RESEARCH PROGRAM ON
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Farmer training workshops on understanding probabilistic seasonal forecasts

Wote, Kenya, 14-16 and 20-23 September 2011

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Workshop Report

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

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Abstract

This report presents the work done during farmer training workshops on probabilistic seasonal forecasting and forecast-based advisories, in Wote, Makueni County, Kenya. This activity took into consideration the fact that farmers in Mahueni County in semi-arid eastern Kenya mainly rely on rainfall for their agricultural production. The rainfall is, however, highly variable in amounts and distribution both seasonally and annually making farming in the region a risky business. The goal of the project was therefore, to train farmers in the identified areas of Makueni to better understand the climate of their location and explore how they can manage the effects of the variability in rainfall in order to improve their farm production. The area was selected due to previous as well as on-going studies implemented by ICRISAT, KALRO and other collaborators. The aim of the training was to empower farmers with knowledge on the use of forecast information and to enable them make better use of this knowledge in their farm planning for improved household food security. The trainings were conducted on the 14-16 and 20-23 September 2011, before the onset of the short rain (October-December) season. It was part of a study that covered twelve villages in Wote Division, Makueni County. Ten farmer participants were selected per village giving a total of 120 farmers. These workshops were sponsored by the Climate Change Agriculture and Food Security (CCAFS) project under the Theme "Adaptation through Managing Climate Risk," and implemented in collaboration with International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT), Kenya Agricultural and Livestock Research Organization (KALRO), Kenya Meteorological Services (KMS), the Ministry of Agriculture (MoA), and International Research Institute for Climate and Society (IRI).

Keywords

Climate Services; Advisories; Training; Kenya

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Contents

Acronyms

CCAFS	CGIAR Research Program in Climate Change, Agriculture and Food Security
DAO	District Agricultural Officer
DLPO	District Livestock Production Officer
ICRAF	International Centre for Research on Agroforestry (now World Agroforestry Centre)
ICRISAT	International Crops Research Institute for the Semi-Arid-Tropics
ILRI	International Livestock Research Institute
IRI	International Research Institute for Climate and Society, Columbia University
KALRO	Kenya Agricultural and Livestock Research Organization
KMS	Kenya Meteorological Services
MoA	Ministry of Agriculture
UoN	University of Nairobi

Introduction and approach

This report describes a set of farmer training workshops on probabilistic seasonal forecasting, and on forecast-based advisories, conducted in Wote, Makueni District, Kenya, prior to the start of the 2001 short rains season. The aim of the training was to empower farmers with knowledge on availability and use of forecast information in order to enable them make better usage of this knowledge in their farm planning for improved household food security and as an adaptation strategy to impacts of climate change. It was part of a randomized test of seasonal forecast communication strategies, led by CCAFS Theme 2, ICRISAT, KALRO and IRI, in collaboration with KMS, University of Nairobi and other partners. The project was designed to assess the feasibility and usefulness of training on downscaled probabilistic seasonal forecasts, and forecast-based management advisories – alone and in combination.

The training team was composed of officers from CCAFS IRI (New York) and ILRI (Nairobi) offices, Kenya Agricultural and Livestock Research Organization (KALRO) Katumani National dryland Farming Research centre, ICRISAT Nairobi and Kambi ya Mawe research centre, Kenya Meteorological Services (KMS) Nairobi and Katumani offices, Ministry of Agriculture Makueni County Agricultural office (CAO), and Ministry of Livestock Development Makueni County Livestock Production office (CLPO).

Advance planning meetings were held to discuss the best way to conduct the trainings. Those in attendance included James Hansen and Kevin Coffey from the IRI, K.P.C. Rao from ICRISAT-Nairobi, Justus Itabari and Emerita Njiru from KALRO-Katumani, Susan Njeri from ICRISAT Kambi ya Mawe research sub-centre, and Robinson Kinuthia Ngugi from University of Nairobi. Decisions covered the number of villages to be involved in the project, treatments and treatment size, training materials, training dates and venues and the survey questionnaire.

Participating farmers were selected from 12 villages surrounding Kambi ya Mawe Research Sub-Centre (Table 1). Participants were selected with the help of the local administration personnel on the basis of their gender (equal representation from female headed and male headed households), their involvement in farm decision-making, their availability in the farms, and willingness to participate in the training. Ten farmers were selected from each village giving a total of 120 farmers. These were then divided into four groups representing four treatments: (1) training on probabilistic seasonal forecasting alone, (2) training on probabilistic forecasting and advisory, (3) advisory alone, and (4) the control: no training and no advisory. Selected farmers were informed in advance and a consensus reached between the planners and farmers on appropriate dates for the workshops. For ease of logistics, the workshop was carried out on two separate dates: treatment 1 and 4 in the first workshop on 14th – 16th September, 2011 and treatments 2 and 3 in the second workshop on 20th – 23rd September, 2011. Each single workshop was planned to host 30 farmers. A separate venue was planned for treatment 4 to avoid mixing with those who were being trained on probabilistic forecasts. Table 1 gives the actual workshop attendance of participants per treatment A survey questionnaire was developed and enumerators identified and trained on its administration.

