Introduction to digital climate information services for aquatic food systems in Malawi: A dialogue-cum-training workshop report

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WorldFish organized the workshop within the scope of the component "Digital fisheries information systems (FIS) and knowledge sharing platform for managers and value chain actors" under the assignment "Genetic improvement, support for aquaculture value chains and promotion of fish in foods systems in the SADC."

We also acknowledge all of the participants of this workshop for their engaging discussion and valuable input. Additionally, we would like to acknowledge the enormous support of the Malawi Department of Fisheries and the Department of Climate Change and Meteorological Services during the workshop.

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Front cover, Peter Mumba/WorldFish.

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List of abbreviations

CIS	climate information services
CWIS	climate and weather information systems
DCCM	Department of Climate Change and Metrological Services
DCIAS	digital climate information and advisory services
DOF	Departments of Fisheries
FIS	fisheries information systems
PROFISHBLUE	Program for Improving Fisheries Governance and Blue Economy Trade Corridors
SADC	Southern African Development Community

Executive summary

On October 3–4, 2023, WorldFish held a dialogue-cum-training workshop on digital climate information and services (CIS) for aquatic food systems in Malawi at Wamkulu Palace in Lilongwe. The workshop was organized in close consultation with the Department of Fisheries (DOF) and the Department of Climate Change and Meteorological Services (DCCM). The event was part of WorldFish's support for the Southern African Development Community (SADC) in executing the Programme for Improving Fisheries Governance and Blue Economy Trade Corridors in SADC Region (PROFISHBLUE), which is funded by the African Development Bank. One of the components of PROFISHBLUE focuses on digital fisheries information systems (FIS) for value chain actors and knowledge sharing platforms. Within this scope of PROFISHBLUE, WorldFish is set to develop a climate informed digital decision support system to disseminate advisories for climate risk management to two SADC countries: Zambia and Malawi. The aim is to de-risk value chains of aquatic food systems in the SADC region.

As part of this, WorldFish arranged the workshop in Malawi with relevant stakeholders and value chain actors of aquatic food systems to identify relevant climate variabilities and extreme risks for aquaculture and fisheries, as well as climate sensitive operations that influence related sensitive management decisions. This is instrumental to gain a better understanding of specific climate challenges that aquatic food producers currently face and to identify the entry points of support climate services required for associated risk management.

In attendance at the workshop were Mr. Maurice Makuwila, acting director for the DOF and PROFISHBLUE focal point from the SADC in Malawi at that time, and Dr. Lucy Mtilatila, director of the DCCMS. Also in attendance were senior distinguished government officials and representatives from the DOF, DCCMS, the private sector, researchers from nongovernmental organizations (NGOs), and academics. Various value chain actors from the fisheries and aquaculture sectors, such as fishers, farmers, processors, market actors, hatchery operators and fingerling traders, also joined the workshop and participated during the panel discussions, individual exercises and group work. It is important to highlight that 30 percent of the participants were women.

The blue economy is a high priority in the SADC region, not only because of sectoral opportunities in enhancing the economy, but also due to the exposure to climate change. As such, the contribution of digital climate information and advisory services (DCIAS) is not limited to addressing economic loss and damage, but to ensure food, nutrition and livelihood security as well. Aquatic food systems are important to ensure food and nutrition security in Malawi. Capture fisheries and aquaculture in the country contribute approximately 4 percent to the total gross domestic product (GDP) and provide about 40 percent of the protein needed for nutritional security. However, the sector is vulnerable to climate change and impacted by climate variabilities and extremes. For instance, rising temperatures have already resulted in decreased water levels in capture fisheries lakes, resulting in degraded vegetation, fewer breeding areas and reduced fish growth. This has increased the mortalities and disease outbreaks and changed feeding behavior in the aquaculture sector.

Against this backdrop, CIS holds tremendous potential for aquatic food systems by providing timely information and tools so that farmers can make more climate-resilient decisions. So far, however, CIS research and projects addressing food security in Malawi have largely focused on land-based agriculture. A few pilots have started focusing on fisheries, like Participatory Integrated Climate Services for Agriculture (E-PICSA) by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) along with Modernized Climate Information and Early Warning System (M-CLIMES) by the DCCMS; however, information about the specific needs for CIS in the aquaculture sector remains scarce. This report addresses that gap.

The workshop started with a panel discussion with a few preselected notable stakeholders and actors from the DOF, DCCMS, the private sector and academia, as well as fish farmers and fish farmers, followed by an individual exercise. Mr. Makuwila noted the importance of CIS for aquatic food systems in Malawi, and Dr. Mtilatila shed light on current initiatives from the government to provide DCIAS for fisheries, such as a WhatsApp group, a hot line number, a risk forecast bulletin and community radio. Challenges were also highlighted, such as the lack of a climate literacy initiative for fishers and fish farmers coupled with limited accessibility to DCIAS.

Participants were then introduced to the basics of climate change and variabilities and their impacts, along with information and services, to directly address decisions and needs for aquaculture. Key concepts covered included climate, weather, variability, timescales in weather and climate information, and lead time, along with the four pillars of climate services (production, translation, communication and use).

Next up was a series of hands-on exercises. This allowed participants to focus on their individual operations and jointly unpack the needs, opportunities and challenges facing DCIAS for aquaculture and fisheries. In this line, a climate adaptive decision-making framework and a module for communicating DCIAS was shared and explained so that farmers can identify different climate sensitive management decisions and the climate information needed to inform those decisions.

Climatic variables like temperature and rainfall play a critical role in daily activities and management decisions regarding stocking fingerlings, culture periods, feed management, managing water depth, protective measures and harvesting decisions. Participants identified their own climate risks, climate sensitive operations and climate-management decisions in order to manage the risks in their own operations using the decision-framework introduced. Each participant developed and presented their own climate-adaptive decision-making flowchart and explained the climate issues in detail, while including women and youths in the context of Malawi. They also mapped the key actors in line with the four pillars of DCIAS, existing digital landscapes, current approaches and the communication modalities for aquaculture and fisheries in Malawi, along with their preferred function and challenges.

Live examples of DCIAS already developed for the SADC region include climate and weather information systems (CWIS) for farmers and fishers in Malawi under the M-CLIMES project by the DCCMS, E-PICCSA under i4AG by GIZ and the intelligent Agricultural Systems Advisory Tool (iSAT) under International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) by the International Livestock Research Institute (ILRI). These DCIAS are relatively new and are currently in the pilot phase. However, these examples provided the participants with an overview of the existing digital landscape for climate-adaptive decision-making and scopes for aquatic food systems to build themselves up. The discussion centered around the strength, weakness, applicability and long-term sustainability of these recently developed digital platforms.

The workshop identified the importance of both seasonal and short-term weather forecasts for strategic planning and day-to-day operational planning, along with a climate literacy program for value chain actors that takes into consideration the interconnectivity of operations among value chains. For instance, the daily activities of fish processors and the decisions of market actors depend on the ability of fishers to catch fish with the knowledge of the weather conditions of a specific day. Conversely, early or late harvest decisions among aquaculture farmers determine what the right time and fair price are for market actors to sell their fish. The workshop also emphasized strengthening collaboration among key actors, climate literacy programs for fishers and fish farmers and a capacity building initiative for different stakeholders.

These findings would add substantial value in developing a digital decision-support system for climate risk management of aquatic food systems in Malawi. PROFISHBLUE will build on this momentum to tailor the DCIAS for aquatic food systems, as defined by the actors who participated in the workshop. Doing so will develop systems to help farmers make climate informed decisions by managing climate risks in a user-friendly way and, thus, build their adaptive capacity for resilience. By using DCIAS to manage climate risks in aquatic food systems, PROFISHBLUE will enhance opportunities for future climate investment in this sector.

