Workshop report: Training on understanding, communicating, and using the downscaled seasonal forecast, Kigali, Rwanda

September 2016

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Training on Understanding, Communicating, and Using the Downscaled Seasonal Forecast

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Workshop Report

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Abstract

This report describes a one-day workshop that presented new downscaled seasonal climate forecasts and a brief training program on how to understand, communicate and use new format with farmer groups. It builds on and extends the previous PICSA training workshops by (a) shifting from the use of station rainfall data to merged gridded data, and (b) introducing experimental seasonal forecasts presented as shifted probability distributions. The workshop began with an introduction to downscaled forecasts in probability-of-exceedance format, and discussion of plans to make these forecasts available through the Meteo-Rwanda maprooms. Key concepts were explained, and their equivalent terms in Kinyarwanda were discussed. Participants were led through an interactive process of eliciting collective memory of rainfall in recent years, developing a time-series graph based on the past 5 years of rainfall data, and then sorting the time series into a probability-of-exceedance graph. Instruction and a breakout group exercise taught participants to interpret probability-of-exceedance graphs. A discussion about El Niño was used to introduce the concept of a seasonal forecast, build confidence that there is a physical basis for seasonal forecasting, reinforce the probabilistic nature of seasonal forecast, and prepare participants to accept the new seasonal forecast format. Showing a probability-of-exceedance graph for El Niño against the probability-of-exceedance for all years is the final step to preparing intermediaries, or the farmers they serve, to understand the new seasonal forecast format. Downscaled forecasts of September-December 2016 total rainfall showed a weak to moderate probability shift towards dryer conditions. The presentation of the current forecast was followed by a discussion of the approach that was presented in the workshop, how the forecast system performs, and how to present the historical and forecast information to farmers. The workshop ended with discussion of action plans for using the new forecasts for project communication and planning activities in the four target districts.

Keywords

Seasonal forecast, Climate services, PICSA, Communication

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Acronyms

CIAT	International Center for Tropical Agriculture (Spanish acronym)
PICSA	Participatory Integrated Climate Services for Agriculture
RAB	Rwanda Agriculture Board
Meteo-Rwanda	Rwanda Meteorological Agency
USAID	United States Agency for International Development

Introduction

This report describes a one-day workshop that presented new downscaled seasonal climate forecasts and a brief training program on how to understand, communicate and use new format with farmer groups. The workshop was part of the Rwanda Climate Services for Agriculture project, supported by the U.S. Agency for International Development (USAID) and led by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Its objectives were to: (a) train intermediaries to interpret, communicate and guide use of new experimental seasonal forecasts; (b) discuss how the new seasonal forecast format fits with other new and planned climate information products; and (c) develop action plans to communicate and use the seasonal forecasts in the four Year-1 pilot districts. The training builds on and extends the previous Participatory Integrated Climate Services for Agriculture (PICSA) training workshops by (a) shifting from the use of station rainfall data to merged gridded data, and (b) introducing experimental seasonal forecasts presented as shifted probability distributions. The workshop, held at Limigo Hotel, Kigali, 1 September 2016, involved 28 participants that included district agricultural extension, Rwanda Agricultural Board (RAB) and Rwanda Meteorological Agency (Meteo-Rwanda) staff, and representatives of farmer organizations (Appendix 1).

Training Process

The training program (Appendix 2) was organized around a workshop process that has been developed by the International Research Institute for Climate and Society (IRI) and employed to help groups of farmers in several countries (Kenya, Senegal, Tanzania) understand and use fully probabilistic downscaled seasonal climate forecasts (Hansen et al. 2004, 2007, 2015; Ndiaye et al. 2013; Njiru et al. 2015). The main steps are: defining and discussing key concepts, understanding and time-series graphs to develop probability-of-exceedance graphs, interpreting probability distributions, using El Niño as a basis for understanding how seasonal forecasts shift probabilities, and presenting and discussing the current seasonal forecasts. A final component of the workshop was action planning for the communication and use of seasonal forecasts for the upcoming September-December 2016 agricultural season (2017 Season A).