Treatment	Villages sampled	Participants
1. Training in probabilistic forecasts	Kathoka, Mulaani, Kambi ya Mawe	29
2. Training and Advisory	Ngunu, Kasarani, Muvau	29
3. Advisory workshop	Soweto, Kyemole, Kithoni	30
4. Control	Senda, Kwa Kathoka, Kivaani	30

Table 1: Villages sampled and the number of participants per treatment

Workshop procedure

On arrival at the workshop venue the participants were registered and a questionnaire administered to each of them by trained enumerators. The objective of this exercise was to gather preliminary information with the objectives of (a) understanding the farmers the project was dealing with, (b) gathering any evidence of climate information delivery and use, and (c) collecting baseline information for future monitoring purposes. A semi-structured questionnaire was used to collect data on management plans including area cultivated, labour and input allocation, soil, crop and livestock management practices, access to weather forecast information and availability and use of credit facilities. The questionnaire session was followed by the workshop opening session which involved self-introduction including the main farming activities that each participant was engaged in and what they expected to gain from the workshop based of what they were informed during their invitation. After knowing one another and listening to each one's expectations a volunteer opened the workshop with a word of prayer. The workshop objectives were discussed with participants and the official opening ceremony conducted. Thereafter each group of farmers was handled depending on the treatment that required to be administered with each session handled by one or more facilitators (Appendix 2).

Training on probabilistic forecasts

This training was done during the first date of the workshop (14th – 16th September, 2011) with 29 farmers from Kathoka, Mulaani, Kambi ya Mawe and second date (21-22 September, 2011) with another 29 from Ngunu, Kasarani, Muvau villages. Appendix 1 presents the workshop structure including notes for facilitators. First training

Workshop opening

Introductions and farmers expectations (facilitator: E. Njiru)

The self-introduction, an opening prayer and a brief discussion of expectations from the workshop helped in "setting the dust" and making the participants more relaxed and ready for the day's activities. The expectations at this stage also gave the facilitators some insight on whether the participating farmers understood the aim of the training.

All invited farmers expected to learn something new from the workshop. The major and common expectations were (a) learning how to make a choice of the crops to plant during the short rain season, (b) understanding the forecast of the coming season, and (c) knowing where to source for improved seeds.

Workshop objectives (facilitator: E. Njiru)

The basics of this training were predictions, probabilities, reliability and decision making. A Bible reading, from Genesis 41, told the story of how God gave the king a dream. Joseph interpreted the dream to be a prediction of 7 years of abundant yields that were to be followed by 7 years of drought with no harvest. It was explained that forecasts did not start with modern civilization but have been there from the biblical times. It showed how predictions of good years were used to counter the effects of bad years, a practice that can be done even now in variable climate situations. However, unlike in the Bible, where God's forecast was deterministic and certain, participants were informed that human forecasts have uncertainty and should be interpreted as probabilities. This uncertainty was compared to predicting a winning soccer team.

The Bible story was used as an introduction to the workshop objectives:

- To create awareness of availability of climate information and how it is derived;
- To train farmers on importance of climate information and how they can apply it in their farm decision making for improved food security; and
- To create a platform for communicating climate information to farmers and receiving their feedback on its use/applicability.

These objectives were related to the workshop expectations. At the end of the workshop participants were expected to: (a) have gained knowledge on forecast information, how it is derived and its importance in farm decision making, (b) be able to interpret forecast information and make decisions accordingly, and (c) appreciate the importance of using forecast information and therefore be collaborators in the project implementation.

Official opening of workshop by CAO Makueni District

The workshop was officially opened by the CAO's representative, Ms. Rosemary Munyao, from Makueni CAO's office. During her opening speech the official informed the farmers that the workshop was expected to be an eye opener to them on issues of food security. They were informed that for them to be food secure, they did not have to grow all types of crops but to have the capacity to grow in plenty what can do well in their area, sell the surplus and buy what is lacking and what cannot grow well in their locations. With the diminishing of land sizes from 50 acres to fragments of less than 2 acres, participants were advised to change from old technologies to new ones, giving an example of Kiambu County in central Kenya where land sizes are very small but farmers have been able to change accordingly to overcome food insecurity. They were reminded that although weather prediction were not always 100% correct, they could still be used as a guide when choosing the best crop to grow in order to reduce the risks of crop failure. A good example was the choice of varieties of maize. Varieties that take less time to mature reduce the risk of total crop failure in case of less rainfall. The same applied to other crops that can tolerate drought such as cassava, sorghum, and millets, which are also the best choices for rain-fed agriculture in the region. Participants were also advised to plant fruit trees that are appropriate for the region and which can generate cash income. Farmers were reminded of the importance of livestock production in the region. This was said to be the most successful farming enterprise of the entire County since one could sell livestock to buy food in case of crop failure.

Goals and constraints to farming (facilitator: D. Mutinda)

In order to get farmers to identify climate variability and its importance relative to other perceived challenges, participants were requested to give their goals in farming and rank the constraints they encounter. The goals were ranked from the topmost as (a) get good harvests, (b) avoid buying foodstuffs, and (c) make money from sale of farm produce. The most important constraints that they identified were: (a) insufficient and unreliable rainfall (leading to poor timing of operations and crop failures), (b) lack of improved seed, (c) lack of inputs (e.g. seed, oxen for carrying out farm operations and fertilizer) leading to late planting, (d) pest and disease damage, (e) weed infestation, (f) lack of information (e.g., not sure of the right seed varieties for different areas), and (g) poor market prices. Seed and fertilizer prices from agro dealers were said to be very high, yet farmers did not get loans and credits due to fear that their land will be auctioned by lending banks/institutions.

