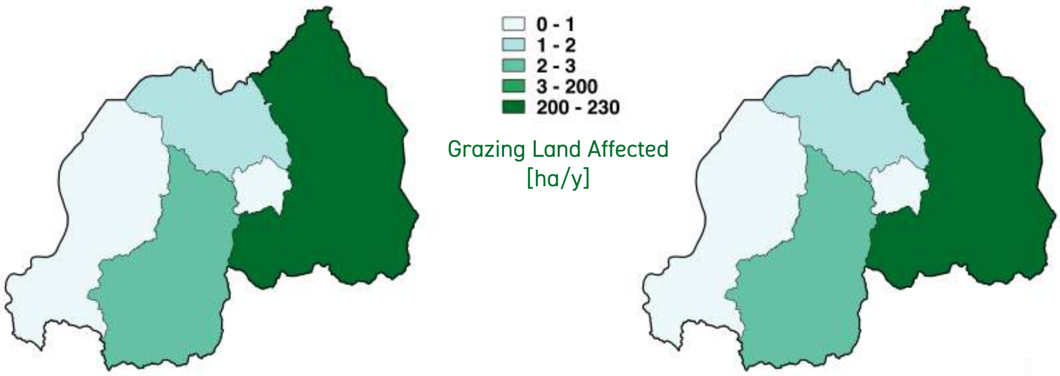


Annual Average Grazing Land Affected

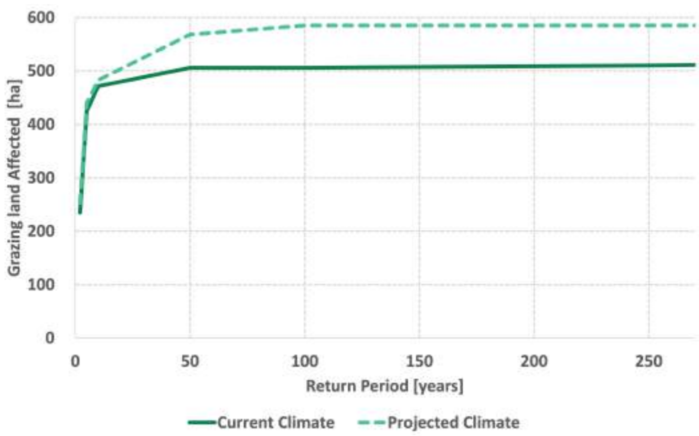


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

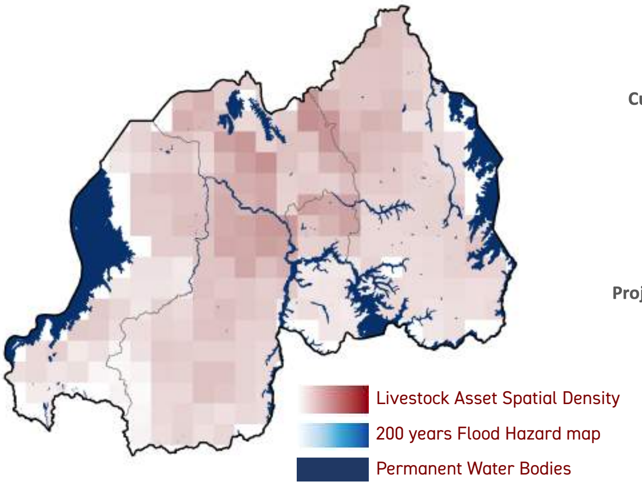


PML Curve - Grazing Land Affected

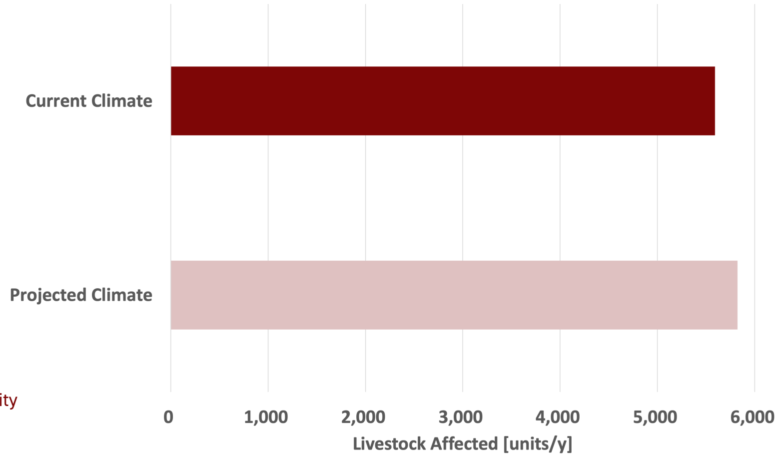


Livestock Affected

Livestock Exposure

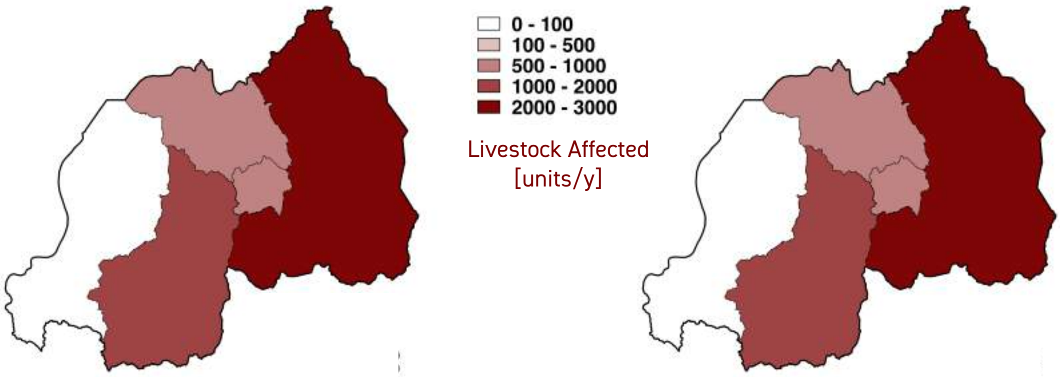


Annual Average Number of Livestock Affected

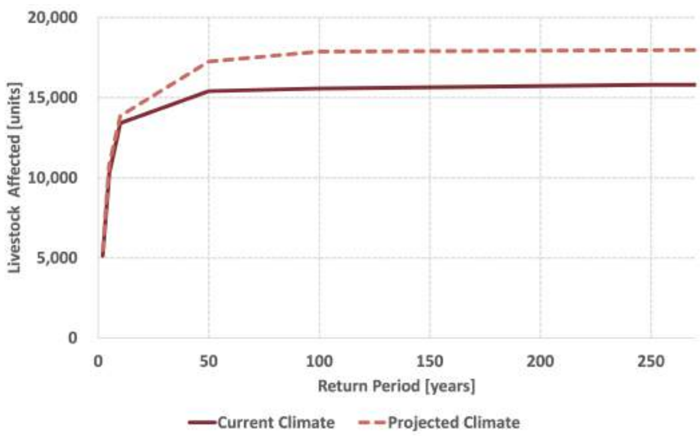


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

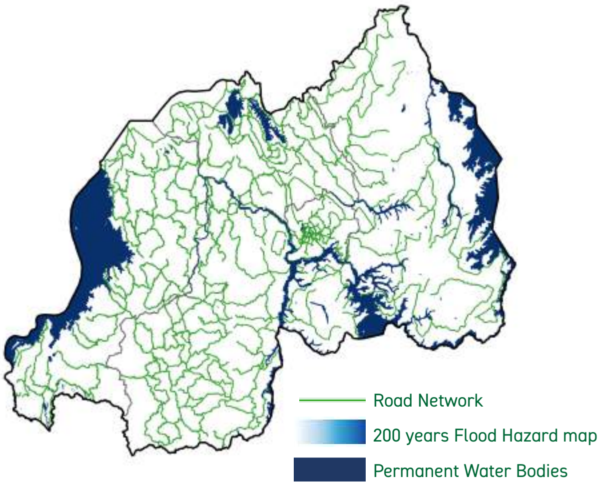


PML Curve - Livestock Affected

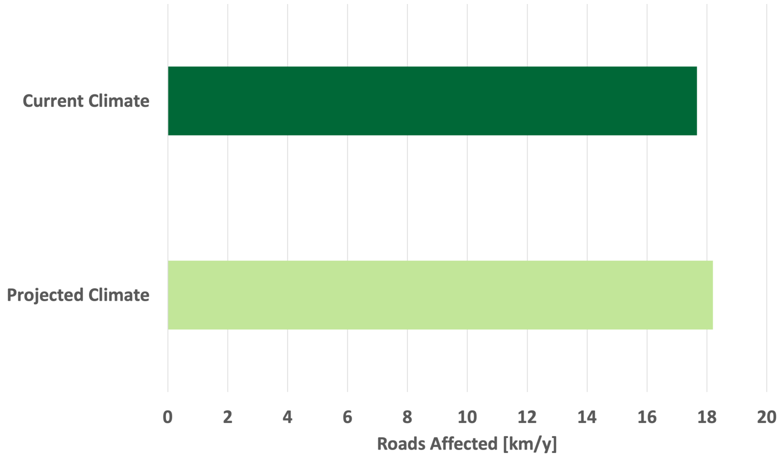


Road Network Affected

Road Network Exposure

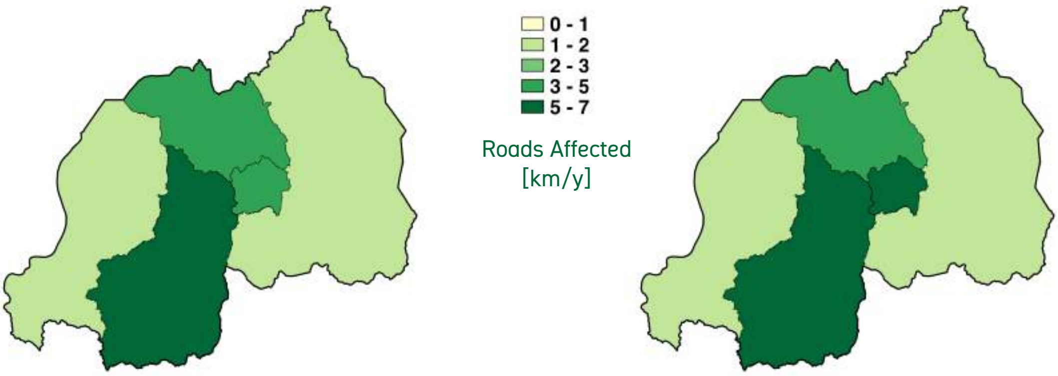


Annual Average Number of Km Affected

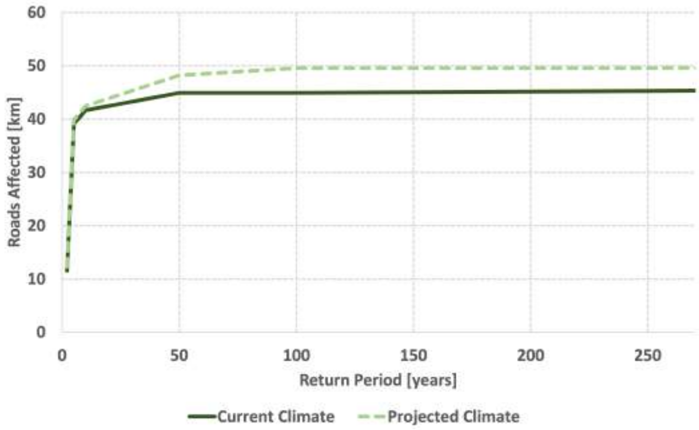


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

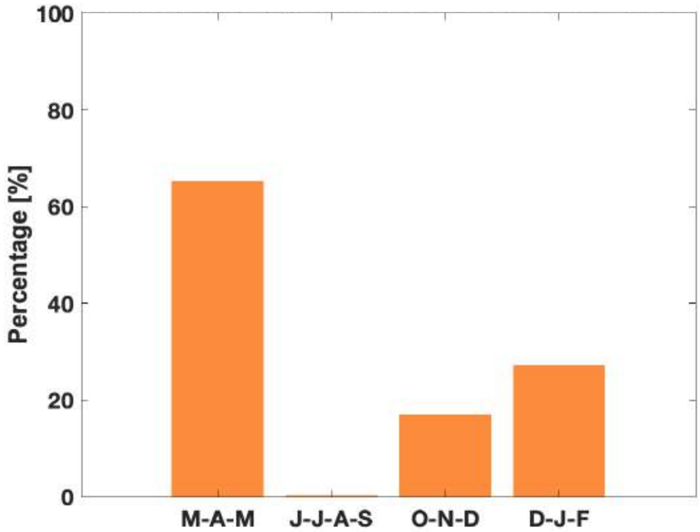


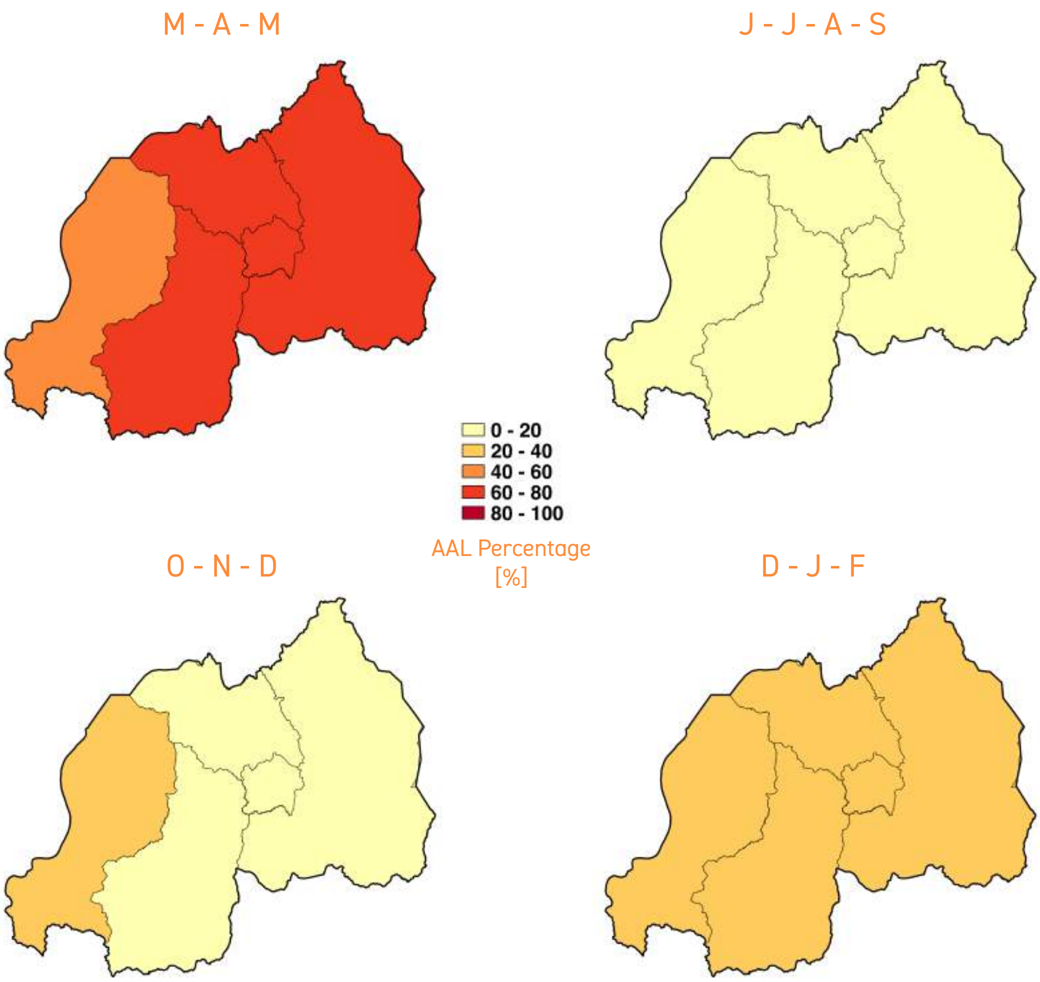
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





IGAD ICPAC · WFP World Food Programme · UNDRR UN Office for Disaster Risk Reduction · Regeringskansliet Ministry for Foreign Affairs Sweden · cima Research Foundation

Towards an IGAD regional flood risk profile (2021):

FEDERAL REPUBLIC OF SOMALIA

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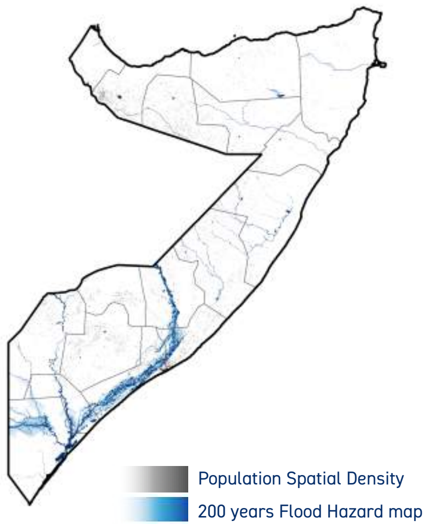
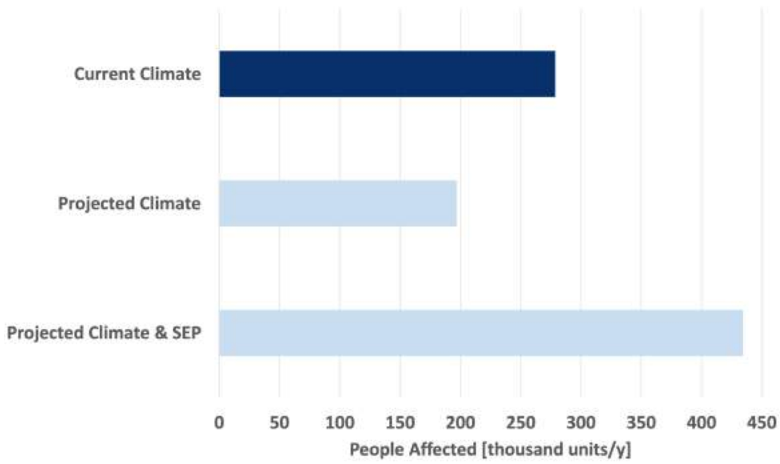
Population Affected

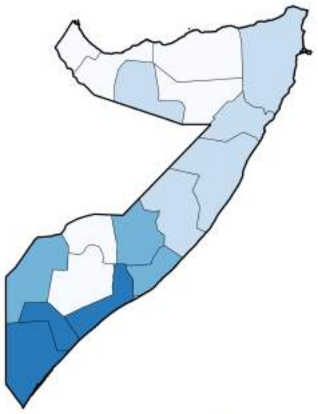
People Exposure



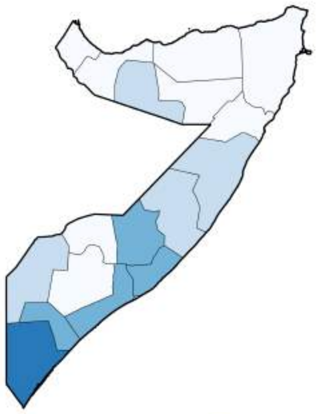
Annual Average Number of People Affected



