SCALING BUNDLED AGRO-CLIMATE ADVISORY SERVICES FOR INTEGRATED AQUACULTURE-AGRICULTURE SYSTEMS IN ZAMBIA

Training workshop report

Yvonne Munyangeri | Livingstone Byandaga | Desire Kagabo | Patrick Mvuyibwami | Mathieu Ouedraogo | Amos Ngwira |Keagan Kakwasha | Evaristo Mapedza

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CGIAR | AICCRA Accelerating Impacts of CGIAR Climate Research for Africa

Highlights

1

At Mansa: SMEs, fisheries extension officers and farmers were trained on the application of bundled CIS and CSA in integrated aquaculture-agriculture systems to enhance crop and fish production. A multi-stakeholder dialogue was also part of the workshop.

2

At Lusaka: extension officers were provided with gender-specific insights on bundled CIS and CSA to be disseminated to farmers, especially women (at least 90% of participants must be women and part of marginalized groups), aimed at improving their adaptive capacity to climate risks through adoption of bundled CIS and CSA. practices to inform their farming related decisions.

3

At Chipata: COMACO field coordinators, government extension workers and master lead farmers were introduced to the use of bundled CIS and CSA as the best approach to enhancing farmers' ability to access, understand and use agro-climatic advisories in crop and fish farming- related decision-making processes.

4

At Kitwe: officers from the Zambian Ministry of Fisheries and Livestock, with agro-dealers, fish farmers and other stakeholders in the fish farming value chain from the Copperbelt province, were trained on the use of bundled CIS and CSA in climate risks management in fish farming.

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Acronyms and abbreviations

AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
CBA	cost-benefit analysis
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIS	climate information services
CSA	climate-smart agriculture
DACA	Digital AgroClimate Advisory
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
MFL	Ministry of Fisheries and Livestock

Executive summary

Agriculture and aquaculture systems in Zambia, as in many sub-Saharan African countries, are vulnerable to climate risks which affect the quality and quantity of crops and fish production. Through AICCRA's work on scaling climate-smart agriculture and climate information services to enhance farmers' resilience to climate change, four training workshops were conducted in four sites in Zambia, at Mansa, Lusaka, Chipata and Kitwe. The aim was to scale up adoption of bundled climate information services (CIS) and climate-smart agriculture/aquaculture (CSA) in the agriculture and aquaculture systems in Zambia. In collaboration with the Zambian Ministry of Fisheries and Livestock (MFL), Better World Connections, Community Markets for Conservation and World Fish, 68 agriculture extensionists, agro-dealers, officers of the MFL in charge of fisheries, entrepreneurs with SMEs, lead fish farmers and other stakeholders were trained on access to, understanding and use of bundled CIS and CSA practices in agriculture and aquaculture systems. Participants were provided with skills on how to get access to CIS through an online platform, the Digital Agro Climate Advisory (DACA), and on how to interpret, translate and use its available location- and context-specific information in decision making. In addition, participants acquired knowledge of basic climate concepts, how changes in climate variables affect crops and fish farming and how to manage climate risks in each system. At least 68 participants, 26% female and 34% youth (<35years old), benefited from these trainings as trainers of trainers and are expected to disseminate the acquired knowledge to their peers and farmers. Results from the training evaluation show that more than 95% of participants received such a training for the first time, covering new subjects such as calculating probabilities, capturing climate information from graphs, linking information on climate variables with crop characteristics to make predictions, among others. Most participants (96%) stated that they will use the acquired knowledge in their work, while all stated that they will disseminate the information to their peers with a greater than 83% level of confidence. Access to these bundles by farmers will enhance their adaptive capacity to climate risks and hence reduce crop and fish production losses, increase crop and fish production and enhance farmers' resilience to climate risks.

BACKGROUND

Farmers' adaptation to climate variability and change is a multi-faceted challenge. The Climate Action team of the Alliance of Bioversity International and CIAT ensures farmers learn best practices suitable for their crops and their local environmental conditions. Similarly, farmers' capacity is enhanced to engage with different farming advice and information and with climate smart agriculture (CSA) practices in a cost-effective manner. CSA practices are broadly defined and include, among others, aspects ranging from crop selection to fertilizer management to soil enrichment. Depending on the CSA focus, climate information services (CIS) at various time scales may support improved farmer decision making both about which CSA practices to apply and when to implement them. The training courses described here provided clear guidance on bundling agricultural innovations associated with CSA with other services such as climate information and financial services (e.g., combining crop varieties that resist drought or heavy rains with recommendations regarding best practices and with access to insurance). The training further demonstrated the synergistic nature between CIS and CSA – and the potential complementarity of each to support the scaling of the other. Together with the trainees and through the training manual we addressed questions such as (1) how can CIS and CSA be bundled together with other agriculture products and services to support sustainable scaling in the delivery of the same? (b) what are the business models that can support the implementation of CIS and CSA in a manner that maximally benefits farmers and does so in a way that is profitable for private sector implementing partners?

The bundles that the trainings focused on were:

a. Integrated aquaculture-agriculture systems: in partnership with World Fish, two trainings were organized for lead aquaculture farmers in Northern Zambia in October and November 2022. These trainings focused on fisheries officers and selected lead farmers from eight districts, three representatives from the Zambia Meteorological Department and three representatives of the main private sector actors: Aquaculture Development Association of Zambia, Aller Aqua Zambia Ltd. and Novetek Animal Feed. These trainings were held at the Crossroads Lodges in Lusaka and Kitwe, Ndola, the provincial capital of the Copperbelt province, but trainees also came from the north-western part of the country.

b. Addressing drought through climate-smart seed varieties: in collaboration with ICRISAT, a training for Community Markets for Conservation field coordinators, government extension workers and master lead farmers was conducted in eastern Zambia. The training took take place from 17th-20th October 2022 at the Eastern Comfort Lodge

c. Bundle 5 on gender and social inclusion: in partnership with Better World Innovations, an NGO, a training of trainers' course on bundling climate information services and climate-smart agriculture was conducted to increase the use of CSA in Central province. This bundle particularly focused on vulnerable women and youth. The training took place from 10th-13th October 2022 at the Golden Peacock Hotel-Olympia.

