Impacts of seasonal climate communication strategies on farm management and livelihoods in Wote, Kenya

Working Paper No. 137

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

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Abstract

This study was undertaken in Wote division, Makueni district, Eastern province, Kenya, to test the effectiveness of different methods of communicating downscaled seasonal climate forecast information, and to assess its impact on management and productivity of smallholder farms. The communication methods tested include training workshops aimed at helping farmers understand downscaled probabilistic climate forecast information, agro-advisories that combined forecast information with advice on potential management options, and a combination of training and agro-advisory workshops. The study was conducted with about 120 farmers, 10 from each of 12 villages selected randomly from the villages that are within a 5 km radius from Kampi Ya Mawe research station for which long-term climate records are available, during the 2011-2012 short rain season. Three surveys, implemented during the pre-, mid- and end-season periods, captured changes in management, productivity, and attitudes, associated with the provision of climate information.

Relative to the control sample, farmers with access to enhanced climate information reduced their cropped area, invested in more intensive crop management, and achieved higher yields with attractive returns on investment relative to farmers in control villages. Farmers from treatment villages also demonstrated appreciation of the role of climate information in planning and managing farm activities, higher satisfaction with the season, and strong interest in receiving climate information on a regular basis. This interest was demonstrated by their willingness to pay a modest amount for the service if required. The evaluation was disaggregated by gender. Gender influenced adjustments to crop mix in response to climate information, with women preferring short-duration legumes. Gender did not appear to affect the subjective value put on climate information, or willingness to pay.

The study findings suggest that both of the workshop-based approaches to communicating climate information improved farers' ability to manage risks. However the sample size was not sufficient to provide conclusive evidence of the impact on yields, investments or livelihoods. It is therefore suggested that similar assessments with a much larger sample in different agro-ecologies, and more comprehensive baseline data collection, be planned to make a more conclusive assessment of farmers' ability to understand, utilize and benefit from seasonal climate forecast information. Such a study should aim to develop and refine training

modules that can help farmers and their support agents better understand climate variability, probabilistic forecasts and their application, and appropriate communication systems aimed at providing timely access to required climate information.

Keywords

Climate Services; Evaluation; Adoption; Kenya.

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Contents

Acronyms

CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
ICRISAT	International Crop Research Institute for the Semi- Arid Tropics
IRI	International Research Institute for Climate & Society
CV	Coefficient of Variation
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KSH	Kenyan shilling
KMD	Kenya Meteorological Department
LR	Long Rains
SR	Short Rains
ENSO	El Niño – Southern Oscillation

Introduction

One of the major constraints that smallholder farmers, operating in semi-arid areas, face is coping with production uncertainties associated with unpredictable seasonal climate conditions. The risks associated with the variability in rainfall coupled with the generally risk-averse nature of smallholder farmers act as major disincentives to investing in improved technologies. As a result, farmers continue to use low-input agriculture aimed at minimizing the use of external inputs like fertilizer to reduce risk (Dercon & Christiaensen 2007, Kebede 1992). Since many farm management decisions, such as which crop to grow on how much area and under what management conditions, are taken without knowing the weather during the crop growth period, it is hypothesized that advance information about the possible conditions (seasonal climate forecasts) will help farmers make more informed decisions, which can reduce risk and allow the use of inputs required to improve productivity and profitability. In general, the climate over east Africa has fairly good predictability due to the strong influence of ENSO (El Niño-Southern Oscillation), and the many national and international meteorological organizations issuing regular seasonal climate forecasts. However, smallholder farmers face significant constraints to using seasonal climate forecast information effectively, a lack of good understanding of the probabilistic nature of the forecast information; and a mismatch between the type, scale and format of information they need and the information that is routinely available (Hansen et al. 2011).

This study therefore evaluates alternative methods of presenting climate information in a format that farmers can readily understand and make use of it. Specific objectives were to: (1) test and refine the design of downscaled, probabilistic seasonal forecast information, and forecast-based management advisories; (2) test and refine a workshop-based process for training farmers to understand and apply probabilistic seasonal forecast information; (3) evaluate the impact of seasonal forecast products and training, and forecast-based management advisories on farmers' management decisions; and (4) elicit farmers' perceptions of the seasonal forecast products, advisories and communication process, and their management responses to the information.