Introduction

WorldFish has been engaged in various activities under PROFISHBLUE, including genetic improvement, support for aquaculture value chains and promoting fish in food systems in the SADC region. One of the project's components is DCIAS for managers and value chain actors. This component focuses on identifying climate variabilities and extreme risks relevant to aquaculture and fisheries in Malawi and Zambia, and aims to develop a climate informed decision support system. The primary goal is to de-risk the value chains of aquatic food systems in the SADC region.

In line with this, WorldFish conducted the workshop to identify climate sensitive operations and corresponding climate sensitive management decisions. The main objectives were to identify relevant fisheries information and then tailor the DCIAS and knowledge sharing platforms accordingly. Additionally, the workshop attempted to determine the key information required to develop a decision framework within the SADC region to provide DCIAS for fish.

This report presents the findings of the workshop involving stakeholders in the fisheries sector, with a specific focus on digital FIS in Malawi. There were a total of 30 participants, including nine women. Participants were drawn from various departments, including the DOF, the DCCMS, civil society organizations and academia, and included fishers, fish farmers, and representatives from WorldFish.

Keynote speech by Mr. Maurice Makuwila, acting director of the DOF in Malawi and PROFISHBLUE focal point.

Background

Climate variabilities and extremes, such as temperature variation, erratic or intense rain, floods, drought, strong winds and cyclones, significantly impact fisheries and aquaculture in the SADC region (Thorton et al. 2022). In Malawi, temperatures have risen at an annual average rate of 0.9°C since 1960 (GEF 2019). This has resulted in decreased water levels and reduced fish catch, particularly in Lake Malawi and Lake Malombe (Kumambala and Ervine 2010; Kainge et al. 2020; Makwinja et al. 2021). In addition, high temperatures and reduced rainfall are causing Lake Chilwa to dry up, though an increased catch of chambo was observed in Lake Malawi during times of increased rainfall.

The aquaculture sector has also been facing extreme cold temperatures that have affected fingerling production and fish growth (UNDP 2016). Fish farmers are experiencing warm temperatures and erratic rains that are drying up ponds and raising the mortality rate of fish species (Global Facility for Disaster Reduction and Recovery 2011). Also, due to El Nino events, dry spells and/or droughts could become more common in Malawi in the future (Mkwambisi et al. 2021), leading to poor water quality in ponds for fish farming operations. Increased temperatures exacerbate the situation, leading to evapotranspiration and further reducing water quality in ponds (Allison et al. 2007; GEF 2019). As such, information on high or low temperatures and erratic or intense rainfall, together with information on dry spells and/or droughts, would help fishers decide when to catch fish. It would also help fish farmers make decisions on fingerling production, and the stocking and harvesting periods, as well as relevant management decisions in line with water quality and feed management.

Winds also have a significant impact on artisanal fishers, who rely on traditional vessels for their fishing operations. Mwera winds, particularly strong southeast winds, deteriorate the conditions on the lake and cause flooding, putting the lives of the fishers at risk and potentially damaging resources like boats and nets. Malawi has had 16 major flooding events and five related storm disasters. Cyclones have also affected the country, including Cyclone Idai in 2019, Tropical Storm Ana and Tropical Cyclone Gombe in 2022 and Tropical Cyclone Freddy in 2023 (World Bank 2019; Government of Malawi 2023). Flooding destroys fish habitats and fishponds, resulting in pollution, invasion of weeds and new species, less production and fish loss. To effectively manage these climate risks, it is crucial to build climate resilience and institutional adaptability to shocks. To achieve this, it is important to provide timely, reliable and context-specific DCIAS tailored for aquatic food systems.

Objectives

The main objective of the workshop was to identify information relevant to fisheries and aquaculture and tailor it to DCIAS. Under this objective, the event had three subobjectives as follows:

1. Gain a better understanding of the specific needs and potential for DCIAS in the aquatic foods sector, along with the existing decision-making process of different stakeholders or organizations, to identify climate impacts and climate sensitive decisions within it.
2. Provide participants with an understanding of DCIAS for aquatic food systems, and then develop a critical assessment of the current use of DCIAS within their arena as well as bottlenecks and pathways for improvement.
3. Create an opportunity for bridging the gap between users (fish farmers) and providers (DCCMS).

Day 1: October 3, 2023

Introductory remarks

Dr. Orton Msiska, country lead for WorldFish Malawi, opened the workshop with a welcome address, after which the participants and organizers introduced themselves. Dr. Msiska emphasized the challenges that climate change poses on the aquatic food system in Malawi and other African countries in the SADC region. He cited the recent Tropical Cyclone Freddy, which affected the southern part of Malawi, causing a lot of damage to infrastructure and affecting agriculture, including fisheries and aquaculture, thus posing a threat to food security. With this in mind, he underscored the importance of concerted efforts from various stakeholders to collaborate and devise strategies to mitigate the impact of climate change on vulnerable communities.

Welcome remarks from Dr. Orton Msiska, country lead for WorldFish Malawi.

Mr. Makuwila then delivered the keynote address, expressing his gratitude to the African Development Bank for its support of PROFISHBLUE and providing an overview of its objectives. He outlined that PROFISHBLUE aims to increase fish trade in the SADC region. He then pointed out that the fisheries sector is a key industry in Malawi, providing direct and indirect employment. It also contributes approximately 4 percent to the GDP and plays a crucial role in improving the nutritional status of the people in Malawi and the SADC region at large.

However, Mr. Makuwila noted that the aquaculture sector in Malawi is still in its early stages and requires the support of various partners, such as WorldFish, to reach its full potential. He highlighted the challenges that climate change poses, which is why the workshop was organized. Incentives are needed to improve the capture fisheries and aquaculture sectors in Malawi, including providing duty waivers to make business easier for farmers and offering loans to farmers so that they can build infrastructure capable of withstanding weather patterns. Additionally, in areas with limited water, there is a need for adaptation, such as using solar power to pump water from underground.

Dr. Peerzadi Rumana Hossain, a WorldFish scientist, made a presentation (Annex 1) on digital FIS and a knowledge sharing platform for managers and value chain actors to set the scene as a component lead. This presentation outlined the key objective, outcome and output for the digital FIS component of the project. In her presentation, Dr. Hossain explained that PROFISHBLUE seeks to develop a DCIAS system for climate informed decision-making to manage climate risks in Zambia and Malawi, considering that fisheries and aquaculture are highly vulnerable sectors to climate change variabilities and extremes. Some activities will include setting up an open-source regional digital platform to share and coordinate data and information, along with related training programs. This will involve identifying information relevant to fish culture in order to accomplish three goals: (1) tailor the DCIAS system and knowledge sharing platform, (2) develop the decision framework and decision support system in the context of the region to manage climate risks for fish and (3) disseminate information on the fish value chain through a sharing application and hands-on training on digital apps. She also presented the findings of a literature review on how climate variabilities affect fisheries and aquaculture. She emphasized that DCIAS can not only help manage climate risks but also improve both food and nutrition security by addressing climate induced loss and damage.

Dr. Peerzadi Rumana Hossain, WorldFish scientist, setting the scene.

Following Dr. Hossain's presentation, stakeholders were given an opportunity to ask questions. The following are some of the key questions that were raised:

Question 1: Where do you want to anchor the fisheries information system platform in Malawi?
Response: This is the main reason we organized this workshop involving various actors from the value chains of capture fisheries and aquaculture—to discuss how we can anchor the digital FIS and the role of the private sector for continuity even after the PROFISHBLUE project ends.