Capacity building on bundled CIS and CSA for stakeholders in the agriculture and aquaculture value chains

In October and November 2022, four consecutive trainings on scaling bundled agro-climate advisories in the agriculture and aquaculture value chains in Zambia were conducted with the aim of building beneficiaries' capacity in climate risks management. Trainings serve as an informative and advisory tool to support trainees in making improved climate-informed decisions, which will have the potential impacts of:

- Better management of climate risks
- Increased crop/fish/livestock productivity
- Improved rural livelihoods
- Improved financial independence at household level

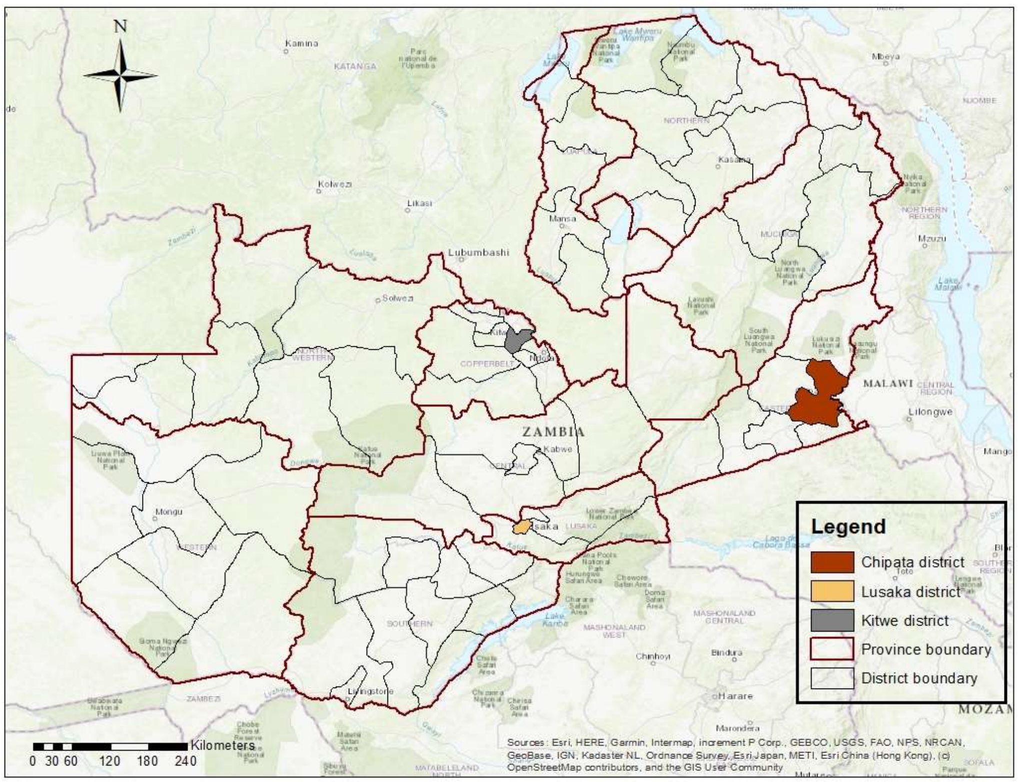
Figure 1. Participants in a training session

Specific objectives of the training:

- To enhance understanding of the impacts of climate change, climate variability and associated risks.
- To enhance access to, understanding and use of bundled agro-climate advisories in crop, livestock, fisheries, and other livelihood activities.

- To improve capacity in seasonal planning related to agricultural and other livelihood activity calendars and their associated climate risks.

The training method used was a face-to-face, interactive, and collaborative approach that included recording of participants expectations, short PowerPoint presentations, question and answer sessions, group activities, group presentations and evaluation. The target group was composed of extension agents (agriculture, livestock, fisheries and livelihood), entrepreneurs, researchers, agro-dealers, farmers and other stakeholders. The DACA[1] application was used as the source of climate graphs that were used during training sessions on climate information and calculation of probabilities. Information on crop characteristics was also acquired through DACA, as well as agro-advisories. Flip charts were prepared for the groups to be able to discuss



and assess climate risks that affect agriculture and aquaculture value chains, and they were used to document and identify management options that farmers use to manage those risks. Target areas were the North, East and Central provinces of Zambia and training sites were, Lusaka, Mansa, Chipata and Kitwe.

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[1] DACA stands for Digital AgroClimate Advisory (DACA) Application https://play.google.com/store/apps/details?id=com.digitalAgroClimeteAdvisory. It was developed to enhance access to, understanding and use of bundled CIS & CSA

Participants were selected from government and private institutions and were composed of Ministry of Fisheries and Livestock (MFL) personnel in charge of fisheries,

Figure 2 Training sites

agro-dealers, field coordinators, entrepreneurs, researchers, farmer leaders and farmers. At least 68 participants (26% female and 34% youth (<35years) attended the training. Among participants, 20 were from Kitwe, 25 were from Chipata and 23 were from Lusaka (Fig.3). The training content covered basic climate concepts, how changes in climate variables affect crops and fish farming and how to manage climate risks in each system.