Key concepts

Definition of terms (facilitator: J. Mwangangi)

Terms commonly used in forecasting were defined in simpler language that could be easily understood by the farmers. These were: *weather*, *climate*, *forecasting*, *variability*, *uncertainty* and *probability*. Participants translated some of them into the local Kikamba language. Forecasting ("forecast" = *woni* in Kikamba) was therefore defined as the art of predicting ("prediction" = *kauthana* in Kikamba) occurrence of an activity. Participants were informed that in meteorology prediction and forecasts are done using long term data collected from a weather station combined with a study of the sea surface temperatures in the Pacific and Indian oceans. Many participants said they were aware of the next season's prediction, which they received from Kenya Metrological Services (KMS) through their local Kikamba language radio station (*Musyi* F.M). The predictions, they said, helped them to decide on which crop to grow. "Weather" was defined as the air, rainfall, and sky condition of a place at a given time and that weather parameters were recorded in a weather station. Participants were informed that "Climate" was a long duration occurrence of the weather in a wider area and that weather records were used in describing the climate. "Climate change" was defined as a change in the normal climatic conditions of an area that persists for a long period. "Climate variability" was given as a term used to describe variations in normal seasonal patterns. "Probability" involved using past recorded figures to predict occurrence of an event in the future. "Variability" (*uvindukanu* in Kikamba) referred to what happened in the past, whereas "uncertainty" (*nzika* in Kikamba) referred to the future e.g. what was coming during the season. There is uncertainty when dealing with probabilities.

Importance of variability and uncertainty (facilitator: J. Hansen, interpreted by D. Mutinda)

The example of choosing a marriage partner was used. Courtship is a form of prediction, as it allows a couple to learn more about each other and therefore reduces uncertainty. Yet one cannot be 100% certain that they will get a spouse with the desired qualities. Participants recognized that this process has lessons for how to understand climate forecasts, but some noted that it was difficult to discuss something this personal in a workshop setting.

Local Indicators/Indigenous forecasts (facilitator: D. Mutinda)

In order for the farmers to appreciate the idea of forecasts, a session on forecasts using indigenous technical knowledge was introduced. The farmers described how in olden days and even at the moment local people predicted the approach of the rainy season by observing some indicators such as the flowering of certain shrubs and trees such as acacia, direction of the wind, time of the year, bird migration, frogs making a certain noise, and the movement of butterflies. However, the participants agreed that these indicators did not give them an idea on how the season going to be. They all agreed that such predictions were and could not be used to decide on what crops or varieties to plant to plant.

Rainfall time series graphs (facilitators: J. Hansen, J. Mwangangi and E. Njiru)

This participatory exercise acted as an introduction to probabilistic seasonal forecasting. Participants were requested to recall the rainfall amounts for the past five years and classify the short rains seasons as dry, medium or wet, depending on their own assessment of rainfall amount. They were then told to recall the performance of their crops during these seasons, and classify them as good, average or poor. These were put in table form to allow them to compare rainfall amounts and the resultant crop yields.

Under the guidance of the facilitators, farmers drew time series bar graphs based on measurements of water in cylinders, equivalent to the amount of rainfall measured at a nearby station, for the short rain seasons in the past five years. Volunteer farmers were asked to measure the depth of the water in the cylinders and mark it on a prepared sheet of paper with "Year" and "Rainfall" axes (Fig. 1, 2).

Figures 1 and 2: Farmers drawing rainfall graphs

The graphs were compared to the table of rainfall amounts and yields developed earlier. Interpretation of the graphs and identification of driest and wettest years and frequencies of years above or below some values were discussed. Participants were then led through a process of sorting the years from driest to wettest, calculating the frequency of years with at least a given amount of rainfall, and plotting this to develop a probability of exceedance graph (see Appendix 1 for details). Emphasis was put on how relative frequency (past) is equivalent to probability (future). This was followed by a recap and discussion session to ensure better understanding of the graphs and how they were derived..

Seasonal forecasts

Farmers were introduced to weather data measurements as well as seasonal forecasts and how they are developed. Knowledge gained in the previous session helped participants understand better how these measurements are done.

El Niño and La Niña years (facilitator: J. Mwangangi)

Participants were taken through definitions and causes of La Niña and El Niño (heating and cooling of the large water masses in the Pacific Ocean which causes movement of air masses upwards and into land masses). A time series graph showing El Niño and La Niña years was used during the discussions. A demonstration of forecasts in tercile format, and how El Nino conditions shift tercile probabilities, was shown using a distribution bar chart. Above and below normal tercile categories were explained. Probability of exceedance graph for El Niño years were discussed, as well as shifts in probabilities (shift to the left = drier climate, right = wetter climate).

Potential management responses for forecast scenarios (facilitators: E. Njiru and D. Mutinda)

This group discussion was intended to test how well participants understood the new graphic forecast format, and to identify what they saw as promising management responses that could be used to inform future research directions as well as their constraints. Four groups of six to seven individuals (two comprising of women and two comprising of men alone) were formed for effective interaction. Each was given drawn graphs of forecasted scenarios with hypothetical probability shifts towards wet or dry. Each group was asked to interpret the graphs and indicate what they would do differently in their farms given the shifts in probability. They were also asked to list the foreseen constraints to the desired management options.

For a forecast that shifts the distribution to the right (i.e., wetter conditions), the practices that farmers said they would carry out differently included early land preparation, early purchase of seeds suitable for high rainfall, planting high yielding crop varieties (e.g. hybrid maize), repair damaged terraces and construct new ones to curb soil erosion, plant early to get all the rains, plant in pure stands and with correct spacing, use pesticides in anticipation of good harvest, apply fertilizers at planting and as side dressing, engage more casual labour, and get loans and credits for farming. The also identified a range of constraints to successfully implementing these changes as lack of funds for inputs, inadequate knowledge and skills on improved agricultural technologies, lack of improved seed and information on appropriate varieties, lack of farmyard manure, lack of farm equipment, pest infestation, increased weed problems, poor soil fertility, lack of labour and draught animals, risk of experiencing less rains than predicted, and lack of good storage facilities.

