


EO Africa // ARIES

D04 - Policy Traceability Matrix analysis

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 <p>The logos are stacked vertically. The top logo is 'Vista' with a purple triangle and a circle. The middle logo is 'vito remote sensing' with a black bird-like icon and a green bar. The bottom logo is 'LIST' with a colorful globe icon.</p>	<p>VISTA Remote Sensing in Geosciences GmbH (VISTA)</p> <p>Vlaamse Instelling voor Technologisch Onderzoek, Naamloze vennootschap (VITO)</p> <p>Luxemburg Institute of Science and Technology (LIST)</p>
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ESA STUDY CONTRACT REPORT

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ABSTRACT: This document provides an overview of relevant continental, regional and institutes and policies related to drought monitoring on the African continent. Version 1.0 Status: 26. January 2023			
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List of Acronyms

ACPC	African Climate Policy Centre
AKTC	Zambian Agricultural Knowledge and Training Centre, LTD
ARIES	EO Africa Explorers project
AU	African Union
CHIME	Copernicus Hyperspectral Imaging Mission for the Environment
CILSS	Comité permanent inter-État de lutte contre la sécheresse au Sahel (Permanent interstate Committee for Drought Control in the Sahel)
CIWA	Cooperation on International Waters in Africa
CWP	Country Water Partnerships
DRAMP	Drought Resilience, Adaptation and Management Policy
DRAPA	Strategic framework for drought risk management and enhancing resilience in Africa
ECOSTRESS	Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station
ECOWAS	Economic Community of West African States
EDO	European Drought Observatory
EnMAP	Environmental Mapping and Analysis Program
FAO	Food and Agricultural Organization of the United Nations
FEWS-NET	Famine Early Warning Systems Network
GEOGLAM	Group on Earth Observations Global Agricultural Monitoring Initiative
GIEWS	Global Information and Early Warning System
GWP	Global Water Partnership
HMNDP	High-Level Meeting on National Drought Policy (2013)
ICPAC	Climate Prediction and Applications Centre
IDSI	Integrated Drought Severity Index
JRC	Joint Research Centre of the European Commission
IDMP	Integrated Drought Management Programme
IN-MHEWS	International Network for Multi-Hazard Early Warning Systems
LSTM	Copernicus Land Surface Temperature Monitoring
NCCC	National Climate Change Committee
NCOF	National Climate Outlook Forums
NDMA	National Drought Management Authority in Kenya
NDMP	National Drought Management Policies
NDRA	National Disaster Risk Assessments
NDRI	National Drought Risk Index
NVAA	National Vulnerability Assessments and Analyses
PRISMA	PRecursore IperSpettrale della Missione Applicativa
RCOF	Regional Climate Outlook Forums
RISDP	Regional Indicative Strategic Development Plan
RVAA	Regional Vulnerability Assessment and Analysis
SADC	Southern Africa Development Community
SADRI	Southern Africa Drought Resilience Initiative
SDDRS	Regional Drought Disaster Resilience Strategy
UNCCD	United Nations Convention to Combat Desertification
UNECA	United Nations Economic Commission for Africa
UNISDR	United Nations Office for Disaster Risk Reduction
USAID	United States Agency for International Development
WMO	World Meteorological Organization