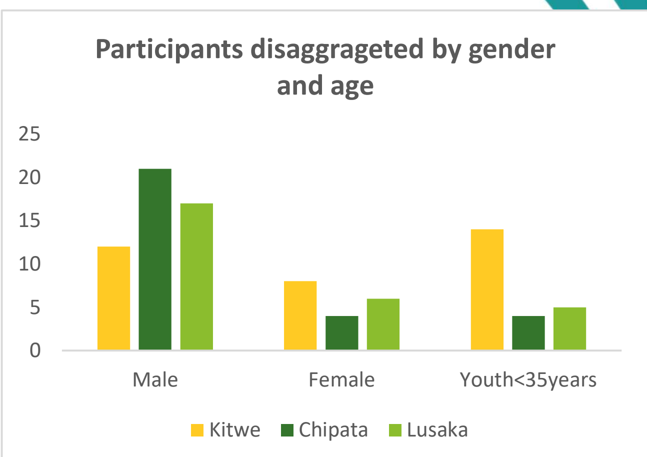


Figure 3 Participants disaggregated by gender and age

On the first day of each training, participants were given the opportunity to express their expectations of the training and each of them wrote his/her expectations down. They were also asked to respond to other questions as they wrote their expectations, including why they thought the training was important to them, strategies to follow for the acquired skills to be useful to them and who would benefit from the skills that would be acquired from the training. In their expectations presentations, participants mainly expressed their wish to know:

1. How they can deal with climate-related shocks in fisheries,
2. How they can increase their crop yield,
3. How they can tell if the season has started in their specific locations,
4. How to prepare for the season based on climate information and
5. How to know the right crop variety suitable for a given location in each season.

These expectations were recorded, to be addressed throughout the training.

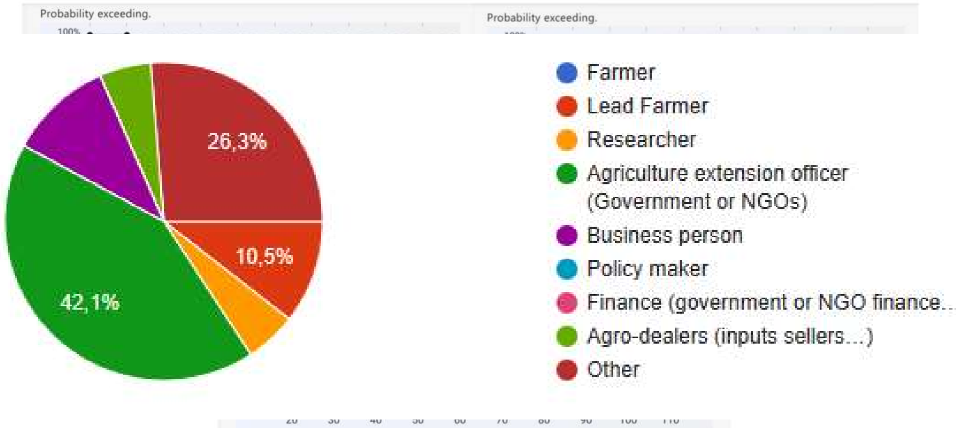


Figure 4 Participants occupation

Understanding climate concepts, reading climate graphs and calculating probabilities

The first part of the training aimed at building participants' capacity to understand basic climate concepts, to read climate graphs to be able to capture and translate information on climate of a specific location, to calculate the probability of a given scenario occurring in relation to weather and climate of a specific area through the season and to be able to inform their farming- related decisions.

Trainees learned to:

- Read climate maps
- Calculate probabilities for seasonal length, seasonal rainfall totals, onsets, cessation, dry spells, etc.
- Evaluate the differences between climate change and climate variability
- Analyse patterns in their locations' climatology

Through exercises and group activities, participants were able to understand patterns in their locations' weather and climate, climate change and variability and how these affects crop and fish farming.

Figure 5 Examples of climate graphs used during the training

Participants were also given explanations of some climate concepts, understand the difference between climate change and climate variability and the role of CIS and CSA in crops and fish farming

After a series of exercises, participants were given the opportunity to present the results of their work and observations on weather and climate in relation to their specific locations.

Participants in their group activities and presenting the results of the exercises and their observations on what climate graphs show in relation to the reality of their locations

Figure 6 Participants in group activities and presenting their results

Exploring bundled CIS and CSA through the Digital AgroClimate Advisory (DACA) application

The aim of this module was to enable participants to navigate the DACA app, to be able to understand, interpret and use its products which include climate information, crop information and agro-advisories. Through hands-on practice, participants were enabled to navigate through DACA, download climate maps, locate their regions and use DACA products to analyze the climate of their locations. DACA bundles climate and crop information to provide sustainable and actionable recommendations along agricultural, livestock and fisheries value chains. Outputs of DACA form the base for development of agro-climate advisories and these serve farmers, extensionists, agro-dealers and other stakeholders to inform their farming-related decisions throughout the season.

