FOCUS-AFRICA

Full-value chain Optimised Climate User-centric Services for Southern Africa

STAKEHOLDER WORKSHOP
Focus on Mozambique

Fourth Stakeholder Workshop Report

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Contents

Acronyms 2
1. Introduction 1
1.1. Overview 1
1.2. Objectives 2
1.3. Expected outcomes 2
2. Information about the venue and participants 3
2.1. Venue 3
2.1. Participants 3
Contents 6
3.1. Workshop Programme 6
Opening: Welcome and Introduction 6
Session 1: Climate services for food security in Mozambique 6
Session 2: Advance understanding of users' requirements, perspectives, and strategies for food security 9
Session 3: Demonstrate seasonal forecasting tools from CS 2, 3 and 4 to identify synergies, challenges, and opportunities for implementation 12
Session 4: Improve mapping of users' requirements for last mile delivery methods of trial climate services (channels of comms, data delivery, visualisation), including post-project sustainability 15
Final remarks 16
Main take away points 17
Annexes 18

Acronyms

ACMAD	African Centre of Meteorological Application for Development
ASAP	Anomaly Hotspots for Agricultural Production
BSC	Barcelona Supercomputing Center
CEB	Central Electricity Board
CS/ CSL	Case Study/ case Study Leader
CSC	Climate Services Centre
CSIR	Council for Scientific and Industrial Research
DCCMS	Department of Climate Change and Meteorological Services in Malawi
CWA	Central Water Authority
DALRRD	Department of Agriculture, Land Reform and Rural Development (South Africa)
DARD	Department of Agriculture & Rural Development (South Africa, North West Province)
EC	European Commission
ENSO	El Niño-Southern Oscillation
EDF	Électricité de France
FA	FOCUS-Africa, Full value-chain Optimized Climate User-centric Services for Southern Africa
FAREI	Food and Agriculture Research and Extension Institute
H2020	Horizon 2020
IA	Irrigation Authority
INAM	Instituto Nacional de Meteorologia (of Mozambique)
MO	United Kingdom Meteorological Office
NMHS	National Meteorological Hydrological Services
Q&A	Question and Answer
SADC	Southern African Development Community
SDAE	Economic Activities District Services (Serviços de Actividades Económicas)
SFWF	Small Farmers and Welfare Fund
SSSA	Scuola Superiore Sant'Anna
TARI	Tanzania Agricultural Research Institute
TMA	Tanzania Meteorological Authority
WEF	Water-Energy-Food
WFP	World Food Program (WFP)
WEMC	World Energy and Meteorology Council
WMA	Wastewater Management Authority
WMO	World Meteorological Organization
WP/WPL	Work Package/ Work Package Leader
WRU	Water Research Unit

1. Introduction

1.1. Overview

FOCUS-Africa (FA) project's main objective is to demonstrate the full value chain of climate services in the Southern African Development Community (SADC) region in four key sectors: agriculture and food security, water, energy, and infrastructure. The full value chain of climate services will be demonstrated by piloting eight case studies in five countries involving a wide range of uses and stakeholders. FOCUS-Africa project began implementation in September 2020.

Planning and organizing stakeholders workshops, as part of the project's Work Package (WP) 1 activities and in collaboration with other WPs, is instrumental for collecting inputs from internal and external entities that are engaged in the development of the FOCUS-Africa climate services. Workshops are being organized approximately every eight months, each time featuring at least one of the countries involved in the case studies. Depending on the travel limitation imposed by the COVID pandemic, the workshops are hosted virtually or in person in the focus country. In the latter case, online access is organized too, to allow for a broader and inclusive participation.

The First FA Stakeholder Workshop was focused on South Africa and took place virtually. It was comprised of Internal workshop (30 November – 1 December 2020) and external stakeholder workshop (9 December 2020) with a focus on related food security case study to incentivize a wider local participation. For the Second FA Stakeholder Workshop Tanzania was selected as the theme country, and the workshop was co-organised with the Tanzania Meteorological Authority (TMA) as the institution mandated to provide climate services in the country. The workshop focused on three sectors: agriculture and food security, energy and infrastructure. The Third FA Stakeholder Workshop took place in a hybrid mode in South Africa 2022 to bring together the consortium members, close partners, advisory board (AB) members, European Union (EU) officers, and local stakeholders in South Africa and Mauritius to better understand the local needs and requirements for related case studies in food security and water.

The **fourth FOCUS-Africa Stakeholder Workshop** took take place in Mozambique in May 2023 in presential mode. The main focus was on case study 3, specifically on food security in Mozambique, even if part of the discussion was broadened to neighbouring Malawi and Tanzania, for which analogous case studies, 2 and 4 respectively, are being developed. The workshop brought together the consortium members, close partners, an advisory board (AB) member, and local stakeholders in Mozambique to share current project case study developments and understand how results can be further improved to target local needs and requirements. The workshop reviewed users' requirements, perspectives, and strategies for climate services delivery in Mozambique, and the broader South African regional context, also providing opportunities to test early versions of trial climate service delivery.

It should be noted that the fourth stakeholder workshop was run immediately following an internal 2-day project meeting, in the Maputo area, and was followed by a 2-day training course on the monitoring and forecasting at the seasonal time scale of the onset of the rainy season. As a result, some of the statistics and commentary in this report may present partial overlap from time to time.

1.2. Objectives

The objectives of the fourth FOCUS-Africa stakeholder workshop were to:

- Promote visibility of FOCUS-Africa project by showcasing the progress and challenges of case study 3 in Mozambique;
- Understand and review users' requirements, perspectives, and strategies for climate services delivery in Mozambique, and other related food security case studies (i.e. case study 1, South Africa, 2, Malawi, and 4, Tanzania), including discussion about the delivery of the trial climate services;
- Better understand end-users' requirements and assess the status of stakeholder engagement;
- Expand the stakeholder network in Mozambique.

These objectives were agreed by the widely represented workshop programme organizing committee, which met regularly every three weeks over the course of several months, with some additional meetings closer to the workshop date to better fine tune the programme. All the project members were invited to attend these meetings and around ten or more team were present at, and contributed to, these meetings.

1.3. Expected outcomes

Based on the above stated objectives, a number of expected outcomes were identified, **also** building on previous stakeholder workshops and **accounting for the more advanced of** project **implementation** activities**. The expected outcomes were:**

- Improved stakeholders' familiarity with planned and produced trial climate services also by receiving feedback from users on the testing of the current status of the trial climate services for the relevant case studies, particularly 3 (Mozambique), but also 2 (Malawi), 4 (Tanzania);
- Advancement in the co-development process by collecting, and later integrating, feedback from the services' testing;
- Identified capacity development needs for climate services providers and end-users in the target countries and case studies;
- Identified additional stakeholders in Mozambique (and wider region) that are engaged in food security.

As with the workshop objectives, the expected outcomes too were agreed by the workshop programme organizing committee.