Local seasonal forecasts in probability-of-exceedance format

The workshop began with an introduction to downscaled forecasts in probability-of-exceedance format, and discussion of plans to make these forecasts available through the Meteo-Rwanda maprooms. The new format has several advantages over the more commonly used tercile maps for presenting seasonal forecasts. First, it matches local historic climate variability and hence the information that decision makers would use in absence of forecast. Second, it provides probabilities associated with any threshold (e.g., minimum rainfall to meet crop demand) that might be relevant to management options. Third, it conveys the accuracy and uncertainty of forecasts in a clear, transparent manner. Finally, well-developed participatory methods make it feasible for farmers and other agricultural decision-makers to understand and apply probabilistic forecasts in this format. The project plans to integrate the approach used in this training into the PICSA curriculum.

Key Concepts

Five key concepts about seasonal climate information were explained, and their equivalent terms in Kinyarwanda were discussed (Table 1). The translation of key concepts in Kinyarwanda was meant to make sure that facilitators or trainers understand the terms and use the words/terms that match what farmers have in mind.

Table 1. Key concepts and agreed Kinyarwanda equivalents.

Concept	**Short explanation**	**Kinyarwanda term**
Variability	Deals with what happened in the past. For example, rainfall in 2015 was different from rainfall in 2014, which was different from rainfall in 2013.	*Ihindagurika*
Frequency	Expresses variability with numbers. For example, in four out of the past ten years I was not able to produce enough maize to feed my family until the next harvest.	*Ubwisubire* or *Inshuro*
Uncertainty	Deals with what will happen in the future. Because the climate has been variable in the past, I am uncertain about what the weather will be like in next growing season.	*Ishidikanya*
Probability	Expresses uncertainty with numbers. For example, there are two chances in five that I will not produce enough maize to feed my family until the next harvest.	*Ibishoboka* or *"Amahirwe y'igihe n'ikirere yo kwisobiramo kurugero rukana hakoreshejwe ijanishwa"*

Forecast (or Prediction)	New information that changes the probabilities about the future. A forecast reduces uncertainty, but doesn't eliminate it completely.	*Iteganyagihe*

Using graphs to understand rainfall variability and probability

Participants were led through an interactive process of eliciting collective memory of rainfall in recent years, developing a time-series graph based on the past 5 years of rainfall data, and then sorting the time series into a probability-of-exceedance graph. The first step involved relating measured time series to participants' collective memory of qualitative rainfall conditions (i.e., wet, medium, or dry) for the past 5 years, for the September-December season. Volunteers then took turns to plot observed quantities on a blank graph (Fig. 1).