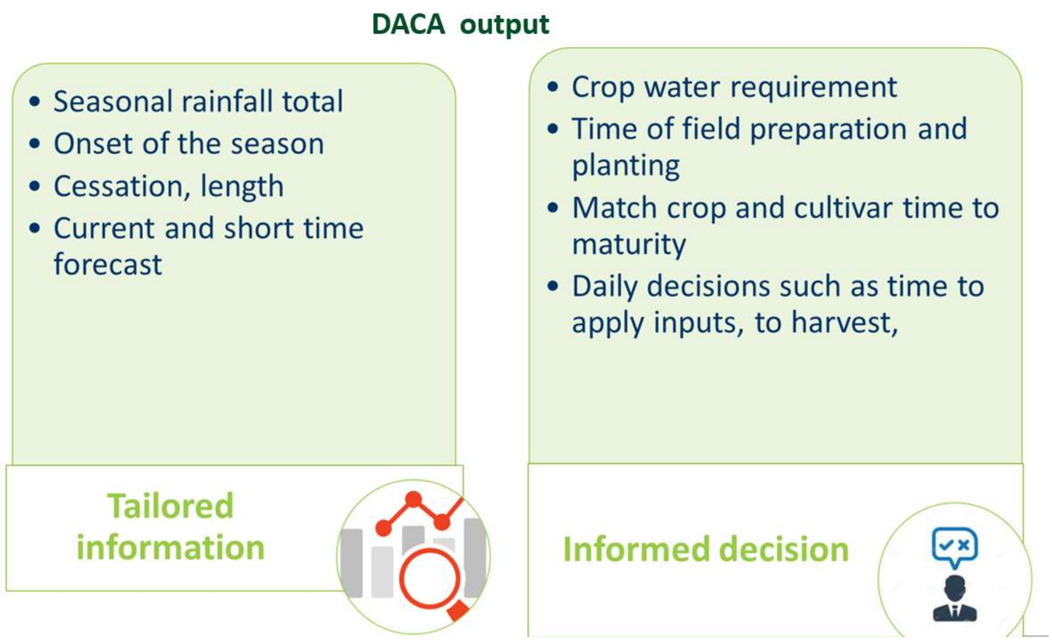
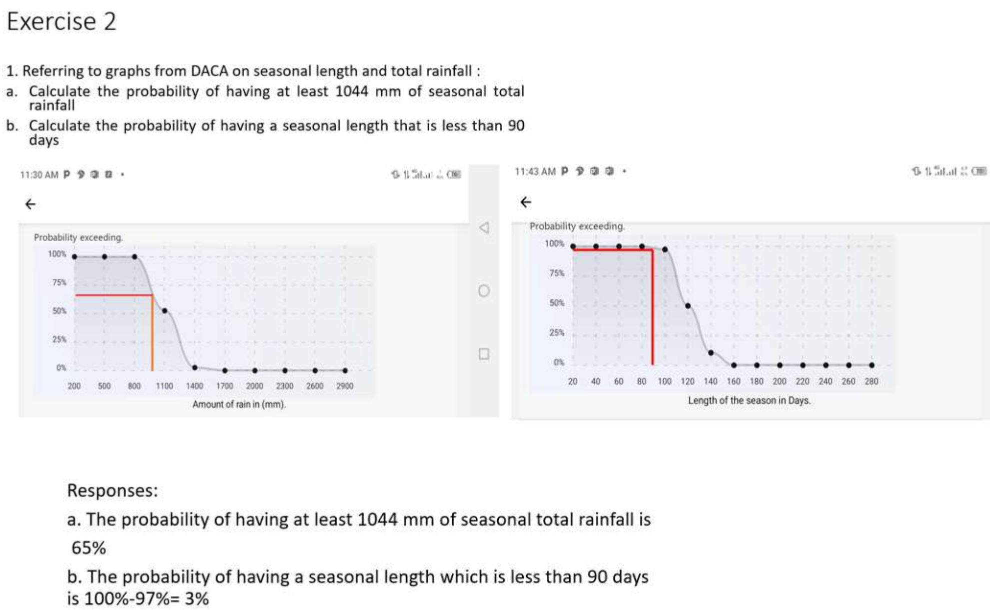


Figure 7 DACA Outputs

Through a series of exercises, participants explored available climate information and crop information, how to download the information, analyze it and use it before the beginning of the season for better seasonal preparations. Participants also acquired knowledge on how to draw climate graphs and calculate probability of exceedance during the season. In the exercises, participants were trained on how to calculate the probability of a given amount of rainfall, a given number of days for the length of the season, the probability for a season to start on a given date and the chances of having a number of dry spells during the season. These exercises were intended to teach participants about variabilities that may happen in a season and inform them of different climate scenarios that may affect crop, livestock or fish production throughout the season.


Exercise 2

1. Referring to graphs from DACA on seasonal length and total rainfall :
a. Calculate the probability of having at least 1044 mm of seasonal total rainfall
b. Calculate the probability of having a seasonal length that is less than 90 days

Responses:
a. The probability of having at least 1044 mm of seasonal total rainfall is 65%
b. The probability of having a seasonal length which is less than 90 days is 100%-97%= 3%

Figure 8 An extract from participants' group exercises

Exploring the links between bundled CIS and CSA and agriculture and aquaculture value chain activities

The main objective of this module was to enable participants to understand the linkages between climate variables and crop characteristics, how variations in climate variables such as temperature, precipitation, humidity, or wind can affect crop growth stages, fish and livestock production and length, onset or cessation of the season. By linking CIS with crop and fish characteristics, participants were able to understand some of the causes of crop/fish production losses due to climate variabilities.

Participants were also given examples of how information on climate variables provides insights on how to prepare for the season. Through exercises and group activities, participants were asked to evaluate whether some crop varieties can grow in a given location, based on climate information extracted from climate graphs downloaded from DACA. Graphs and crop tables were used to calculate probabilities and make decisions on which varieties had more or less chance to grow in a given season, in a given location.