1 Introduction

Droughts are considered the most relevant hazard in terms of economic losses in many areas around the globe. They are recurring, slow-onset hazards, belong to the most widespread climate extremes, are projected to increase in magnitude and frequency, and cause major impacts on human and natural systems. The agricultural sector is in many regions, and especially in developing countries, the key economic factor and basis for livelihoods, yet highly vulnerable to climate-related hazards. A review of post disaster needs assessments revealed that worldwide 83% of agricultural loss and damage between 2006 and 2016 was attributed to droughts. In order to create resilient and productive agricultural systems, there is a clear need for efficient tools to monitor and predict (1) the occurrence of droughts and (2) their impact on agricultural productivity. Such monitoring and early warning systems would ultimately serve two purposes. On the one hand, they allow to accurately determine the damage suffered by past drought events and hence provide valuable inputs for governments/insurance companies to compensate people for their economic losses. On the other hand, early warning systems facilitate robust planning and informed decision-making during the period leading up to a major drought event, in turn reducing the potential consequences of future drought events on people's livelihoods, especially in vulnerable communities. During the High-Level Meeting on National Drought Policy (HMNDP), held in Geneva from 11 to 15 March 2013 between the World Meteorological Organization (WMO) and the Secretariat of the United Nations Convention to Combat Desertification (UNCCD), it was hence declared that **developing effective drought policies**, including drought monitoring and early warning systems, was **pertinent to reducing societal vulnerability to the effects of drought**.

Within "ARIES" experimental EO analysis techniques will be developed based on high-resolution thermal and hyperspectral EO data in order to produce a set of indicators relevant for monitoring both the occurrence and impact of droughts in Africa, and as such respond to the need for advanced monitoring tools as outlined above. To ensure the specific set of indicators to be developed is relevant for the African context, the definition and characteristics of these indicators are being determined in close collaboration with several African stakeholders active in the domain of agricultural management and/or drought monitoring (for more information, see Deliverable 2 – African Early Adopters Characterization). Oftentimes, the program and activities of these African institutes are highly determined by global, regional and/or local drought policy frameworks and directives. In order to gain a better understanding of the context in which the ARIES project is operating and as such also optimize the relevance of the work performed within this project to the involved African parties, **this Policy Traceability Matrix analysis aims to provide an overview of relevant continental (Section 2), regional (Section 3) and national (Section 4) institutes and policies related to drought monitoring on the African continent**. Within Section 4 we limit our analysis to those countries directly involved within the ARIES project, i.e. Senegal, Mali, Niger, Kenya and Zambia. Finally, **Section 5 provides a link between the proposed indicators to be developed within ARIES and the identified policy frameworks**.

2 Continental drought policy frameworks in Africa

In order to understand the origin of regional to local drought policies, one needs to dive into more generic international frameworks on (natural) disaster risk reductions. In 2005, a world conference on disaster reduction was held, which adopted the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Conference provided a unique opportunity to promote a strategic and systematic approach to reducing vulnerabilities and risks to hazards. The identified priorities for action included: identification, assessment and monitoring disaster risks and enhance early warning; compilation and standardization of statistical information and data on regional disaster risks, impacts and losses; and provision of easily understandable information on disaster risks to citizens in high-risk areas. Later, this framework was followed by the United Nations Sendai Framework for Disaster Risk Reduction 2015-2030, which now also includes technological hazards aside from natural disasters. A key approach of the Sendai Framework is that nations take a proactive approach to managing and preparing for disasters. It lays out four priorities for action to reduce risks from natural disasters: i) Understanding disaster risk; ii) Strengthening disaster risk governance to manage disaster risk; iii) Building resilience by investing in disaster risk reduction, and; iv) Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction. The priorities and principles of the Sendai Framework provide a strong foundation for drought resilience, adaptation and management policies that can reduce risks associated with drought at national and subnational scales.

Specifically for droughts, the general principles on disaster risk reduction as outlined by e.g. the Sendai Framework have been translated into more concrete actions and guidelines during the HMNDP 2013 meeting in Geneva (see higher). An important outcome of this meeting was a declaration encouraging Governments to develop and implement National Drought Management Policies (NDMP) that incorporate appropriate technology and innovation to aid prediction, preparedness, and risk mitigation of drought. To achieve this, Governments were recommended to:

- Develop national drought policies and preparedness plans that emphasise risk management
- Harmonise regional, national, and local efforts to manage the risk of drought
- Monitor the World Meteorological Organization (WMO) -recommended drought indicators and use them to forecast impending drought
- Increase knowledge sharing amongst the public and stakeholders to improve the general understanding and preparedness for drought.