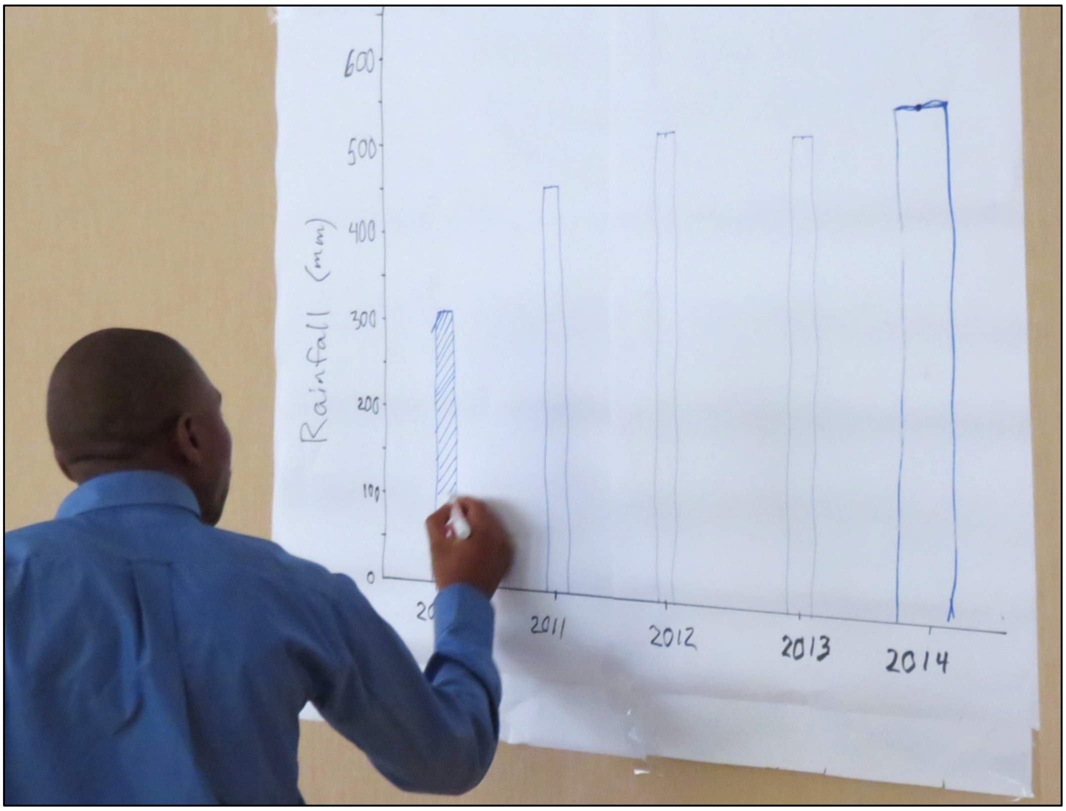

Figure 1. Participatory development of rainfall time series graph based on the last five years of available data.

Second, on a blank graph with quantity (e.g., seasonal rainfall) on the x-axis and frequency (e.g., "Years with at least this much rain") on the y-axis, participants sorted the time series of observations into frequency, sorting from lowest to highest (if using probability of exceedance). Changing the y-axis from "number of years…" to percentage results in a probability distribution, in probability-of-exceedance format (Fig. 2).

Involving participants (farmers or intermediaries) in a hands-on process of developing graphs seems to help them understand the graph formats. Once farmers have gone through the process of deriving a time series and probability-of-exceedance graph based on the past five years of data, they can understand computer-generated graphs that incorporate more years of data.