Question 2: Why are you only focusing on temperature and rainfall?
Response: Because temperature and rainfall are the two key climatic variables that affect aquatic environments and/or drive the other water quality parameters of a pond's aquatic environment. Besides, temperature and rain are the two main daily variabilities of weather. However, the project is open to considering any other variables that may be beneficial in crafting DCIAS for aquatic food systems in Malawi.

Question 3: What is the difference between early warning systems and climate information services?
Response: Early warning systems are mainly focused on climatic extremes like floods, droughts, cyclones, etc., and, accordingly, disaster risk management. Climate information services focus on daily climate variabilities like temperature fluctuations, cold spells, erratic or intense rain, dry spells, etc., and, accordingly, climate risk management in day-to-day operations.

Question 4: How will the advisory be disseminated, since the SMS system is only working at the capture fisheries level?
Response: This is the primary reason for convening this workshop—to understand the existing systems in Malawi and determine the most effective way to integrate our efforts without duplicating the work already accomplished on the same.

Panel discussion

This session entailed an interactive discussion with industry players based on predetermined discussion questions (Annex 2) concerning DCIAS within the context of climate change in Malawi. Keagan Kakwasha, monitoring, evaluation and learning specialist with WorldFish, moderated the panel, which included expert representatives from the DOF, DCCMS, academia and the private sector, as well as fishers and fish farmers.

Department of Fisheries

Regarding how climate variabilities and extremes affect fisheries and aquaculture in Malawi, the DOF first sheds light on events like drought, cyclones and floods, because climatic extremes affect fishing communities and fish farmers by destroying landing sites, fishing gear, fishponds, and, in the worst-case scenario, leading to loss of lives as well. Climate variabilities also affect the livelihoods of fishers and fish farmers, as they lack coping strategies to manage the associated risks in their daily operations. On the most important climate issues, the DOF highlighted floods and droughts for aquaculture and both strong winds and stormy rains for capture fisheries, particularly for value chain actors like fishers, fish traders and fish processors. Fishers use primitive methods to predict weather variabilities to decide when to go fishing, and fish traders need information about the availability of fish at the landing site, while fish processors need information on which methods to use during extreme events to aid in drying the fish. However, there are several interventions occurring in the sustainable fisheries component of the project. The DOF is collaborating with the climate department on various projects. For example, the Ministry of Agriculture is currently spearheading the pilot of an e-government initiative, which the DOF aims to adopt for the fishing community.

Department of Climate Change and Meteorological Services

The DCCMS provides a lot of climate information, including for the fisheries sector. It offers tailored advisories depending on the industry, whether for fishers or farmers. However, farmers and fishers often do not actively seek out this information. Typically, the DCCMS issues information to fishers directly, such as weather forecasts before they go fishing in lakes and also warnings about strong winds with a 5-day focus, from the first day to the last day. The system is designed based on specific requests that fishers make. The DCCMS was in the process of piloting DCIAS in Mangochi, Salima and Monkey Bay. The platform involved crops and livestock, and one of the key lessons learned from this phase was how to package messages that targeted beneficiaries, who are mostly small-scale fishers, could access and use more easily. So, information is available, but access remains a challenge. The DCCMS relies on WhatsApp groups, and the assumption is that individuals in these groups will share the information. Additionally, extension workers and community radio stations play a crucial role in sharing climate information. Nonetheless, it is uncertain whether fishers actively use the information or not. Therefore, a feedback mechanism is needed to understand whether this is an effective method.

Academia

Professor Fanuel Kapute pointed out that no research has been done in the context of Malawi when it comes to climate impacts on fisheries and aquaculture nor has a needs assessment been done on climate risk information and services for fishers and fish farmers. However, a few on climate relevant issues have been done, such as energy-saving processes in fish farming, specifically solar energy. He also mentioned that there were no estimates on the loss and damage caused by climatic events. Regarding DCIAS, however, there is still a long way to go in terms of accessibility. The main concern is the limited access to smartphones and the internet. Better access to both would allow fishers and fish farmers to access DCIAS.

Fishers

Fishers flagged the difference between the climate today and seven years ago, when most of them started fishing. This has significantly affected their business, resulting in reduced catches. They are experiencing significant losses—to the extent that they are unable to pay workers, and their expenditures are surpassing their income. In addition, they still use traditional fishing methods. What they really need are new technologies for catching fish and capacity building in terms of fish preservation, because clients who purchase from them are facing losses from increases in temperature. Although the DCCMS does alert fishers about the Mwera winds in advance, the fishers said that they need support for capacity building and sharing knowledge on climate literacy programs in order to manage climate risks in their daily operations and activities.

Fish farmers

Fish farmers from the Basin in Mzuzu said that they are also experiencing climate change issues, particularly floods. However, they said that they have taken preventive measures in advance, like planting sugar cane to strengthen their dikes, so that they did not incur any loss. In their community, however, the impacts of floods, such as ponds being washed away, have led to loss of fish and income because they did not prepare themselves for this type of climatic event. As such, it is evident that DCIAS would help them manage climate risks if they had the time to make proper management decisions prior to climatic events.

Selecting fish species is also important to avoid loss. For instance, catfish do not require a lot of water, and they grow well even during periods of less rainfall. Site selection is also important, based on local climatic parameters. Lake Mzuzu is suitable for fish farming because of an abundance of water. Fish farmers in Mzuzu said that they use climate information to maintain their ponds. For instance, if they receive information about heavy rainfalls, they can raise the heights of their dikes and dig them deeper. During periods of high temperatures, they can deepen their ponds to reduce evaporation and prevent them from drying up. They also said that climate change in areas such as Mzuzu has actually benefitted fish farmers, as the fish grow faster when temperatures are higher. Also according to information from the DCCMS, temperatures have risen by 0.02°C across districts in Malawi. And with heavy rainfall, ponds do not completely dry up during the dry season.

Private sector

Representatives from the private sector said that they used to buy feed from Zambia, but now they produce 300–1000 kg per hour in Malawi when their machines are fully functional. They supply both the Southern and Northern regions, produce fingerlings throughout the year and have expanded to indoor hatcheries. Climate change has affected all of these activities, leading to, for example, increased market volatility for fish feed. So, DCIAS could help the private sector predict periods of market volatility and, accordingly, help the sector decide when the best time is to produce feed.

Individual exercise

Participants were given an opportunity through an individual exercise to share their climate adaptive decision-making to de-risk aquaculture and fisheries and value chains. All of the participants who took part acknowledged that climate change had affected them. This included actors from both capture fisheries and aquaculture operations. Using a climate adaptative decision-making flowchart (Annex 3), the actors identified a wide range of information, starting from specific needs of DCIAS together with climate sensitive management decisions and the lead time to the worst that can happen in the absence of DCIAS. They also sketched the status of DCIAS, along with suitable platforms, in the context of Malawi. The information is shown in Table 1.

A DOF official delivers her presentation.