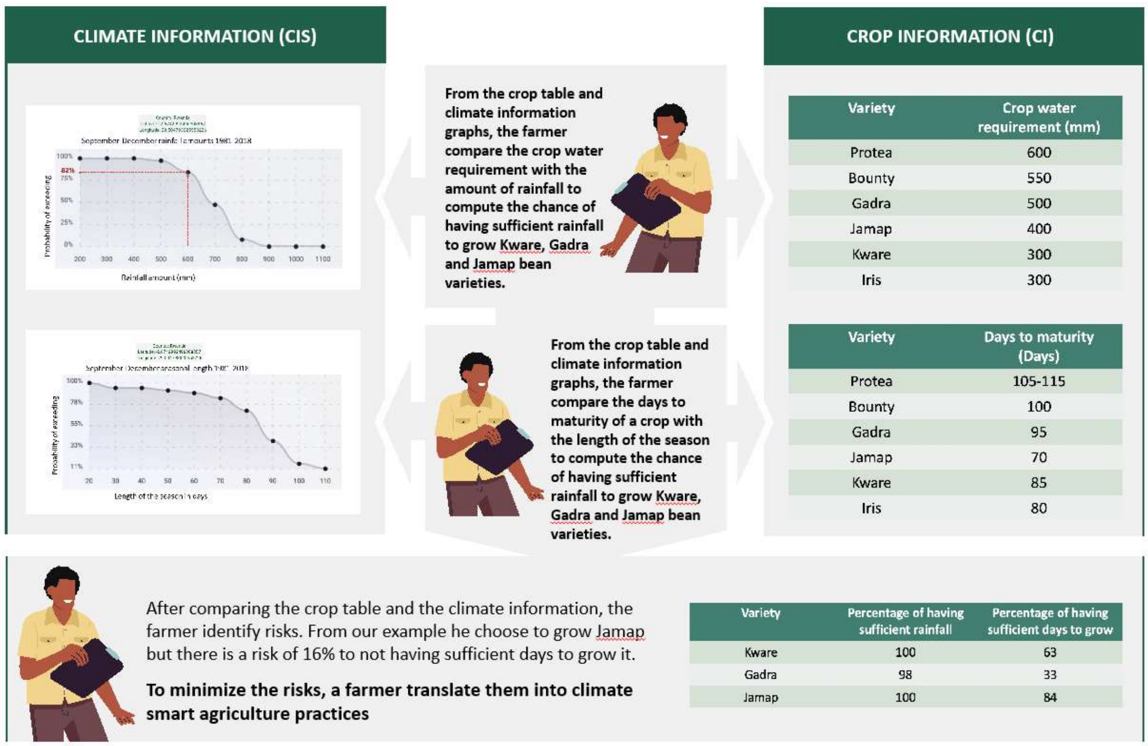


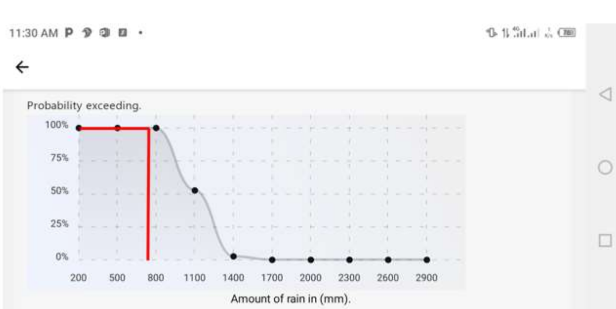
Figure 9 Illustration of how climate information and crop information are linked to calculate probabilities

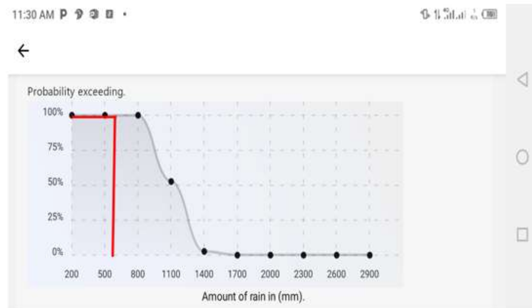
Exercises included questions such as the following:

- 1. Suppose that the risk of a particular crop disease greatly increases if seasonal rainfall is more than 780 mm. What is the probability that this will happen?
- 2. Suppose that yields of a high yielding bean variety are likely to fail if seasonal rainfall is below 696 mm. What is the probability that this will happen?

Below are extracts from participants' responses to the above questions:

- Exercises 1&2

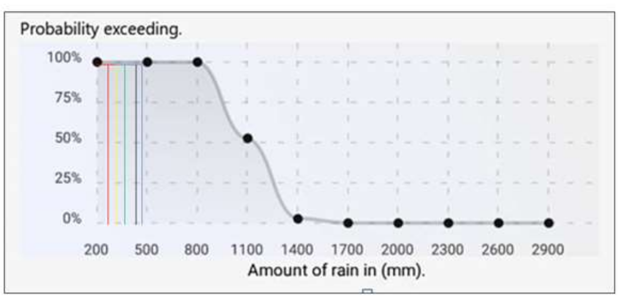


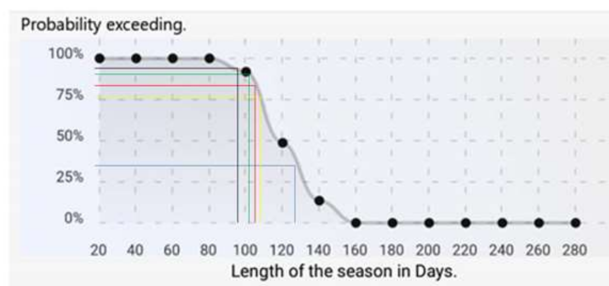


1. The Probability that seasonal rainfall will be more than 780mm is 100%, meaning that the probability of a particular crop disease to greatly increases is also **100%**
2. The probability that the seasonal rainfall will be below 696 mm is 100%-100%= 0%, meaning that the probability for yields of a high yielding bean variety to fail is **0%**