Methods

The study was conducted in Wote division, Makueni district, Eastern province, Kenya during the 2011-2012 short rain season, in collaboration with Kenya Meteorological Department (KMD) and Kenya Agricultural Research Institute (KARI). The district lies in the semi-arid zone and is characterized by high variability in annual and seasonal rainfall. The average annual rainfall recorded at Kampi Ya Mawe research station, located within 5 km radius from the target villages, is 650 mm with a 66% reliability (amounts that exceed in 10 out of 15 years) of getting 520 mm. The rainfall is distributed over two rainy seasons, the long rains (LR) occurring in March-May and short rains (SR) occurring October-December. The SR season is generally considered more reliable, and receives slightly higher rainfall, than the LR season. The general characteristics of rainfall, derived from 1960-2010 rainfall data (excluding incomplete years: 2000, 2001, 2003, 2004 and 2005) are summarized in Table 1. The probability distribution of rainfall is presented in Figure 1. On an average, SR season receives about 300 mm of rainfall with 48% coefficient of variation (CV). Compared to LR season, rainfall during SR season is about 50 mm higher with a lower CV, and generally has higher probability of exceedance for a given amount of rainfall.

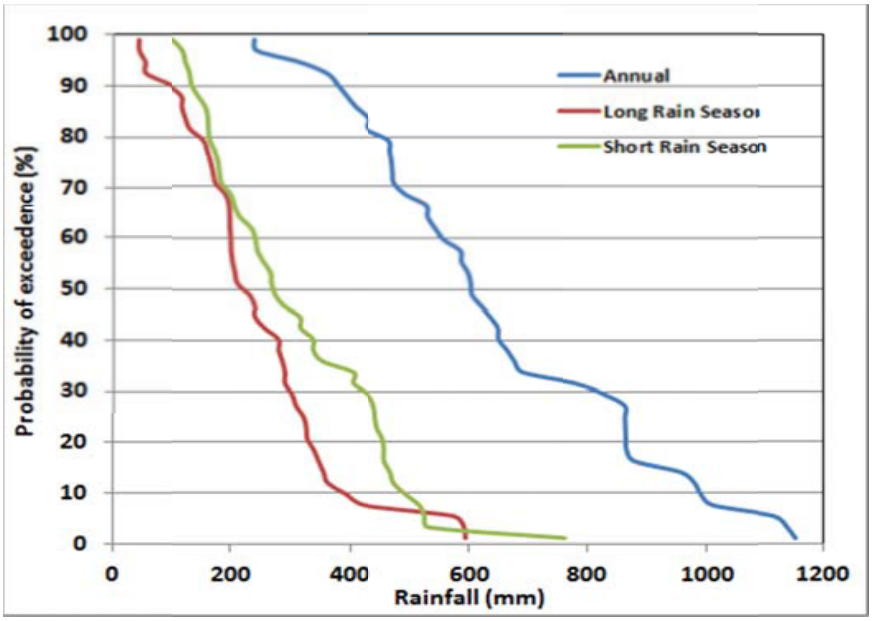

Figure 1: Probability of exceedance of annual and long and short rain season rainfall at Kampi Ya Mawe.

Month	Mean	Min	Max	Median	Std Dev	Std Error	Skewness	CV (%)
Jan	44.6	0.0	299.0	33.2	63.5	9.5	2.8	142.6
Feb	30.8	0.0	148.9	16.2	37.1	5.5	1.4	120.4
Mar	81.5	0.0	295.5	72.6	74.7	11.0	1.2	91.6
Apr	129.6	1.2	298.3	109.4	77.1	11.4	0.4	59.5
May	36.5	1.2	131.7	29.3	30.6	4.5	0.9	83.6
Jun	7.7	0.0	117.6	1.3	18.6	2.7	4.9	242.1
Jul	2.3	0.0	31.1	0.8	4.8	0.7	4.9	209.0
Aug	4.4	0.0	29.3	1.0	7.2	1.1	2.0	161.4
Sep	4.4	0.0	32.0	1.0	7.3	1.1	2.3	168.2
Oct	46.7	0.0	219.7	22.6	58.9	8.7	1.6	126.3
Nov	168.1	0.0	428.3	166.7	89.9	13.3	0.5	53.5
Dec	93.9	0.0	269.3	81.2	69.6	10.3	0.7	74.1
Annual	649.5	239.3	1153.5	602.1	239.3	35.3	0.4	36.8
Long Rains	247.7	42.5	593.5	221.8	130.8	19.3	0.9	52.8
Short Rains	308.7	104.1	762.8	270.8	148.7	21.9	0.7	48.2

Table 1: Distribution and variability in monthly, seasonal and annual rainfall at Kampi Ya Mawe research station in Makueni district, Kenya.