Actors	Climate information needed	Climate sensitive management decisions	Lead time	The worst case scenario if I don't use the information to make decisions	Information currently being used	Tools or apps suitable for CIS
• Fish farmers • Feed manufacturers • Fish processors • Fishers • Market actors	• Extreme low and high temperatures • Mwera winds • Heavy rains • Thunderstorms • Cyclones • Floods • Dry spells	• Harvest the fish before the ponds are flooded or dried. • Raise the pond dikes after seasonal bulleting. • Plant bananas to reduce runoff of water. • Plant grass, trees and sugar cane to hold dikes in place. • Dig drainage canals to lead water away from the ponds. • Prepare a flood pond and raise the dikes. • Stock ponds earlier so that they are harvested before the rains. • Decide when to stock fingerlings or sell what are in the ponds. • Avoid going fishing, and keep vessels safe.	• 1 month • 3 months • 2 weeks	• Monetary loss • Waste of time • Fish loss • Fishpond damage • Fish harvested before the target market size and loss of income from low prices • Hampered business	• Climate weather information from the DCCMS • Weather forecasts from the DOF	• Radio • Facebook • WhatsApp • Traditional methods • SMS • Voice call
• Academics • Government officials • NGOs • Private sector	• Floods • Extreme heat • Onset of rain • Strong/high winds • Cold spells	• Decide whether to stock fingerlings earlier or later with the onset of rains. • Decide whether to harvest fish earlier or later with floods and dry periods. • Make sound fishing decisions. • Make sound decisions on processing and selling. • Allocate funds to prepare for risks.	• 1 week • Seasonal	• Loss of life or infrastructure • Loss of livelihoods (income) • Loss of fish	• Periodic weather forecasts from the DCCMS • Weather app from Google • Zanyengo forecast information • Forecasts or warnings shared on WhatsApp	• Radio • SMS • Zanyengo • CWIS • WhatsApp

Table 1. Summary of the individual decision-making flowchart activity.

Day 2: October 4, 2023

Group exercise

The group exercise module (Annex 4) was designed to identify the existing climate information and advisory services for fisheries and aquaculture along with the challenges, including the key actors involved in generating, translating, transferring and using DCIAS in Malawi. Alinafe Maluwa, a research assistant at WorldFish Malawi, facilitated the group exercise.

Group work on communicating DCIAS for aquatic food systems in Malawi.

The groups presented the results from their discussion. The presentations revealed that the DCCMS is the key actor for generating DCIAS, while the DOF is the main one for transferring it. From there, DCIAS is transferred through extension workers, beach village committees, churches and NGOs. The participants also identified a range of users (Table 2).

Furthermore, the group presentation covered various aspects of the existing digital landscape in Malawi for both aquaculture and fisheries. This included an overview of the available agrometeorological and early warning services and the current approach of DCIAS in the country, as well as the functions and challenges associated with these services (Table 3).

Who are the key actors, stakeholders and organizations for each pillar of DCIAS in Malawi?			
Generation	**Translation**	**Transfer**	**Users**
DCCMS (main mandate) DOF Agriculture weather stations Academia	DCCMS DOF (main mandate) Agriculture weather stations Department of Disaster Management Affairs	Extension workers Churches Beach village committees NGOs	Fishers Farmers Policymakers Researchers Crop farmers Fish processors Fish traders Extension officers Beach village committees Fish off-takers Feed manufacturers

Table 2. Summary of the key actors in line with the four pillars of DCIAS.

Some of the early warning services highlighted in the presentations included CWIS linked to SMS, early warning messages for winds and a WhatsApp group for DOF officials and/or farmers. In terms of the current approach, methods such as news bulletins, extension workers, public address systems, WhatsApp, SMS and voice calls were all discussed. The group also presented on how DCIAS function in Malawi, emphasizing key roles such as producing seasonal forecasts, raising awareness among fishers and farmers, and providing timely extreme weather alerts. Regarding challenges, participants identified issues such as the absence of specific bulletins targeting fishers and farmers, lack of timely access to information for some users, expensive data tariffs, and literacy levels, which affect the ability of farmers to understand the information.

During the Q&A and discussion session of the group exercise, the participants were asked about the challenges that extension workers face in delivering DCIAS. They replied that the information comes in bulk, and it requires an officer to isolate the relevant information suitable for fishers and/or farmers. Sometimes, the extension worker does not have the technical knowhow needed to understand climatic issues. As for the digital aspect and open-access issue of CIS in Malawi, the participants said that some of the available CIS are digital, but they are still in the early or pilot stage of development, so access is limited.

Available CIS systems/platforms	Current approach to digital CIS	Functions preferred	Communications modalities	Challenges for CIS
CWIS linked to SMS	News bulletin	Seasonal forecast	Beach village committees	No specific bulleting targeting fisher and farmers
Early warning messages for strong winds	Radio programs	Raising awareness among fishers and farmers	Extension workers	Some users do not have access to timely information
WhatsApp groups	Public address system	Extreme weather alerts	Radio stations	Expensive data tariffs
Radio programs	Broadcast media	Adapting to local climate	Social media, particularly WhatsApp	Literacy levels for reading and using CIS
TV programs	Apps (Oxfam distributes media)	Weather forecast and advisory for fishers	Voice calls	SMS use limited in terms of its capacity
Digital weather stations	WhatsApp		SMS	Fluctuating or no mobile networks in other areas
M-CLIMES	SMS and voice calls		TV	Technical understanding of the information
E-PICSA for agricrops	Farmers and fishers groups			Lack of climate literacy
	Extension workers			Lack of awareness for use of CIS offered by DCCMs
	DCCMS			Lack of infrastructural and technical capacity of DCCMS (in terms of equipment to increase coverage and maintenance/ personnel)
	CWIS linked to SMS			Difficulty in message interpretation
				Infrastructure to generate CIS–some weather stations not functioning

Table 3. Summary of the group work on communicating CIS.

Presentations

There are three examples of DCIAS already developed in this context for this region: (1) CWIS for farmers and fishers in Malawi under the M-CLIMES project by the DCCMS, (2) E-PICSA under i4AG by GIZ, and (3) iSAT under ICRISAT by the ILRI.

intelligent Agricultural Systems Advisory Tool (iSAT)

Ram Dhulipala, senior scientist at the ILRI, presented iSAT as an existing platform that can deliver DCIAS. This is crucial for achieving better adoption and impact when DCIAS offer real-time, location-specific and crop-specific advisories based on historical, current and predicted conditions, ranging from daily to seasonal scales. iSAT is designed to help smallholder farmers manage climate risks through timely, location- and crop-specific forecast-based agroadvisories. It responds to both tactical and strategic needs, supporting decision-making under highly variable climatic conditions using science-based climate information. This digital system operates through two main components: Preseason Advisory and In-season Advisory. The Preseason Advisory relies on insights from historical climate data, El Niño/La Niña occurrences and other relevant indicators, while the In-season Advisory is based on rainfall data from the previous week and the start of the season. The latter uses short- and medium-range forecasts and is issued a week after the Preseason Advisory. This comprehensive approach ensures that farmers receive timely and relevant information to make informed decisions, helping them manage climate-related risks in agriculture in a sustainable manner. iSAT can be used for aquatic food systems as well; however, the decision framework for specific fish species needs to be developed and incorporated within this system to make it operationalize for aquaculture and/or fisheries. This system is USSD and GSM supported, so it can send DCIAS to fish farmers through SMS for farmers that are registered in the system. And it is automated for registered users to receive information and advisories through SMS.

Climate and weather information systems (CWIS)

Mr. Tolani Kanyenda, principal meteorologist for the DCCMS, made a presentation on the current digital landscape for climate information and advisory services using a CWIS, which was developed under the M-CLIMES project of the Government of Malawi with support from the United Nations Development Programme (UNDP) and financed by the Green Climate Fund. This system generates DCIAS for fishers on extreme waves and wind, periods of strong sunshine, dry spells, excessive moisture, etc. However, only those with permission from the DCCMS can access this system, so it is not an open access platform. Currently, the DCCMS is disseminating information via the DOF through a WhatsApp group.

Participatory Integrated Climate Services for Agriculture (E-PICSA)

Mfumu Kuseni from GIZ presented the E-PICSA app, which is currently under development for crop agriculture. This app will be able to provide climate information to farmers, including historical data and daily forecasts. The manual is available in English and will also be translated into Chichewa and Tumbuka. When it is operational, farmers will receive 10-day forecasts during the rainy season, starting on October 1, 2024. The app is only in the pilot phase, and farmers must be given access from the DCCMS to be able to use it.