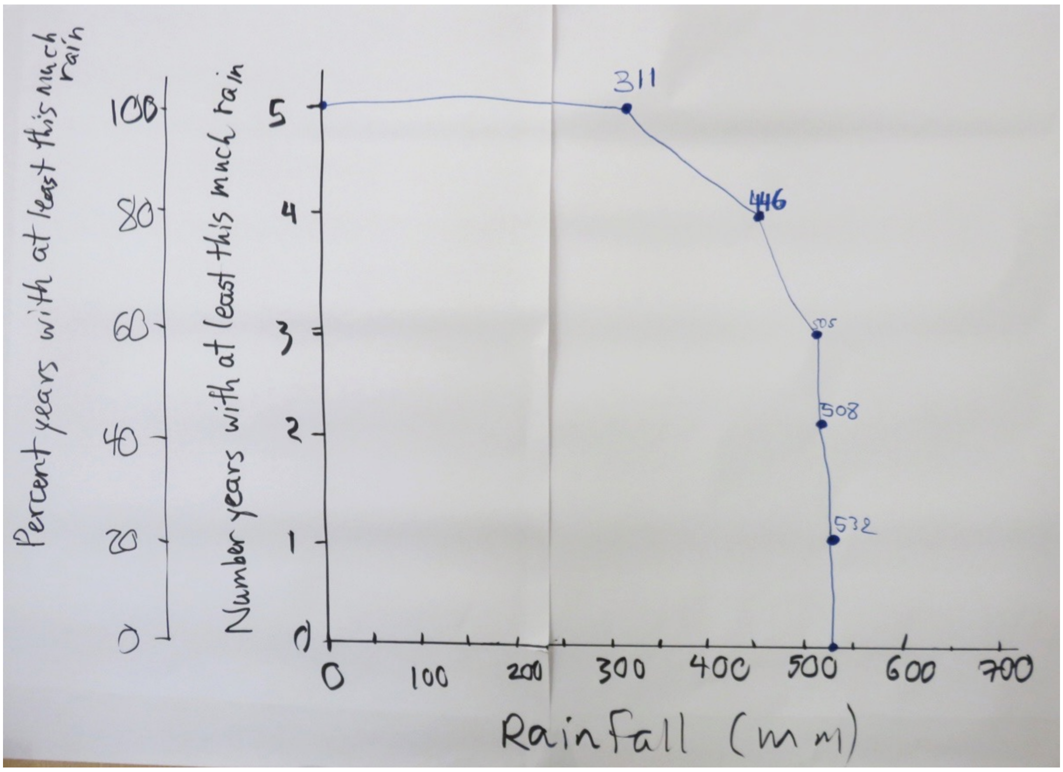

Figure 2: Probability-of-exceedance of total seasonal rainfall, developed by participants based on last five years of data.

Interpreting probability-of-exceedance graphs

Trained intermediaries are expected to be comfortable interpreting probability-of-exceedance. Following instruction on this, participants were divided into their four home districts, provided with historical October-December rainfall probability-of-exceedance graphs for their districts, and requested to answer a set of questions, designed to reinforce their ability to interpret probability-of-exceedance graphs:

1. The median is the middle of the distribution, meaning that 50% of years are wetter and 50% of the years are drier (for the September-December season). Find the median rainfall.

2. Suppose that the risk of a particular crop disease greatly increases, and fungicide application is recommended, if seasonal rainfall is more than 400 mm. What is the probability that this will happen?

3. Suppose that yields of a high yielding bean variety are likely to fail if seasonal rainfall is below 250 mm. What is the probability that this will happen?

4. Seasonal rainfall forecasts are sometimes expressed as the probability of experiencing "below normal," "normal" and "above normal" rainfall. "Below normal" refers to the driest 1/3 of years, "normal" is the middle 1/3 of years, and "above normal" is the wettest 1/3 of years. What is the range of September-December rainfall that would fall in the "normal" category?

Participants agreed that the answers (Table 2) reflected key differences in the climates of the four districts.

Table 2. Answers to breakout group questions on the interpretation of rainfall probability-of-exceedance graphs.

District	Question			
	1	2	3	4
Kayonza	380	35%	3%	325-412 mm
Nyanza	370	40%	7%	330-420 mm
Ngororero	500	94%	0%	480-540 mm
Burera	500	90%	0%	460-530 mm

Using El Niño to illustrate seasonal forecasts as a probability shift

A discussion about El Niño was used to introduce the concept of a seasonal forecast, build confidence that there is a physical basis for seasonal forecasting, reinforce the probabilistic nature of seasonal forecast, and prepare participants to accept the new seasonal forecast format. Prior experience in Kenya and Tanzania suggests that most farmers have heard of El Niño, and that it can therefore be used to illustrate how knowing something about sea surface temperatures—widely used directly or indirectly in seasonal climate prediction—can shift the probability distribution of rainfall during an upcoming season.

A globe was used to explain that El Niño refers to warmer-than-normal surface temperatures over a large portion of the eastern equatorial Pacific Ocean. By highlighting past El Niño years in a rainfall time series graph, participants recgnized that El Niño shifts the probability distribution towards wetter conditions (Fig. 3). Showing a probability-of-exceedance graph for El Niño against the probability-of-exceedance for all years confirmed this, as seen in the case of Nyanza (Fig. 9). Although the seasonal forecasts that Meteo Rwanda prepared, with IRI technical support, are not based only on El Niño-related sea surface temperatures, the shifted probability distribution shown in Figure 4 is close to the new format for the seasonal forecasts that the project introduced.