The study design consisted of four treatments, including three different methods of presenting downscaled probabilistic seasonal: (1) control with group interactions but no climate information; (2) two day training workshop with farmers to make them better understand the probability theory and its implications in decision making along with forecast information; (3) interpreting and presenting seasonal forecast information and its agricultural significance in the form of an agro-advisory; and (4) a combination of the training workshop and advisory.

The program and contents of the training workshop are described in Njiru et al. (2015), and the agro-advisory developed for 2011-2012 SR season based on the seasonal climate forecast issued by Kenya Meteorological Department is in Annex 1. For each treatment, three villages were randomly selected from the villages that are within 5 km radius of the meteorological station located on the KARI research farm in Kampi Ya Mawe. The three villages were treated as replicates. A total of 120 farmers, 10 farmers from each of the 12 study villages, were selected again randomly from a list of households compiled by village elders. To ensure equal representation of men and women farmers in all the treatments, randomization was carried out separately for male- and female-headed households. However, the final composition of the groups had more women than men since some of the male farmers

identified did not participate. Table 2 presents a treatment-wise list of villages and gender composition of the groups.

Treatment	Villages	Total	No of men farmers			No of women farmers		
			Pre-season	Mid-season	End-season	Pre-season	Mid-season	End-season
1. Control	Senda	9	4	5	4	5	4	5
	Kwa Kathoka	11	3	2	3	8	8	8
	Kivaani	8	4	2	4	4	6	4
2. Training	Kathoka	10	5	3	5	5	4	5
	Mulaani	10	5	7	5	5	4	4
	Kambi ya Mawe	9	5	4	3	4	6	7
3. Advisory	Soweto	10	4	2	3	6	6	6
	Kyemole	9	3	5	4	6	4	4
	Kithoni	10	5	5	5	5	6	5
4. Combined	Ngunu	9	3	4	3	6	6	5
	Kasarani	10	4	4	4	6	6	5
	Muvau	12	7	1	5	5	3	5
Total		117	52	44	48	65	63	63

Table 2: Details of the study villages with number of men and women farmers participated in the pre-, mid- and end-season surveys.

The effectiveness of treatments was assessed by collecting data on crops, varieties and management practices initially planned, those practices that were implemented during the season and outcome of the practices implemented through three different surveys conducted during the period of experimentation. The first one, pre-season survey was aimed at capturing the expectations and plans that the farmers had at the start of the season and before providing them with the forecast information. This was conducted in September 2011, a month before the start of the season. The second one referred to as mid-season survey was conducted in February 2012 to document the crops, varieties and management practices that were actually adopted by the farmers. The third, end-season, survey was conducted in May 2012 to capture the outcome of various practices adopted by the farmers. The survey instruments used during the pre-, mid- and end-season surveys are appended to this report (Annex 2, 3 and 4). The surveys were administered by a group of trained enumerators under the supervision of technical staff from KARI and ICRISAT. The same enumerators were used in all the three surveys. The data was then entered into electronic versions of the survey forms, which were loaded into an MS access database for further tabulation and analysis. Due to time constraints, the pre-season survey questionnaire was limited in scope to only capture farmer's plans for

the coming crop season, i.e., the 2011-2012 SR season. Other general information related to the household composition, education, holding size and income sources was captured in the end-season survey. Unfortunately, not all farmers were available at the time of these surveys were conducted. Of the 117 farmers who initially participated in the study, 107 were available for mid-season survey while 111 participated in the end- season survey.

Results and Discussion

Profile of participants

The general household characteristics are based on the information collected during the end-season survey in which 111 of the initial 117 participated. In this survey 61% of the respondents are women. Though more women participated in the study, partly due to non-availability of men and partly as replacements, not all women are household heads. Since the views expressed are more a reflection of the respondent than the household, the grouping of men and women farmers is based on the gender of the respondent and not that of the household head.

Average household size was larger for male-headed than female-headed households were both at aggregate and treatment level (Table 3). The number of family members migrated and family members involved in off farm activities are also high in case of male households. Due to smaller size of the household, female households have fewer family members working on the farm. The number of household members working on the farm was lowest in T4 villages and highest in T1 villages. No major differences in the level of education were observed among the men and women groups and across the treatment villages (Table 4). All but four women and one male farmer had primary or higher level education.

The average size of participants' farms was about 4 ha. Average farm size was slightly larger for female farmers than for male farmers (Table 5). Women farmers in T2 villages and men farmers in T4 villages owned smaller farms, and men and women farmers in T3 villages owned larger farms. However, area cultivated during the 2011-2012 SR season varied little between men and women. About 46% of the total 426 ha land owned by all households was cultivated during the season. The average size of the cultivated area per household, within

treatment and gender groupings, ranged from 1.5 ha in case of women farmers in T2 villages to 2.2 ha by male farmers in T1 villages.