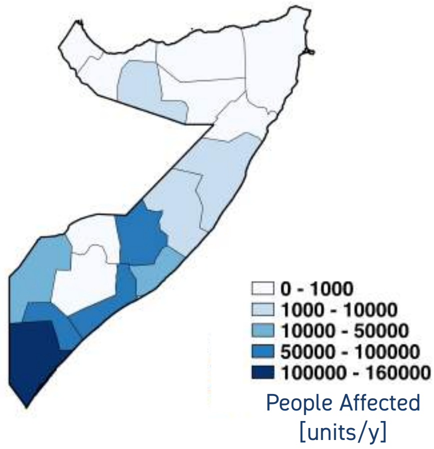
Absolute Number in Current Climate Conditions



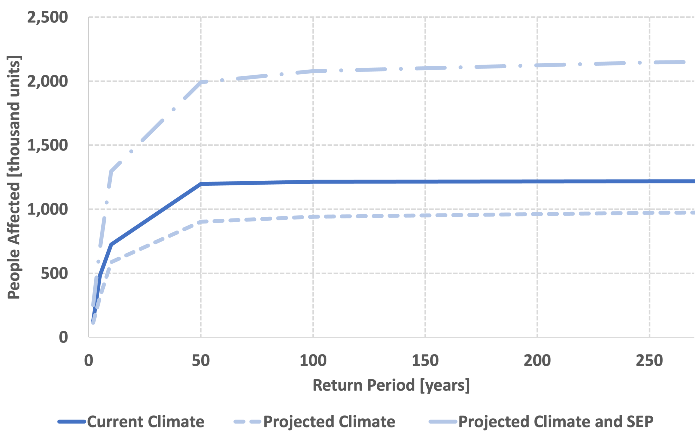
Absolute Number in Projected Climate Conditions



Absolute Number in Projected Climate Conditions with UN Population Projection

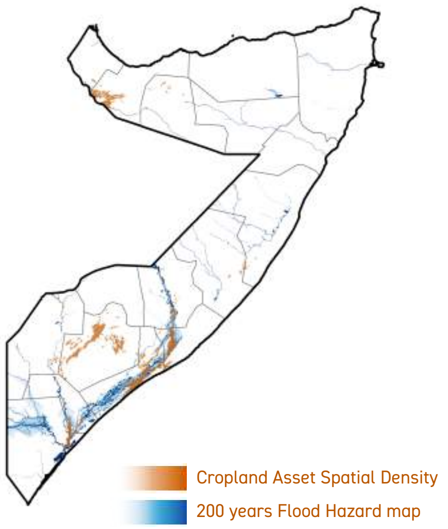


PML Curve - People Affected

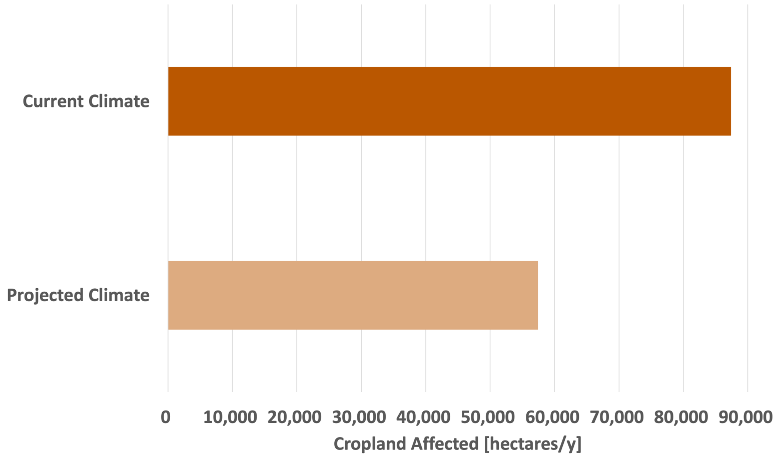


Cropland Affected

Cropland Exposure

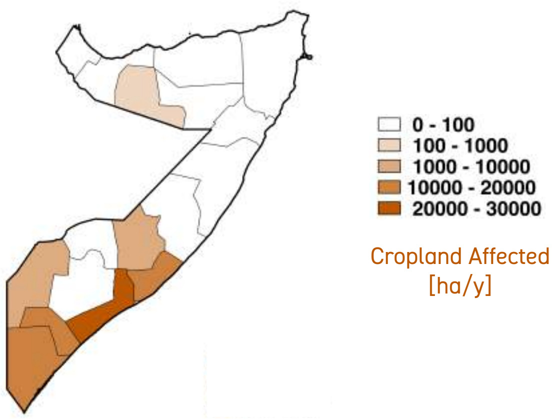


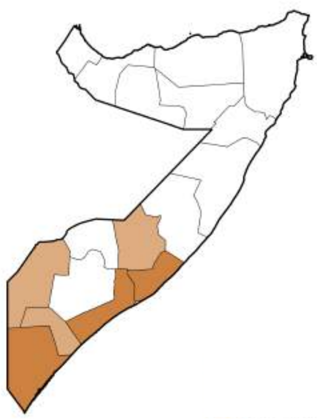
Annual Average Cropland Affected



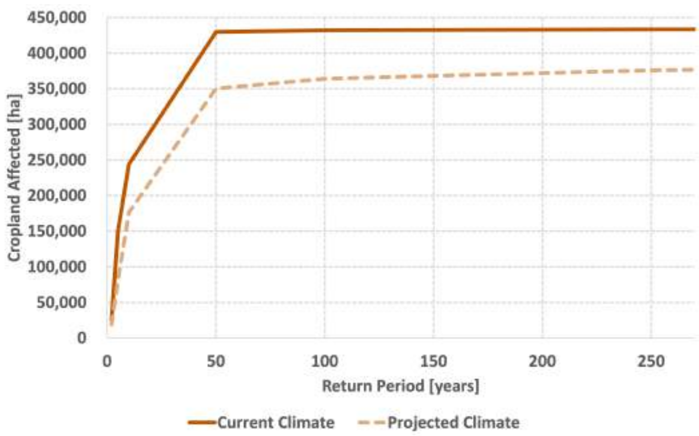
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions



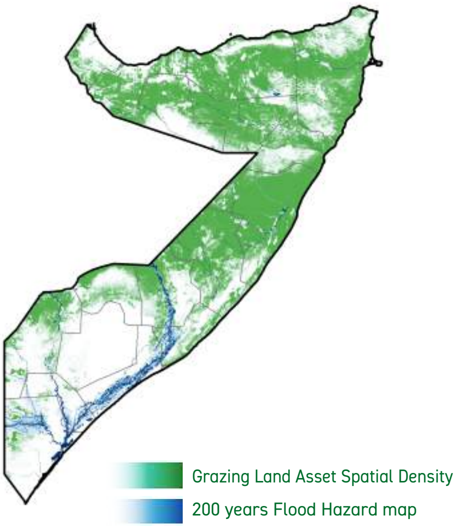


PML Curve - Cropland Affected

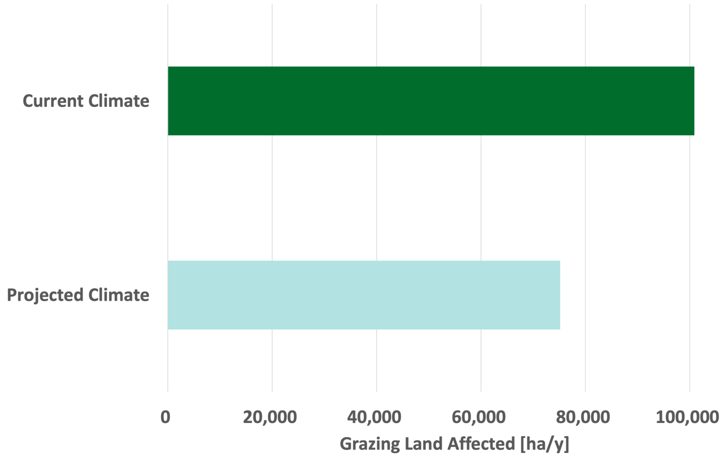


Grazing Land Affected

Grazing Land Exposure

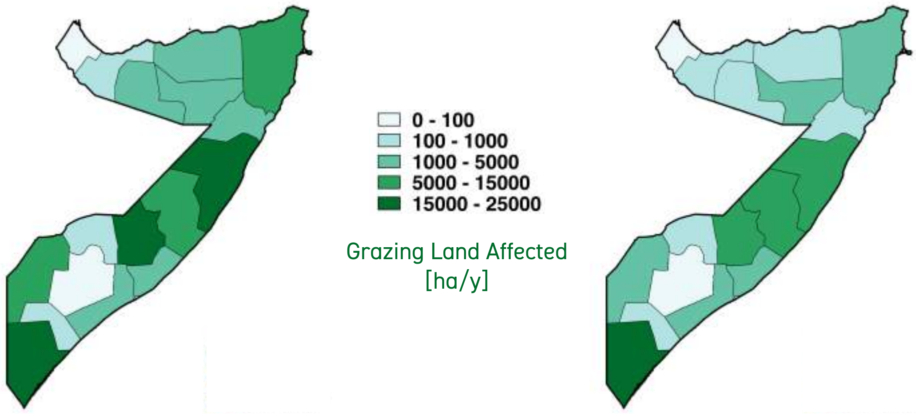


Annual Average Grazing Land Affected

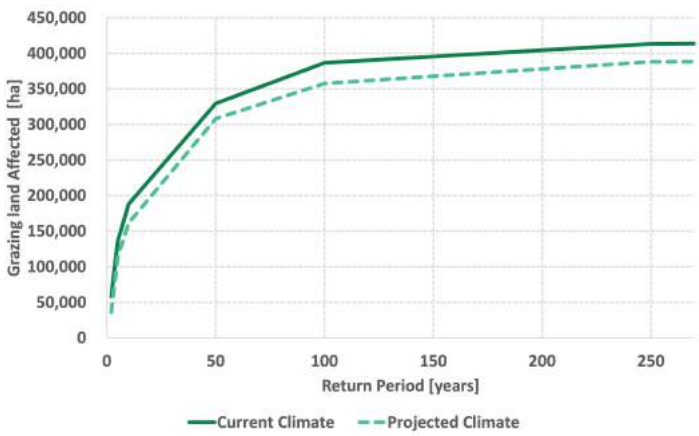


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

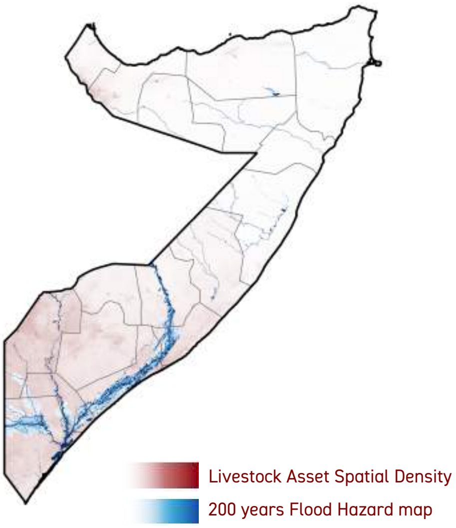


PML Curve - Grazing Land Affected

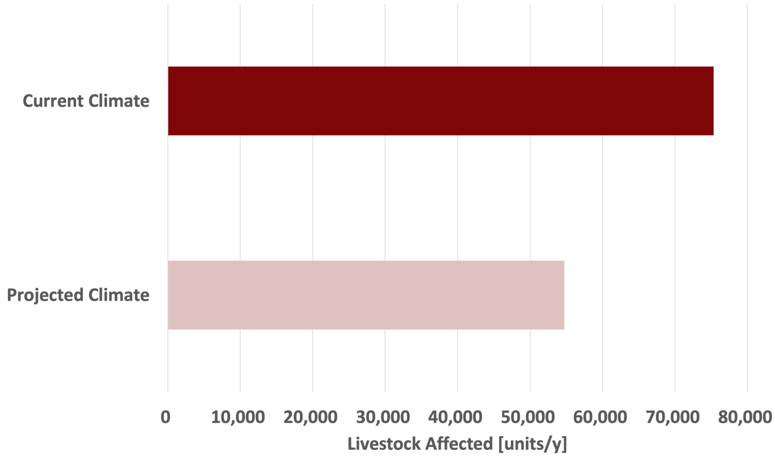


Livestock Affected

Livestock Exposure

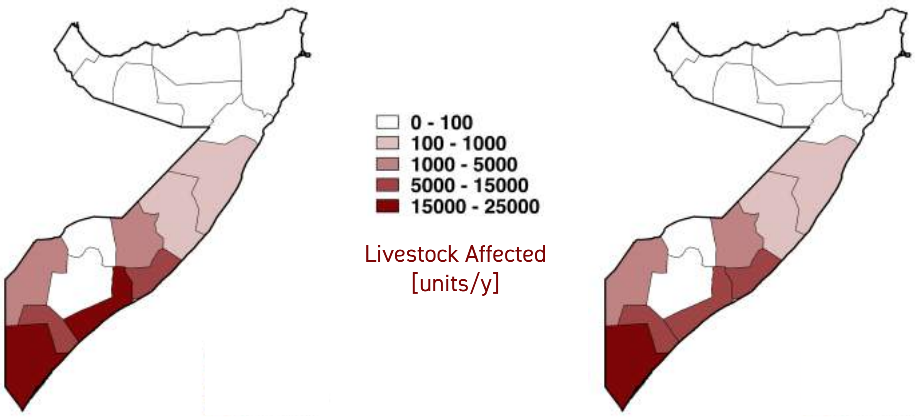


Annual Average Number of Livestock Affected

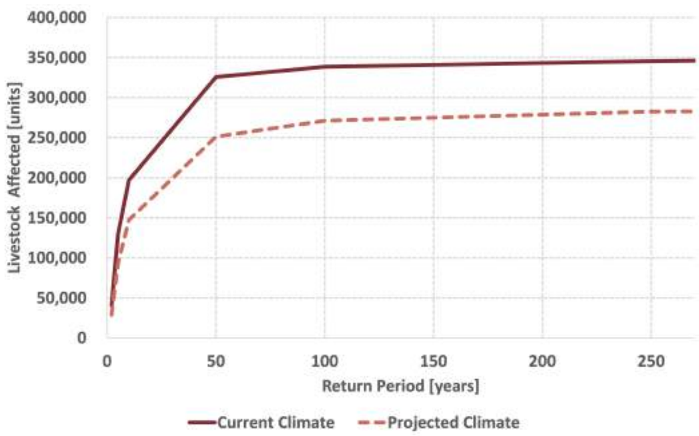


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

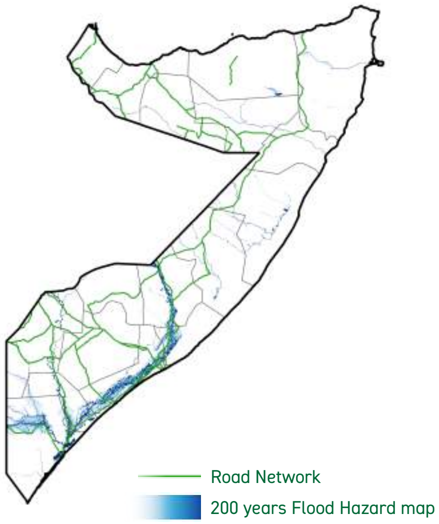


PML Curve - Livestock Affected

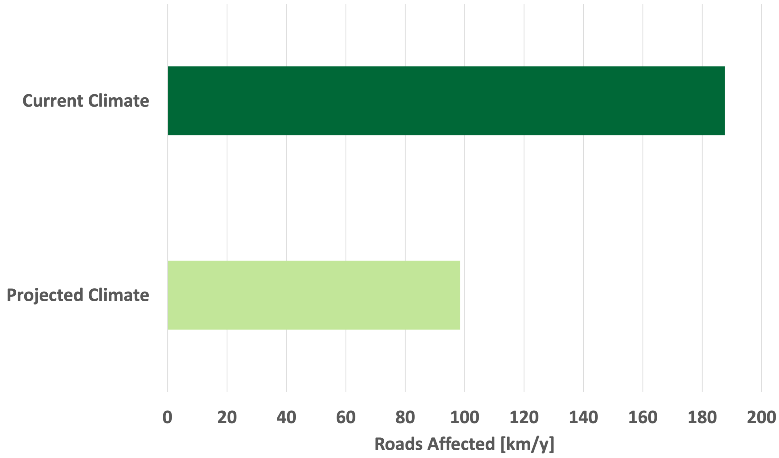


Road Network Affected

Road Network Exposure

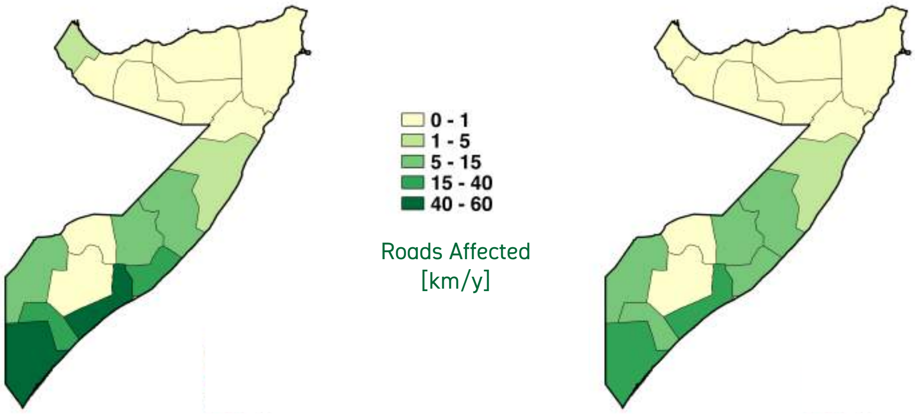


Annual Average Number of Km Affected

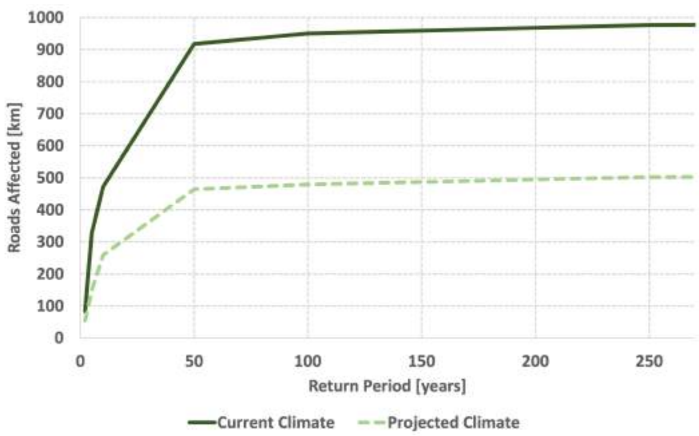


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

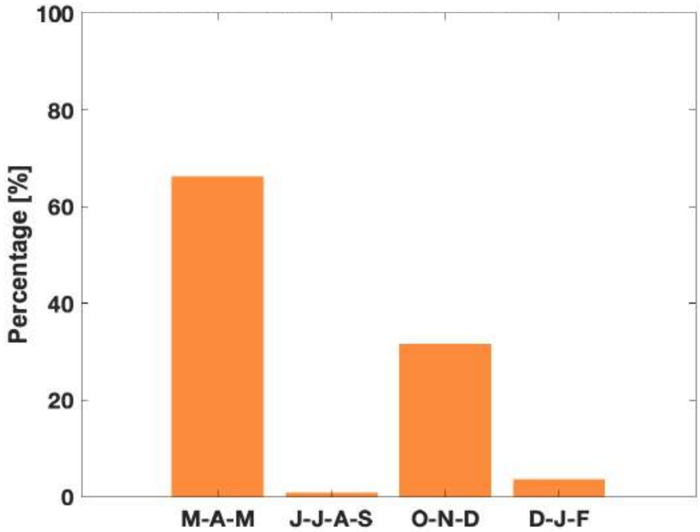


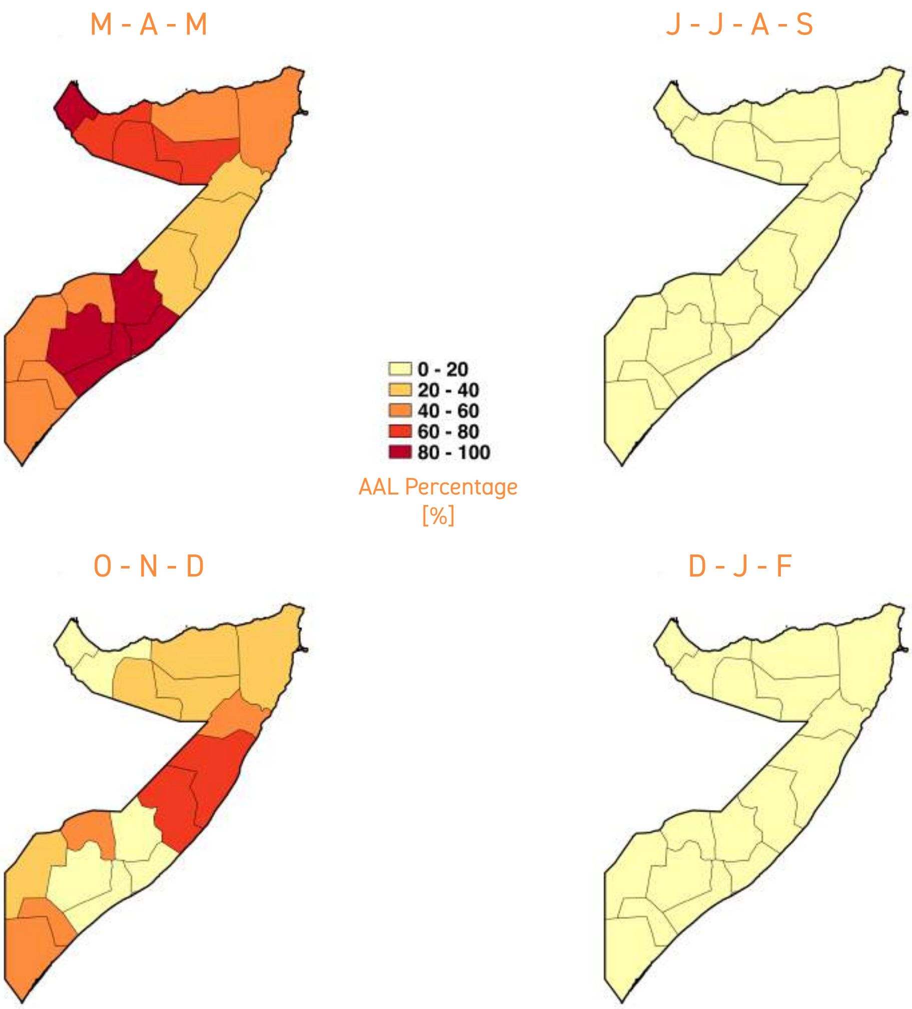
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





Towards an IGAD regional flood risk profile (2021): **REPUBLIC OF SOUTH SUDAN**

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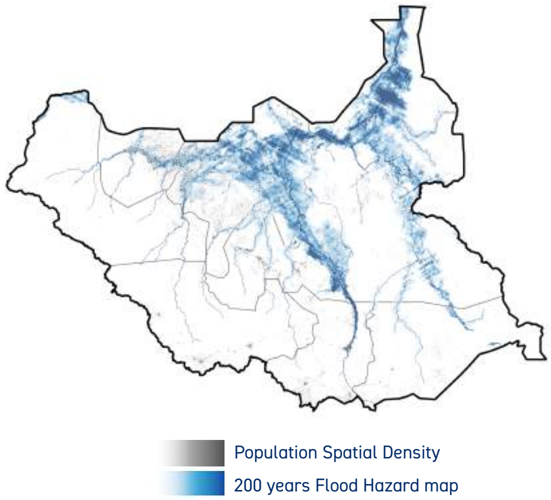
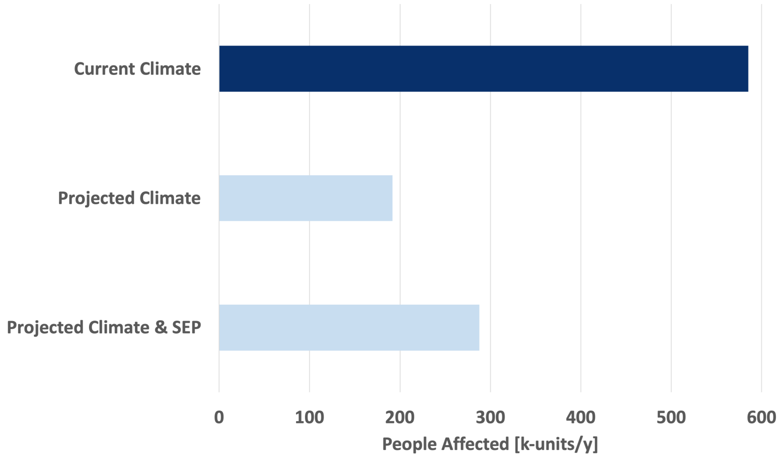
Population Affected

People Exposure



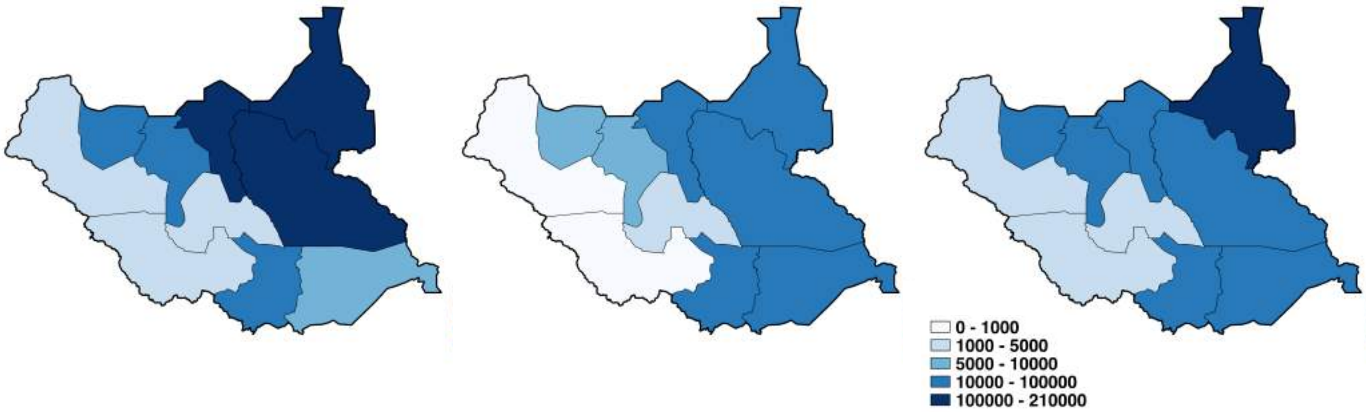
Annual Average Number of People Affected



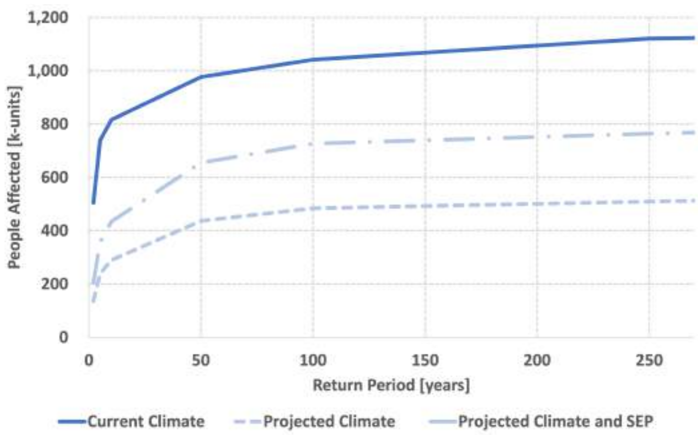
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