Feedback from the participants

Most of the systems that can provide DCIAS do not tailor and generate information and advisories for fish farmers for both day-to-day operations and seasonal planning. As such, DCIAS for fish farmers is urgently needed. However, as the platforms developed for DCIAS are largely of limited access for all, open access platforms need to be considered and developed in the future, particularly for smallholder farmers, who need free information and services. In addition to this, the sustainability of the digital platforms (who will own them, associated costs, how to include the business model, etc.) also need to be considered in advance to avoid any future disruptions within the system. Participants also emphasized the need for large-scale capacity development initiatives on DCIAS for aquatic food systems, along with a climate literacy program for successful implementation, scaling, use and adoption of the DCIAS systems and platforms focusing on fisheries and aquaculture.

Closing remarks

Dr. Msiska delivered the closing remarks. Dr. Msiska expressed his gratitude for all the stakeholders who attended the meeting, acknowledging their time dedicated to this important dialogue. He emphasized that the impacts of climate change in Malawi are becoming increasingly evident, citing the recent devastation caused by Cyclone Freddy. He stressed that all projects involved in capture fisheries and aquaculture should integrate climate considerations to be successful.

Conclusion and way forward

The event revealed that DCIAS are strongly focused on agricultural crops in Malawi, with a few recent startups for fisheries, while CIS for aquaculture are completely new. This workshop was the first of its kind in Malawi, which highlighted the critical need for DCIAS in the aquaculture sector. Lack of use of climate information to anticipate climate risks for the sector indicates regular associated loss and damage, so it is urgent that CIS are brought into policies, practices and capacity building efforts. The workshop brought together users and providers of climate information to discuss climate sensitive decisions along aquaculture value chains together with the challenges and opportunities. This acted as a starting point to bridge the gap among users and service providers. Through various activities using materials developed for the workshop, participants were able to provide recommendations for different stakeholders and actors to enhance the development of DCIAS for aquaculture. The key recommendation to come out of the workshop focused on large-scale capacity building initiatives for different value chain actors and stakeholders followed by strengthening collaboration among relevant government organizations, such as the DCCMS, DOF, Department of Disaster Management Affairs and PROFISHBLUE. Together, they can build on this momentum and continue to tailor the climate informed decision support system for aquaculture. Consequently, follow-up activities would include developing a decision framework by identifying the climatic thresholds for the most cultured fish species, an air–water temperature model to embed in the decision framework and a context-specific decision support system for aquaculture DCIAS in Malawi.

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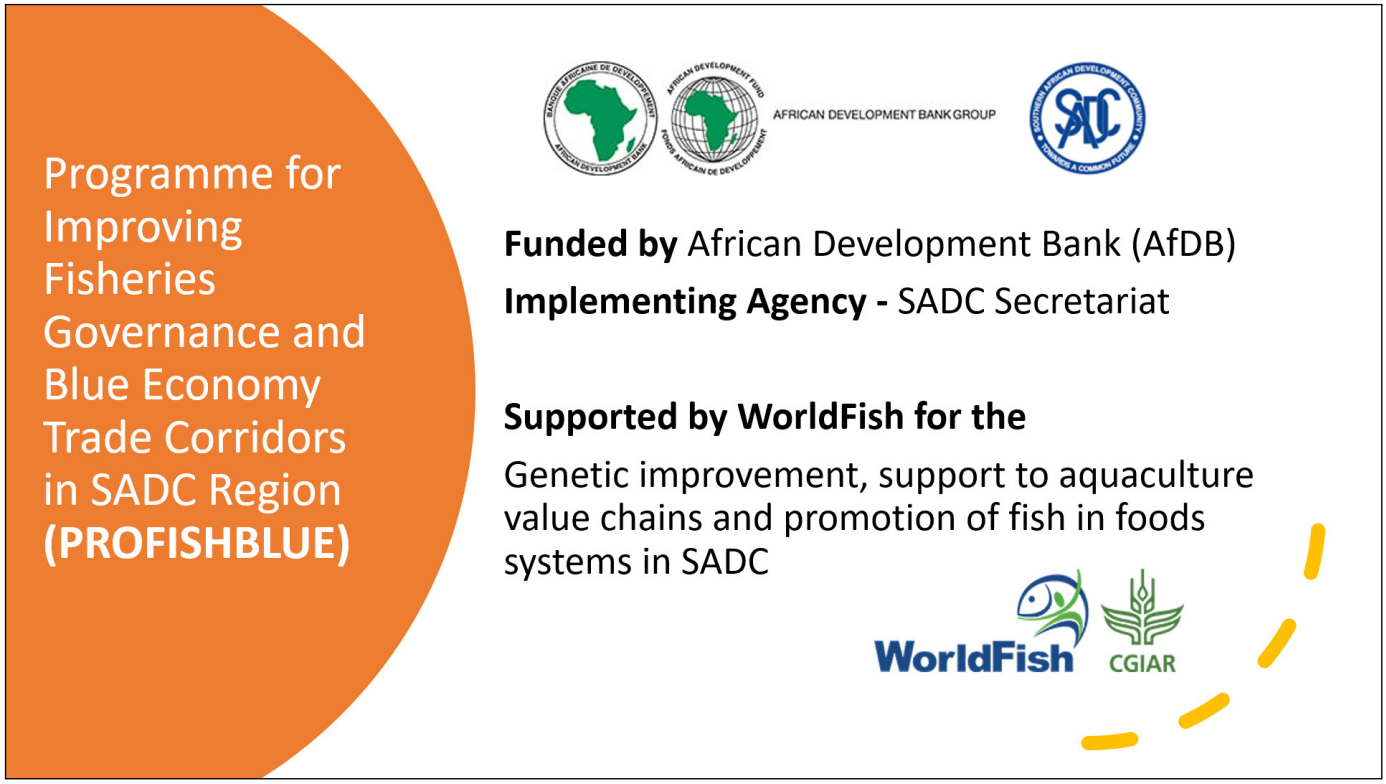
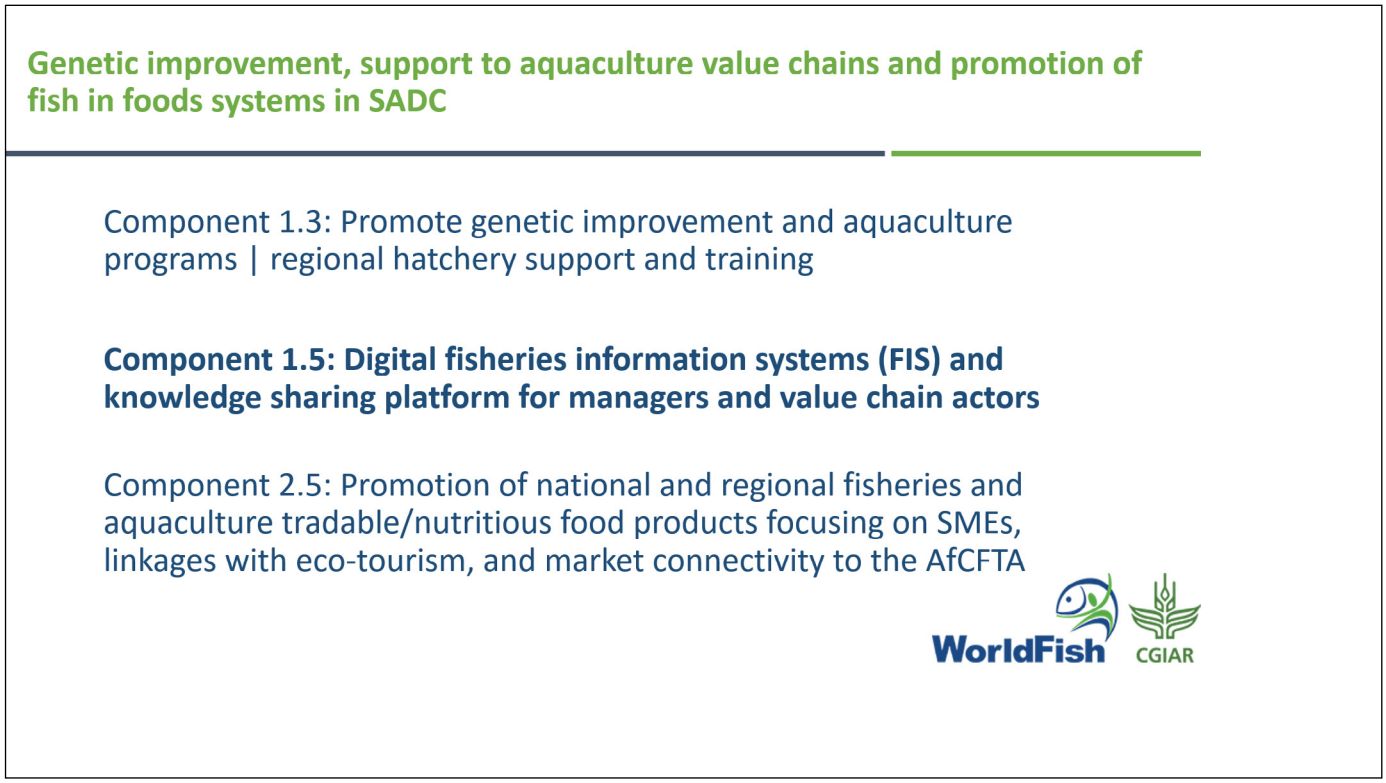
Annex 1. Screenshots from Dr. Hossain's presentation