Through time, many different specific frameworks and guidelines have been established to aid (African) governments in building National Disaster Risk Assessments (NDRA's) in general and NDMP's specifically for drought risk management. The most predominant ones include:

- Focusing on the first priority action of the Sendai Framework (understanding disaster risk), the National Disaster Risk Assessment (NDRA) guidelines published in 2017 by the United Nations Office for Disaster Risk Reduction (UNISDR) intends to give an incentive to countries and

support them in establishing their own national systems for understanding disaster risk that can be the key repository of all risk information that is available in public. Importantly, geospatial information, including information derived from earth observation, is explicitly recognized as an important contribution to understanding risk and implementing the NDRA.

- Also, in response to the Sendai Framework, the WMO established the [International Network for Multi-Hazard Early Warning Systems \(IN-MHEWS\)](#), which is tasked with encouraging and monitoring the implementation of multi-hazard early warning systems by governments worldwide, providing guidelines and support for implementing these systems and documenting necessary requirements and encountered challenges in doing so.
- The [Integrated Drought Management Programme \(IDMP\)](#), launched by the WMO and the Global Water Partnership (GWP). IDMP's objective is to support stakeholders at all levels by providing policy and management guidance and by sharing scientific information, knowledge and best practices for Integrated Drought Management. This led to the publication of the [National Drought Management Policy Guidelines: A Template for Action](#) in 2014, which serves as an important baseline for many regional drought policy frameworks (see next section).
- The [Strategic framework for drought risk management and enhancing resilience in Africa \(DRAPA\)](#), a joint effort between the UNCCD, WMO and the Food and Agricultural Organization of the United Nations (FAO) and published in 2018, explains the key concepts behind Integrated Drought Risk Management (Monitoring droughts and establishing early warning systems, Assessment of drought vulnerability and Increasing drought preparedness, mitigation and response) and provides step-by-step, high-level guidelines for governments on how this framework can be implemented locally.
- The [Drought Resilience, Adaptation and Management Policy \(DRAMP\)](#) framework established by the UNCCD and published in 2019, identifies pragmatic actions for countries to better prepare and respond to drought, and guides the design and implementation of drought policy at national to sub-national level. As such, it provides more detailed and technical guidance as compared to the DRAPA mentioned before. Among the UNCCD's drought resilience technical guidelines, it is stated explicitly that it is essential to align drought monitoring and early warning systems, as well as policy and management planning and decision-making, with quantitative index-based values that robustly identify drought severity, onset and duration. Taking into consideration more than one drought index not only increases our capabilities to characterize droughts, but also allows us to examine the sensitivity and accuracy of and the correlation and coherence between different indicators.

Aside from these practical policy guidelines, international organizations have been setting up various early warning systems with regard to climate hazards and food security, offering freely accessible information to (African) governments. These tools can easily be adopted by those governments and can provide the basis for more in-depth early warning systems at the regional to national level. Such tools typically combine low resolution Earth Observation data and local expert knowledge to assess the current weather and crop conditions and, based on that, make predictions related to food security. Examples include:

- [FEWS-NET](#) established by the United States Agency for International Development (USAID) and publishing Food Security Outlook reports three times a year, along with more regular Food Security Outlook Updates, containing an analysis of the current situation.
- [FAO GIEWS](#) (Global Information and Early Warning System), delivering similar reports and outlooks on food security as FEWS-NET, operated by experts of FAO and supported by FAO's Agricultural Stress Index system ([ASIS](#)), an earth observation based tool to assess impacts of agricultural droughts in near-real time.
- [CropMonitor](#), by the Group on Earth Observations Global Agricultural Monitoring Initiative (GEOGLAM), issuing regular reports on the conditions of the most important food crops in vulnerable countries around the world.
- The African Climate Policy Centre (ACPC) of the UN Economic Commission for Africa (UNECA) is offering tailored [climate information services](#) through a network of Regional and National Climate Outlook Forums (RCOF and NCOF respectively), ensuring good accessibility to key climatic indicators for all its member states.