	Size of HH		Migrated members		Working off farm		Working on farm	
Treatment	Female	Male	Female	Male	Female	Male	Female	Male
1. Control	5.1	8.9	0.4	0.7	0.2	1.3	3.8	4.5
2. Training	6.5	7.8	0.8	1.5	0.9	1.2	3.9	3.8
3. Advisory	6.0	8.4	1.6	1.6	0.5	1.6	2.9	3.4
4. Combined	5.7	6.8	0.7	0.9	0.9	2.7	2.7	3.0
All	5.8	8.0	0.9	1.2	0.6	1.7	3.3	3.7

Table 3: Size and status of the household members.

	Female farmers				Male farmers			
Treatment	None	Primary	Secon-dary	Higher	None	Primary	Secon-dary	Higher
1. Control	3.0	9.0	5.0	0.0	0.0	4.0	7.0	0.0
2. Training	0.0	13.0	3.0	0.0	1.0	6.0	5.0	1.0
3. Advisory	1.0	7.0	6.0	1.0	0.0	8.0	4.0	0.0
4. Combined	0.0	7.0	6.0	2.0	0.0	4.0	5.0	3.0
All	4	36	20	3	1	22	21	4

Table 4: Level of education of participating men and women farmers.

	Total landholding		Total area cultivated		Average farm size		Average area cultivated		Percent of total area cultivated	
Treatment	F	M	F	M	F	M	F	M	F	M
1. Control	73.9	47.4	29.7	23.9	4.34	4.31	1.75	2.17	40	50
2. Training	45.3	43.8	24.1	24.6	2.83	3.37	1.50	1.89	53	56
3. Advisory	79.1	54.0	25.2	22.1	5.27	4.50	1.68	1.84	32	41
4. Combined	48.2	34.6	26.0	21.5	3.21	2.88	1.73	1.80	54	62
All	246.5	179.9	105.0	92.0	3.91	3.75	1.67	1.92	43	51

Table 5: Total and cultivated (during 2011–2012 SR season) land in the target villages by the participating female (F) and male (M) farmers.

Agriculture contributed about 40% of the total household income (Table 6); with livestock, casual employment and remittances being other important sources of household income. Among the treatment villages, T3 villages had the smallest proportion of income from agriculture (30.5% compared to above 40% in case of other treatments) and the largest

contribution from business activities. In case of T2 villages, remittances were the second highest contributor to the total household income.

	Farming			Employment			
Treatment	Crops	Livestock	Business	Casual	Regular	Remittance	Other
1. Control	42.0	25.3	2.5	10.2	5.3	9.4	5.2
2. Training	43.6	10.6	1.1	13.0	6.0	20.6	5.2
3. Advisory	30.5	16.2	16.1	18.4	3.5	9.8	5.5
4. Combined	40.5	12.9	2.9	15.9	10.8	7.8	9.1
Grand Total	39.1	16.2	5.7	14.4	6.4	11.9	6.3

Table 6: Distribution of household income across different sources (percent).

Forecast and rainfall during the season

The forecast issued by Kenya Meteorological Department (Appendix 5) predicted that the study region would receive normal to near-normal rainfall with a tendency to above-normal (enhanced) during the 2011-2012 short rain season. The forecast further indicated that the area is likely to realize the onset during the third to fourth week of October and cessation during the third to fourth week of December.

Although rains started as early as second week of October, it was only during the last week of October that this area received good planting rains (Fig. 2). About 37 mm rain was received over five days during the last week of October. The total rainfall recorded during the season (Oct-Dec) was 205 mm, which is 66% of the normal. Although the season started and progressed along the predicted lines up to December, very little rain was received during December 2011 and January 2012. Crops planted with the first rains during last week of October performed better compared to those planted in the month of November. Late planted crops experienced severe stress during the grain filling stage, which adversely affected their performance.