When presented with a hypothetical forecast shifted to the left (i.e., dryer conditions), the management changes they identified included early dry planting, use of farmyard manure, construction of water harvesting structures, use of early maturing crops and varieties, use of drought tolerant crops (e.g. sorghum, millet, cassava, finger millet), use of improved seeds, planting using recommended spacing, plant in furrows to retain moisture, mulching (especially kitchen gardens), early and thorough weeding to avoid moisture competition, use of pesticides for pest attacks during dry spells within the season, early preparation of storage facilities, and early harvest and improved drying and storage to avoid losses. Constraints identified under this forecast scenario included lack of seeds, lack of agricultural implements, insufficient labour, increased pest damage that is expensive to control, insufficient skills and training on improved management techniques, and increased damage by wild animals such as squirrels and hares.

Seasonal forecast, predicted vs. measured rainfall (facilitator: R.K. Ngugi)

Farmers were presented with current forecast (for the coming October-December season) in the area. An open discussion on the seasonal forecast was followed by explanations of predicted vs. measured rainfall. It was noted that there could be positive or negative variations from predicted values due to uncertainty in forecasting which farmers needed to be aware about in order to change their plans accordingly.

Workshop closing (R.K. Ngugi, E. Njiru and Laula C.)

A facilitated a discussion on the way forward was conducted. Farmers freely gave their feeling about the workshop and generally agreed on some points as a way forward for the project. These included: (a) need for establishment of demonstration plots for training purposes; (b) frequent meetings to review progress, (c) report/feedback of the questionnaire, (d) on-station and on-farm demonstration, (e) provision of seed from KALRO, (f) farm management training to be conducted, and (g) need to issue certificates of participation to workshop participants.

Laula C. thanked the participants and promised to come back. She talked of the countries which are covered by the project i.e. Tanzania, Uganda and Ethiopia, and said that there will be frequent visits to the farmers in Wote by the project team members.

The Chief, who was also a participant, thanked the organizers and requested for the workshop feedback. He promised to share the information about any future meetings with his people and urged each participant to talk to other farmers about what they had learnt.

The official closing was once again done by the CAO representative who thanked the organizers and facilitators from KALRO Katumani, KMS, ICRISAT, UoN, Chief and the farmers. She described the workshop as a beginning of better things to come and took the opportunity to request participants to start preparing their land in readiness for planting in the following month. Farmers were also asked to make arrangement with the division office so that they could collect seed on time. Those trained in common Interest Groups were requested to implement whatever they learnt immediately before forgetting to avoid unnecessary problems. Participants were reminded that in order to reduce poverty levels in they should combine farming technologies appropriately and have knowledge about the weather in their area as a step forward in farming.

The workshop closed with a prayer from a volunteer farmer.

Second training

This training was done on 21-22 September 2011and involved 29 members from Ngunu, Kasarani, Muvau villages. This workshop generally followed the same sequence as the first workshop, with facilitators guiding participants in discussions and group activities. Only minor differences were captured in the farmers' responses as summarized below.

Introductions, farmers expectations and workshop objectives (facilitator: E. Njiru)

All farmers expected to learn something new from the workshop. However, a few of them also expected to be given free seeds for planting.

Goals and constraints to farming (facilitator: D. Mutinda)

All participating farmers came from the same areas and had similar background and farming constraints. The list produced in the previous training was therefore maintained after discussion..

Definition of terms (facilitators: J. Mwangangi and E. Njiru)

Definitions of *forecasting, predicting, weather, climate*, *climate change, climate variability* and *probability* were given, and farmers suggested local language translations for some of the terms. These were similar to those given before.

Importance of variability and uncertainty (facilitators: E. Njiru and D. Mutinda)

The example of choosing a marriage partner was used as an illustration of how collecting additional information can reduce uncertainty about a decision. Participants were first requested to list the qualities they desired in a spouse and the steps they followed in getting a marriage partner. The men listed the steps they take as: (1) praying, (2) looking for your match, (3) informing her of your intention to marry her, (4) courtship, (5) informing parents of both spouses of your intention to marry, (6) visiting parents, (7) starting marriage negotiations, and (8) wedding. They were asked how long they could take to cover all these steps and the answers varied from a few months to several years. However, they all agreed that the longer one took, the more they learnt and got to know their spouse better and hence the lesser the chances of disagreement once they were married; whereas the lesser the time taken, the little one knew about their spouse and the greater the chances of disagreement and separations. However, even if one knew their spouse so well before their marriage, there were still chances that some of the good or bad behaviour would remain hidden only to be noticed later in their married life.

Other sessions (facilitators: J. Mwangangi, C.K. Ariithi, D. Mutinda and E. Njiru)

Local Indicators and indigenous forecasts, Rainfall time series graphs, Seasonal forecasts, El Niño and La Niña and Recap and questions sessions were done as in the previous training.

Group discussion of potential management responses (facilitators: D. Mutinda, C. Ariithi, E. Njiru, S. Njeri and J. Mwangangi)

Enumerators sat with the groups to record their discussions and any arising comments or questions for later discussion. Judging by their interpretation of the graphs, farmers appeared to have understood the concept of probabilities and shifting of probabilities to the left or right of the predicted graphs. What farmers could do differently in case of the various shifts in graphs and the constraints involved were similar to what had been discussed in the previous workshop. The session was followed by explanation and discussion on seasonal forecast, predicted vs. measured rainfall and way forward.

Way forward (facilitators: E. Njiru and C. Ariithi)

Farmers requested for establishment of demonstration plots and farmer field schools for training purposes. They also requested the trainers to visit their farms during the season to see the extra efforts they will have put in their farming programmes as a result of this training. Participants requested more training and feedback sessions.