3 Regional institutes and policies relevant for drought monitoring in Africa

The drought risk management guidelines contained within the IDMP, DRAPA and DRAMP frameworks have been adopted and adapted at regional level, where groups of countries with similar climate and socioeconomic structures established regional institutes, in turn drafting regional policies and helping their member states tackle droughts and water scarcity. Here, we provide a short overview of some of the most relevant regional initiatives for Western, Eastern and Southern Africa:

- The [IDMP](#) by WMO and GWP established several [regional sub-programs](#), helping countries set up their own national drought policies through so-called [Country Water Partnerships](#) (CWP). These CWP's provide a multi-stakeholder platform for dialogue, bringing together government ministries and agencies comprising those charged with the responsibility of implementing drought policies; NGOs, private companies and local academia working on related research and knowledge dissemination. Examples of such sub-programs include the IDMP in West Africa ([IDMP WAF](#)), which helped establish national policies in Burkina Faso, Benin and Niger, and IDMP in Horn of Africa ([IDMP HOA](#)), being most active in Ethiopia and Sudan.
- The [Climate Prediction and Applications Centre](#) (ICPAC) is providing climate services to 11 East African countries and established the [East Africa Drought Watch](#) platform which monitors drought conditions in near-real time using a combination of indicators derived from Earth Observation data and related to precipitation, soil moisture and vegetation condition. The system is a local adaptation of the European Drought Observatory (EDO) and was developed in close collaboration with the Joint Research Centre of the European Commission (JRC).
- The [Southern Africa Development Community](#) (SADC) has focused on vulnerability analysis and food security at both regional and country levels since 1999. In 2006 it established a Regional Vulnerability Assessment and Analysis (RVAA) Program resulting in annual National

Vulnerability Assessments and Analyses (NVAA) in most countries of Southern Africa. In 2011 it released a Climate Change Adaptation Strategy, in 2016 a Regional Disaster Preparedness and Response Strategy and recently a Regional Indicative Strategic Development Plan (RISDP) 2020–2030 as well as a regional Drought Disaster Resilience Strategy (SDDRS).

- The [Southern Africa Drought Resilience Initiative](#) (SADRI) by the World Bank and the Cooperation on International Waters in Africa (CIWA), aims to provide a forum for knowledge exchange among SADC Member States and development partners on effective drought risk management. The initiative specifically publishes country-specific Drought Resilience Profiles, providing spatially explicit snapshot overviews of drought resilience capacity in each of the 16 SADC Member States. Within these profiles, drought risk is assessed as a combination of drought hazard, exposure and vulnerability by means of the National Drought Risk Index (NDRI), of which the Integrated Drought Severity Index (IDSI) is one of the components. IDSI calculations integrate satellite-based observations of vegetation conditions and climate data and other biophysical information such as land cover/land use type, topography and river basin details.
- The [AGRHYMET](#) regional Centre was created in 1974, as a specialized institution of the [Permanent interstate Committee for Drought Control in the Sahel](#) (CILSS). It has 13 member states and is covering the ECOWAS region. The primary objectives for AGRHYMET are to contribute to achieving food security and increased agricultural production in the Economic Community of West African States (ECOWAS) region and to improve the natural resources management in the Sahel, by providing training and information to development stakeholders and partners in agro-ecology. Agrhymet is included in the ARIES project as one of the African Early Adopters.

All the aforementioned regional initiatives on drought monitoring have significantly contributed to capacity building, user awareness and information availability, especially in developing and least-developed countries, despite the challenges of limited resources and human and infrastructural capacities. However, African nations' responses to droughts remain limited at a country level and reflect their social and economic circumstances. Despite considerable advances in drought preparedness, monitoring and management on a global scale, the current situation in many African nations reveals that most governments have not yet given drought risk management the necessary priority. Most "at risk" countries utilise the crisis management strategy where Governments and donors devote funds to response efforts rather than to long-term programmes that deal with planning, mitigation, and readiness for drought-related disasters. In the next section, we specifically look into some example countries most relevant for the ARIES project.