Component 1.5: Digital fisheries information systems (FIS) and knowledge sharing platform for managers and value chain actors

Component 1.5 Team of WorldFish

Led by Dr. Peerzadi Rumana Hossain, Scientist - Climate Change
Netsayi Mudege PhD, Senior Scientist – Aquatic Food Systems
Keagan Kakwasha, MEL Specialist
Peter Mumba, Research Analyst
Alinafe Maluwa, Research Assistant

Overall Project Lead by Dr. Rose Basiita, Senior Scientist

Key Objective, Outcome and Output for component 1.5 of digital FIS

Objective: Strengthening institutional capacity and knowledge towards adaptation and mitigation of impacts of climate change and build resilience to other vulnerabilities to the sector

Outcome: Increased production and productivity of fish and fisheries products by de-risking value chains

Output: Knowledge product, Planning tool and Training for building climate resilience

What we will be doing!

Developing a digital climate information and services system for climate informed decision making for aquaculture and/or fisheries to manage climate risks

Geography – Zambia and Malawi

Key Activity 1: Set-up an open-source regional digital platform for data and info sharing and coordination and related training programs

To set up the digital platform, we will be

- Identifying fisheries/fish culture relevant information to tailor climate information services (CIS) system and knowledge sharing platform

- Developing decision framework in context of the region to provide CIS for fish

- Developing digital decision support system for fish to manage climate risks

Key Activity 2: Disseminate fish value chain information and sharing application and hands-on training on digital apps

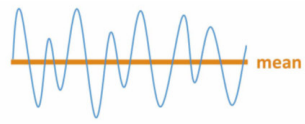
To disseminate fish value chain information, we will be

- *Conducting training sessions to enhance the capacity of fish-farmers and their support agents in understanding and using climate information services*

What Digital Climate Information and Advisory Services is?

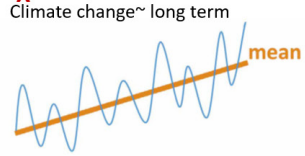
Climate information service is the use of climate/weather information in reducing associated risks and thus, assist in better decision-making approach

√
Climate variability~ short term

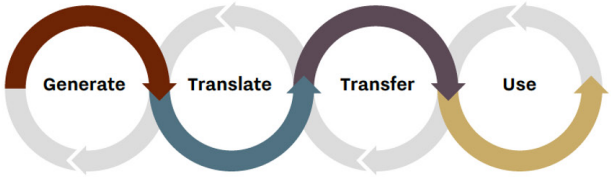


Around a steady mean

X
Climate change~ long term



Changes over longer time



- Tailored to the needs of the user,
- Based on scientifically credible information
- Proper connection between the user and the supplier

Why climate information and advisory services is important for aquatic food systems

The blue economy is of high priority in the SADC region not only due to the sectoral opportunities in enhancing the economy, but also due to the exposure to climate variabilities and extremes such as heavy rains; heatwaves; drought; flooding; cyclones etc.

These climatic issues result risks like economic losses and thus, affect food, nutrition and livelihood security of both fishers and fish-farmers.

Therefore, the digital climate information and services system can help to take climate informed decision by managing climate risks and thus, build their adaptative capacity for resilience.

This way (I mean by de-risking aquatic food systems' value chains), the project can enhance opportunities for future climate investment in the sector as well.

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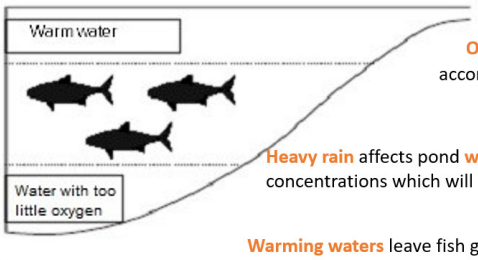
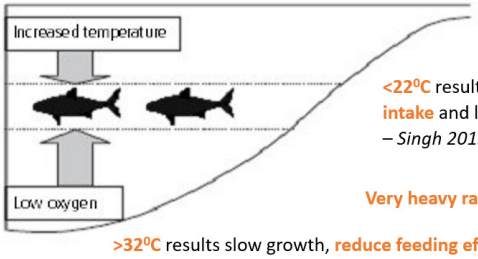
How climate variability is affecting aquatic food systems



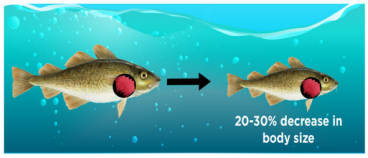
Outside 25-30^{0}C range results pond **water quality degradation** and accordingly affect food consumption, growth and oxygen consumption *Hossain et al. 2013*

Heavy rain affects pond **water quality parameters** like turbidity, pH and dissolved O_2 concentrations which will have impact on fish physiology and food intake – *Zadeh et al. 2012*

Warming waters leave fish gasping for more air and **shrinking in size** - *Pauly & Cheung (2018)*



<22^{0}C results **less feed intake** and less body weight – *Singh 2019*



Very heavy rain results flood which affects **fish enclosures** - *Olaoye et al. 2010*

>32^{0}C results slow growth, **reduce feeding efficiency** and increase mortality - *Adak adey et al. (2015)*

Low or no rain results salinity increase and consequently affects **survival and growth to fingerlings**, causes disease outbreak, reduces feeding rate and declines production