Alongside the workshop programme organising committee, a local organising committee was also set in place which met regularly every three weeks, to discuss all the logistics (venue identification and hire, invitation of speakers and their support, transportation, etc.) to ensure a smooth stakeholder workshop execution, as it happened.

2. Information about the venue and participants

2.1. Venue

The FA fourth stakeholder workshop was held in a location in the immediate periphery of Maputo, Mozambique's' capital. The venue, the Lugar do Mar at Macaneta Island, was chosen due to its proximity to Maputo, the suitable conference facilities and the accommodation opportunity to host all participants. Given the strength of the wifi network could not be guaranteed, the organising committee felt that remote attendance would have been risky and therefore it was not organised.

Photo 1: Stakeholders Workshop Venue – Lugar do Mar, Macaneta, Mozambique

2.1. Participants

A total of 70 participated, in presence, at the FA fourth stakeholder workshop. Although as mentioned no formal facilities were set in place for virtual attendance, project team were able to connect with the assistance of colleagues at the venue via mobile connections and properly follow proceedings.

Figure 1 illustrates the distribution of attendees by country, as provided at the time of registering. A large proportion attended from **Mozambique** (the location and focus of part of the workshop).

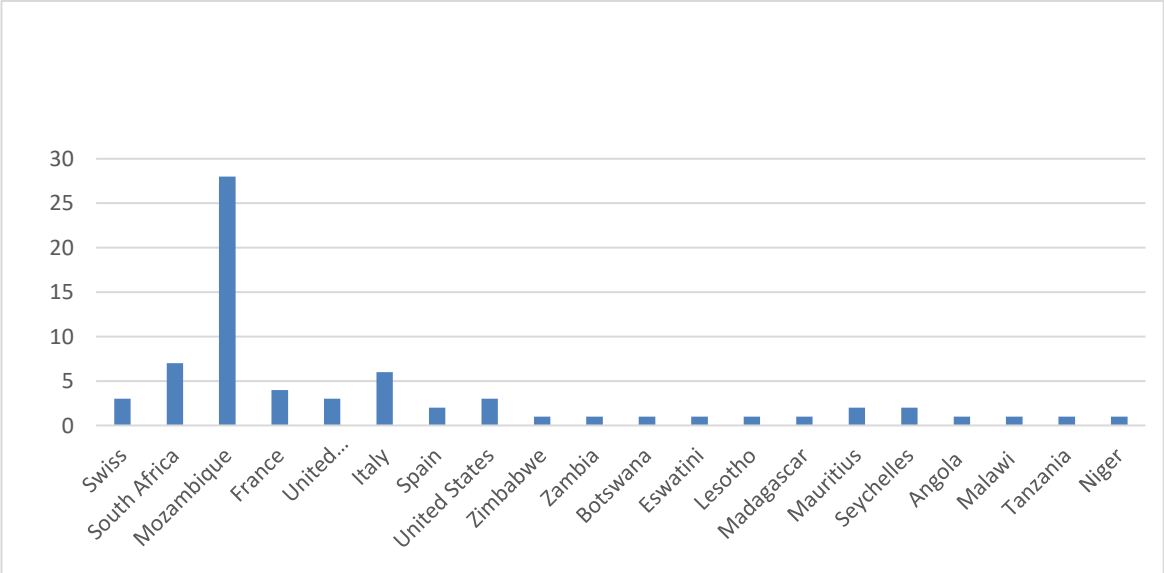

Figure 1: Distribution of attendees by country for the combined Consortium Assembly and Stakeholder Workshop.