4 National drought policy frameworks in Africa

4.1 Senegal

Within Senegal we can identify three important Ministerial Decrees relevant to drought management and food security in general:

- [Ministerial Order No. 6579](#) (2009) establishing the Technical Committee for disaster risk declaration - responsible for reporting and verifying natural calamities affecting rural areas and causing losses to farms, livestock, forestry and fishing. Activities of this Committee could primarily rely on available drought monitoring applications at low spatial resolution, as presented above.
- [Ministerial Decree 1220](#) (2011) establishing the National Climate Change Committee (NCCC). The NCCC is comprised of several governmental bodies, non-governmental organizations, universities and research institutes and plays an important role in raising awareness and disseminating information on climate change issues to all involved stakeholders.
- [Ministerial Decree No. 9.719](#) (2015) on the institutional framework of the Project for the Development of Resilience to Recurrent Food Insecurity in the Sahel, established within the Ministry of Agriculture and Rural Equipment. The aim of the project is to contribute to the reduction of food insecurity and to the development of the resilience of vulnerable populations in Senegal. Amongst the approaches put forward to accomplish said goals are the promotion of sustainable agricultural practices and digitalization of agriculture.

4.2 Mali

Important national policies in Mali related to natural disaster risk monitoring, food security and strengthening of the agricultural sector include:

- [National Policy on Climate Change](#) (2011). The vision of the National Policy on Climate Change in Mali is to define by 2025 a framework for sustainable socio-economic development that integrates the challenges of climate change in all sectors of its development. The document is organised around 8 political and institutional objectives, most relevant being (4) prevention and management of risks and natural disasters and (6) strengthening research for development, extension and technology transfer, and the generation of appropriate information and data.
- The [National Agricultural Policy and Agricultural Development Policy](#) (2013) – aimed at strengthening the agricultural sector in Mali to ensure food security and sovereignty. Amongst the five specific objectives listed, two are particularly relevant in the context of the ARIES project, i.e. (3) modernizing agricultural production systems and (4) ensuring the development of technological innovations through agricultural research and vocational training. These national policies are closely linked to the [National Agricultural Sector Investment Plan](#) established in 2014 and determining key investment strategies for ten years (2015-2025) in the agricultural domain.
- [Decree No. 2016-0006 P-RM](#) (2016) instituting the National Mechanism for Early Warning and Security Risk Response. The National Early Warning and Response Mechanism's mission is to collect information and data on threats, good governance, security and peace in Mali, to alert the Government, to suggest appropriate responses for the identified threats, to monitor and / or coordinate the implementation of the responses agreed to by the Government.
- [Decree No. 2016-0102 P-RM on food insecurity](#) (2016). This decree establishes the organisation and operating procedures of the project to strengthen resilience to food insecurity in Mali. The Project's mission is to protect the livelihoods of the most vulnerable households; to sustainably strengthen the means of production of herdsmen, farmers and fishermen; develop

their adaptation capacities to climate change and to help policy-makers to have the necessary and reliable information in decision-making related to potential food security crises.

- [Cadre Stratégique pour la Relance Économique et le Développement Durable](#) 2019-2023. This strategic document focuses on 5 axes for sustainable development in Mali. The most notable sub-objectives within this context include (i) promoting the use of innovative technology for a green economy, and for sustainable production and consumption, and (ii) the promotion of a sustainable and modern and productive agricultural sector by strengthening land tenure, supporting small farmers, promoting agricultural entrepreneurship and improving technological capacities.