- Exercise 3. Calculate the probability of having sufficient rainfall and days to grow Peru-34, Pl31074, Suchitan, Turrialba and V-7593 bean varieties

Graphs from DACA. 1. (left) Rainfall totals/ 2. (right) Seasonal length





Legend:

- V-7593: Black
- Turrialba: Yellow
- Suchitan: Green
- PL31074: Red
- Peru 34: Blue

Peru 34	PL31074	Suchitan	Turrialba	V-7593
• Water requirement : 390 • Days to maturity: 128 • Probability to have sufficient rainfall to grow Peru-34 is 100% • Probability to have sufficient days to grow Peru-34 is 32%	• Water requirement : 280 • Days to maturity: 104 • Probability to have sufficient rainfall to grow PL31074 is 100% • Probability to have sufficient days to grow PL31074 is 84%	• Water requirement : 330 • Days to maturity: 101 • Probability to have sufficient rainfall to grow Suchitan is 100% • Probability to have sufficient days to grow Suchitan is 87.5%	• Water requirement : 320 • Days to maturity: 106 • Probability to have sufficient rainfall to grow Turrialba is 100% • Probability to have sufficient days to grow Turrialba is 75%	• Water requirement : 350 • Days to maturity: 95 • Probability to have sufficient rainfall to grow V-7593 is 100% • Probability to have sufficient days to grow V-7593 is 90%

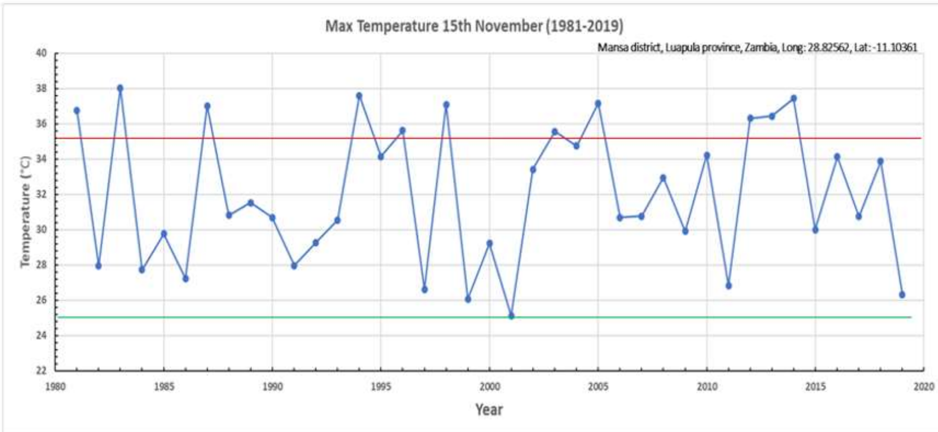
In Kitwe, the majority of participants were from the MFL Department of Fisheries and they oversee fish farming-related activities. Therefore, a particular exercise was prepared for them to be able to understand how changes in climate variables such as temperature can affect fish production. The exercise was given on the *Oreochromis niloticus* fish species, commonly known as tilapia, and widely farmed by smallholder farmers in Zambia. Below is the exercise and an extract from participants' responses.

A. Suppose that the risk of a particular disease for Tilapia greatly increases if the temperature is more than 35 degrees Celsius. What is the probability that this will happen?

B. Suppose that pond quality reduces if the temperature is below 25 degrees Celsius. What is the probability that this will happen?

Legend:

- Red for QA
- Green for QB



Answers

A. Probability is (11/39) x 100 = 28.2%

B. Probability is 0%

Adaptation to climate risks with climate-smart agriculture practices and seasonal planning

Prediction, forecast, probability or likelihood are common words in climate-related subjects because predictions are never certain to be 100% accurate. Therefore, this module aimed at providing participants with a full package of advisories to inform their farming-related decisions throughout the season. Beside the availability of climate information, forecasts and probabilities, climate variability is real, and its effects may happen at any time. Participants were thus provided with advisories that might serve them as they advise farmers on the season to maximize the chances of having high yields and high-quality products and improving their resilience to climate risks. Various CSA practices were explored and discussed. Participants were also reminded that farmers choose what type of practices they apply depending on the type of risks, ability to apply the technique and the social and financial context in which the farmer lives. Below is a list of identified CSA technologies that participants thought were most important in their locations for profitable crop and fish farming:

a. Water-smart: irrigation, tied ridges, mulching, water harvesting, etc.
b. Weather- and knowledge-smart: DACA, radio, smart phone, TV, etc.
c. Carbon-smart/nutrient-smart: organic manure, tillage, etc.
d. Seed-smart/breed-smart: quality seeds, early maturing varieties, improved livestock breeds, resilient seeds, etc.

e. Institutional-smart/market-smart: market information, financial services, capacity building, etc.

In addition, participants were taught how to do seasonal planning based on climate information (seasonal forecast, short-term forecast, historical climate information). This session consisted of three components: preparation of a seasonal calendar, preparation of a seasonal adaptation plan and preparation of cost-benefit analysis (CBA), or simply a farmer's budget. These three components are important in helping farmers to analyze the season, before it even starts, based on bundled CIS and CSA available with DACA, seasonal forecasts, information on dry spells and short-term forecasts.

In one exercise, participants were able to analyze and plan for an upcoming season for one of the group members, playing the role of a farmer and using real information. Participants were able to compare different scenarios, with different crop varieties and different locations to see the differences in the probability of success for certain crops to grow in one location rather than another, based on their climate requirements. Seasonal calendars and seasonal adaptation plans were developed, based on real weather data for each chosen location, and appropriate mitigation measures were also identified with CSA practices.