Absolute Number in Projected Climate Conditions with UN Population Projection

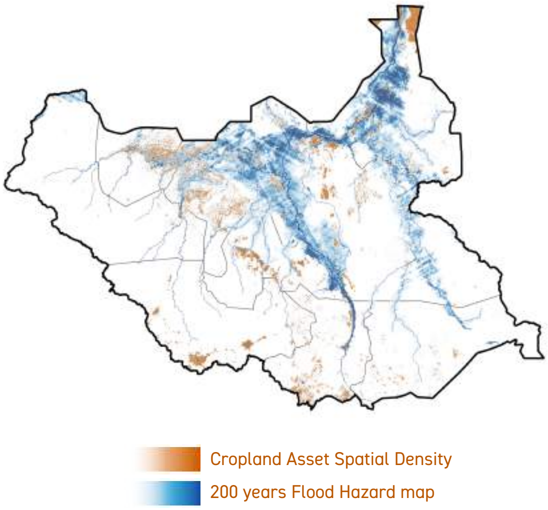


PML Curve - People Affected

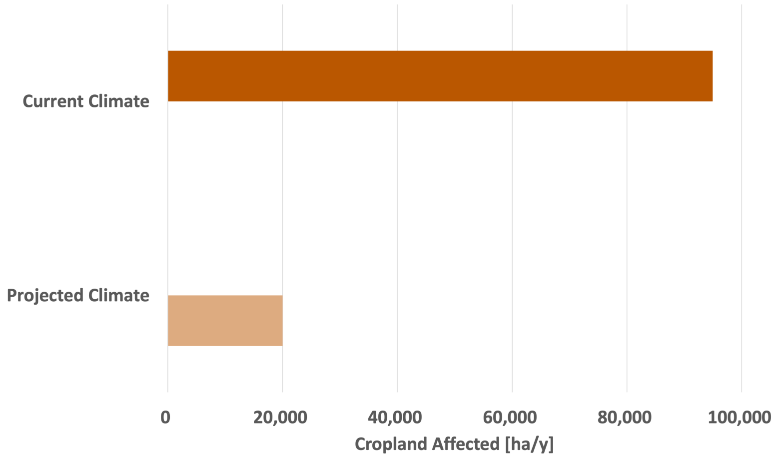


Cropland Affected

Cropland Exposure

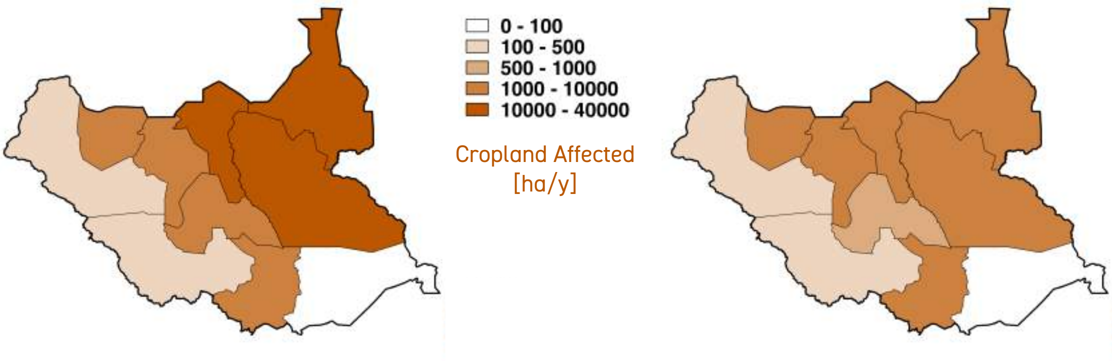


Annual Average Cropland Affected

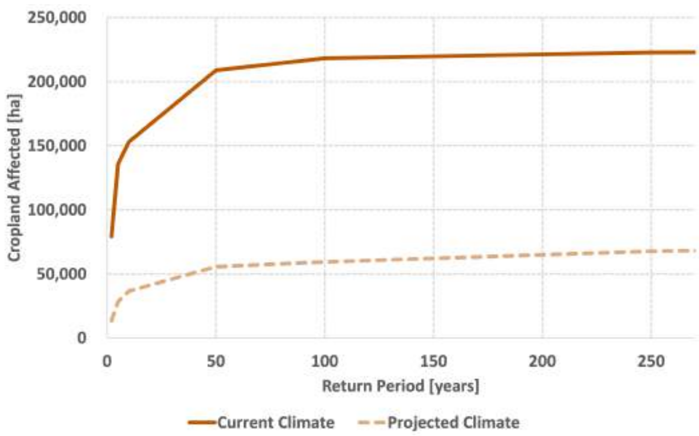


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

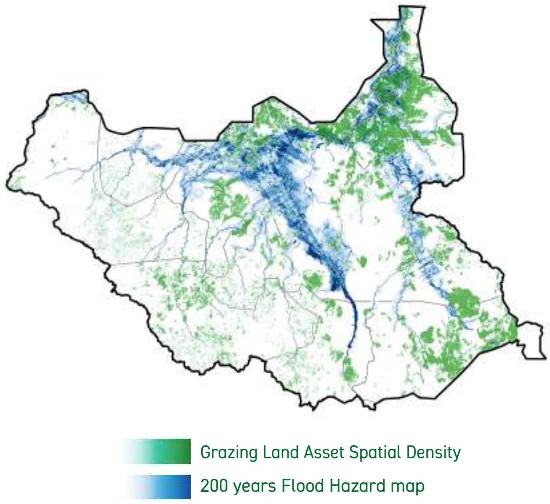


PML Curve - Cropland Affected

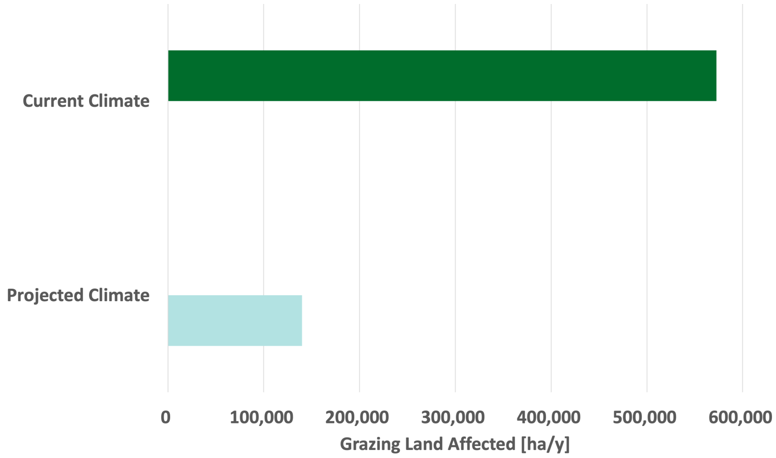


Grazing Land Affected

Grazing Land Exposure

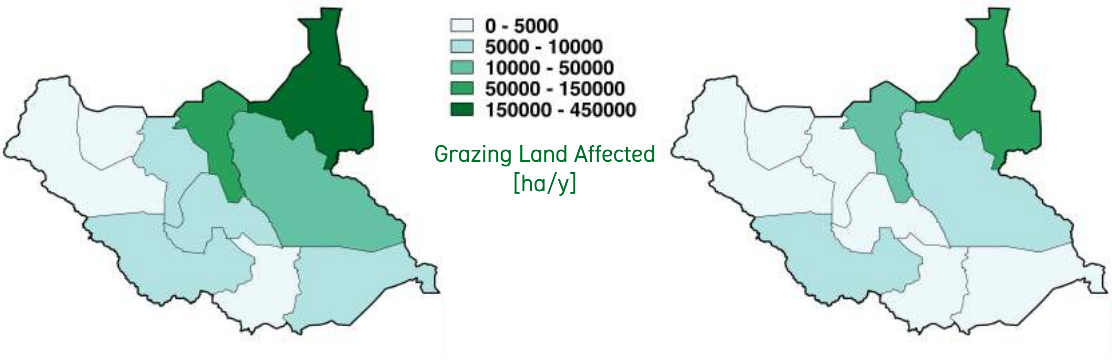


Annual Average Grazing Land Affected

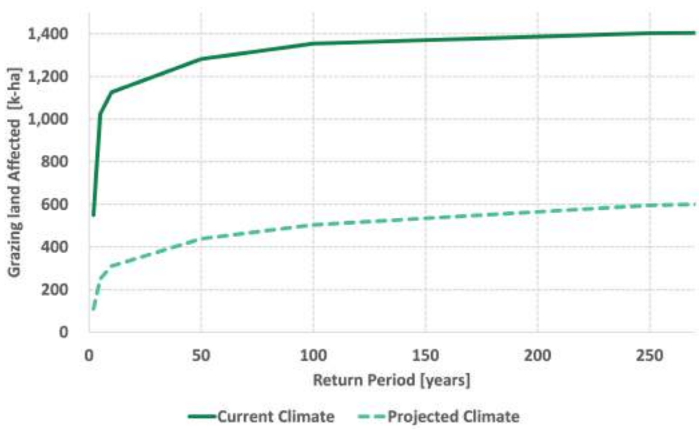


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

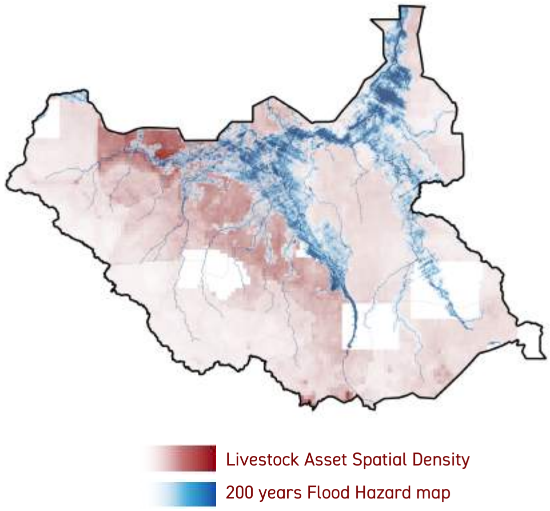


PML Curve - Grazing Land Affected

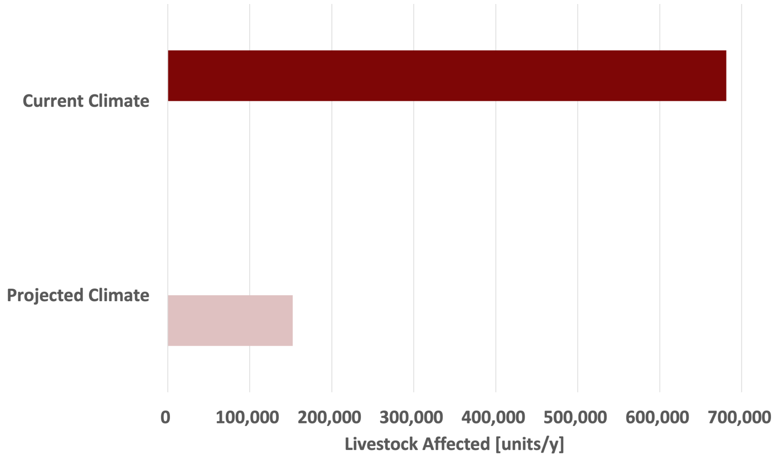


Livestock Affected

Livestock Exposure

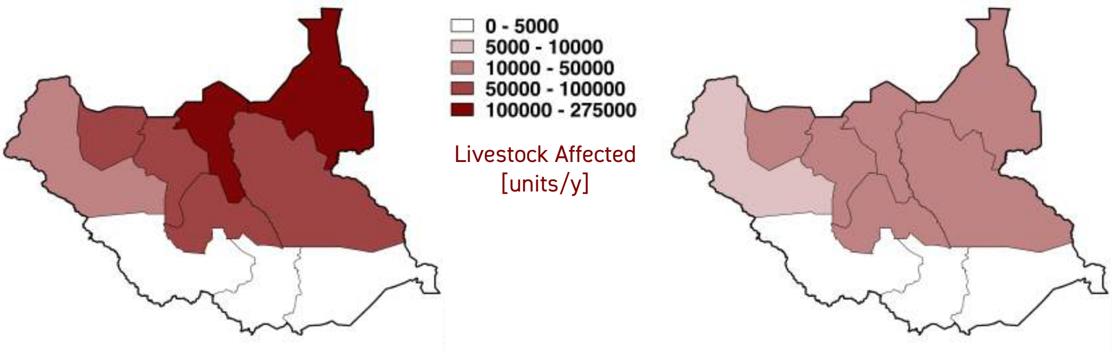


Annual Average Number of Livestock Affected

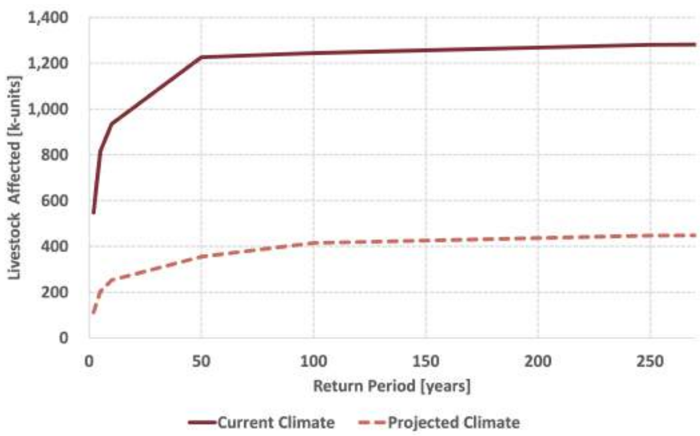


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

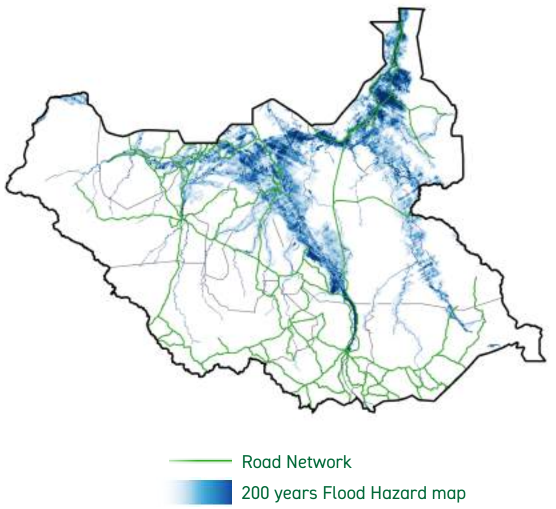


PML Curve - Livestock Affected

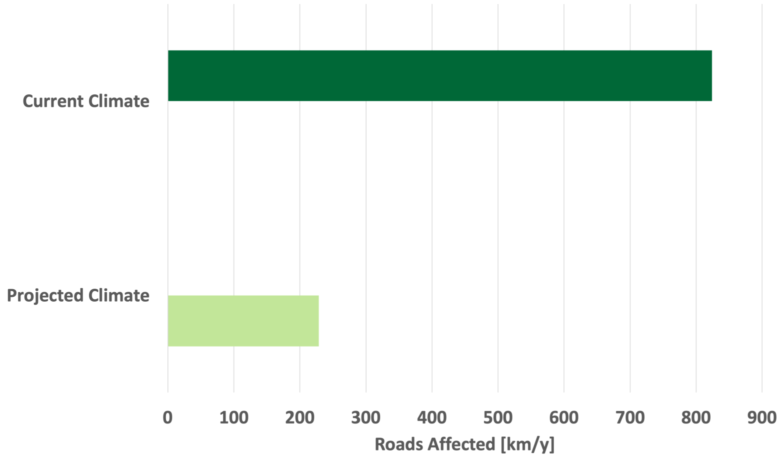


Road Network Affected

Road Network Exposure

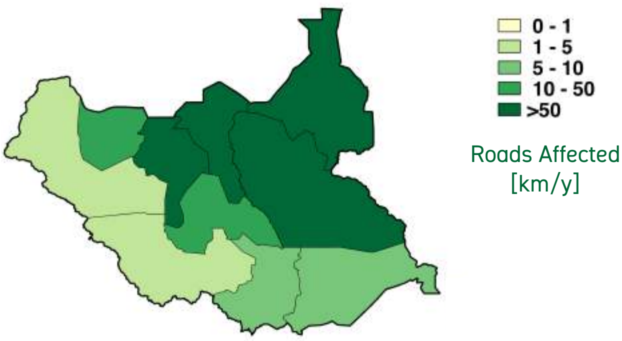


Annual Average Number of Km Affected

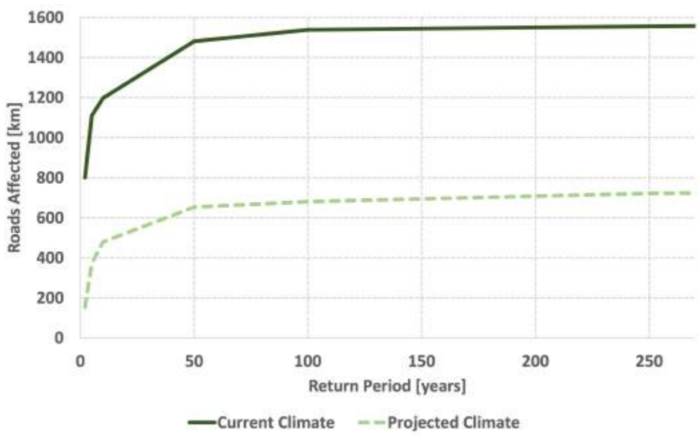


Absolute Number in Current Climate Conditions

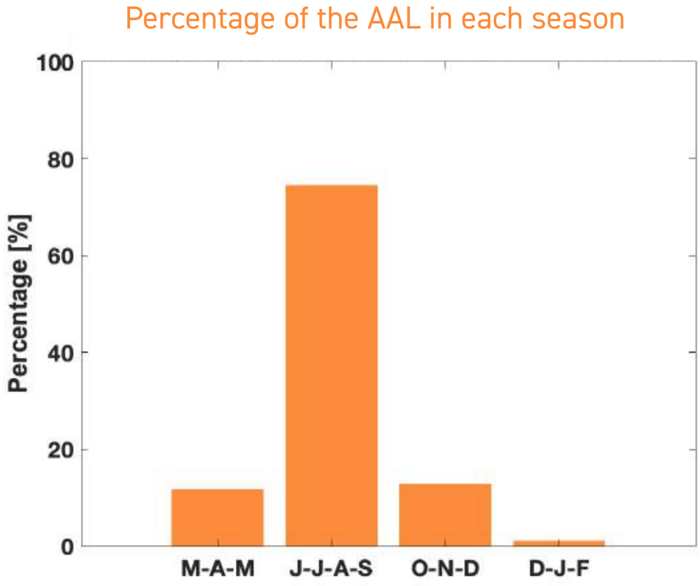
Absolute Number in Projected Climate Conditions

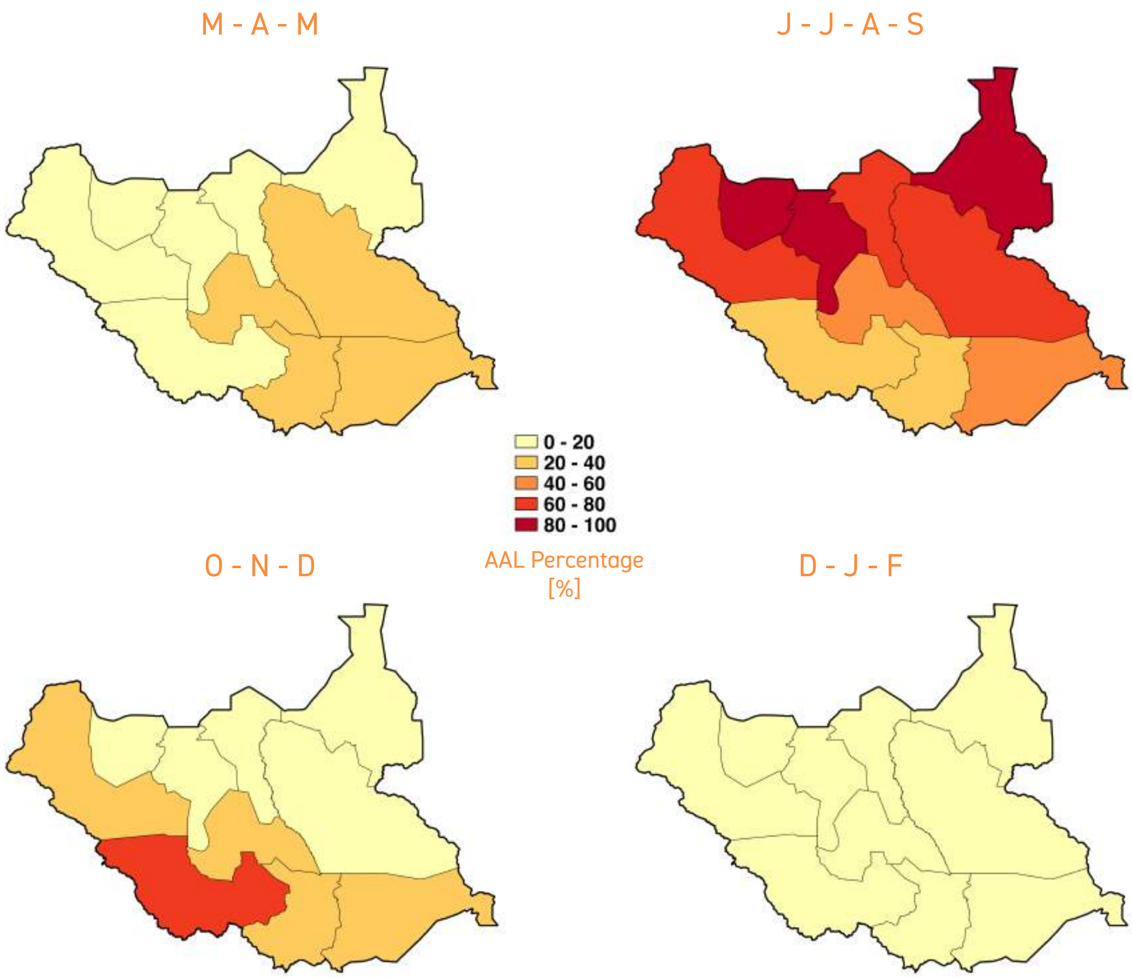


PML Curve - Km of Roads Affected



Seasonal Outlook





IGAD ICPAC

WFP World Food Programme

UNDRR UN Office for Disaster Risk Reduction

REGERINGSKANSLIET Ministry for Foreign Affairs Sweden

cima RESEARCH FOUNDATION

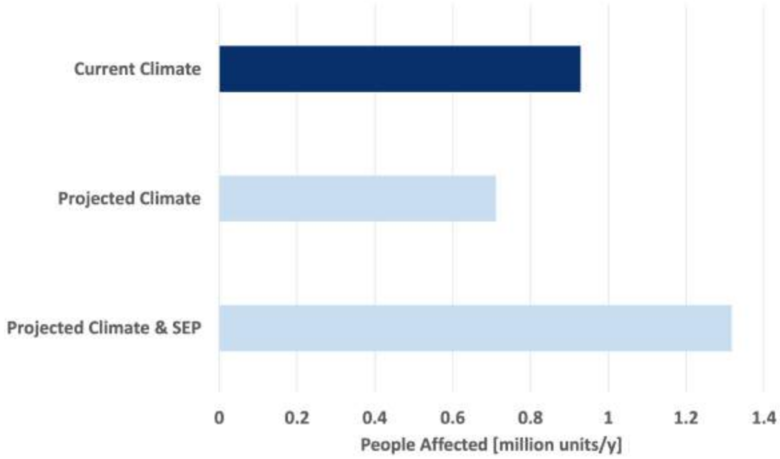
Towards an IGAD regional flood risk profile (2021): **REPUBLIC OF THE SUDAN**

This study was undertaken during Phase I of the Horn of Africa Partnership for Early Warning for Early Action project, aiming to increase the availability and use of disaster risk information for decision-making in the IGAD region. (Document prepared for consultation with Member States)

Population Affected

People Exposure

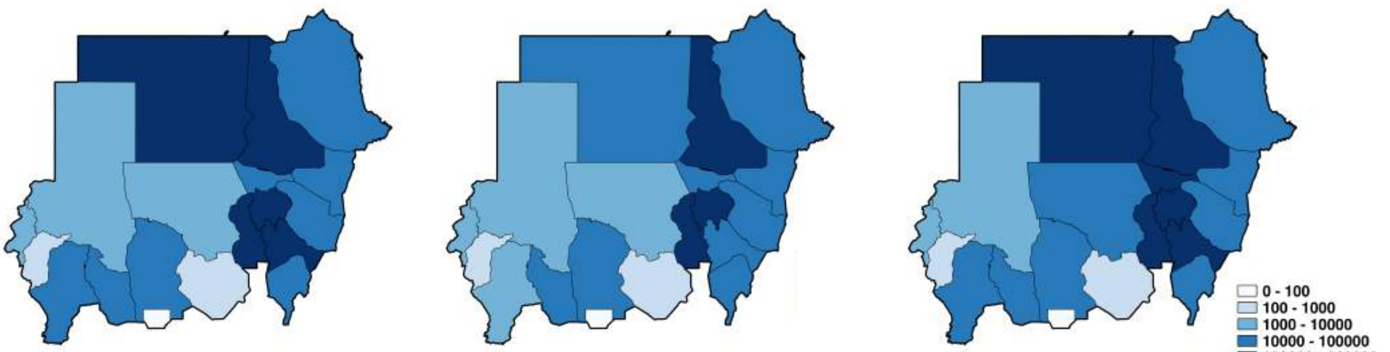
Annual Average Number of People Affected



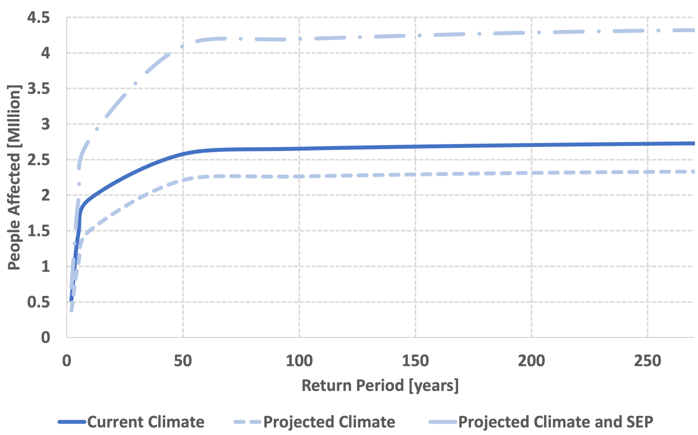
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