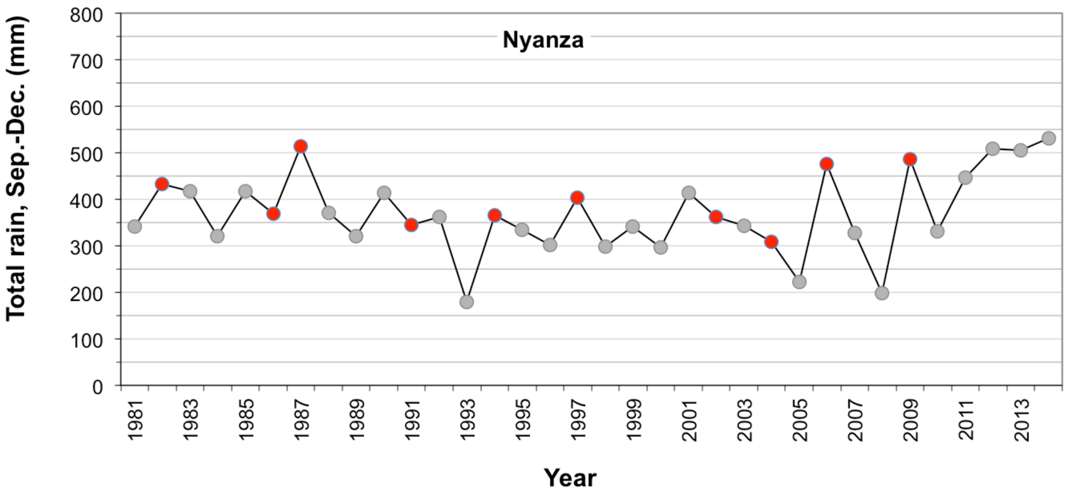

Figure 3: Nyanza time series graph highlighting El Niño years (red).

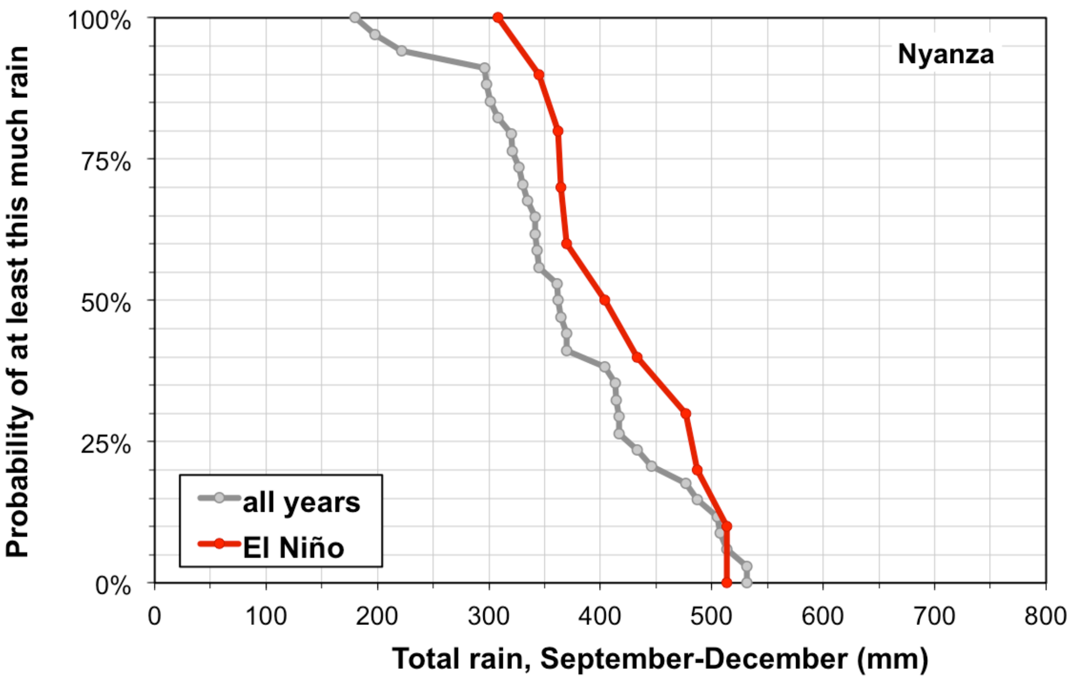

Figure 4. Nyanza probability-of-exceedance graphs for El Niño years (red) and all years.