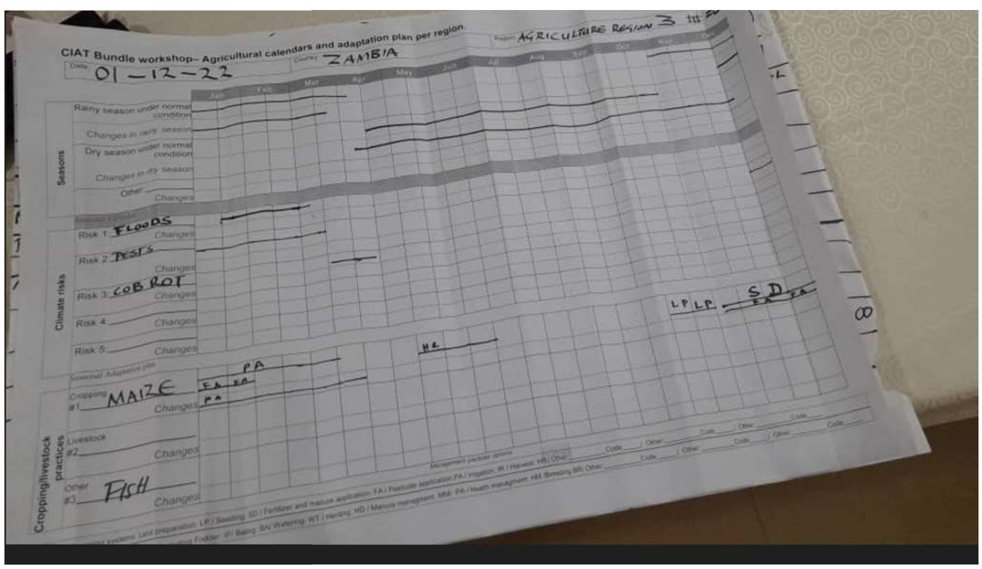


Figure 10 An example of seasonal calendar and seasonal adaptation plan developed by a group of participants

Considering that each farmer’s context is different, socially or financially, participants were taught how to advise a farmer on preparing a CBA before the season starts. The CBA must include all activities and their costs related to the crop or fish varieties that they intend to grow during the season. Any CSA practices identified to prevent or mitigate the effects of climate risks must also

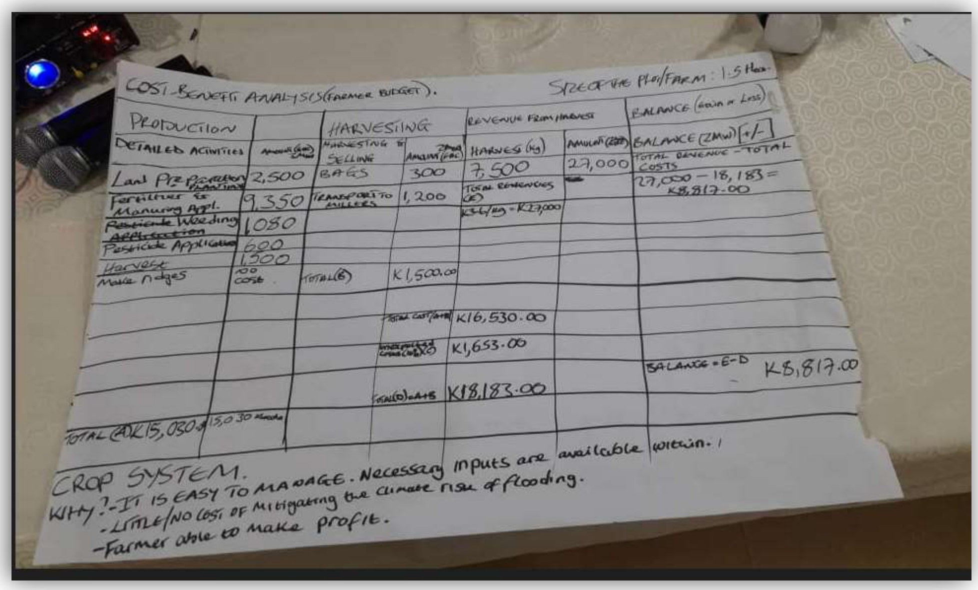


Figure 11 An example of a CBA developed by a group of participants

be costed to ensure that calculations of a farmer’s benefits at the end of the season are realistic.

Training evaluation and dissemination of bundled CIS and CSA

Towards the end of the training participants were given the opportunity to evaluate the training and formulate dissemination plans. An online questionnaire was sent to participants by email. The evaluation questionnaire had questions including questions like what was new for you in the training, Which part of the training was more interesting to you in training, Which part of the training was hard to understand in training, Which part of the training was easy to understand in training, What is your level of confidence to properly deliver the same training workshop to others (Agricultural extension agents, lead farmers, …), Would you use a part or all the content of the training workshop in your professional work?, Would you recommend this training to others (colleagues or partners…)?, How can you describe the training methodology? , Was the training scheduling and time appropriate and enough for you?, Would you please list at least three things you have benefited from the training?, What do you think can be improved for future trainings, Please provide any other comment(s) or recommendation (s) that would help to improve the quality and content of the training workshop what was new to you in this course? Results from the training evaluation show that more than 95% of participants received such a training for the first time, covering new subjects such as calculating probabilities, capturing climate information from graphs, linking information on climate variables with crop characteristics to make predictions, among others. The majority of participants (96%) stated that they will use the acquired knowledge in their work, while 100% stated that they will disseminate the information to their peers, with an 83% confidence level

Regarding the question on new subjects learnt, 95% stated that the DACA app was new to them, 87% answered that calculating probabilities was new, while more than 69% stated that they learnt about bundling of CIS and CSA for the first time. Most participants had some level of higher education — 40% high school diploma, 35% a bachelor's degree, 10% a master's degree — which might justify their level of confidence in disseminating acquired knowledge to more stakeholders of the agriculture and aquaculture systems. Participants developed and submitted their dissemination plans which were kept for reference during monitoring, evaluation and learning activities.