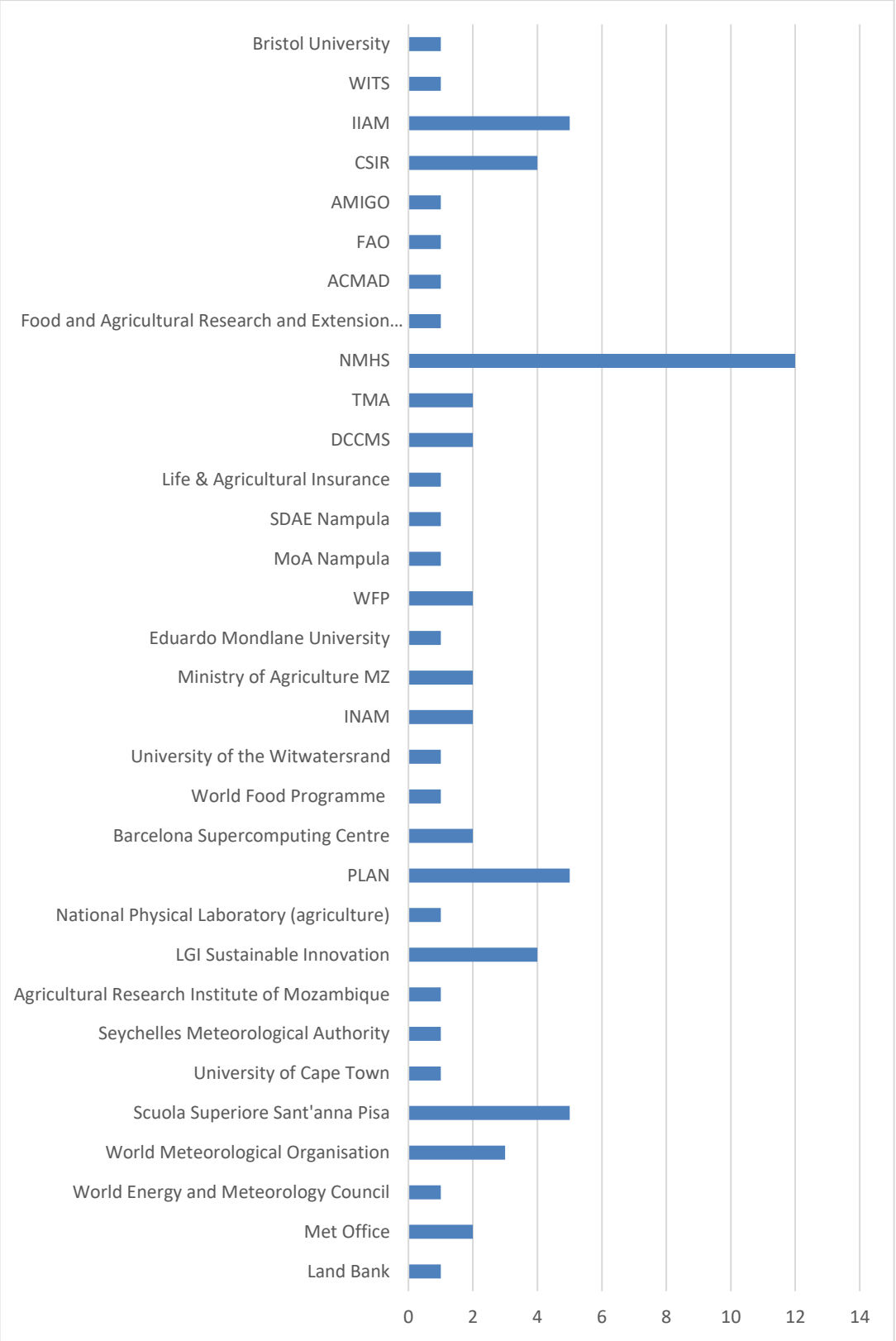

Figure 2: Attendees by organization

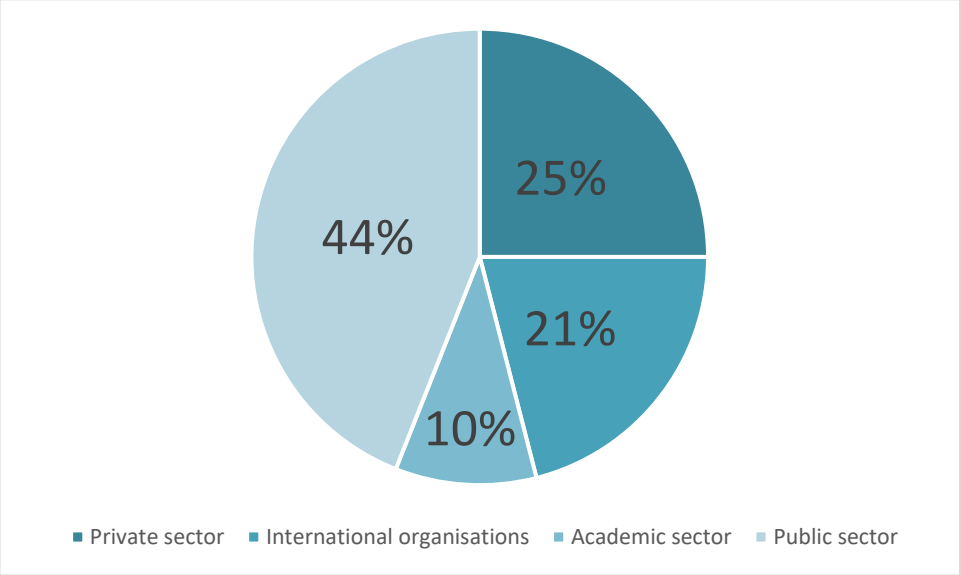

Figure 3: Attendees by sector


Photo 2: Stakeholders Workshop Participants

Link to all photos[1]

1 https://wmoomm.sharepoint.com/:f:/s/XB_Projects/EkLzY_3WBa1Gr4VbgAwBHCUBRfVlxFmTaSZc3GvbpB_FlQ?e=eWupIh

Contents

3.1. Workshop Programme

The workshop hosted by the Focus-Africa project team was structured around one day, and composed of a mix of presentations, panel discussions and break-out group dialogues. The presentations served to introduce the specific case study objective of the workshop, namely case study 3 (food security, Mozambique). The programme is shown in Annex 1.

Opening: Welcome and Introduction

The Workshop was kicked off by the opening speech by **Dr. Paulino Munisse**, a principal investigator at the Institute of Agronomic Research of Mozambique (IIAM), who extended a warm welcome to the participants of the workshop. He emphasized that the workshop is going to cover important aspects of the project, which is the more relevant given the ongoing climate crisis in Mozambique, and hoped for fruitful discussions to assist achieve impactful results as a group. Dr. Munisse also noted that the meeting is taking place in a rural area of Mozambique, highlighting the importance of understanding its conditions.

Following Dr. Munisse's opening, **Ms. Roberta Boscolo**, lead of Climate and Energy Services at the World Meteorological Organisation and Co-ordinator of the Focus Africa Project, introduced the project. She explained that Focus Africa is a research project funded by the European Union, aimed at developing climate services for different sectors in Africa, and described the project's goals which are demonstrating the functioning of the value chain of climate services and their ability to provide information to key socio-economic sectors. Ms. Boscolo highlighted that the project is a collaborative effort involving different institutions from Africa and Europe, and several key sectors, specifically water management, infrastructure, energy, agriculture and food security. She explained the full value chain of climate services, which involves understanding user requirements, building knowledge, transforming products to meet user requirements, and demonstrating their socio-economic benefits.

Ms. Boscolo emphasised that this is the first time a project workshop is held in Mozambique and that it is important to understand why the project is meeting here, and build the following discussion in the workshop on this knowledge. Moreover, given FA is a demonstration project which also involve socio-economic benefits, the results can later be applied to other geographies. For this to happen it is important not to work in silos, to make the final result bigger than the sum of the parts. Further, we need to contextualise the problem, the user requirements, and the products and if the process does not work we want to understand why. Ms Boscolo then detailed the work packages of the project, which involve understanding stakeholders' requirements, contextualizing these requirements, understanding climate processes, co-producing and co-evaluating products, assessing impact, and developing capacity, and shared the project's case studies in different countries. She pointed out that the more we study these case studies and their sectors (agriculture, energy, …) the more we see the interconnections between them, under the so-called nexus. In terms of stakeholder workshops, although the project started under COVID19 restrictions, with the first two workshops run virtually, in 2022 there have several important exchanges, with the workshop in South Africa, but also in country missions as well as an important side event at COP27 organised with EU to showcase FA results.

Session 1: Climate services for food security in Mozambique

This first session saw presentations from major players in the connection between climate services and food security in Mozambique. **Dr Missa Mustafà**, Deputy Director General of INAM, started the session by providing an outline about the INAM activities in the country. Dr Mustafà thanked the hosts for the opportunity to share the work and achievements of the Mozambique Meteorological Service. The Mozambique Meteorological Service, a government organization under the Ministry of Transportation and Communication, is administratively independent, dealing with issues directly without needing ministerial approval. They also possess technical and scientific independence to conduct research based on government-set principles. Their vision is to be a world-class climate service provider and contribute to the sustainable development of the country. As a key player in early warning systems, they work closely with the Ministry of Agriculture and are a crucial partner in monitoring climate and weather patterns for the benefit of agriculture. The services they provide are closely linked to agriculture, water resource management, and natural disaster management. They focus on climate service for agriculture. They have been providing climate data to the agricultural sector, continually improving their services based on evolving requirements.

As part of their early warning systems, they develop seasonal forecasts which are vital for agricultural planning. and set in place contingency plans to guide the government in dealing with the rainy/wet seasons. More broadly, they provide data on potential cyclones each season, assisting in planning and preparation for such events. They also provide data used by the health sector, specifically for epidemic planning related to cholera and malaria. They write an annual climate report detailing climatic performance, including information on cyclones, rainfall, and temperature trends. At INAM they are working to

overcome challenges such as the lack of sufficient climate stations across the country. They aim to have one meteorological station per district by 2025. Overall INAM is continuously striving to improve their services based on user requirements and to ensure data quality.

INAM also partners with the World Food Program (WFP) in monitoring drought across the country and issues a monthly newsletter detailing their findings, and they seek other opportunities including potential financing from the WMO, and participation in meetings such as the current one for knowledge exchange. They also acknowledge weaknesses in areas like climate modelling and are working towards improving these areas for better service provision. The importance of their work is emphasized by the role of agriculture in the economic development of Mozambique. Dr Mustafà ended his speech by expressing gratitude for the opportunity to share and learn from partners.