Figures 3 and 4: Farmers expressing their views during the workshop

Closing of second workshop on probabilistic forecast

A vote of thanks was extended by one farmer selected by her fellow farmers and by the Chief, who was also a participant in the workshop.

Closing remarks were given by the County Livestock Production Officer, Mr. Benson Mutua. The officer encouraged farmers to be ready to learn new ideas in order to diversify their farming and increase their production especially with the current challenges caused by adverse seasonal variability. Farmers were also challenge to venture into agricultural activities that had shown to be good in income generation such as rearing of local chicken and growing of high value drought escaping crops like green grams. They were reminded to make full use of the agricultural extension and livestock services currently available to them. Farmers were advised to use the information and knowledge they had acquired from the training workshop and always be ready to go for more training whenever they were called upon to do so.

Training on use of Advisory (facilitators: R. Munyao and J. Kinyue)

Two groups received training on use of advisories. The advisories had earlier been developed by the training team consisting of joint collaboration between ICRISAT, KALRO, MoA, KMS, UoN and CCAFs. The groups involved in the training comprised of members under treatment 2 (probabilistic forecast and advisory) and those that belonged to treatment 3 (advisory alone). The trainings took place on 21 and 22 September 2011 (Plates 5 and 6). Participants from the advisory group who had not attended the workshop earlier were first registered and taken through the questionnaire session before the start of the workshop which were facilitated by officers from the County agricultural office. Appendix 2 summarizes the program for the day.

Discussions were open and included a brief review of the previous rainfall season, the expected rainfall amounts, starting date and distribution, implications of the expected rainfall and management options that would best suit predicted rainfall conditions. After discussions, each farmer in this group was issued with promised copy of the advisory for their reference and use during the season.

Figures 5 and 6: Mr. Kinyue discussing Advisory, and section of farmers receiving information on Advisory.

Workshop for control group

Group 4 members were the control group. In order to harmonize treatments as much as possible members of this group were brought together in a workshop setting on the afternoon of the second day of the first workshop. However, the meeting was conducted in a separate venue to avoid mixing with the probabilistic training group and leakage of information between groups undergoing different treatments. The same questionnaire was administered after which the group was taken a brief discussion on the general farming activities in the area. The facilitator took the opportunity to discuss with farmers some of the recommended agronomic practices such as land preparation, crop spacing, weeding requirements and proper post-harvest handling of produce to reduce wastes and by pests and disease causing pathogens such as afflotoxin which was common in the area during the period the workshops were being held. No specific climate information was given to this group.

Appendix 1: Probabilistic Forecast Workshop Program and Facilitator Notes

Day 1	
Session 1 7:30-10:00	**Registration** **Administer questionnaire** **Tea, socializing**
Session 2 10:00-1:00	**Introductory Session**
	Prayer (nominated participant) **Introduce participants** **Workshop objectives. Genesis 41.** *Genesis 41 is the first recorded story about a climate forecast and its application to agriculture and food security. Why did Egypt have food when there was famine in the rest of the Middle East? Knowing about future climate conditions allowed Egypt to prepare. Information was not enough; it had to be combined with good decisions. Notice that they used the forecast of good years to prepare for the bad years; the forecast of bad years would not have been very useful if they had not taken advantage of the good years. Like the Bible story, we are here to talk about climate forecasts, and about decisions based on forecasts. There is one big difference from the Bible story. Only God knows with certainty exactly what the future climate will be like. Meteorologists can make useful forecasts a few months in advance, but there is still some uncertainty. The workshop will present forecasts in a new way, and help participants better understand the uncertainties in seasonal forecasts.* **Goals and constraints (or challenges) for farming.** **Rank three most important constraints.** *The intent is to identify the importance of climate variability (in their own terms) in the context of other perceived challenges/problems that farmers face.* **Definitions (weather vs. climate)** *"<u>Weather</u>" has to do with what happens in a particular day at a particular place. "<u>Climate</u>" refers to longer times and larger regions. Illustrate by contrasting climate (i.e., long-term average temperature and rainfall) between two familiar locations. "<u>Climate variability</u>" has to do with how periods of several months, e.g., short rains season or growing season conditions, differ from year to year. "<u>Climate change</u>" deals with long-term (at-least multiple decades)changes in things like average temperature and average rainfall, which are driven in part by changes in the atmosphere from human activity.* *A "<u>seasonal climate forecast</u>" is a forecast of conditions for the next few months. We believe it could be useful for farm management because it matches the time between decisions made around planting, and the outcome of those decisions at the end of the growing season. A seasonal climate forecast is different from a weather forecast, because it has considerable uncertainty, and it cannot tell when rainfall or other weather will occur.* **Local/indigenous indicators (accuracy, lead time, decisions, similarities with "scientific/modern" forecasts)**
	Importance of variability and uncertainty. Key concepts and closest Gikamba words:

"Variability." Deals with what happened in the past.

"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 the future.

"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.

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

Forecast and decision analogies

We tried using the decision about who to marry as an illustration. "X out of 10 single men in my village would make excellent husbands. If a single woman were to chose her husband by putting the names of all available men in a box, and picking one at random, the probably of getting an excellent husband would be x out of 10. However, we do several things to get to know that person better. This reduces the uncertainty, and increases the probability of marrying an excellent husband. However, all of us who are married know that there were some surprises after we got married. (One participant told me that this illustration didn't work well in this culture, because marriage is a very private topic.) Another illustration that might work in some places is guessing (or betting) which team will win a sporting event. Past record of wins and losses against a particular team (or similar teams) gives an idea of the probability that your favorite team will win the next game. Suppose you learn that the star player on your team (or the opposing team) is injured and can't play. This new information provides a forecast; it changes the probability.