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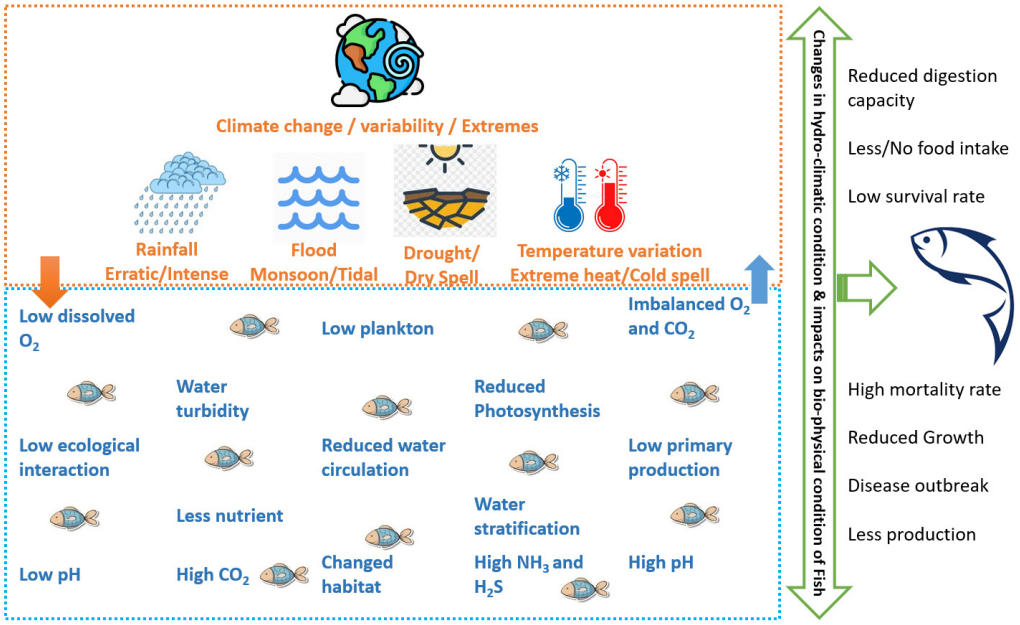
Climate challenges being faced by the fish-farmers



Key findings to flag for digital climate information and advisory services of aquatic food systems

1% increase in aquaculture production by managing climate risks using CIS can provide 24,000 tons of fish for catering 1 million people with protein *(Hossain et al. 2021)*

https://doi.org/10.3389/fsufs.2021.677069

However, availability of actionable climate information and practice of context specific climate services are in a stage of infancy and no major efforts are reported so far even though this sector is highly vulnerable to climate change *(Montes et al. 2022)*

https://doi.org/10.1016/j.cliser.2022.100292

Potential economic value of aquaculture CIS could be up to USD 14 million a year, if 10 percent of the damage can be offset by appropriate CIS through a range of multi-sector efforts to establish and extend these services to end-users at scale *(Hossain et al. 2024)*

https://doi.org/10.1016/j.crm.2023.100582

Through PROFISHBLUE we have started working on DCIAS for Malawi

Annex 2. Questions for the panel discussion

For the DOF

1. From your experience, how are climate variabilities and extremes affecting fisheries and aquaculture in Malawi? Which do you think is the most important to address?
2. Is the DOF providing any information and services to any value chain actors in line with these climate issues? If yes, how, and if no, do you have any suggestions? Do you think that DCIAS would be useful for fish farmers and fishers?
3. Do you receive any weather forecast warnings from the DCCMS for fishers and/or fish farmers? If yes, would you please share in detail? If no, do you think the DOF and DCCMS can work together on a joint aqua-meteorological bulletin on a regular basis?

For the DCCMS

1. Is the DCCMS currently providing any information and services for aquaculture and fisheries?
2. If yes, how you are disseminating it, and what type of info and services is it? Is it through the DOF or your own department? Is it in digital form or another form? Do you monitor whether fishers use the information and services?
3. If not, how do you think they should be used? Should your department take the initiative on this? Do you think that climate variabilities and extreme weather forecasts are needed so that fishers and fish farmers can manage climate risks?

For academics

1. Have you done any research on the climate impacts on fisheries and aquaculture or any needs assessment on climate risk information and services for fishers and fish farmers?
2. Can you please give us a rough estimate of loss and damage occurred by extreme heat, erratic or intense rain, high winds, dry spells, cold spells, etc.?
3. Do you think that if this type of climate risk information is provided earlier to fishers and fish farmers, this could help them modify their management decisions and accordingly climate risk management?

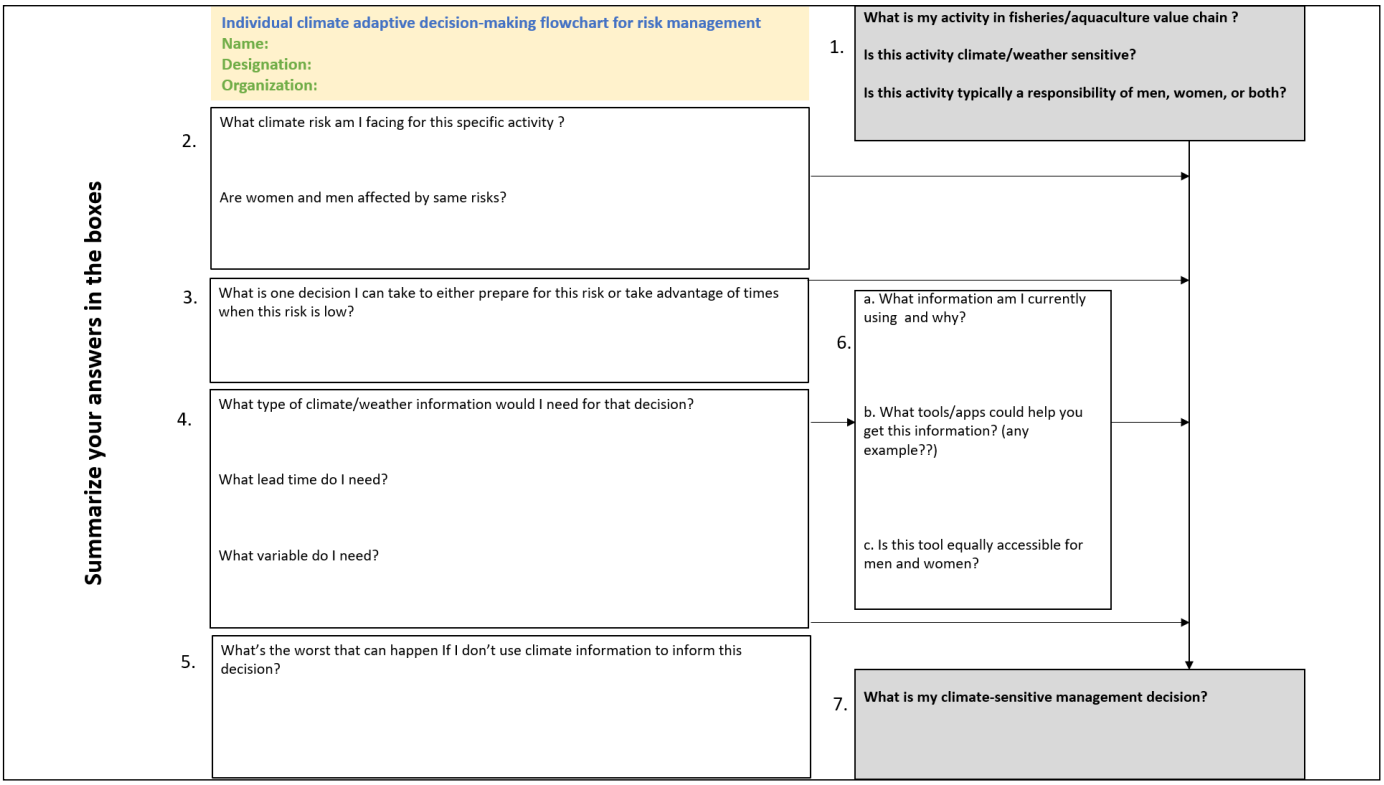
For fishers and fish farmers

1. Where do you fish? How long have you been fishing as a profession? Are any of your activities affected by any climate or weather issues? If yes, tell us in detail.
2. What type of loss do you suffer for that specific climate or weather event?
3. Do you currently use this type of climate or weather information for any of your activities to make decisions? If yes, which source?
4. If no, do you think that if you were provided with that climate or weather information 5–7 days earlier, you would be able to change or modify any of your decisions to manage the associated risks of climate or weather?