Current seasonal forecast and its implications

Training activities up to this point were designed to help intermediaries understand the concepts and format of the downscaled seasonal forecast, and a process they can use with farmers. Then, forecasts of total rainfall for the September-December season (2017 Season A), downscaled for one location in each of the four target districts (Siebert et al. 2016), were presented and discussed (Fig. 5). The forecasts show a weak (Burera, Ngororero) or moderate (Nyanza) probability shift towards dryer conditions, except for Kayonza where the forecast aligns closely with the historical probability distribution.

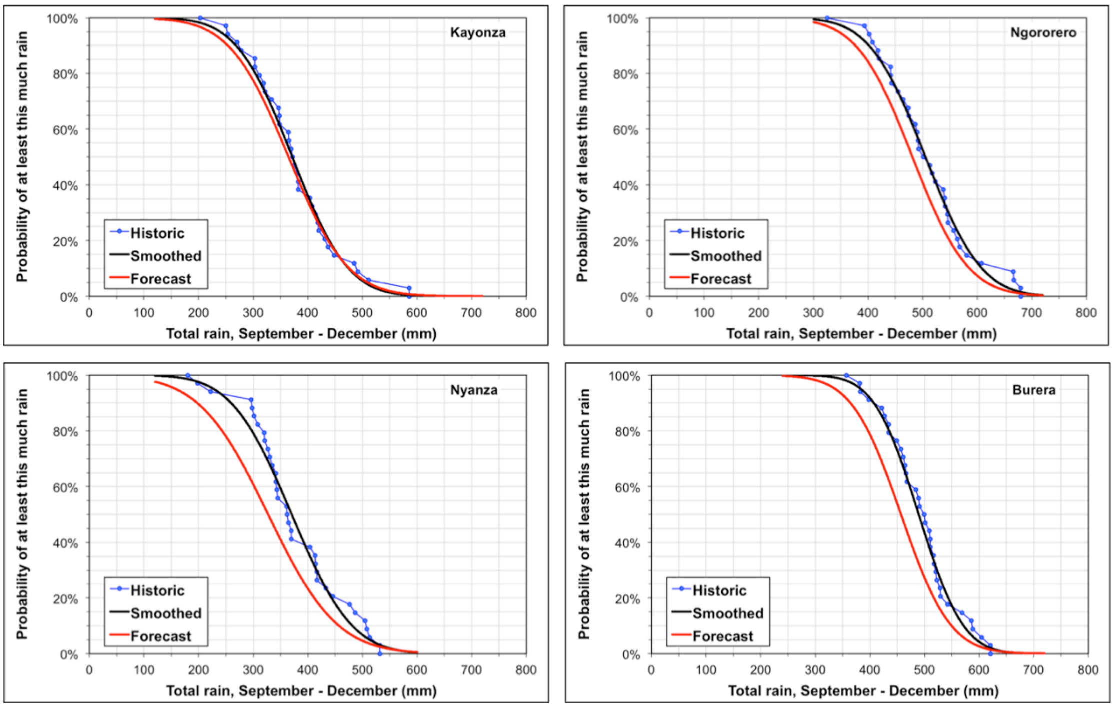

Figure 5. Forecasts of September-December 2016 total rainfall for each Year-1 pilot district, developed August 2016 (Siebert et al. 2016).

The presentation of the current forecast was followed by a discussion of the approach that was presented in the workshop, how the forecast system performs, and how to present the historical and forecast information to farmers. Participants agreed that the new format is more useful than the conventional tercile seasonal forecast maps. Most participants agreed that a time series would be easier to understand by farmers if presented as a bar graph rather than a line graph. Participants from agricultural extension recommended using large format printouts instead of computer-based projections when bringing climate services information to farmers. Participants agreed that hands-on involvement of farmers in developing graphs, based on a small (~5-year) subset of recent data, would help build their understanding, trust and confidence.