Absolute Number in Projected Climate Conditions with UN Population Projection

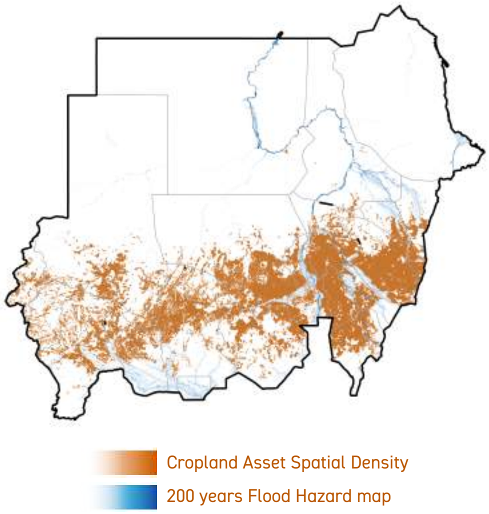


PML Curve - People Affected

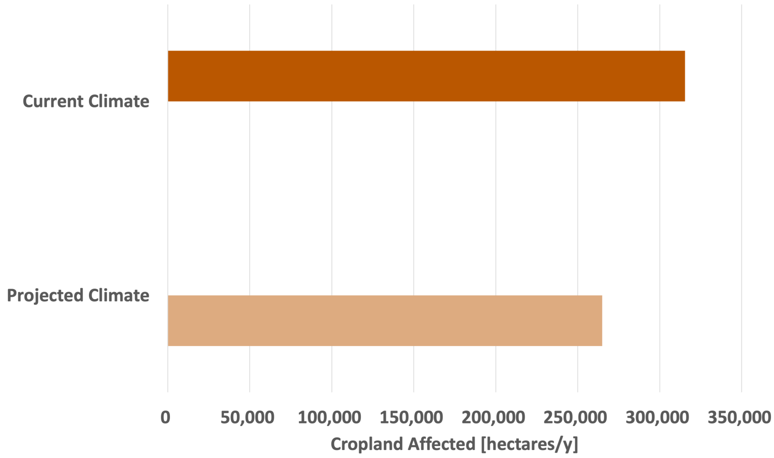


Cropland Affected

Cropland Exposure

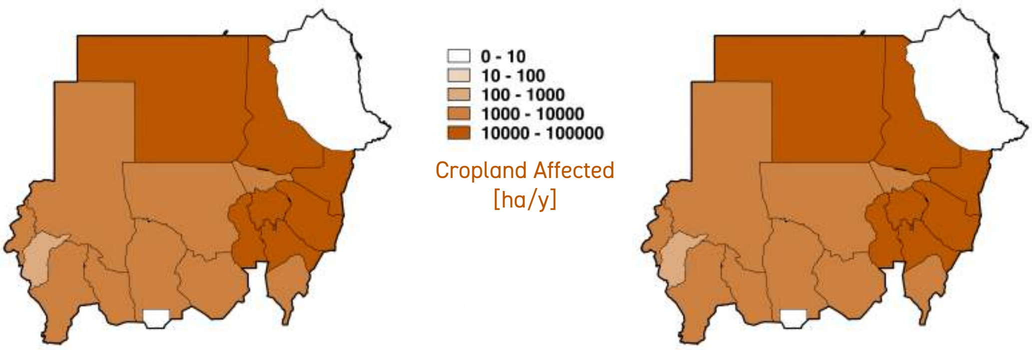


Annual Average Cropland Affected

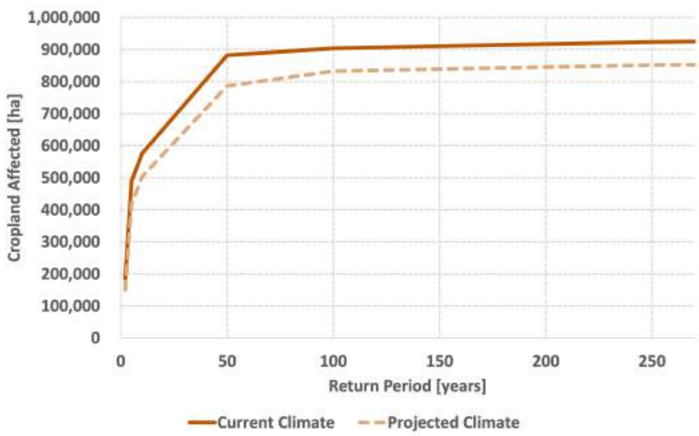


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

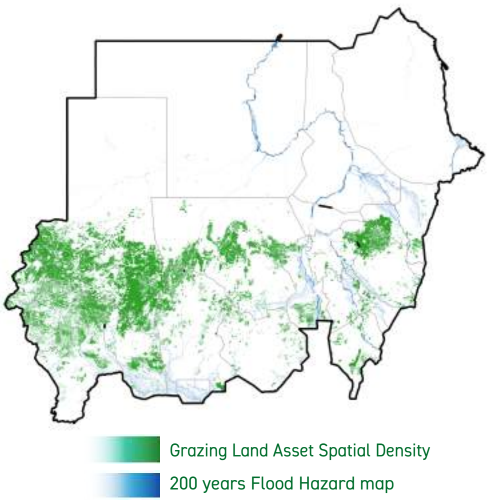


PML Curve - Cropland Affected

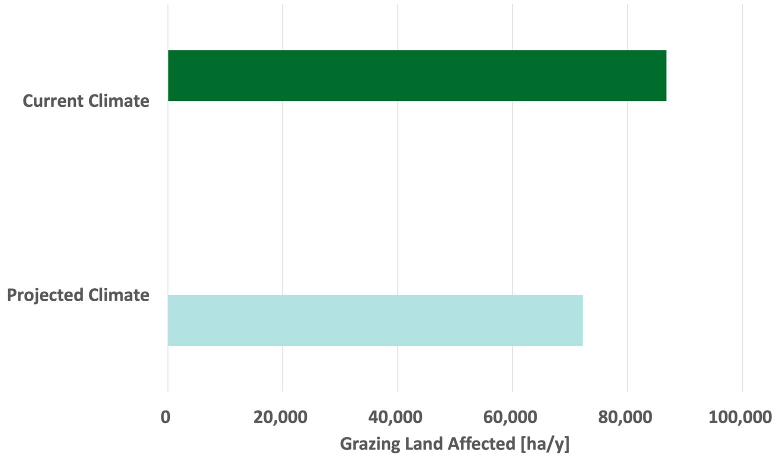


Grazing Land Affected

Grazing Land Exposure

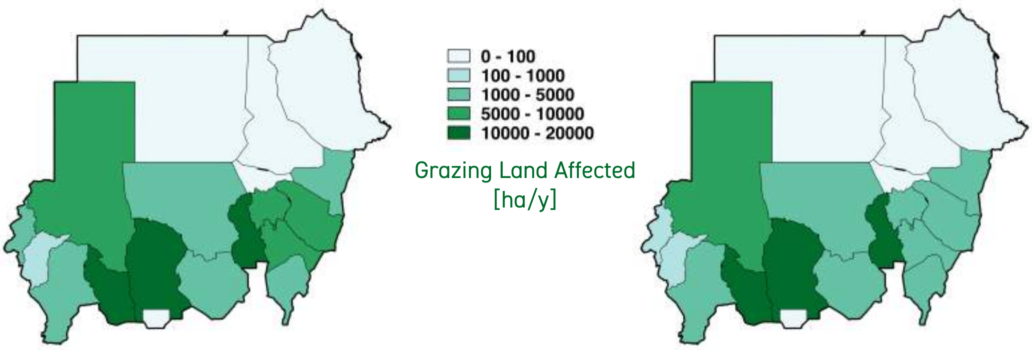


Annual Average Grazing Land Affected

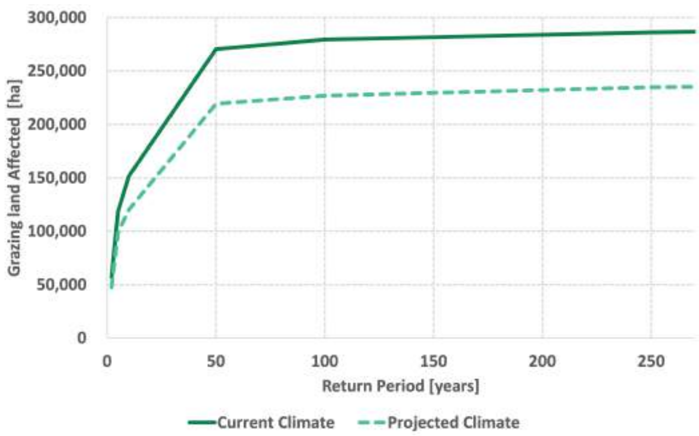


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

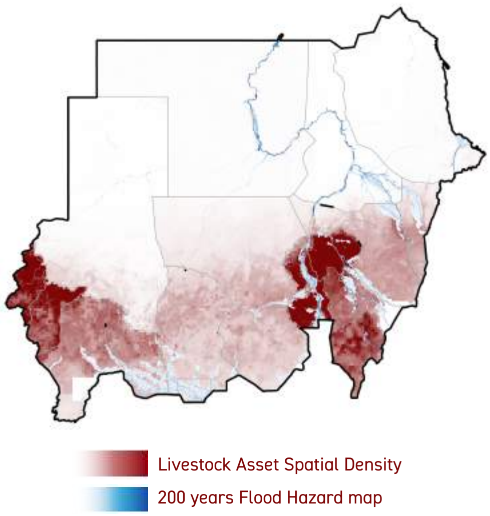


PML Curve - Grazing Land Affected

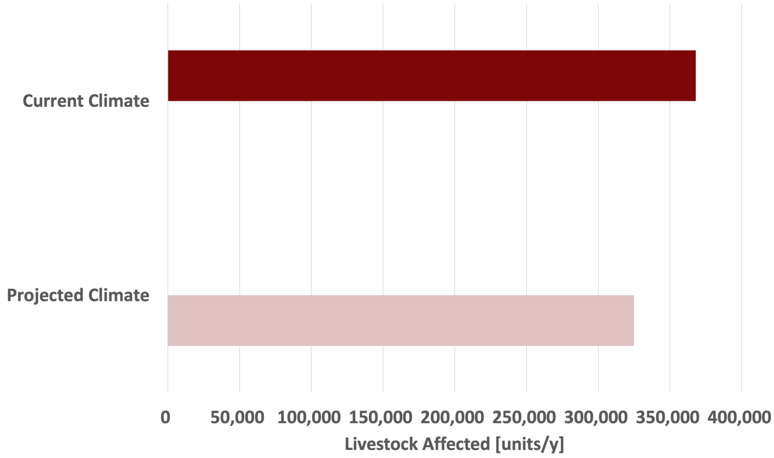


Livestock Affected

Livestock Exposure

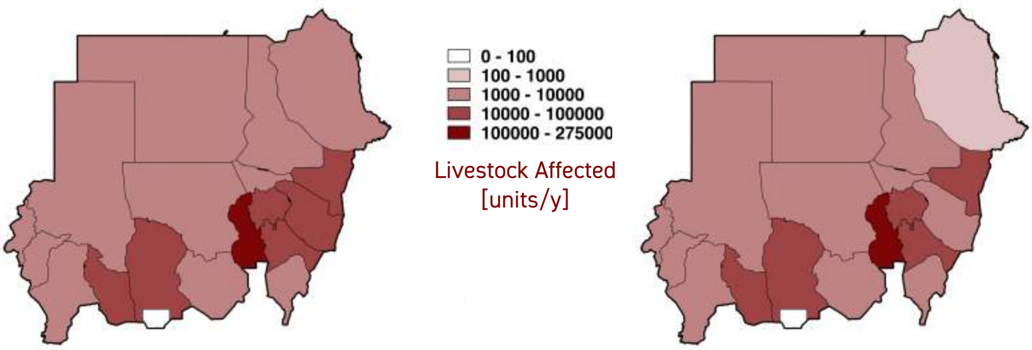


Annual Average Number of Livestock Affected

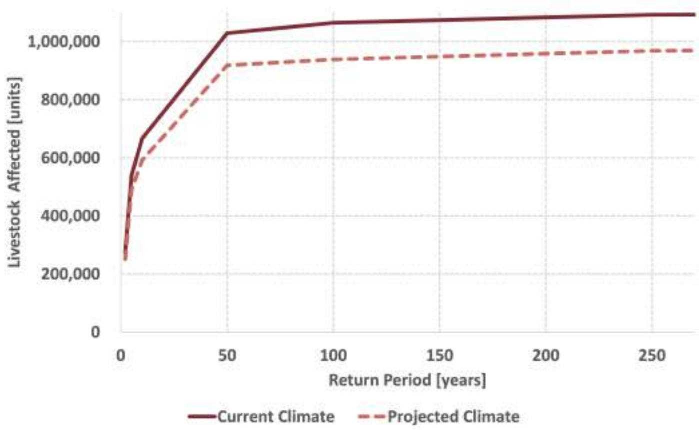


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

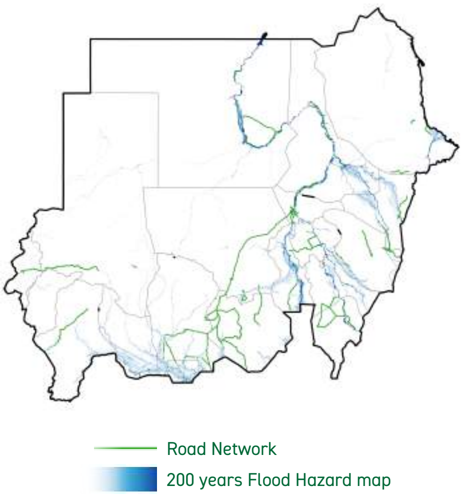


PML Curve - Livestock Affected

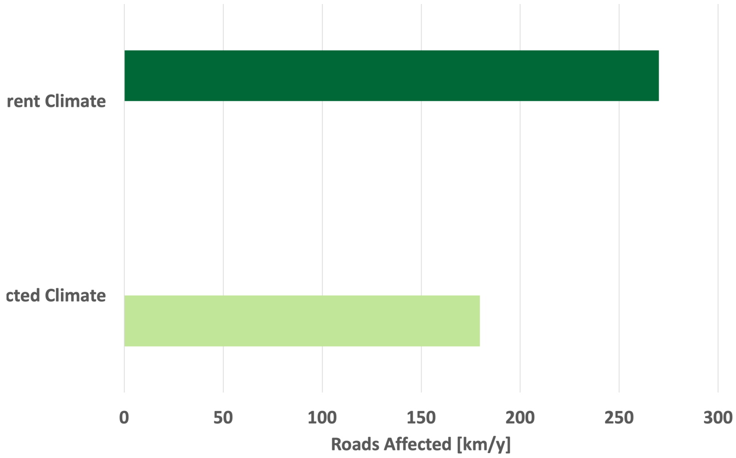


Road Network Affected

Road Network Exposure

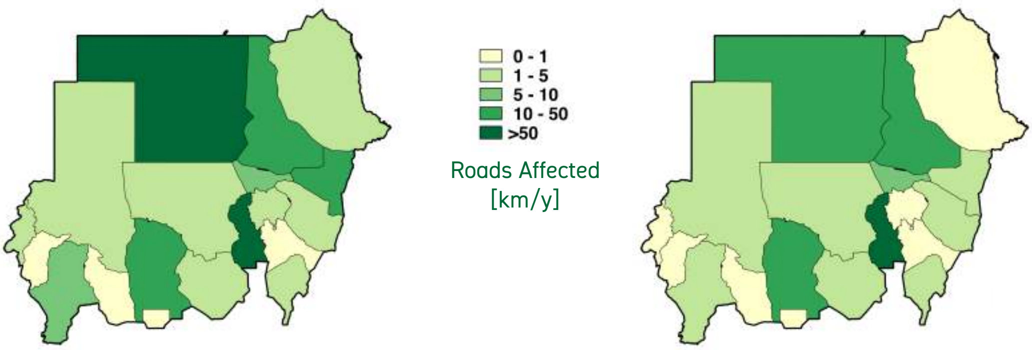


Annual Average Number of Km Affected

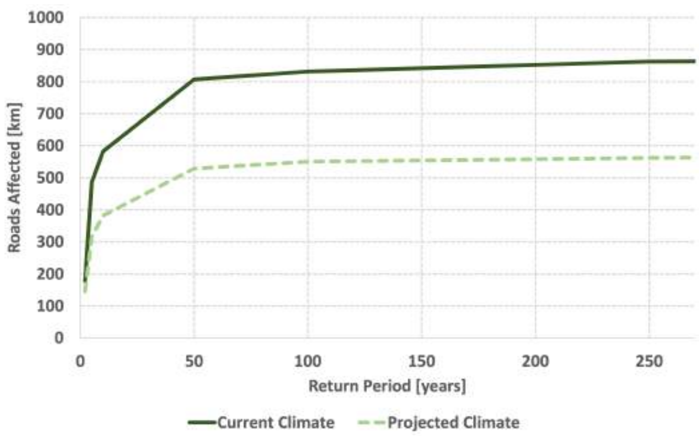


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

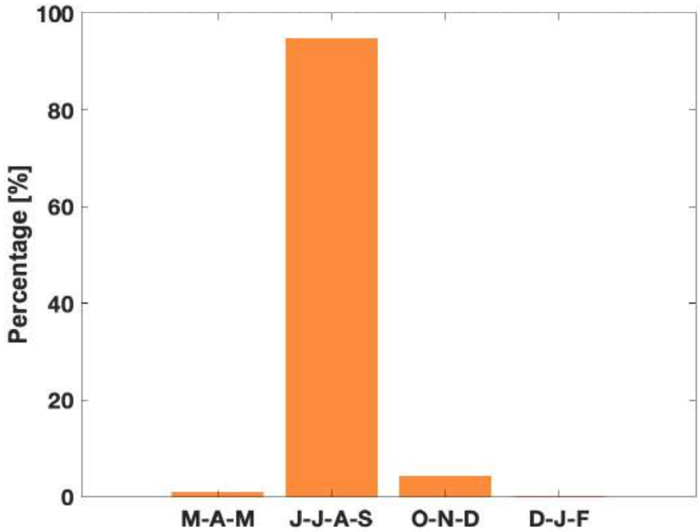


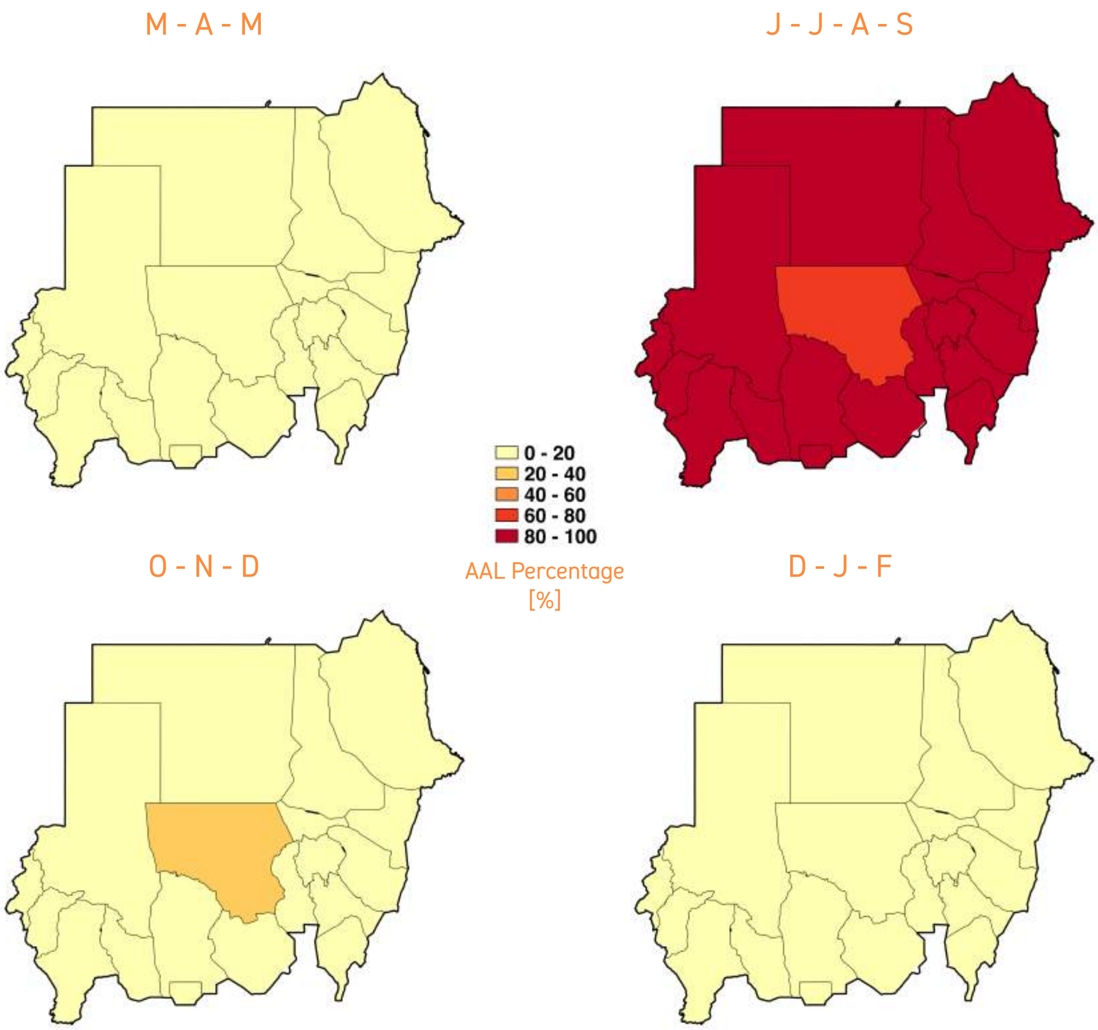
PML Curve - Km of Roads Affected

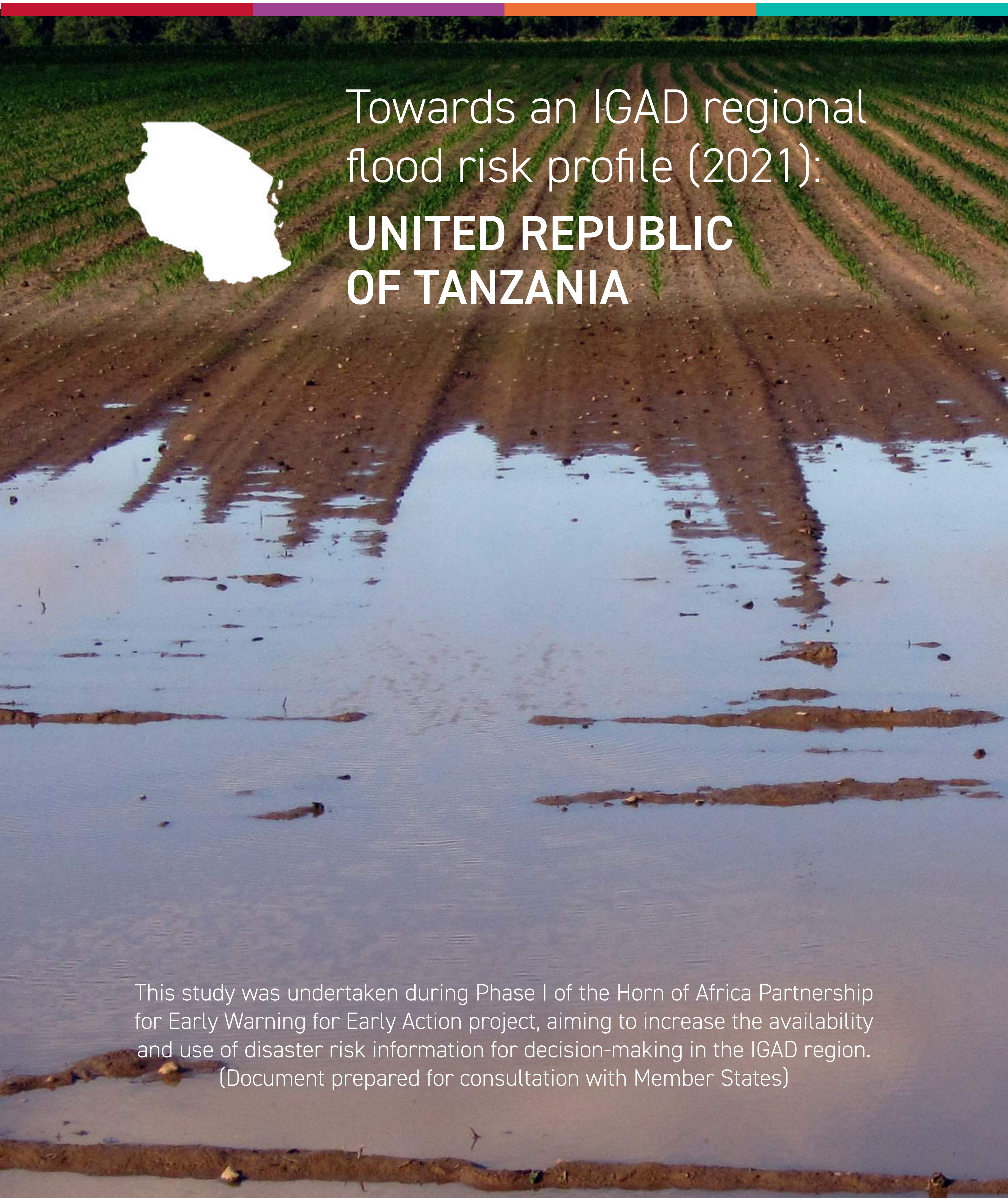


Seasonal Outlook

Percentage of the AAL in each season