Conclusion

Training activities on scaling bundled agroclimatic advisory services for integrated agriculture-aquaculture systems were successfully completed in Mansa, Lusaka, Chipata and Kitwe cities, leaving participants with hands-on experience of digital tools providing bundled CIS and CSA that can be used to enhance farmers' resilience to climate risks. From learning to read climate graphs to using the new digital tool, from linking this information source with agriculture and aquaculture value chains to seasonal planning, participants were provided with an eye-opening approach to identifying major climate risks in both value chains and to analyzing climate and crop data to make predictions; and with many options for managing climate risks through CSA practices in the agriculture and aquaculture value chains. With the seasonal planning tools provided to participants, including seasonal calendars, seasonal adaptation plans and cost benefit analyses, participants are expected to disseminate their acquired knowledge to their peers and farmers to enhance their capacity to adapt to climate risks in both agriculture and aquaculture systems. to, understanding and translating bundled Through the dissemination activities of trained trainers, bundled CIS and CSA will reach more stakeholders in both agriculture and aquaculture value chains and hence contribute to a more resilient food system and healthy environment.

About the authors

Yvonne Munyangeri (y.munyangeri@cgiar.org) is a Research Associate at the Alliance of Bioversity International and CIAT.

Livingstone Byandaga (l.byandaga@cgiar.org) is a Senior Research Associate at the Alliance of Bioversity International and CIAT.

Desire Kagabo (d.kagabo@cgiar.org) is a Scientist and Project Leader at the Alliance of Bioversity International and CIAT.

Patrick Mvuyibwami (p.mvuyibwami@cgiar.org) is a Research Associate at the Alliance of Bioversity International and CIAT.

Mathieu Ouedraogo (m.ouedraogo@cgiar.org) is a Senior Scientist - Climate Information Services-AICCRA, at the Alliance of Bioversity International and CIAT.

Amos Ngwira (A.Ngwira@cgiar.org) is a Scientist at ICRISAT.

Keagan Kakwasha (k.kakwasha@cgiar.org) is a monitoring, evaluation and learning specialist at World Fish.

Evaristo Mapedza (E.Mapedza@cgiar.org) is a senior researcher at the International Water Management Institute.

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Annex 1:

TRAINING WORKSHOP AGENDA

DAY ONE:	
Time	Activity
09.00 – 09.15	Introduction of participants
	Welcome remarks
09.15 – 09.45	Overview of the training workshop
09.45 – 10.15	Participants' expectations
10.15 – 10.45	Coffee break-group photo
10.45 – 11.45	Basics of agro-climate advisories for improved agricultural risks management: • Climate information services and climate-smart agriculture/fisheries/livestock • Climate change and variability • etc. Q & A session
11.45 – 12.30	Practical work through guided exercises 1
12.30 – 13.30	Lunch break
13.30 –14.30	Presentations from groups for exercises in plenary
14.30 – 15.15	Accessing climate information through digital (online) platforms (e.g., DACA, Maproom, etc.)
15.15 – 16.00	Understanding and use of climate information/services
16.00 – 16.30	Coffee break
16.30 – 17.00	Practical work through guided exercises 2
17.00	End of DAY ONE

DAY TWO:	Activity
09.00 – 10:30	Continued practical work through guided exercises 2
10.30 – 11.00	Coffee break
11.00 – 11.40	Presentations from groups for exercises 2 in plenary
11.40 – 12.30	Exploring the relationship between climate information services and crops/livestock/fisheries Q&A session
12.30 – 13.30	Lunch
13.30 – 14.30	• Understanding climate-smart agriculture (CSA) and its processes • Crop-based CSA technologies and practices Q&A session
14.30 – 15.30	Practical work through guided exercises 3
15.30 – 16.00	Coffee break
16.00 – 17.00	Continued practical work through guided exercises 3
17.00	End of DAY TWO

DAY THREE:	Activity
9.00 – 9.30	Recap of Day TWO
9.30 – 10.30	Presentations from groups for exercises 3 in plenary
10.30 – 11.00	Coffee break
11.00 – 12.00	Principles of bundling CIS, CSA and other services/products
12.00 – 13.00	Practical work through guided exercises 4
13.00 – 14.00	Lunch
14.00 – 15.00	Presentations from groups for exercises 4 in plenary
15.00 – 15.30	Developing a seasonal calendar

15.30 – 16.00	Coffee break
16.00 – 16.30	Developing a seasonal adaptation plan
16.30 – 17.00	Developing a farmer's budget

DAY FOUR	Activity
09.00 – 09.30	Recap of DAY THREE
09.30 – 10.30	Practical work through guided exercises 5
10.30 – 11.00	Coffee break
11.00 – 12.30	Presentations from groups for exercises 5 in plenary
12.30 – 13.00	Presentation of M & E tools
13.00 – 14.00	Lunch
14.00 – 15.00	Each participant develops a dissemination plan for CIS/CSA training rolled out
15.00 – 16.00	Training evaluation and feedback
16.00	End of the training workshop and closing remarks

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture.

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