Lunch
1:00-2:00

Session 3
2:00-4:00

Using Graphs to Understand Rainfall Variability

Memory of past seasons

Ask participants to classify the short rains season for the past 5 years as good, medium, poor based on crop yields. Repeat in terms of rainfall: wet, medium or dry. Record on a chart. Note and discuss any obvious differences in yields and rain.

Year	Crops	Rainfall
2010		
2009		
2008		
2007		
2006		

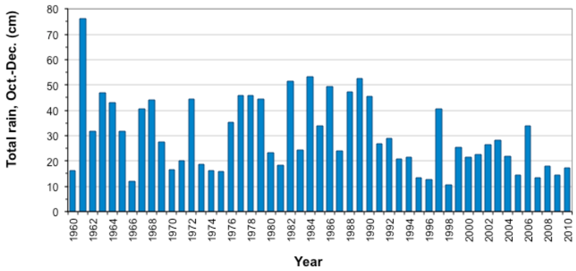
Rainfall time series graph exercise

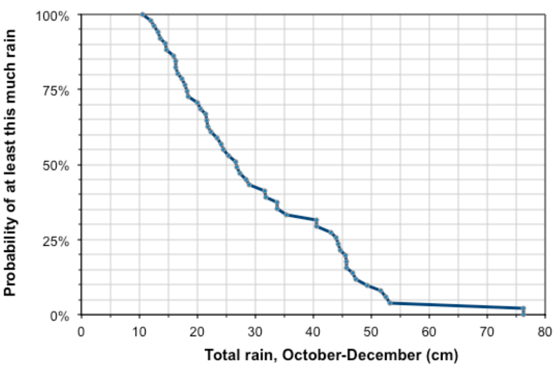
Show cylinders filled with depths of water corresponding to measured rainfall for each of the past 5 years. Ask volunteers to measure the depth, and mark it on a prepared sheet of paper, with Year and Rainfall axes. Write the amount of rainfall above the mark. Add sides and shading to make a bar graph. Discuss interpretation (as a picture of rainfall depths).

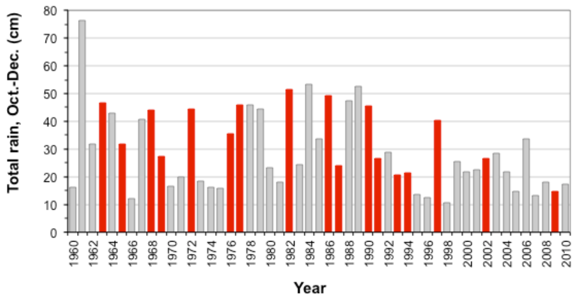
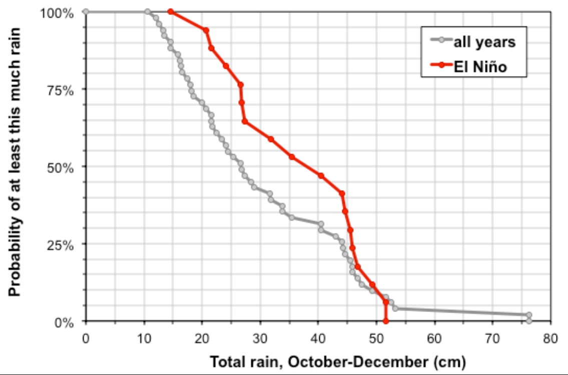
Note this should be done with measured rainfall, not participant's estimates of what rainfall was.

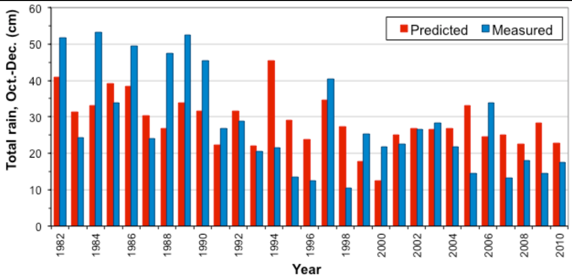
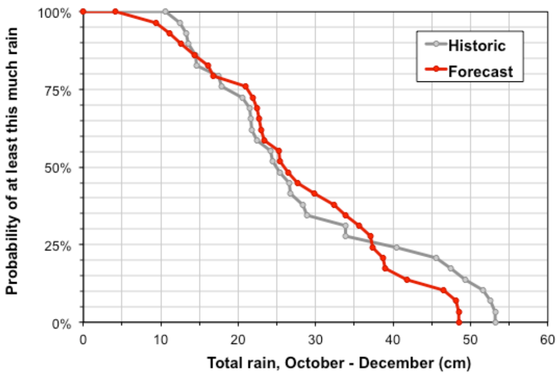
Discuss how it relates to their memory of good and bad yield, high and low rainfall years.

Show complete time-series graph.