Towards an IGAD regional flood risk profile (2021):

UNITED REPUBLIC OF TANZANIA

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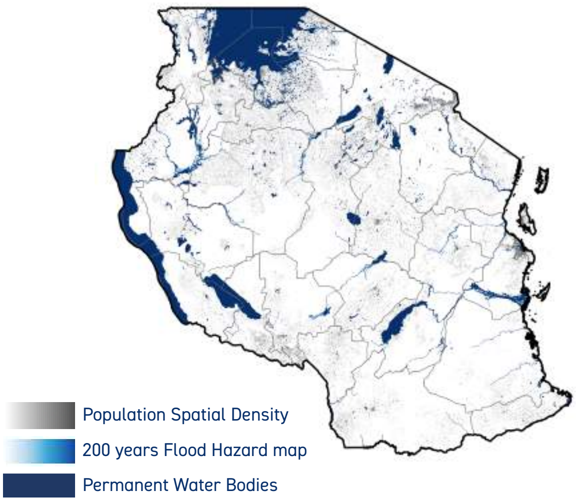
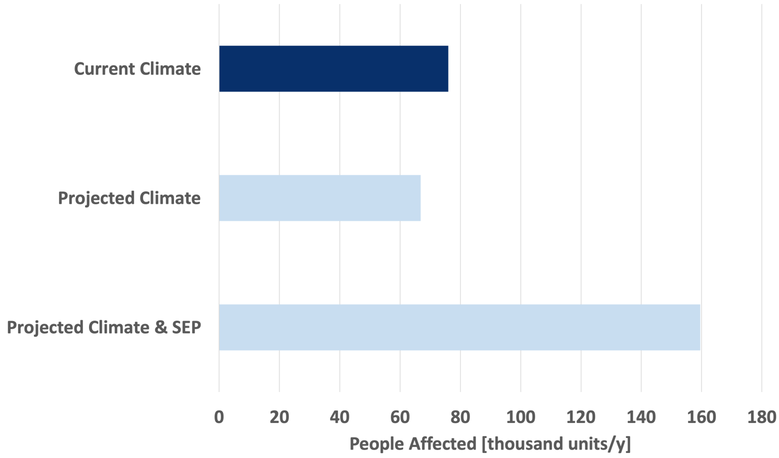
(Document prepared for consultation with Member States)

Population Affected

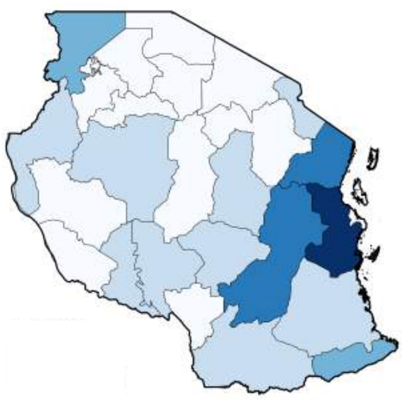
People Exposure



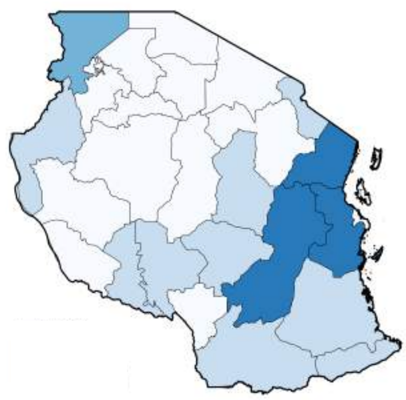
Annual Average Number of People Affected



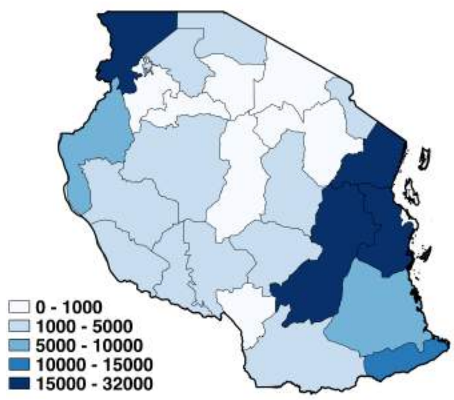
Absolute Number in Current Climate Conditions



Absolute Number in Projected Climate Conditions

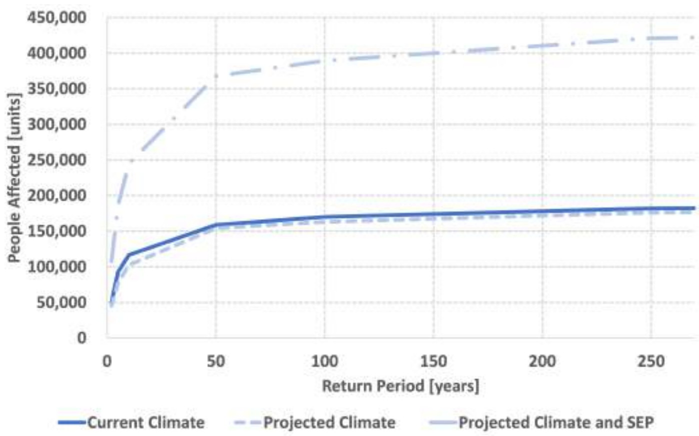


Absolute Number in Projected Climate Conditions with UN Population Projection



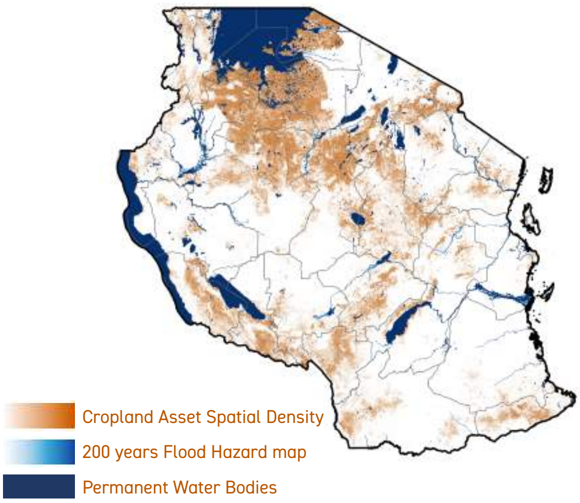
People Affected [units/y]

PML Curve - People Affected

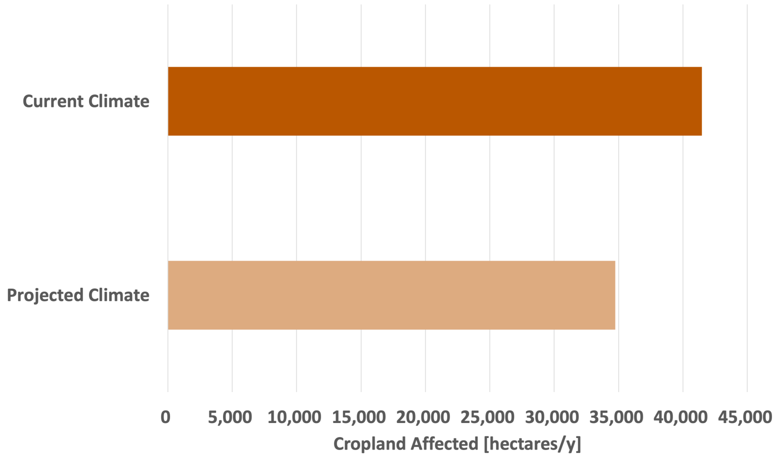


Cropland Affected

Cropland Exposure

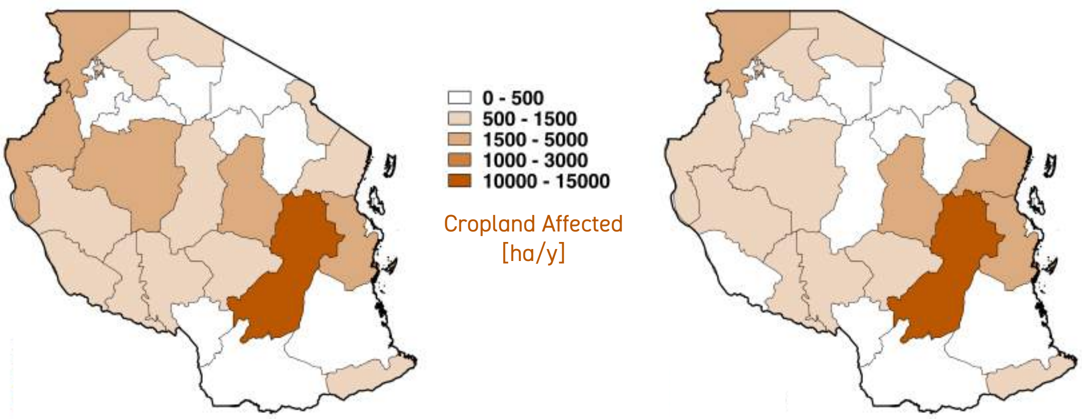


Annual Average Cropland Affected

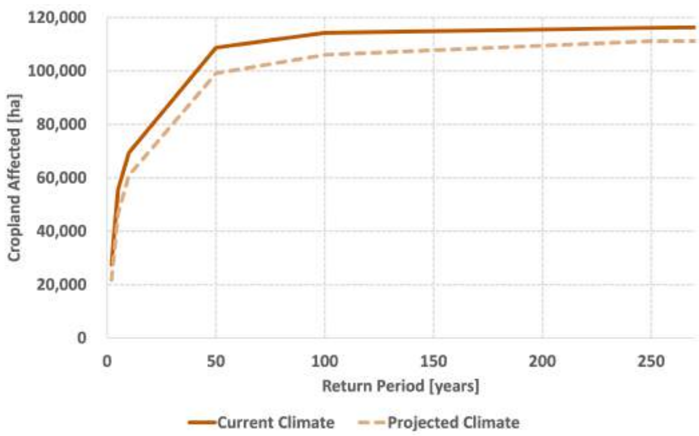


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

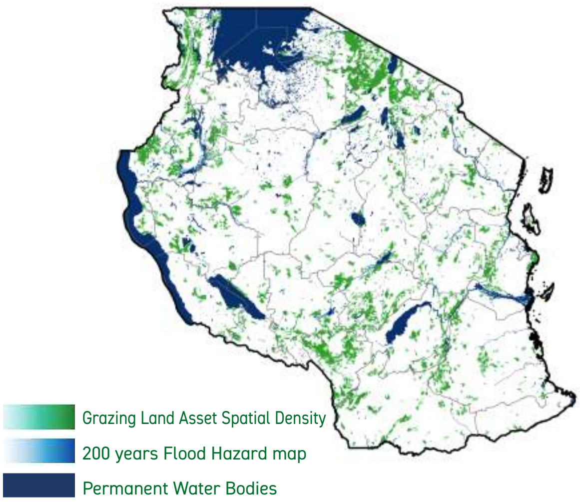


PML Curve - Cropland Affected

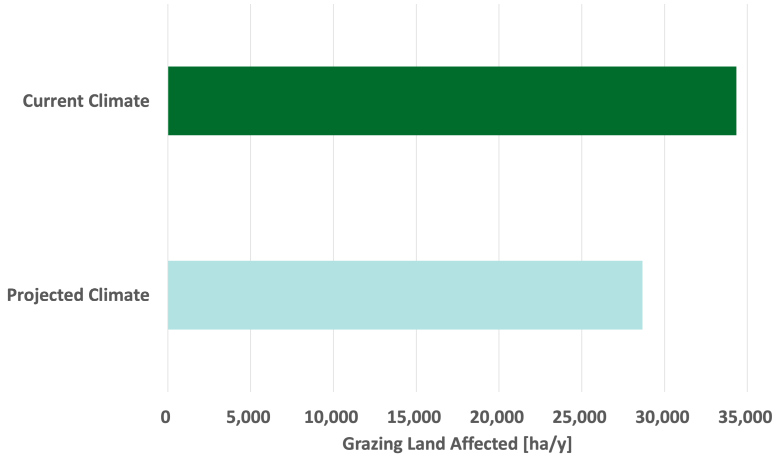


Grazing Land Affected

Grazing Land Exposure

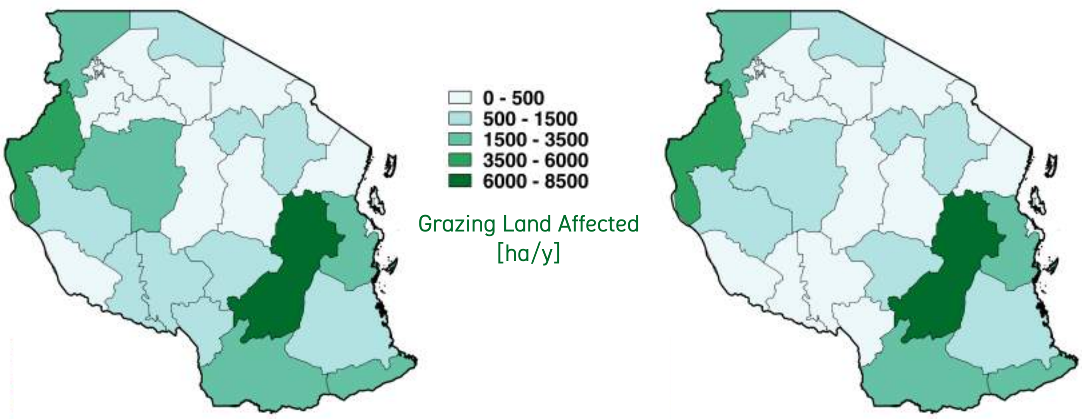


Annual Average Grazing Land Affected

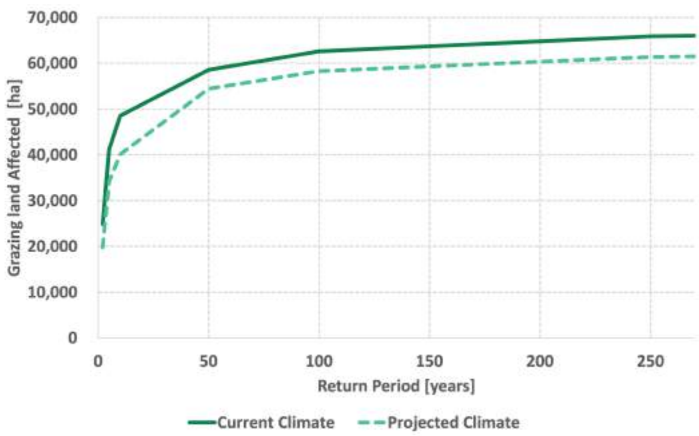


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

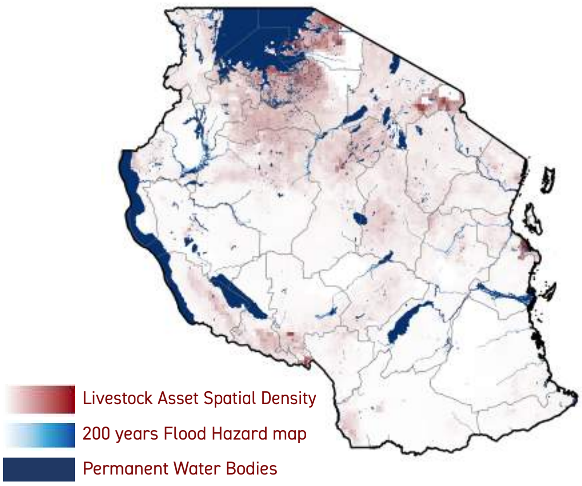


PML Curve - Grazing Land Affected

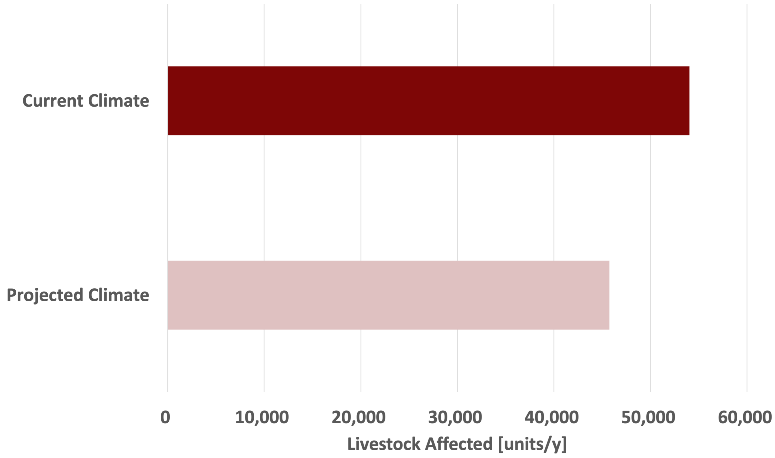


Livestock Affected

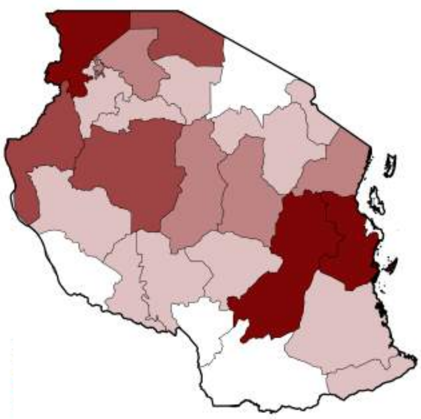
Livestock Exposure



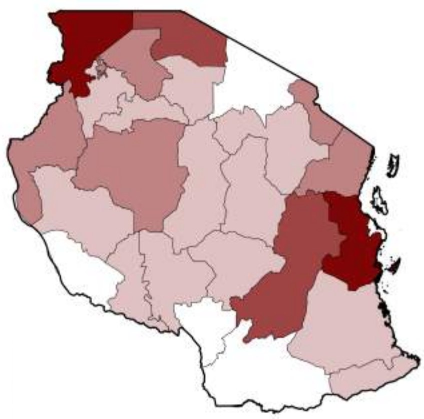
Annual Average Number of Livestock Affected