Photo 3: Dr Missa Mustafà presentation

A few questions followed the presentation, starting with Ms Mecklina Merchades (TMA) who, after expressing appreciation for Mozambique's ambition to enhance meteorological observations, asked about the relative role of manual versus automatic weather stations and particularly the maintenance of manual stations. She also enquired another matter, namely how farmers actually use seasonal forecasts, given the importance of agriculture in the economy of Mozambique. In response, Dr Mustafà clarified that the current initiative aims to transition from manual to automated rainfall stations. Over the last five years, all rainfall stations have been automated and are no longer manual, with 74 out of 154 districts now covered by automated stations. The data generated from these stations is primarily used by the agriculture sector. The generated information is passed onto the Ministry of Agriculture, where extension officers work on it. The next talk should further clarify this point. Next, Francisco from the Angola Meteorological Service poses questions regarding the maintenance, replacement of sensors, and data checking in automated stations. The response acknowledges challenges such as solar panel theft and the need for ongoing training and spare parts for maintenance, indicating that these issues are currently being worked on.

The second presentation of the session was given jointly by **Mr Hitem Jentilal** and **Mr Zulmira Mumino** of the Ministry of Agriculture on climate user-centric optimised services for southern Africa. Both Mr Jentilal and Mr Mumino are agricultural engineers with over 20 years of experience. They discussed their work in using climate data for agricultural purposes, specifically interpreting data from the Meteorological Service at the start of the wet or rain season to forecast crop health and water availability. An agricultural technical recommendation is designed at the beginning of the season and crop stages are monitored throughout. They noted that over 70% of their country's population is engaged in agriculture, with potential for more usage of the available 30 million arable lands. However, their geographical position makes their country vulnerable to droughts, floods, and cyclones, which affect the majority of their farmers, 80% of whom are smallholder farmers with average land holdings of a hectare. They highlighted the value of timely data provision, not just on climate but also market prices and farming techniques to link farmers within and outside their country.

Besides the Meteorological Service data, they also utilize satellite data for remote areas, monitoring crops and providing real-time data for users. They have various tools for progress monitoring in the field, and partnerships with regional fields and the WFP to gather and distribute data. They talked about the dissemination of this information which is not just at the national level but also down to sub-district levels. The data generated includes information on land operation levels, crop

evolution, vegetation changes, and challenges in terms of access to inputs like seeds and fertilizers, as well as crop disease-related issues. They also discussed the recent need to assess the impact of crop diseases and the doubling of extension officers who are trained depending on their deployment district. In this context, they identified challenges in building capacity on an annual basis and shared their use of high-accuracy satellite data, despite its high cost. Further, they mentioned the possibility of using SMS and texting, as well as community broadcasters for sharing early warning information, even by registering farmers with their phone numbers. However it is still challenging to reach the 4 million farmers in need of this information.

A few questions were taken after the presentation, with a notable one about asking for additional information provided by their service compared to the Meteorological Service. Mr Jantilal explained that their bulletin focuses on agricultural aspects like water satisfaction, crop water requirements, land preparation, input availability, crop stages, and estimated production, and emphasized the difference between their service and the Meteorological Service, with the latter focusing on climate rainfall and temperature while they provide more crop-specific information and impact assessments.

The third presentation was given by **Mr Alfredo Novela**, a program officer from the World Food Program (WFP), who presented on the applications of climate science for agriculture. Mr Novela talked about the main activities of the WFP, with a focus on the integrated climate service for agriculture and early and anticipated actions. He emphasized the WFP's integrated vision, including risk management, ecosystem preservation, and conservation of agriculture. A crucial part of the WFP's work is enhancing community capacity to access formal and informal financial services, such as saving and credit services. Risk-taking, particularly climate risk, is integral to this approach. The WFP's primary target group is smallholder farmers and they also have a risk transfer plan focusing on actions like micro-insurance. Mr Novela discussed an integrated management plan for water and ecosystem-based adaptation, as well as an early warning system within disaster risk reduction management, and touched on the Participatory Integrated Service (PICSA)[2], a methodology used by the WFP since 2018. PICSA uses climate data to assist farmers in making decisions, particularly about crop and substance options. The PICSA approach consists of 12 steps, with the top seven steps deemed most useful to farmers. These steps involve using historical and climate data, including a seasonal climate forecast, to help farmers make informed decisions. The WFP translates complex data into easy-to-understand language for farmers. They also conduct an assessment of the PICSA approach after each campaign. In concluding, Mr Novela highlighted that each step of the PICSA approach has its own unique activity, including a map on resource allocation and he emphasized that PICSA is not just a methodology but also a planning and decision-making tool.

A delegate expressed gratitude for the nice presentations and the work of WFP, and then enquired about the organization's focus on financing more drought forecasts than flooding, given that their geographical area is more prone to flooding. Mr Novela explained that despite the variety of disasters Mozambique faces, drought is a primary concern, especially in the southern part, which is a poorer region. He highlighted that the country did not have the necessary tools to manage drought effectively and that the institution is set up to manage droughts. They are working on instruments to aid in decision-making.

The last presentation of the session was given by **Dr Matteo Dell'Acqua**, of SSSA, and case study 3 leader. He discussed how the work in case study 3 combines climate science with agronomic science to contribute to Mozambique's situation. The work comes from an angle based on experimental agriculture, to develop products such as different management practices, new crop varieties, and climate services for agriculture. Dr Dell'Acqua stressed the need for product profiling, keeping the end-users (farmers) in mind. He underlined the importance of creating usable, practical products while highlighting the risk of creating scientifically strong products that are not usable, drawing a comparison with Blackberry phones. He emphasized the development of climate-ready resilient crop varieties and user-friendly climate services that may yield less but are more usable by farmers and described a transdisciplinary approach, combining climate science, socio-economics, genetics, and crop development.

Dr Dell'Acqua's team has been engaging with farmers in Nampula, discussing the crop varieties they are growing and why. The research area is the Mogovolas district, a region prone to extreme events and characterized by low-income agriculture. Focus group discussions were held with local farmers in the region in 2021.These discussions identified the knowledge of the start of the rainy season as crucial for guiding crop decisions. Surveys were conducted in hundreds of households in Mogovolas, covering social climate conditions, use of climate services, and choice of crop varieties. Training sessions were held at INAM and more are planned for the future. Other sessions are also planned, including one in Nampula to present innovations to stakeholders. Past activities included discussions with village chiefs and extension workers from the Nametil area.