	Discuss graph interpretation. For example: *What was the wettest year?* *What was the driest year?* *How many years had more than 40 cm October-December rainfall? …less than 20 cm rainfall?* *What is the percent probability of getting <40 cm or > 20 cm of rain?*
	Probability of exceedance graph exercise Develop probability of exceedance graph from the 5-year time series graph that farmers drew. *Starting with a blank graph with quantity (e.g., seasonal rainfall) on the x-axis and frequency (e.g., "Years with at least this much rain," 0 to 5) on the y-axis, allow farmers to sort from lowest to highest onto the new graph. Connect the points.* *Presenting information as (relative) frequencies rather than equivalent probabilities has a positive effect on many quantitative reasoning or estimation tasks. The frequency of experiencing any climatic category or exceeding any climatic quantity is easily derived from a time series sorted by climatic outcome. We do it interactively for only the past 5 years, so participants understand how it is derived from the time series.* *Review from Session 2that relative frequency (in the past) is equivalent to probability (in the future). Add a second y-axis, and label it "Probability of at-least this much rain." It will be scaled 0% to 100%, where 100% corresponds to 5 (out of 5) years.* *Show complete probability of exceedance graph.*  *Discuss interpretation. This graph allows you to see the probability associated with a given amount of rain, or the amount of rain associated with a given probability. For example:* *Probability of getting at least 40 cm? (33%)* *Probability of getting less than 20 cm? (100% - 69%, or 31%)* How much rainfall would you exceed in half of the years? *Referring to the answers to the time series graph interpretation questions, show how the probability of exceedance graph makes it easier to see the probability of experience particular amounts of rainfall.* *This is probably the most complicated step. Some training is clearly needed in order for a person to understand an unfamiliar graphic format.* *Draw hypothetical shift to the left, and discuss interpretation. Repeat for a shift to the right.* *One way to explain a shift of the climatological distribution to the right or left is to ask farmers to identify and discuss the climate in locations that are somewhat wetter or dryer. I heard feedback that one of the female breakout groups misunderstood a forecast expressed in this format, and interpreted it literally to refer to a different location,instead of a hypothetical forecast for Kamp Ya Mawi.*

	The appropriate amount of explanation and repetition may depend on the audience.
	Day 2
Session 4 8:00-10:00	**Understanding Seasonal Forecasts**
	Recap, questions (20 min)
	El Niño to illustrate seasonal forecasts *The objective is to show how knowing something about ocean temperatures gives some information about the short rains season in Kenya.* *Describe the El Niño phenomenon* *El Niño (and La Niña) an important example of how the ocean influences climate in many parts of the world, including Kenya. El Nino refers to unusually warm temperatures in the eastern Pacific, near the equator. For a long time, Fishermen in Peru and Ecuador noticed usually warm waters every few years. Because it was usually strongest at the end of the year, near Christmas, they called it "El Nino," which is Spanish for Little Boy, and refers to baby Jesus. Warm oceans cause air to rise and produce rain. The air comes down over cooler parts of the ocean, preventing rain. When the eastern Pacific is unusually warm, the tropical rainfall that usually happens in the western Pacific moves toward the east.* *Highlight El Niño (or La Niña) years in time series graphs. Discuss how knowing that the next season will be an El Niño (or La Niña) would influence their expectations.*  *Show probability of exceedance graph for Nino years, and compare with climatological distribution. Discuss how to interpret this type of forecast in terms of shifted probabilities.* 
	Assign breakout groups, give instructions.
Break 10:00-10:20	
Session 5 10:20-1:00	**Breakout Groups**
	Breakout groups to identify potential management responses to forecast scenarios. (1hr15min) *This activity has two objectives. (1) It is a way to test how much participants*

	understand the new graphic forecast format. (2) It is also an opportunity to identify what they see as promising management responses, which might inform future research directions. *Assign group forecast scenarios in the form of hypothetical probability shifts toward wet, or dry. Each type of forecast will have separate female and male groups.* *Ask what the forecast means.* *Ask what they would do differently.* *Ask the group to write responses on a flipchart.* *Emphasize that this not the forecast for this year, but a hypothetical (or imaginary?) forecast presented in the format that we have been teaching them to understand.*
	Report back. (1hr15min)
Lunch 1:00-2:00	
Session 6	**2011 Short Rains Seasonal Forecast**
	 *Show time series of forecasts with observed rainfall. Note that predicted and measured amounts are not the same, but that years with high predicted rainfall often have high measured rainfall, and hears with low rainfall predictions often have low measured rainfall. Discuss how confident participants would be in this type of forecast system.* *Do the same for number of rain days.*
	Present and discuss the current KMS forecast statement.  *Present and discuss the forecast for October-December total rainfall and number of rain days.* *Ensure sufficient time for discussion and questions from participants. However, avoid providing management recommendations.*
	Briefly review the research process and plans for the remainder of the season. *To manage expectations, might need to say something to the effect that we cannot promise that this information will be provided in future years.* Wrap-up and prayer.

Appendix 2: Advisory Workshop Program

Morning group

Activity	Facilitator	Time
Arrival and registration	Mr Kitheka	7.15 - 8.00 AM
Questionnaire administration	Enumerators	7.30 - 10.00 AM
Tea break	All	10.00 - 10.30 AM
Prayer	Farmer	10.30 AM
Introductions	DAEO - Rosemary	10.30 - 10.40 AM
Welcome address	DAEO - Rosemary	10.40 - 10.50 AM
Objectives	Emerita	10.50 - 10.55 AM
Crop production constraints	Mutinda	10.55 - 11.00 AM
Forecast	Jackson	11.00 - 11.20 AM
Advisory	Emerita	11.20 - 12.30 PM
Way forward and expectations	Emerita and Mutinda	12.30 - 12.50 PM
Closing remarks	Rosemary/Emerita	12.50 - 1.00 PM
Prayer	Farmer	1.00 PM
Lunch break	All	1.00 - 2.00 PM
Depature	Farmer	

Afternoon group

Activity	Facilitator	Time
Arrival and registration	Mr Kitheka	12.00 - 1.00 PM
Lunch		1.00 - 2.00 PM
Prayer	Farmer	2.00 - 2.05 PM
Introductions	DAEO - Rosemary	2.05 - 2.15 PM
Welcome address	DAEO - Rosemary	2.15 - 2.25 PM
Objectives	Emerita	2.25 - 2.35 PM
Forecast	Jackson	2.35 - 2.55 PM
Advisory	Rosemary	2.55 - 4.00 PM
Way forward and expectations	Emerita and Mutinda	4.00 - 4.15 PM
Closing remarks	Rosemary/Emerita	4.15 - 4.20 PM
Prayer	Farmer	4.20 - 4.25 PM
Tea break and departure	All	4.25 -

Appendix 3: Weather-based agro-advisory for Kampi Ya Mawe

Additional Information

- Farmers are encouraged to take advantage of subsidized farm inputs provided by the Government through the National Cereals & Produce Board (NCPB) to improve productivity
- Farmers are also advised to take advantage of small grants provided by the Government through the "Njaa Marufuku" program to buy the necessary inputs and increase productivity
- Farmers are encouraged to take up fish farming and benefit from support from the Fisheries Dept. under the Economic Stimulus Program

Important Note

The information provided here is general information based on the October-December 2011 seasonal forecast issued by Kenya Meteorological Department.