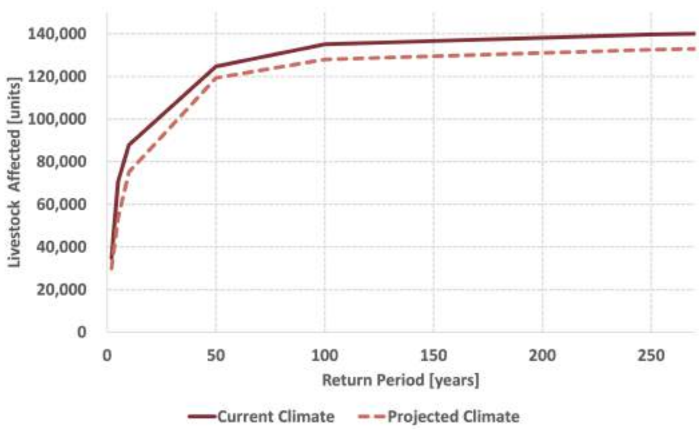
Absolute Number in Current Climate Conditions



Absolute Number in Projected Climate Conditions

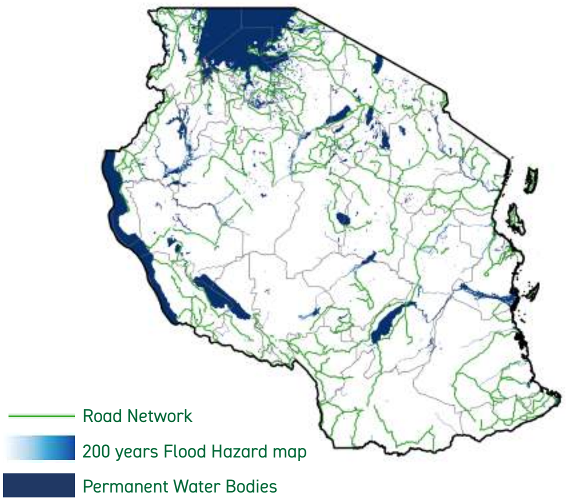


PML Curve - Livestock Affected

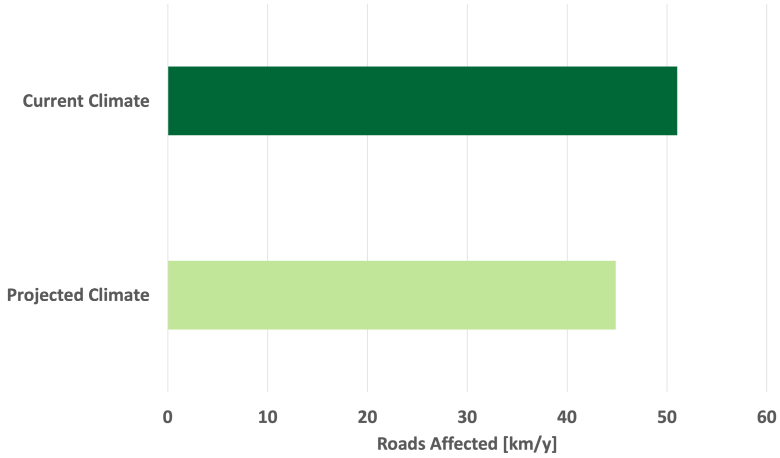


Road Network Affected

Road Network Exposure

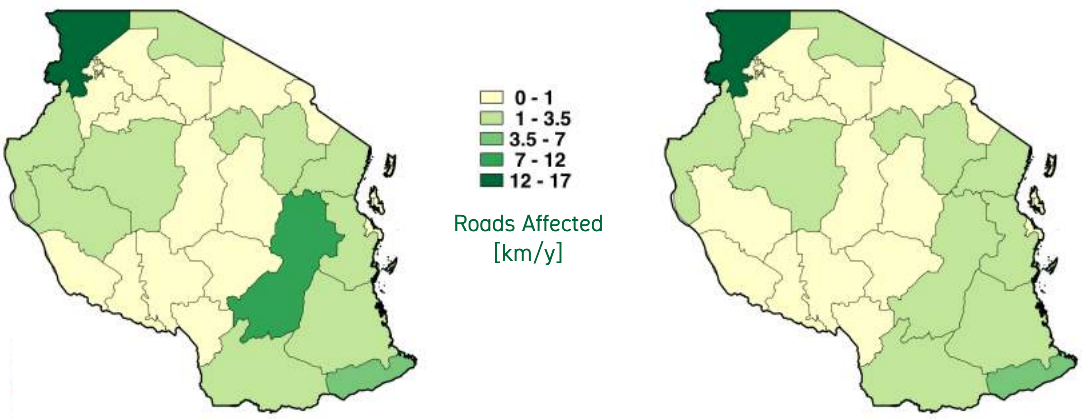


Annual Average Number of Km Affected

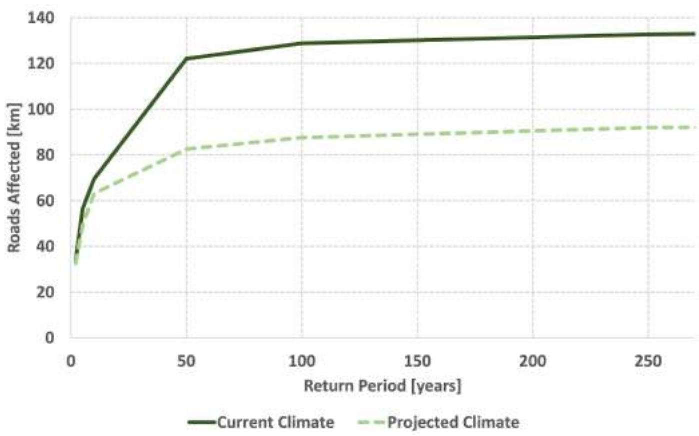


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

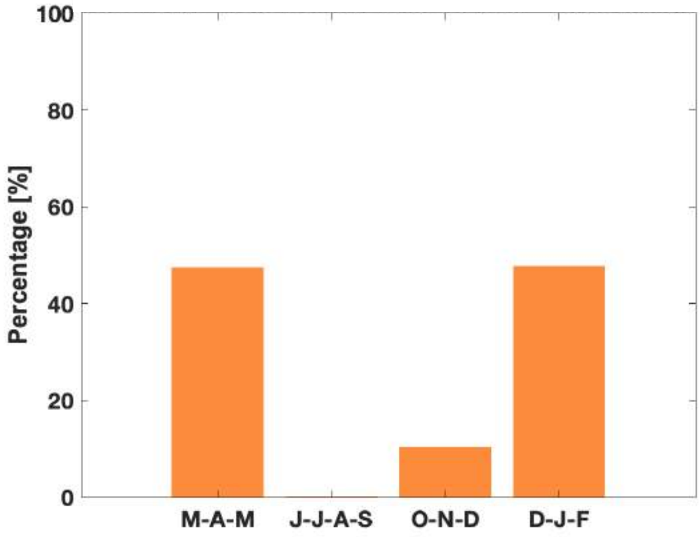


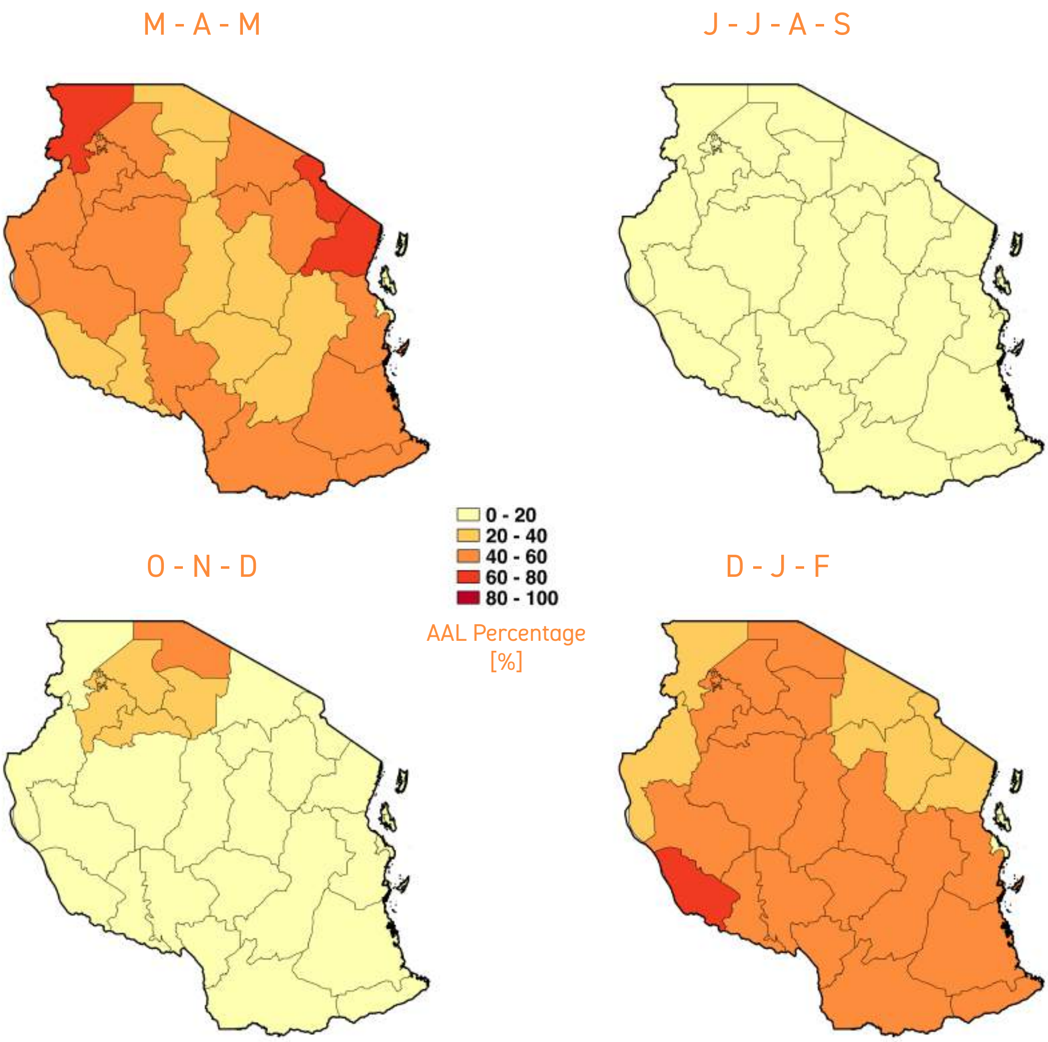
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





Towards an IGAD regional flood risk profile (2021): **REPUBLIC OF UGANDA**

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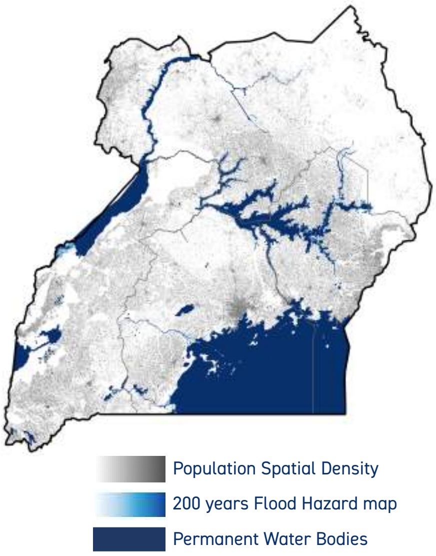
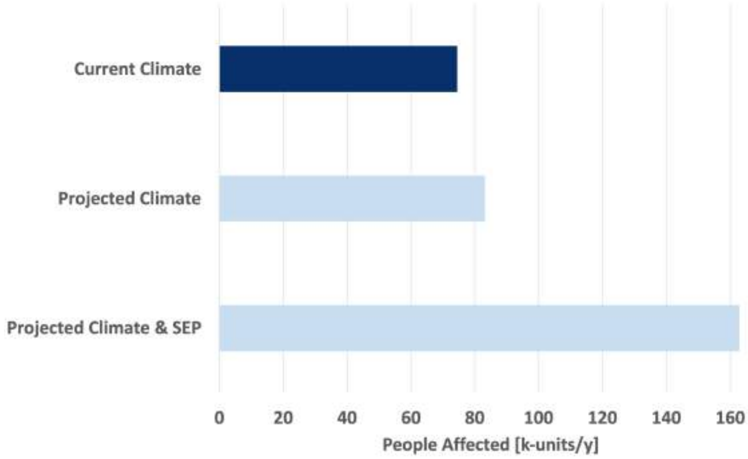
(Document prepared for consultation with Member States)

Population Affected

People Exposure



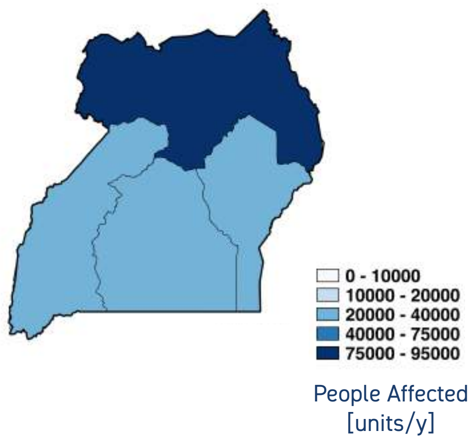
Annual Average Number of People Affected



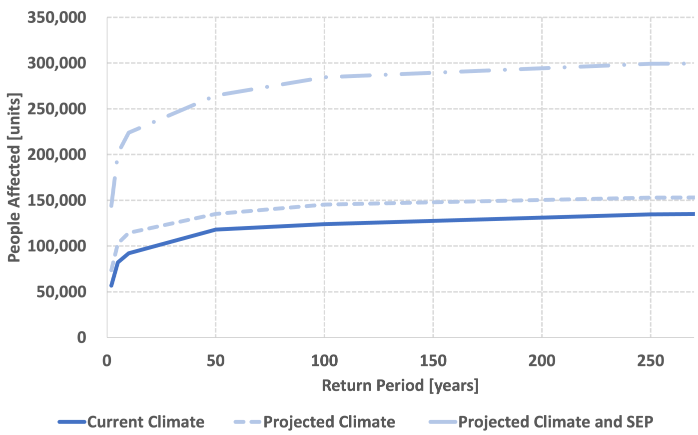
Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