Case study 3 is also working on crop genomics, specifically exploring the diversity of cow-pea rice, which is stored at IIAM's

[2] https://ccafs.cgiar.org/resources/tools/participatory-integrated-climate-services-agriculture-picsa

gene bank. The diversity of cowpea in Mozambique is found to be unique to the region and potentially valuable in identifying varieties resilient to specific climate conditions. There is a trend of shortening rainy seasons in Mozambique over the last 40 years, which links to decreased yields in cereals like maize, rice, and sorghum. To respond to the challenges presented by changing climate conditions, the team is developing an index to estimate the onset of the rainy season. This index is not only based on rainfall but also on soil diversity, blending these two pieces of information to calculate the soil's water retention capacity. A tool (AquaBEHER) has been developed to further aid in this research, which will be discussed in future training sessions and meetings.

Photo 4: Dr Matteo Dell'Acqua presentation

A question to Dr Dell'Acqua was whether they had examined the nutritional value of climate-resilient crop varieties. He responded that they currently lack the capacity to analyse this but acknowledged the importance of considering multiple factors (growth, quality, resilience) when evaluating crop varieties. He mentioned ongoing field evaluations with farmers and the need to consider cooking and nutritional aspects in future work. Another question enquired about the source of the data for their evapotranspiration model. They represented an insurance company and were curious about the resolution level of the data, especially considering the importance of understanding microclimates in specific locations. They also asked about risk transfer or risk financing solutions in the context of improving resilience and access to credit for smallholder farmers, suggesting that the team could learn from countries like Mauritius. They also mentioned the importance of crop cutting in the context of risk transfer and financing, and of understanding final production yields. Dr Dell'Acqua thanked the speaker for their points and promised a follow up from other speakers as he was not the best person to address these issues. Regarding the question about data resolution and water pressure, Dr Dell'Acqua deferred to team member Dr Robel Takele Miteku who stated that they are working with a resolution of about 10 km, which is equivalent to a provincial level, and that their seasonal forecast is at a similar scale.

Session 2: Advance understanding of users' requirements, perspectives, and strategies for food security

This session was based around a panel discussion which was preceded by an introductory presentation by **Prof. Rogerio Chiulele**, of the Eduardo Mondlane University, on climate requirements for agronomy in Mozambique, specifically discussing some of the challenges and opportunities to enhance food security in the face of climate change.

In Mozambique, when we talk about agriculture, we refer to any product sector, which involves a lot of people. Not only does it deal with food but also involves animal farming, and therefore it is the major source for livelihoods: more than 70% of the people depend on their price for livelihoods, and about 6% also depend on it for employment. It is the major contributing sector for economic growth, contributing more than 30% to the GDP, including export revenue. This sector is mainly dominated by small scale farmers (less than 10 workers): about 98% are small scale, 2% are medium and less than 1% are large organisations. Overall, there is low production, low productivity, and even low quality of the production, which limits the possibility of the country to, for example, export the products to Europe and America. What are the causes for that low productivity? We have a country which is highly dependent on rainfall, and as the previously indicated, there are also frequent droughts, as well as floods, and that complicates production. But in addition to that, we have limited adoption and use of improved technology, best production practices, and best practice.

There are also serious problems in terms of access to services. Only 6.9% of farmers receives technical assistance and less than 3.6% had access to loans, but very little or none reaches the 90% of small scale farmers. In terms of the use of inputs, only 5.5% use pesticides, 8.8% manure, 7.8% fertilizers, 9.1% irrigation, and less than 10% used improved variety seeds. The impact of all these, of poor performance of agriculture sector, mainly in rural areas. The last budget survey in 2019-2023, indicated that the crop malnutrition is around 38%, and it is high in rural areas with 33% and urban areas with 28%, which lead to serious problems in terms of social development, and even human development, associated with poor agricultural performance. This means that if we do something to improve the performance of the agriculture sector, we are likely to have social development happening in this country.

How can we improve the performance of the agriculture sector, and bring together the food security in the country? We need to work so that we enhance adoption and use of improved variety, and improved technology, and best practices. And that can be done in terms of research, which is integrating participatory, gender responsive, combined with adoption of farm access network and community practices. By doing that, meaning that we involve people in the process of doing the research, so that they adopt technologies that will be generated. But also, we need not to forget in terms of bringing together gender issues which are critical, in terms of bringing technologies which are appropriate for men, or sometimes for women, or for young people. However, it is critical to involve farmers in the process of developing new technology as otherwise there is a risk it will not make any impact on people's lives, noting also that there is a difference in terms of the specific technology between men and women.

As part of technology development, Prof. Chiulele said that key elements in the context of climate change are the adoption and use of climate services, specifically storage of data, seasonal forecasting, and prediction of future climate scenarios, and to do that there is the need to create awareness, capacity, enhanced availability and accessibility of climate services so that people in the preparation of the climate of their production process start using climate services. For example, in Australia, there is a clear evidence that adoption and use of climate services have been useful in building resilience against future drought and even climate risk. How can we ensure climate services are widely adopted? In the case of participatory research, general responsive research approach, and adoption of farmers' networks, there will be a need first to understand the importance of adoption of technology. Up to now, we see the level of use of improved variety, improved seed and all kinds of technology is very low, but it is not clear why farmers are not adopting technology. In the process we need to engage different stakeholders, including producers, researchers, policy makers, which are involved in agriculture in the process of understanding the process of developing improved technology, while developing technologies that are ecologically and socially acceptable and sustainable. This involves strengthening institutions that are working in providing climate service, and also doing capacity development through human resources, providing finances, creating an environment where technically they can work. It is also critical to engage farmers through extension officers, which are critical for farmers' engagement. For instance, we showed that it is possible to involve families in the engagement process: this can really help in terms of bringing technology and practical approaches which are going to improve performance agriculture production. Overall, science is key in enhancing the adoption of climate services, and with the advancement of science in recent years this adoption is continually improving.

A few questions followed. The first was directed at understanding whether farmers are conservative or innovators based on Prof. Chiulele's experience of working with farmers. In other words how willing are farmers to embrace this innovation, speaking of crop varieties or climate services? Prof. Chiulele explained that there are two groups of farmers: those who are very conservative and do not use anything which they do not know well, and instead those more market oriented who when they see a technology which they perceive can make a change in their lives, they go for it. But as he showed, 90% are small scale farmers and the majority are subsistence farmers, meaning that you have less potential of new technology being adopted if nothing is being done to change this in this way of thinking. As a follow up question, it was enquired whether these market oriented farmers could be a driving force to encourage other farmers into the adoption of new innovation, to which Prof. Chiulele agreed this could be a potential path to follow.

A second participant went further on this point, commenting that he did not fully agree with the idea that the farmers who are not really market oriented are conservative. In his dealings with farmers he has discovered that farmers are also researchers in a way or another. On the other hand, our approach to farmers could at times be perceived as a little condescending. In order to avoid this, farmers need to be involved in the process of co-production as early as possible. In responding, Prof. Chiulele agreed this is indeed an important point, that farmers should be involved in the process of research, as he also emphasised during his presentation. And again that involvement should take place from the beginning when setting up the problem, the objective of the solution and the technology to be developed: his can only increase the likelihood of accepting and adopting the technology. However, the point about farmers who are not market oriented, tend to be conservative, in general holds true with some exceptions.