The information should be used in conjunction with the forecast updates issued by KMD and technical advice provided by the nearest agricultural extension office.

This advisory is a collaborative effort of the following institutions

ICRISAT Science with a human face – International Crops research institute fro the Semi-Arid Tropics

Kenya Agricultural Research Institute (KARI)

Ministry of Agriculture

Kenya Meteorological department

University of Nairobi

CLIMATE CHANGE AGRICULTURE AND FOOD SECURITY – CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Weather Based Agro-advisory for Kampi Ya Mawe

September 2011

About this advisory

This advisory was developed on 20th September 2011 by a team of scientists from Kenya Meteorological Department (KMD), Kenya Agricultural Research Institute (KARI), International Crops Research Institute for the Semi-arid Tropics (ICRISAT), University of Nairobi (UoN) and officers from the Ministry of Agriculture. Due consideration was also given to farmers' preferences and views on the adoptability and usefulness of these management practices. This advisory presents the potential options for OND season of 2011.

The advisory is mainly aimed at supporting the farm level decision making in Kampi Ya Mawe area in planning agricultural activities for the Oct-Dec 2011 Rain Season. Application of this advisory to other areas will depend on similarities in soil and climatic conditions of such places with those of Kampi Ya Mawe.

Performance of March-May 2011 Rain Season

- The long-term average rainfall for Kampi Ya Mawe during MAM season is 281 mm.
- The county was predicted to receive below normal (slightly depressed) rainfall
- As predicted, the area received less than 70% of the long-term average rainfall which resulted in the failure of most crops planted

Outlook for Oct-Dec 2011 Rain Season

- Kampi ya Mawe county is expected to receive normal to above normal (enhanced) rainfall
- The area is expected to realize the onset in the third to fourth week of October and cessation in the third to fourth week of December
- Rainfall is predicted to be well distributed within the 2011 short rain season

Agricultural implications of forecast

- The seasonal forecast issued by met department indicates that there is a high probability to get sufficient rainfall to grow a good crop of about 100 days duration
- Farmers are advised to plant crops of their choice at the earliest opportunity by dry planting after preparing the farm in the 3rd week of October.
- They are advised to conserve moisture by harvesting run-off from roads and other uncultivated areas; repairing their terraces; rehabilitating dams and water pans; constructing tied ridges or contour furrows; double-digging; carrying out timely weeding, and by mulching where possible.
- Farmers are encouraged to plant early maturing/drought-tolerant crop varieties such as :

Crop	Variety
Maize	KCB, DLCI, KDV4, DH02, DH04, DUMA 43, DK8031 etc
Green grams	N26, N22 & KS20
Beans	KATX 69, KATX 56, KAT B1& 9, and Mwitemania
Pigeonpea	Mbaazi I & II, Kat 60/8, ICEAP00850
Cowpea	M66, K80, KVU-27-1, KVU419 & KENKUNDE
Dolichos	DL1002 & DL1009
Sorghum	Gadam, Seredo & Serena
Pearl & Finger millet	KAT/PM 1,2 & 3; KAT/FM 1

- Legumes are a preferred choice for fields where maize was grown during the March-May 2011 season
- Those opting to grow cotton may consider HART 89

- Farmers opting to grow sweet potatoes are encouraged to consider KSP20, SPK004 & Kemb 10
- Other suitable crops include local amaranthus, butter nut, water melon and pumpkins.
- Farmers are advised to use certified seeds from reputed sources
- Plant maize at one plant per hill at 90x30 cm or two plants per hill at 90x60 cm, cowpea at 60x20 cm, beans at 45x20 cm, sorghum at 60x20 cm for sole crop and 120x15 cm when intercropped with a row of legume, pearl millet at 60x15 cm for sole crop and 120x15 cm when intercropped with a row of legume, dolichos at 50 x50 cm, green grams at 45x15 cm, finger millet at 30x10 cm, pigeonpea at 90x60 cm and sweet potato at 75x50 cm
- For those with fruit (mango and orange) orchards or bananas, we advise that they prune, cut & burn fruit stalks, manure and construct negarims around them to harvest water, before the start of the season
- Farmers are encouraged to use manure and chemical fertilizers, but with advice from agric. extension officers. Split application of fertilizer half at the time of planting and half three weeks after emergence will have low risk
- Use NPK mixture at sowing and CAN for later application. Apply fertilizer close to the planting hill and cover. Also consider planting primed seed treated with grow-plus.
- Farmers are advised to watch out for aphids especially in cowpea and fruit trees; army worms; stem borers and termites in maize; shoot fly and stalk borers in sorghum and report outbreaks to agricultural extension officers
- Timely weeding, and regular scouting for insect pests is recommended. Report outbreak of pests and diseases to agricultural extension officers
- This forecast is based on the existing conditions and there is always a possibility for the trends to change. Keep monitoring the monthly and weekly forecasts issued by meteorological department from time to time and make changes as required.