4.3 Niger

The country of Niger has a long and diverse track record of national policies related to climate change and food security. Most notably:

- Already in 1997 the [Technical Commission on Climate Change and Variability](#) was established, tasked with developing and monitoring the [National Policy on Climate Change](#) (2012). The latter gathers all actions necessary to strengthen the adaptation capacities and resilience of communities, improve local knowledge and promote open communication with regards to potential adverse effects of climate change.
- [Strategic Framework for Sustainable Land Management](#) in Niger, 2015-2029 (2019). This framework sets the strategic goals related to sustainable management of natural resources in the country, accompanied by a financial investment plan to reach those goals. Within the document, reference is made to the need to set up a data-driven knowledge base allowing to document the effects of implemented measures.
- [National Strategy and Plan for Adaptation to Climate Change in the Agricultural Sector](#) (2020-2035). This strategy corresponds to the agricultural sector's version of the National Adaptation Plan. It focuses intensely on the need for not only sustainable, but also (climate-) smart agricultural management practices to increase the resilience of communities against natural hazards caused by climate change.

4.4 Kenya

Key policies related to droughts and food security in Kenya include:

- The 2009 [National Policy for Disaster Management](#) and [National Disaster Response Plan](#), detailing the high-level principles and assumptions that go into the government's planning for disaster response, as well as the concrete procedures, roles, and responsibilities of disaster responders. Droughts are specifically recognized as an important risk to the country.
- The [2013-2017 Climate Change Action Plan](#) and subsequent [National Climate Change Action Plan 2018-2022](#), both aiming to strengthen the country's path towards sustainable, climate-resilient and low carbon development. Focusing strongly on Adaptation and Mitigation strategies, the Plan seeks, amongst others to: 1) reduce risks to communities and infrastructure resulting from climate-related disasters such as droughts and floods, 2) Increase food and

nutrition security through enhanced productivity and resilience of the agricultural sector, whilst at the same time moving towards low carbon emitting agricultural systems.

- The [National Environment Policy](#) of 2013 provides a general framework for an integrated approach to sustainable management of Kenya's environment and natural resources. Amongst its recommended policy actions it explicitly includes the need to strengthen and enhance an early warning and response system for disaster risk reduction.
- The 2016 [Climate Risk Management Framework for Kenya](#) outlines how the government intends to harmonise its climate change and disaster risk policies mentioned above. It identifies ten priority areas for concrete actions, one of which includes the explicit analysis of levels of exposure, vulnerability to disasters and the capacity to overcome such disasters at the local level.
- In 2016, Kenya establishes the [National Drought Management Authority](#) (NDMA) with the mission of offering tools and instruments to ensure that drought does not lead to emergencies and that the impacts of climate change are sufficiently mitigated. The NDMA provides a platform for long-term planning and action, as well as a mechanism for coordination across government bodies and all stakeholders. It offers monthly reports on current drought conditions, drought early warning and assessment of rainfall.
- [Kenya Climate Smart Agriculture Strategy 2017-2026](#), established in 2017 to improve the resilience of agricultural systems while at the same time reducing emissions from these systems. One key focus area of this strategy is minimizing vulnerability of the agricultural sector to changes in rainfall and temperature, extreme weather events, and unsustainable land/water management and utilization through the adoption of sustainable land use management practices.

4.5 Zambia

Similarly, to the other countries covered in this section, Zambia has established various policy frameworks related to climate change, drought risk management and food security:

- The [2010 National Climate Change Response Strategy](#) has been developed to support and facilitate a coordinated response to climate change issues in the country. The document emphasises on the development of agriculture as the main engine of income expansion, which can only be realized through the development of sustainable land use systems to enhance agricultural production and ensure food security under the changing climate.
- The 2011 [National Agriculture Policy 2012-2030](#) acknowledges that crop production varies from year to year due to the effects of climate change, that the agricultural sector contributes to climate change through emissions and unsustainable production practices, and provides that the sector needs to promote production practices that minimise contribution to climate change, such as conservation farming and tree planting.
- Partly in response to the earlier mentioned National Agriculture Policy, the [Zambian Agricultural Knowledge and Training Centre](#), LTD (AKTC) was funded as spin-off from a project within the Bilateral Cooperation Program of the Federal Ministry of Food and Agriculture in Germany and the Zambian Ministry of Agriculture in 2015. AKTC focuses on the demonstration of sustainable,

low emission agricultural practices and subsequent capacity building towards farmers, agricultural advisors and students. AKTC is included in the ARIES project as one of the African Early Adopters.