With a third question, the participant referred to the statement made that climate services can help increase the resilience

of the agriculture sector, and wondered whether there is a way to locally track resilience through indicators. Prof. Chiulele does not have specific information on such indicators for Mozambique, but he again refers to other countries climate services have been widely adopted and they have been shown to be useful to increase resilience. However, he also noted that what is being done in terms of climates services with projects like FA looks very promising in the context of resilience.

The **panel discussion** started with short introductions by the five panellists, in addition to Prof. Chiulele, three representatives from hydro-met services – Mr Anacleto Duvane (Mozambique), Dr Lucy Mtilatila (Malawi) and Ms Mecklina Merchades (Tanzania) – one representing the insurance sector – Mr Israel Muchena (Life & Agricultural Insurance) – and one the extension workers – Mr Isoscelino Jose Drayver (SDAE).

Photo 5: Panel discussion (session 2)

Panel Chair Question	Panel Answer
What are the challenges faced by Hydro-Met Services?	**Mozambique**: They participate in SARCOF then do downscaling, work with agriculture sector and water and healthy sector. They prepare special scenarios for the ag sector, they have been supporting the ag community in understanding the weather info. **Malawi**: In the past five years, we have worked on participatory integrated climate services for agriculture by working directly with the farmers in the communities in the sense that they are engaged so that they understand the climate of their locality, including probability of onset of the rainy season, the dry spells, the wet spells, etc. This activity is successful because it is tailored to the locality of the farmers involved. The challenge with this initiative is that it is localised so it is expensive to reach out to many communities. Malawi relies on extension workers that reach farmers but it is not enough. There is still lack of knowledge from farmers, including around capacity building activities. On the positive side, there has been increase by 35% of climate services (based on a UNDP survey) because of these initiatives. Another challenge is that sometimes there is lack of knowledge by the farmers that the climate information is available from the met service to support their planning and management in the fields. This lack of knowledge may arise from the fact that there is also an assumption by the met service that we know what farmers need, while trying to push the information produced. But it is really when we engage with farmers that we realize and understand their needs and then we can tailor information in a much better way, but it is expensive. **Tanzania**: In terms of climate services for agriculture activities, there is inadequate capacity in providing quality information; if we had a better service, we could address the needs of farmers in a more effective way; there is also inadequate budget for infrastructure, hence we need the meteorological infrastructure and enhance capacity of professionals to check their quality. And since the farmers need high quality weather

	information, but also very specific, we have to make sure that we enhance the observation infrastructure. In addition to that, we need to enhance capacity of the main services to provide quality weather information. It is also important for hydromet services, as weather and climate experts, to put ourselves in the shoes of the farmers, specifically the farmers who are very local, not so much the commercial farming activities. The latter are aware, advanced and educated. In terms of (small-scale) farmers who are very local, without internet access, electricity, not even smartphones, the key is to provide very simple information so they can easily interpret it, but also make it easier for the local farmers also to understand without their systems. Currently the agro-met information provided by hydromet services, for instance through bulletins, contain details such as synoptic features or high pressure systems, which does not mean much to farmers, and so the presentation should be revised.
How does access of info could be improved from an extension officer perspective? And what's the best way for the dissemination of information?	To improve the information, from the beginning the climate information must reach extension officers through the most direct channel by exposing the investigation methods and the work together on the production of services. Also need to explore other channels than bulletins, especially involving extension officers. And the closer one relates to farmers the more successful the approach can be. For instance, it is important to understand local knowledge, through local insights and participatory interventions, also considering that in Southern Africa there is a very strong oral tradition of traditional folklore stories. So for instance when one present a (technological) solution they should try to relate it to their local experience, indigenous knowledge and resources rather than tell them that this technology works in Europe or Australia, as that feels very disconnected to them
How does the insurance sector address these challenges?	The insurance sector can play a critical role in terms of these services they could provide, such as the sharing of knowledge on management of risks especially the climate risks knowledge. In terms of protecting the thousands of small-scales farmers, there are insurers which offer some solutions to mitigate risk for the farmers. However, currently only less than 1% of farmers purchase insurance in Mozambique, which means that there is very little risk mitigation. At the same time, in neighbouring Zambia, the experience is quite different – thanks to the Farmer Input Support Project a million small-scale farmers (25% of the population) take out an insurance. The problem for Mozambique, it was argued, is that these farmers have minimal disposable income and can not afford to buy insurance or even try new technology, like climate services. Instead, they should be given the chance to try and test for free new technology before committing to it if they find it useful.
So how to scale it up? So where do you see the role of universities in all of this?	Universities have a major role in terms of doing the research and trying to understand how participatory partnership can help. It is important to have projects in which farmers are involved from the beginning in terms of setting the objectives, explaining where we want to go, what we want to achieve, then to discussed how to do it. It is interesting to notice how the farmers can contribute considerably in terms of generating critical results, which can lead even to acceptance and adoption of the technology.

Session 3: Demonstrate seasonal forecasting tools from CS 2, 3 and 4 to identify synergies, challenges, and opportunities for implementation

The session started with an introduction and demonstration of a visualisation tool that is being used and further developed under FA, the **Teal tool**[3], for the delivery of climate services. Mr Kristian Nielsen presented the Teal tool focusing on indicators that are relevant for the onset of the rainy seasons, number of dry and wet days, onset and cessation. These are calculated using the *standard technique*, as used by TMA, but there are several situations when this technique is not robust as it is based on a number of thresholds. As a result, another approach was explored, which we currently call *alternate technique*, which is more stable as it is based on the accumulation of precipitation.

With the Teal tool one can visualise several indicators, such as onset of the rainy season, cessation, cumulative precipitation, number of wet and dry days in a season. The indicators are currently available for the historical period only, but we are already working on the visualisation of the seasonal forecasts. The current design is to use graphs with box plots, so they also provide a representation of the uncertainty of the onset of the rainy season. The team is also working on a text-based

[3] https://tealtool.earth

information, via a downloadable pdf file, therefore without needing to explore various combinations which may be slow with a weak internet connection.

Photo 6: Working group, Teal tool demonstration (session 3)

Following, Dr Dell'Acqua presented another tool developed under the project, for estimating agronomic calendar of a wet season, and called **AquaBEHER**. This is a tool which is coded in R and that essentially computes and integrates daily reference evapotranspiration. It then estimates soil water balance and the agronomic calendar (onset, cessation, number of rainy days). It works with computations by R package, it takes daily data as inputs in an excel file, but one can also use gridded data which will give a map, which will provide agronomic season.

AquaBEHER can run a basic laptop but for spatial estimations over large domains/region would need high-spec computer. Computational power can be a bottleneck if a large domain is needed, but the team is working on optimising it. The package can be integrated, and it also has a graphical user interface that has been developed in the project and is called AquaBEHERgui. It can be used anywhere with crop production. The target users are nation met services, Agricultural research centres. The package is already publicly available on the internet.