Participants from Meteo-Rwanda and from farmer organizations offered differing perspectives about presenting farmers with time series graphs of hindcast and observed rainfall. Participants from farmer organizations argued that they could increase farmers' trust in the forecasts, while participants from Meteo-Rwanda expressed concern that the hindcast time series could be misunderstood and lead to confusion.

In the plenary discussions, several questions were raised about bringing the historic and seasonal forecast information to farmer end-users in the form of probability-of-excellence graphs. Participants noted that probability-of-exceedence graphs are initially difficult to understand, yet are very useful. The response from farmers to the use of graphs, in the PICSA process so far, has been overwhelmingly positive. Participants recommended developing explanations for the probability-of-exceedance graphs and related concepts, in Kinyarwanda. They also proposed developing a plan to train intermediaries at least to the Sector Agronomist level, and potentially the Farmer Promoter level, to understand and interpret these graphs. The question of whether farmer end users should be trained to understand historic and forecast probabilities, in the form of probability-of-exceedance graphs, was raised but not resolved. One suggestion was to focus on shifts in the probability of exceeding climatic thresholds associated with particular management options, but not the graphs, when bringing the information to farmers. However, the training facilitator (James Hansen, who is also project leader) noted that farmers in Kenya, Tanzania, and Senegal have been able to understand and make use of historical and forecast probability-of-exceedance graphs, and that Rwanda farmers have consistently responded well to the graphs used in the PICSA process.

Noting that farmers consistently identify climate variability as their greatest concern, participants recommended including information about the timing of rain, and timing of planting, and rainfall distribution and intensity, in addition to seasonal rainfall totals. Short, intense rain is not as good as rainfall that is evenly distributed throughout the growing season. Participants agreed that information about dry spells could capture part of this concern. The facilitator noted that the project plans to expand the existing Meteo-Rwanda maprooms to include these additional information products.

Action plans for communicating and using the seasonal forecasts

The session on developing action plans around the seasonal forecast began with a quick refresher on the PICSA process, and how PISCA is being integrated into the existing Twigire Muhinzi agricultural extension approach led by RAB. Participants reviewed the main management options that farmers discussed during earlier training activities (in July) for each of the pilot districts: Kayonza (maize, beans and cassava), Nyanza (maize, RAB provision of hybrid seed as a statutory condition), Burera (potatoes, beans and wheat), and Ngororero (maize, potatoes, beans and tea).

Although the objective of the session was to develop action plans for rolling out the new, downscaled seasonal forecasts with farmers engaged in the PICSA process, the discussion covered several other aspects of planning in the target districts. This included a request to develop plans to roll out the PICSA approach to more farmers in the four pilot districts. Sector Agronomists were requested to put in place rain gauges in each sector and supervise the data collection, to contribute to the validation of forecasts provided by Meteo-Rwanda. Agronomists were also encouraged to contribute to districts plans by providing timely information on seasonal forecasts and crops requirements. Participants recommended packing climate information with agronomic advisory information (e.g., types of inputs, seeds, mineral and organic inputs, pesticides).

In the final closing remarks, Moussa Senge spoke on behalf of participants to thank the facilitators and to remind everyone to always think of the farmer and find ways to give them right information on climate. Participants committed themselves to always provide climate or weather forecast information to farmers to help them improve their livelihoods.

Conclusion

The workshop involved a core group of intermediaries who had been involved in previous PICSA training, and play an active role in communicating climate information in the Rwanda Climate Services for Agriculture project. It introduced new downscaled seasonal forecasts for each of the four target districts, and extended the earlier PICSA training by (a) shifting from the use of station rainfall data to merged gridded data, and (b) introducing experimental seasonal forecasts presented as shifted probability distributions. The new format introduced in the workshop addresses several limitations of the more commonly used tercile maps for presenting seasonal forecasts. The project plans to integrate the approach used in this training into the PICSA process and curriculum.