- The [National Disaster Management Policy \(2015-2020\)](#) promotes sustainable development among vulnerable communities to improve their resilience. This is accomplished through, amongst others, development and implementation of Disaster Risk Management plans, and development of an integrated disaster risk management information and communication system in order to enhance timely decision making.
- The 2016 [National Policy on Climate Change](#) provides a framework for coordinating climate change programmes in order to ensure climate resilient and low carbon development pathways for sustainable development towards the attainment of Zambia's Vision 2030. Amongst its specific objectives are included: (1) promotion of adaptation and disaster risk reduction measures and (2) promotion of sustainable land use management practices.

5 Linking ARIES indicators to policy frameworks

From listing the various policy frameworks and institutions dealing with natural disaster risk management and food security as was done in the previous sections, one can identify a number of general observations and trends within these types of policies:

- All policies related to the management of natural disasters, including droughts, are essentially centred around three pillars: (1) Vulnerability and impact assessment, (2) Near-real time monitoring and early warning systems and (3) Mitigation, preparedness, resilience and response.
- The beneficial role of information derived from Earth Observation has been repeatedly stated for pillars 1 and 2. Assessment of the impact of past drought events and early warning systems require near-real time, quantitative information on meteorological variables, soil moisture and vegetation response to current climatic conditions. Considering the relatively large spatial scales (regional to continental) over which these phenomena occur, low-resolution (300 m – 1 km) data provides sufficiently detailed information to inform governments on past and imminent drought events, allowing for timely decision making. Many early warning systems have already been established, both at continental, regional and national level, providing exactly the information as pointed out in the previous point.
- Throughout the years, a shift is taking place in regional and national policies: whereas the primary focus used to be on the monitoring and early warning of natural disasters (pillars 1 and 2), it is more and more migrating towards increasing resilience and implementing concrete mitigation measures to prevent adverse impacts of such disasters (pillar 3).
- The sustainable management of natural resources, and especially adoption of low-carbon, sustainable agricultural production systems, is increasingly being recognized as a key component to increase resilience of local communities towards natural hazards such as droughts.

- In order to achieve the goal outlined in the previous point, there is a clear need for the enhancement of digital tools for high-resolution crop monitoring at field scale. Not only will this allow research institutes and farmers to objectively identify optimal crop management practices tuned to their specific local conditions (in turn facilitating capacity development activities in this field), but it will also provide the necessary tools to farmers to quickly and correctly respond to adverse crop growing conditions with a minimal waste of resources.

The specific characteristics of the most commonly used and freely available Earth Observation constellations so far only allowed us to provide adequate information related to drought conditions at continental and regional scale or did not sufficiently allow to disentangle the impacts of different environmental stressors on the agricultural production systems. With the advent of higher resolution thermal and hyperspectral sensors such as ECOSTRESS, LSTM, PRISMA, EnMAP and CHIME, our local crop and drought monitoring capabilities are expected to grow exponentially. Within ARIES, we therefore proposed to develop indicators related to both biomass production (leaf area) and crop water stress/crop water content at spatial resolutions of 10 to 70 m. Given the policy overview in the previous sections and the reasoning as outlined in this section, we are convinced that such indicators would respond to the ever-evolving data needs of the agricultural sector in Africa. By doing so, we hope to actively contribute towards strengthening the resilience of the most vulnerable communities against the adverse impacts of natural disasters such as droughts and towards increasing food security on the African continent.