Three break-out groups followed the Teal tool and the AquaBEHER presentations. The aims of the break-out group discussions were twofold:

i) To demonstrate and receive feedback on the seasonal forecast products developed by CS 2, 3 and 4;
ii) To gather an understanding of how climate information is used for agronomic purposes by smallholder farmers.

Each of the groups tackled the above briefs with one focussing on hydromet services, one on the use of AquaBEHER, and one on the use of the Teal tool.

Break-out group	Main points of discussion
1. Focus on the multi-annual prediction product, with hydro-met services	The participants of this breakout group were representatives of the national hydro-meteorological services. They were presented with novel output of the project: a multi-annual climate prediction for Southern African Development Community and more specifically for Tanzania. It consisted of several printed pages predicting temperature, precipitation, and drought conditions for the next 1-5 years. Some of the feedback received included: • Participants from Malawi expressed the wish to have the same multi-annual prediction for Malawi once shapefiles are obtained, to resemble the Tanzanian one • Some of the participants did not like that the areas with no skill or no most likely category were left white. They suggested to show something different instead, such as climatology or persistence, while marking that this comes from a different source than the model results.

	• Some island countries (e.g., Mauritius, Comoros and Seychelles) were not shown in the initial product with the SADC maps because there are no or few grid points over them. The participants suggested to include them, even if scientifically the results are less significant. • Participants suggested to separate SADC and Tanzania areas into different documents. • It was also suggested that the content of the documents should be distributed differently to increase clarity, e.g., different pages for different variables. • Considering participants are people regularly working with climate data, they suggested to include the scorecard for the models and multi-model in the prediction document itself. They are interested in knowing which models perform better and whether there is consistently better skill in a certain season or region. • There was a request to access the Shiny app online where the users can directly explore all the available results of the multi-annual predictions made in the project. • There was an interest to compare the forecasted years with the last few years or analogue years. • There was an interest to show the values of the thresholds between the different categories of probability, to increase understanding and actionability of the information.
2. Focus on AquaBEHER	The stakeholders described the tool as beneficial and addressing a crucial and frequently requested climate service for the agricultural sector. They showed interest about the possibility of integrating it into their operational services, from Mozambique and beyond. The stakeholders also provided specific suggestions for enhancing the tool: • It would be interesting to add seasonal forecasting capabilities including dry and wet spell information, soil moisture indices, WRSI (Water Requirement Satisfaction Index) for crops like maize, rice, ground nuts, and common beans. • It would be useful to incorporate an alternate method to generate seasonal forecasts for the wet season calendar by merging the official seasonal forecast from NMHS with the AquaBEHER water balance model. • The graphical user interface is very useful and can be further improved, e.g. introducing an option to display multiple variables or indices within a single plot, or implementing a function to showcase aggregated statistics of derived indices across different administrative boundaries. • There is the need to providing a comprehensive user guide and manual along with the tool as well as offering more extensive hands-on training sessions, allocating sufficient time for each aspect of the tool's usage. • The tool should be engineered to simplify and minimize the complexity associated with dependencies during the installation process, as well as including a feature for downloading and pre-processing the required input datasets.
3. Focus on Teal tool	The group discussed ways to improve the delivery of FA trial climate services by the Teal tool. Suggestions included: • It would be useful to have an explanation, as well as some basic analysis as background information for the users to make sure they understand it well – it was pointed to available information, including the use of the embedded TealBot • Different areas for small countries like Mauritius (case study 8), or high resolution – it was explained that there are already sub-country areas for Mauritius • Could consider additional indicators (e.g. SPI) as well as display of anomalies – some of this is under development, based on user feedbacks • With specific reference to Mauritius (but it could be useful for other regions), it would be useful to have consecutive dry days (for sugar cane, tea, maize as north of the island is dry); and there is also a strong demand for the onset season, and the number of wet days, so planning for sowing time can be

	optimised • Have accessibility tests been done (e.g. appropriate colour schemes for colour blindness) – it was indicated that attention has been paid but colours are regularly reviewed • It was asked whether there will there be point specific forecasts – the tool is built around shapefiles rather than points, but the shapes can be very small. • It would be useful to have a button for feedback – though there used to be one in previous versions, it was noted that there is also TealBot and contact information; the button can be re-instated • It would be useful for users to set specific thresholds (e.g. 400 mm of rain) – this would not be so easy as these need to be precomputed otherwise it would take too long to compute them on the fly, but we could select and precompute a set of thresholds • Could consider use of other precipitation datasets such as Tamsat

Session 4: Improve mapping of users' requirements for last mile delivery methods of trial climate services (channels of comms, data delivery, visualisation), including post-project sustainability

The fourth and final session was organised around three break-out group discussions. Each group addressed the same topic, namely ways to improve last mile delivery methods of trial climate services and their sustainability beyond the FA project, although two focused more on the delivery and one on the sustainability, also in line with the group expertise. Accordingly, the groups were divided in terms of the following people's expertise:

i) Farmers, extension officers, village chiefs, farmers associations, local government (focus on last mile delivery)
ii) NGOs, universities, other intermediary stakeholders (focus on last mile delivery)
iii) Service providers (met services, Govt depts) (focus on post-project sustainability)

The main points discussed and reported by each group are reported in the following table.

Break-out group	Main points of discussion
1. Farmers, extension officers, village chiefs, farmers associations, local government (focus on last mile delivery)	Discussed climate and weather information flow in Mozambique mainly, in order to understand the uptake of the FA project and how it can be regularly updated: • It was noted how the information comes from INAM to the Ministry of Agriculture. It is then channelled to the province then to the district. From the district, the information is transmitted toto the extension officers and the local leaders, who will relay it together to the smallholder farmers • It is interesting to note how the district department delivers the information to all stakeholders involved, namely extension officers, chiefs of communities and local leaders, as a way of building trust to the final users, the farmers • In terms of last mile delivery, there is a barrier due to the fact that some farmers can not read, and often do not have a phone. Written information in the shape of advisories, SMS or WhatsApp appear therefore to be challenging • The use of drawings could help to ensure the information reach the final users. A board prepared by extensionists or local leaders could be kept in a place of reference, like the office of the chief of the village. Even if sometimes the information is transmitted via vocal messages, there is risk of misunderstanding
2. NGOs, universities, other intermediary stakeholders (focus on last mile delivery)	From the perspective of NGOs, which have intensive contacts with local community, these challenges have been reported for the last mile delivery: • Lack of downscaled information, and also historical data; however the government is working towards having met stations, especially in the north of the country • The farmers do not receive information on time often because it has been generated though projects; also, once completed these projects often interrupt their services (issue of sustainability); even then it is a very small percentage of farmers who can access project information, typically 1-2% • Farmers need to pay for radios, some farmers do not receive at all the

	information if they do pay for a radio • Multiple stakeholders, such as extension officers, delivering information to farmers do not have access to it readily, which creates a lot of misunderstanding • It is recommended that more funding is needed for direct communication to farmers; for this there needs to be increased advocacy directed to the government
3. Service providers (met services, Govt depts) (focus on post-project sustainability)	The group reviewed the information flow for some met services: • Each of met service drew their information flow and compared them • Each met services deliver information through many channels, to several institutions, including via social media, radio, WhatsApp groups that directly reach extension officers • It was again remarked that many farmers do not have access to phones • There is a strong need for tailoring of information, though it is recognised that this has a high cost; there are some services that are commercial for tailored information; for this reason it is important to try to access funding for projects to maintain continuity via e.g. the Green Climate Fund.