For private sector actors

1. You may have understood our talking points for DCIAS for fisheries and aquaculture. Would you please share your thoughts on these?
2. How can the private sector get involved and what should its role be?
3. What limitations do you see from your perspective regarding DCIAS for fisheries and aquaculture?
4. What can be done to overcome these limitations?

Annex 3. Flowchart for the exercise module on climate adaptive decision-making



Annex 4. Group exercise module on communicating climate information services

PROGRAMME FOR IMPROVING FISHERIES GOVERNANCE AND BLUE ECONOMY TRADE CORRIDORS IN SADC REGION (PROFISHBLUE)

Group Work on

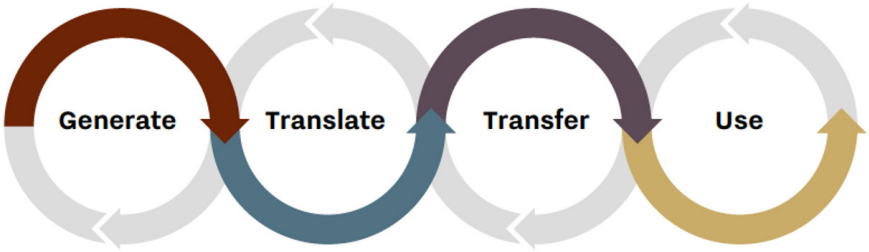
Communicating Climate information and Advisory Services

Date: 3 – 4 October 2023
Venue: Lilongwe, Malawi

Peerzadi Rumana Hossain PhD
Netsayi Mudege PhD
Peter Mumba
Keagan Kakwasha
Alinafe Maluwa

AFRICAN DEVELOPMENT BANK GROUP CGIAR WorldFish

Who are the key actors/key stakeholders/key organizations for each pillar for Digital CIAS for Malawi



Flip Chart Activity

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Existing Digital Landscapes for Aquaculture and Fisheries in Malawi

- Available Agrometeorological and early warning tools for advisory services in Malawi for aquaculture and fisheries
- Identify the current approach of Digital Climate Information and Advisory Services in Malawi (Type of info and services provide currently)
- Current Communication modalities in Malawi
  - Broadcast Media (Radio/TV/Newspaper)
  - Internet (Smart phone, App, Email, Website- DoF/DoCCMS/Any other
  - Social media – Facebook/WhatsApp/ Any other
  - Basic Mobile Phone – SMS/Voice Call/ Any other
  - Group Meeting– Emergency announcement/Peer to peer Training/Demonstration/Seminar/meeting/Farmers or Fishers group

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Functions and Communications Preferred

Functions Preferred *(Examples)*	**Communication modalities expected** *(from the communication modalities identified)*
Awareness	
Climate literacy	
Adapting to current local climate	
Seasonal Forecast for Strategic planning	
Weather forecasts for Day-to-day Operational Planning	
Extreme weather alerts for reduced loss and damage	
Customized information & advisories for extension services	
Any other?	

Challenges for Digital Climate Information and Advisory Services in Malawi

For Instance,

- Gaps in the capacity of fishers/fish farmers to access, understand and act on weather information
- Fisheries/Aquaculture extension capacity to deliver digital climate information and advisory services at scale
- Capacity of national meteorological services to routinely provide tailored local weather information for aquatic food systems
- Governance processes (i.e., bringing farmers/fishers into co-production) to bring the voice of farmers/fishers into climate services
- Any other in context of Malawi

Annex 5. List of participants

No.	Name	Gender	Organization	Designation	Region	District
1	Dr. Orton Msiska	M	WorldFish	Country lead	Central	Lilongwe
2	Dr. Peerzadi Rumana Hossain	F	WorldFish	Scientist and project leader	Bangladesh	
3	Peter Mumba	M	WorldFish	Research analyst	Zambia	
4	Keagan Kakwasha	M	WorldFish	Monitoring, evaluation and learning specialist	Zambia	
5	Alinafe Maluwa	M	WorldFish	Research assistant	Southern	Zomba
6	Trevor Maele	M	WorldFish	Finance manager	Central	Lilongwe
7	Norman Chitenje	M	WorldFish	Accountant	Central	Lilongwe
8	Olivia Kanyalika	F	WorldFish	Office assistant	Central	Lilongwe
9	Julius Kamwendo	M	WorldFish	Driver	Central	Lilongwe
10	Ceasor Mhango	M	WorldFish	Driver	Southern	Zomba
11	Dr. Maurice Makuwila	M	DOF	Acting director of fisheries (at that time)	Central	Lilongwe
12	Dr. Hastings Zidana	M	DOF	Deputy director of aquaculture (at that time)	Central	Lilongwe
13	Dr. Maxon Ngochera	M	DOF	Senior deputy director of capture fisheries	Central	Lilongwe
14	Titus Phiri	M	DOF, DCCMS	Deputy director of aquaculture	Southern	Zomba
15	Lucy Mtilatila	F	DCCMS	Director	Southern	Blantyre
16	Tolani Kanyenda	M	DCCMS	Principal officer	Southern	Blantyre
17	Henry Mapwesera	M	GIZ (private partner)	Aquaculture roundtable coordinator	Central	Lilongwe
18	Mara Gellner	F	GIZ (private partner)	Technical advisor	Central	Lilongwe
19	Professor Fanuel Kapute	M	Mzuzu University,	Director of research	Northern	Mzuzu
20	Dr. Austin Mtethiwa	M	Lilongwe University of Agriculture and Natural Resources	Head of department (aquaculture and fisheries)	Central	Lilongwe
21	Kingsley Fumulani	M	Aquaponics for Life	Technical officer	Central	Lilongwe
22	Hammis Nyampesi	M	Nyampesi Fish Products	Fish processor and CEO	Eastern	Mangochi
23	James Banda	M	DOF	Principal fisheries officer	Eastern	Mangochi
24	Luka Mhonie	M	Smallholder fisher association	Fisher	Eastern	Mangochi
25	John Bokosi	M	Fish farmer	Hatchery operator	Southern	Mulanje
26	Dorothy Twaibu	F	Fish farmer	Hatchery operator	Southern	Zomba
27	Laness Kaunda	F	Fish farmer	Hatchery operator	Nothern	Mzuzu
28	Atusaye Msiska	F	Fish landing actor	Chairperson (fish processor)	Eastern	Mangochi
29	Griffin Kunje	M	Apoche Feeds	CEO	Central	Lilongwe
30	Yusuf Kasweje	M	Commercial fisher association	Member	Central	Salima
31	Forence Mwangonde	F	Vipsa Chambo	Hatchery operator	Nothern	Mzuzu
32	Carolyn Munthali	F	DOF	Principal officer	Central	Lilongwe
33	Biziwick Lita	M	DOF	Driver	Southern	Zomba
34	Mfumu Kuseni	M	GIZ	Junior climate change advisor	Central	Lilongwe

About WorldFish

WorldFish is a leading international research organization working to transform aquatic food systems to reduce hunger, malnutrition and poverty. It collaborates with international, regional and national partners to co-develop and deliver scientific innovations, evidence for policy, and knowledge to enable equitable and inclusive impact for millions who depend on fish for their livelihoods. As a member of CGIAR, WorldFish contributes to building a food- and nutrition-secure future and restoring natural resources. Headquartered in Penang, Malaysia, with country offices across Africa, Asia and the Pacific, WorldFish strives to create resilient and inclusive food systems for shared prosperity.

For more information, please visit www.worldfishcenter.org