Absolute Number in Projected Climate Conditions with UN Population Projection

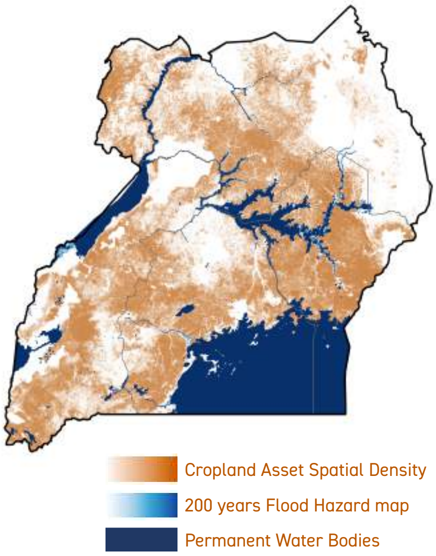


PML Curve - People Affected

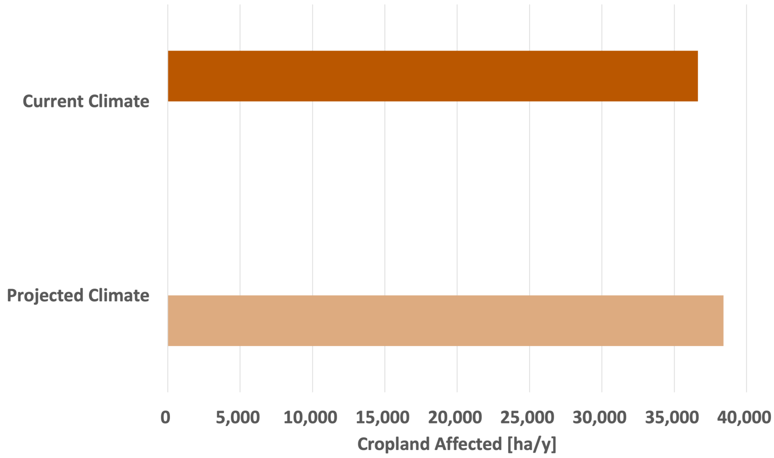


Cropland Affected

Cropland Exposure

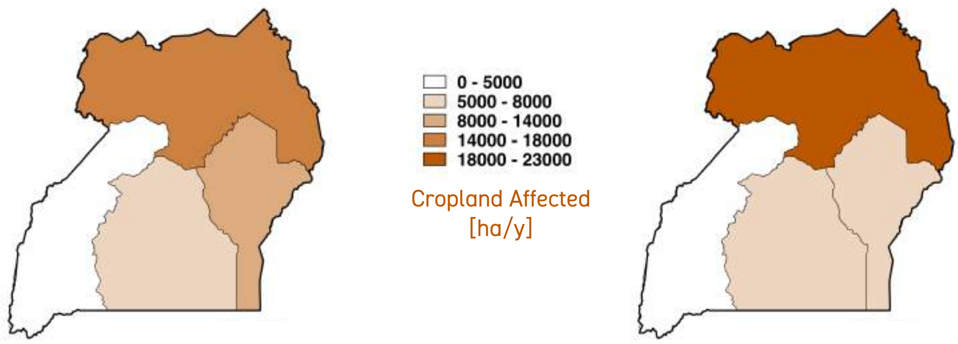


Annual Average Cropland Affected

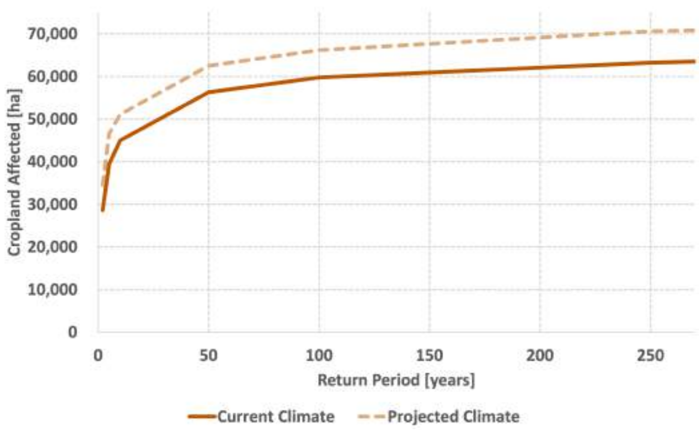


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

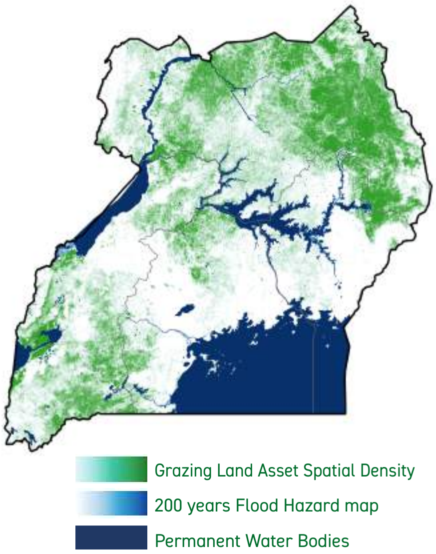


PML Curve - Cropland Affected

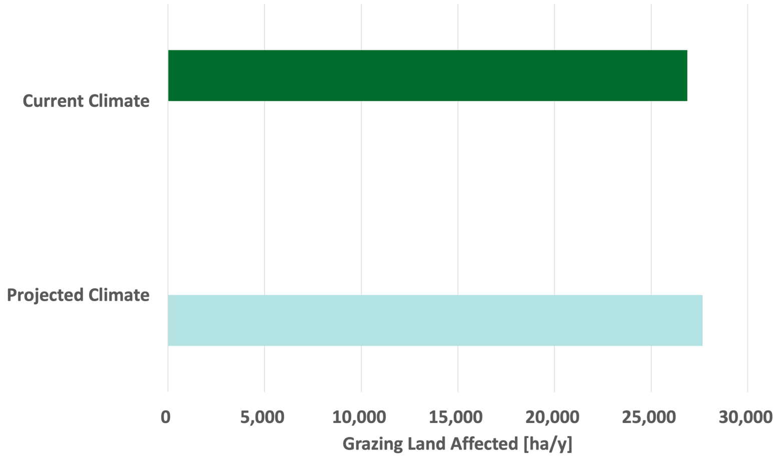


Grazing Land Affected

Grazing Land Exposure

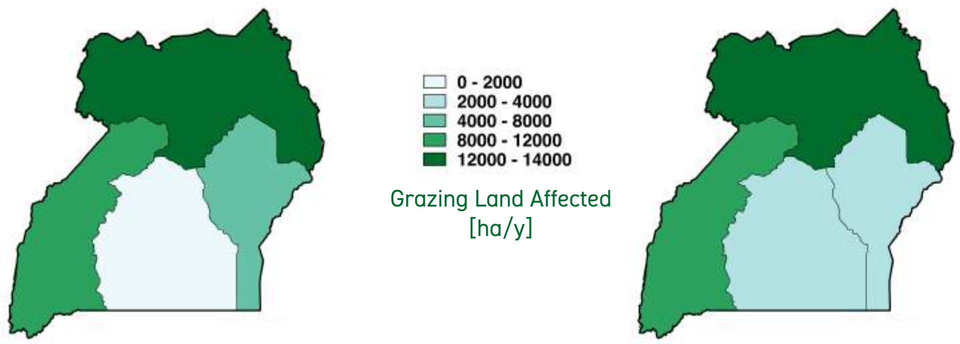


Annual Average Grazing Land Affected

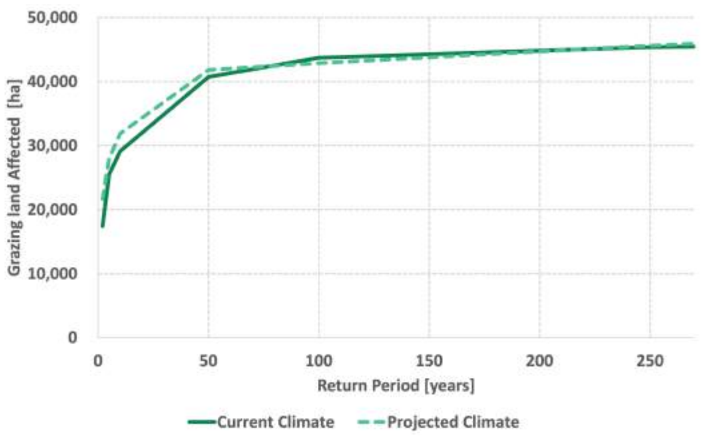


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

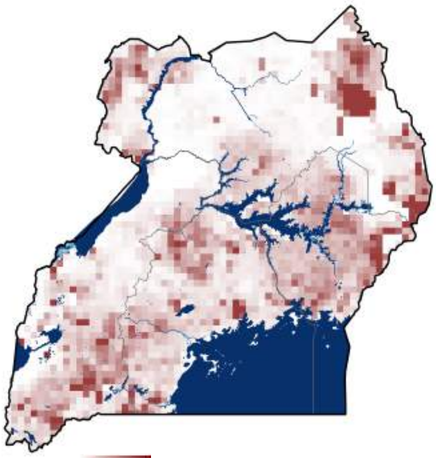


PML Curve - Grazing Land Affected

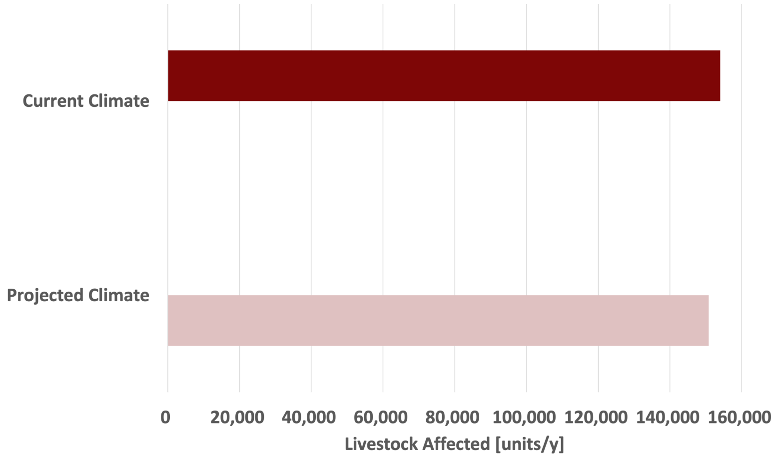


Livestock Affected

Livestock Exposure

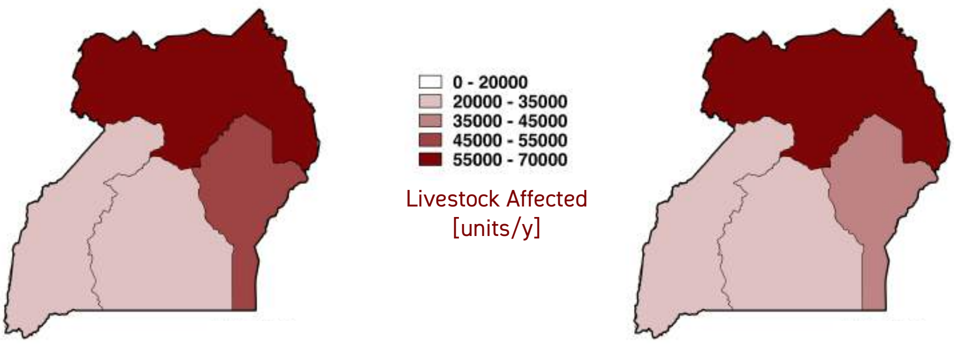


Annual Average Number of Livestock Affected

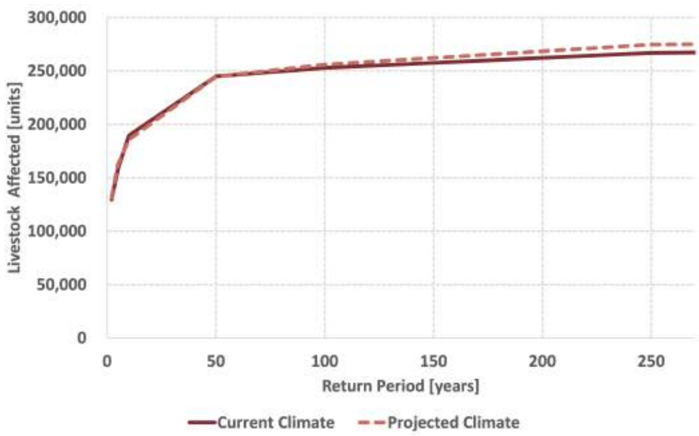


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

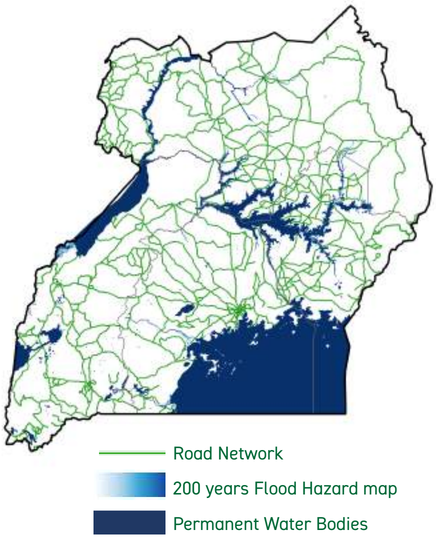


PML Curve - Livestock Affected

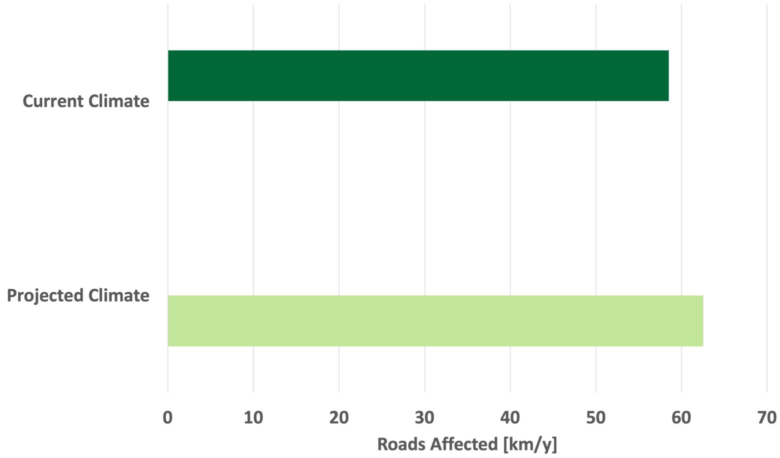


Road Network Affected

Road Network Exposure

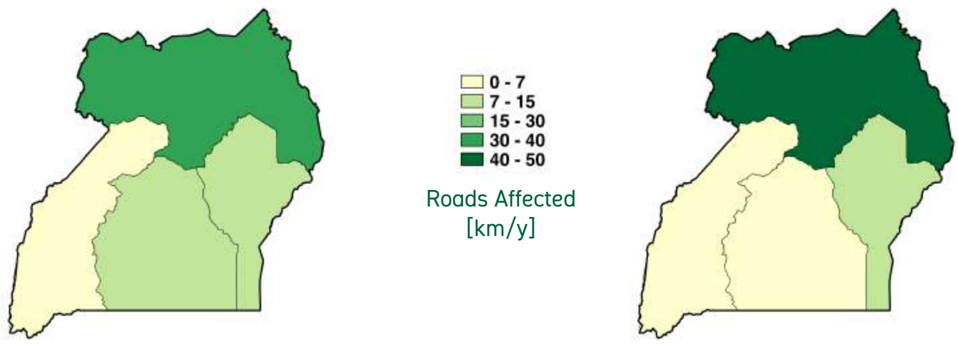


Annual Average Number of Km Affected

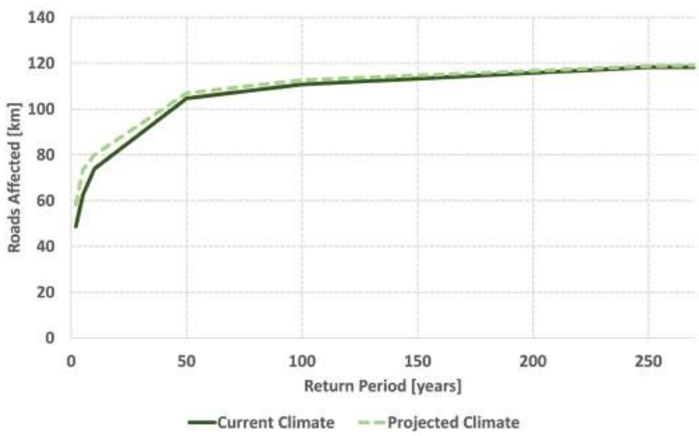


Absolute Number in Current Climate Conditions

Absolute Number in Projected Climate Conditions

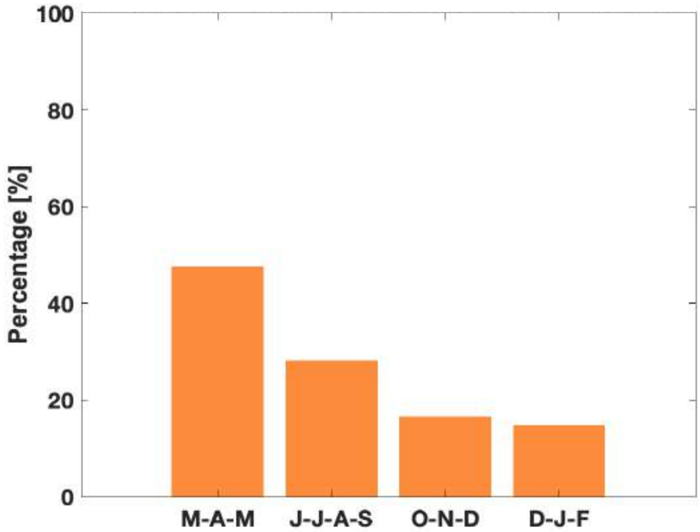


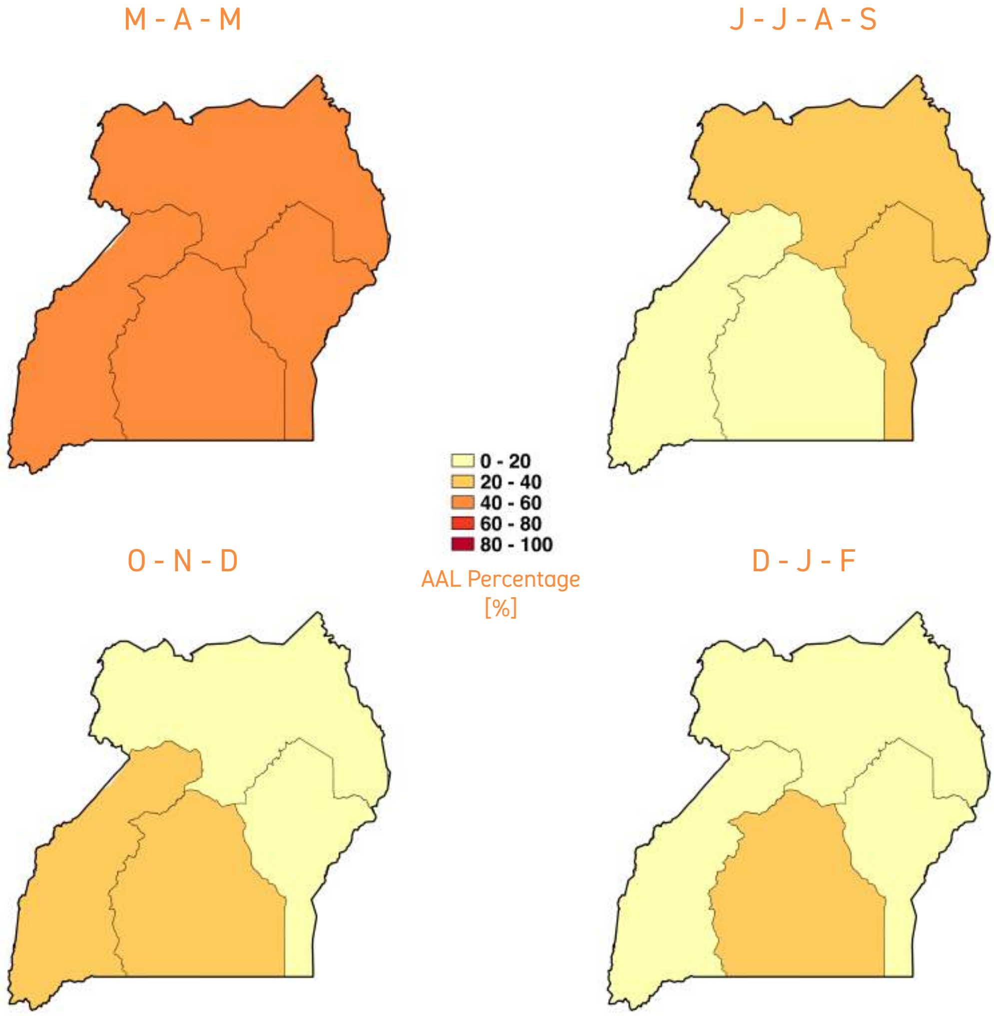
PML Curve - Km of Roads Affected



Seasonal Outlook

Percentage of the AAL in each season





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