Photo 7: Working group discussion (session 4)

Final remarks

Ms Roberta Boscolo, Dr Matteo Dell'Acqua, and Dr Missa Mustafà provided some final remarks and acknowledgements to wrap up the workshop. Ms Boscolo thanked everybody for the excellent collaboration during the workshop and really appreciate everybody's contributions. This means a lot for the FA project, of course for Mozambique, but also in general, for all the components of the project. Dr Dell'Acqua also thanked everybody on behalf of the coordination of the case study 3 for their time and energy to participate in the discussions. These will be very useful learning lessons, not only for us working in Mozambique, but for the entire SADC region. The feedback received about the production of the case study tools will be used to advance the impact of Focus Africa.

Dr Mustafà thanked everybody on behalf of INAM for the opportunity to have this interaction between the FA project and some of the climate service experts of Mozambique. It has been a very good opportunity to increase capacity of these experts. Dr Mustafà remarked the challenges in Mozambique, to do with problems with dissemination of information mainly due to the many local languages, even if the official language is Portuguese. And if information needs to be used by farmers, there is the need to spend a lot of time to translate it and communicate it to different communities. He emphasised it is very important to continue to exchange experiences to try to overcome communication barriers. It should be done on a regular, almost day-to-day, basis, in a similar way to what has been done during this workshop, by explaining technical information, translating into the reality of the field, through strong collaborations.

Main take away points

A list of the most important points raised during the Stakeholder Workshop are provided in the following:

- Critical role of participatory approaches for the co-production of climate services for agriculture by working directly with the farmers in the communities by understanding the climate of their locality, including probability of onset of the rainy season, the dry spells, the wet spells, etc.
- Need to better tailor the climate information, keeping the messages simple, avoiding technical terminology like high pressure systems
- Importance of accessing local weather and climate data, including by installing new weather stations
- Need to explore various communications channels other than web pages or even bulletins, especially involving extension officers, and ensuring the appropriate information reaches the farmers
- A major barrier is due to the fact that some farmers do not know how to read, and often do not have a phone: it is hard to prepare written information, such as recent advisories that could be shared, and even communicate via SMS or WhatsApp is a challenge
- Important to consider that in Southern Africa there is a very strong oral tradition of traditional folklore stories. So for instance when one present a technological solution they should try to relate it to their local experience, indigenous knowledge and resources rather than tell them that this technology works in Europe or Australia, as that feels very disconnected to them
- Universities have a major role in terms of doing the research and trying to understand how participatory partnership can help. It is important to involve farmers in projects from its early stages, including setting the objectives: farmers can contribute considerably in terms of generating critical results, which can later lead to acceptance and adoption of the technology
- Need to increase percentage of people insured to provide an alternate way to mitigate risk: only less than 1% of farmers currently purchase insurance in Mozambique
- A tool to compute agriculture relevant indicators, and the agronomic calendar, called AquaBEHER, developed as part of case study 3 has been presented, with positive feedback from the attendees
- Agriculture relevant indicators precomputed as part of the project have been co-developed as new components of the visualisation web tool, called Teal, with positive and constructive feedback from the attendees

Annexes

Annex 1: Agenda

FOCUS-Africa 4th Stakeholder Workshop
Wednesday 10th May 2023
Programme
(all times in Mozambique local time, i.e. UTC+2)

Time	Title	Chair/Speaker
08:30 – 09:00	**Arrival**	
09:00 – 09:20	Opening remarks, project introduction Welcome	Chair: Matteo Dell'Acqua (SSSA) Roberta Boscolo (WMO) Paulino Munisse (IIAM)
	Session 1: Climate services for food security in Mozambique	
09:20 – 10:50	State-of-the-art for the work related to climate services for agriculture in Mozambique (15 min each) Q&A (15 min) Case Study 3 updates (25 min): the science and products	Chair: Matteo Dell'Acqua (SSSA) • Missa Mustafà (INAM) • Hitem Jentilal and Zulmira Mumino (Ministry of Agriculture) • Alfredo Novela (World Food Programme) With the three speakers Matteo Dell'Acqua (SSSA)
10:50 – 11:15	**Coffee break**	
	Session 2: Advance understanding of users' requirements, perspectives, and strategies for food security	
11:15 – 12:15	Introduction: climate requirements for agronomy (20 min) Panel discussion (40 min)	Chair: Dragana Bojovic (BSC) Rogerio Chiulele (Eduardo Mondlane University) • Anacleto Duvane (INAM) • Israel Muchena (Life & Agricultural Insurance) • Lucy Mtilatila (DCMMS) • Mecklina Merchades (TMA) • Isoscelino Jose Drayver (SDAE)

12:15 – 13:30	**Lunch**	
	Session 3: Demonstrate seasonal forecasting tools from CS 2, 3 and 4 to identify synergies, challenges, and opportunities for implementation	
13:30-15:00	Introduction and demo of Teal tool Three break-out groups. Aims: i) To demonstrate and receive feedback on the seasonal forecast products developed by CS 2, 3 and 4; ii) To gather an understanding of how climate information is used for agronomic purposes by smallholder farmers. Short presentations of the CS 2, 3, 4 tools will also be given.	Matteo Dell'Acqua (SSSA) and Kristian Nielsen (WEMC) Moderators: 1. Dragana Bojovic (BSC) 2. Matteo Dell'Acqua (SSSA) 3. Kristian Nielsen (WEMC)
15:00– 15:30	**Coffee break**	
	Session 4: Improve mapping of users' requirements for last mile delivery methods of trial climate services (channels of comms, data delivery, visualisation), including post-project sustainability	
15:30 – 17:00	Introduction Three break-out group discussions divided by: i) Farmers, extension officers, village chiefs, farmers associations, local government (focus on last mile delivery) ii) NGOs, universities, other intermediary stakeholders (focus on last mile delivery) iii) Service providers (met services, Govt depts) (focus on post-project sustainability)	Chair: Sebastian Grey (WMO) Moderators: i) Marie Veys (LGI) ii) Mercy Macharia (SSSA) iii) Ilaria Vigo (BSC)
17:00 – 17:30	Plenary reporting, summary and next steps	All Participants
19:30	**Group Dinner**	

Annex 2: Presentations

All presentations are available at the following link.

Link to Presentations[4]

[4] https://wmoomm.sharepoint.com/:f:/s/XB_Projects/EmHI_XS-XdRAqtQmGUHXsQABTXi87N4fDxJ_JP4kiwL4Og?e=fjQxSg