The forecasts of total rainfall for the September-December season (2017 Season A), downscaled for one location in each of the four target districts, show a weak (Burera, Ngororero) or moderate (Nyanza) probability shift towards dryer conditions, except for Kayonza where the forecast aligns closely with the historical probability distribution.

Several recommendations came out of workshop discussions, including: (a) endorsing the new format for presenting seasonal forecasts; (b) using large format printouts instead of computer-based presentation to bring graphical climate information to farmers; (c) using hands-on development of graphs as a way to build farmers' understanding, trust, and confidence; and (d) developing online information about the timing of rain, and timing of planting and rainfall distribution and intensity, in addition to seasonal rainfall totals. There was some debate about how much detail about probabilistic seasonal forecasts should be provided to farmers, and whether probability-of-exceedance graphs of seasonal forecasts should be packaged with time series of hindcasts and observations.

The workshop only partially achieved its objective of producing action plans for rolling out the new, downscaled seasonal forecasts with farmers engaged in the PICSA process. Planning discussions touched on extending the PICSA process to more farmers in the four initial pilot districts, providing rain gauges in each sector to help validate forecasts, bringing climate information into district planning, and packing climate information with agronomic advisory information.

Appendix 1. Workshop Program

Time	Session
9:00-9:45	Introduction, objectives and key concepts
9:45-10:30	Using graphs to understand rainfall variability and forecast probability
10:30-10:45	Coffee Break
10:45-11:30	Interpreting a probability-of-exceedance graph
11:30-12:00	Using El Nig a probability-of-exceedance graph
12:00-12:45	2016 seasonal forecast and its implications
12:45-13:15	Discussion of current and planned products, relative to demand
13:15-14:00	Review action plans for Planning and Review process
14:00	Workshop closure, Lunch

Appendix 2: Participants

Name	Institution	Position	Email	Gender	Age group U ≤ 35 yrs B > 35 yrs
Mukamurara Julienne	Kayonza District	Ass. District Agronomist	juspeae@yahoo.fr	F	U
Twahirwa Anthony	Meteo Rwanda	Meteo Rwanda	rwaky@yahoo.com	M	B
Kayinamura Emmanuel	CIAT	Internee	kayinamuraemmy@gmail.com	M	U
Nsengiyumva Theogene	RAB	Agronomist	nsetheos@gmail.com	M	U
Senge K. Moussa	RAB	Twigire Coordinator	kyembwamoussa@gmail.com	M	U
Mukarubayiza Florentine	Radio Huguka	Journalist, Head of Community services program	mukaflorente@yahoo.fr	F	B
Gahigi Emmanuel	RAB	Research assistant	gaimable13@gmail.com	M	B
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Nyiramahoro Eugenie	DERN	Responsible d' Appui Technique	nmahoreug@yahoo.fr	F	B
Nizeyimana Jean de Dieu	RAB	Twigire Zonal Coordinator	nizeyjado@gmail.com	M	U
Kimenyi Clement	Organization de Travail pour les Progres (O.T.P)	O.T.P Representative	clekime@yahoo.fr	M	B
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Gakwavu Thomas	RAB	RAB Research technician	t.gakwavu@yahoo.com	M	B
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Floribert Vuguziga	Meteo Rwanda	Meteo Rwanda	vfloribert@yahoo.com	M	B
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Kazora Jonah	Meteo – Rwanda	Meteo – Rwanda	kzjonah@yahoo.com	M	U
Mukamana Blandine	Meteo - Rwanda	Meteo - Rwanda	mublandy@gmail.com	F	U
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Desire Kagabo	CIAT	Climate Services for Agriculture' project coordinator, Rwanda	d.kagabo@cgiar.org	M	B
James Hanser	IRI/CCAFS	IRI/CCAFS	jhansen@iri.columbia.edu	M	B
Theogene Mugabonake	Nyanza District	District Agronomist	mugathe@gmail.com	M	U

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