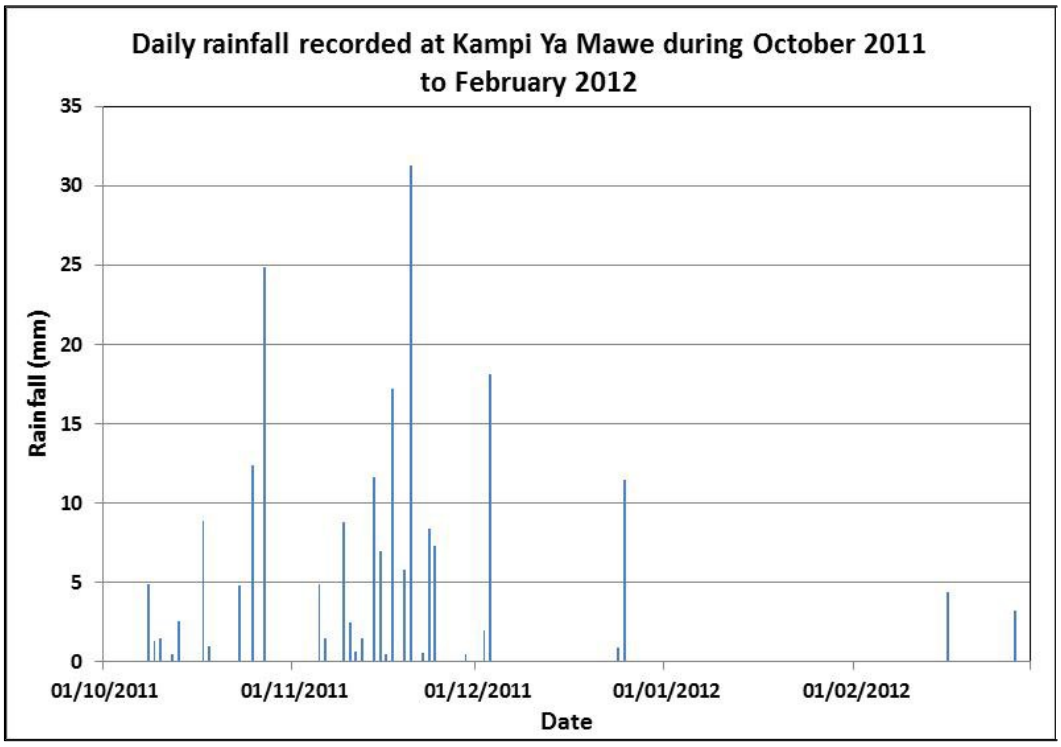

Figure 2: Distribution of daily rainfall, 1 October to 28 February, Kampi Ya Mawe.

Impact of provision of climate information

The influence of providing climate information on farm management was assessed by comparing participants' initial plans, captured through the pre-season survey, with mid-season and end-season surveys, and by comparing practices adopted in treatment villages with control villages. The key decisions with potential to be influenced by climate information provided include selection of crops and varieties, allocation of land among various crop enterprises, and investment in agricultural inputs. In addition, a change in the attitude and perceptions of the farmers about climate variability was also hypothesized, in response to improved understanding about the variability in climate and uncertainty associated with the forecasts. The survey questionnaires were structured to capture these changes as well as how farmers perceive and value the role of climate information.

Crop choice and land allocation

The total area initially planned for cropping and that was actually planted during the season showed different trends in control villages and treatment villages. While the total area planted in T1 villages was more than what was initially planned, in the case of T2, T3 and T4 villages it was less than that was initially planned by the farmers from these villages (Fig. 3). Since the numbers of farmers that participated in the two surveys were not the same, the data were

also analysed and presented as average area per farmer (Fig. 4). In both cases the trends remain the same. In case of control (T1) villages, the area actually planted was about 35% more than initially planned. In contrast, the farmers in treatment villages reduce the area cropped relative to their plans before the start of the season. The highest reduction, about 20%, was observed in T2 villages where the area actually cropped was only 1.62 ha compared to the initial plan to crop 2.04 ha.

Differences between treatment and control villages were also evident in farmers' choice of crops. In all villages, maize was the primary crop, and occupied nearly half of the cultivated area. Compared to pre-season plans, area plated to maize was 43% higher in T1 villages and 47% lower in T3 villages. The change was marginal (<10%) in T2 and T4 villages. Area planted to bean also differed between treatment and control villages. While farmers in control villages reduced the area planted to 0.03 ha from 0.25 ha planned, but in treatment villages the area under beans was similar to initial plans. Area planted to pigeonpea and sorghum crops, which are known for their high levels of tolerance to drought, showed significant differences between treatment and control villages. Farmers in control villages increased the area under these crops by about 60%, but farmers in treatment villages reduced it by a similar magnitude. Farmers in control villages followed the traditional risk management practice of extensive cultivation with few inputs, and a crop mix that is more biased towards drought-tolerant crops and short duration legumes that can escape drought. Although farmers' management in the treatment villages was similar, they adjusted it by reducing the area under cultivation, and changed allocation of land among crops relative to their initial plans for the season.

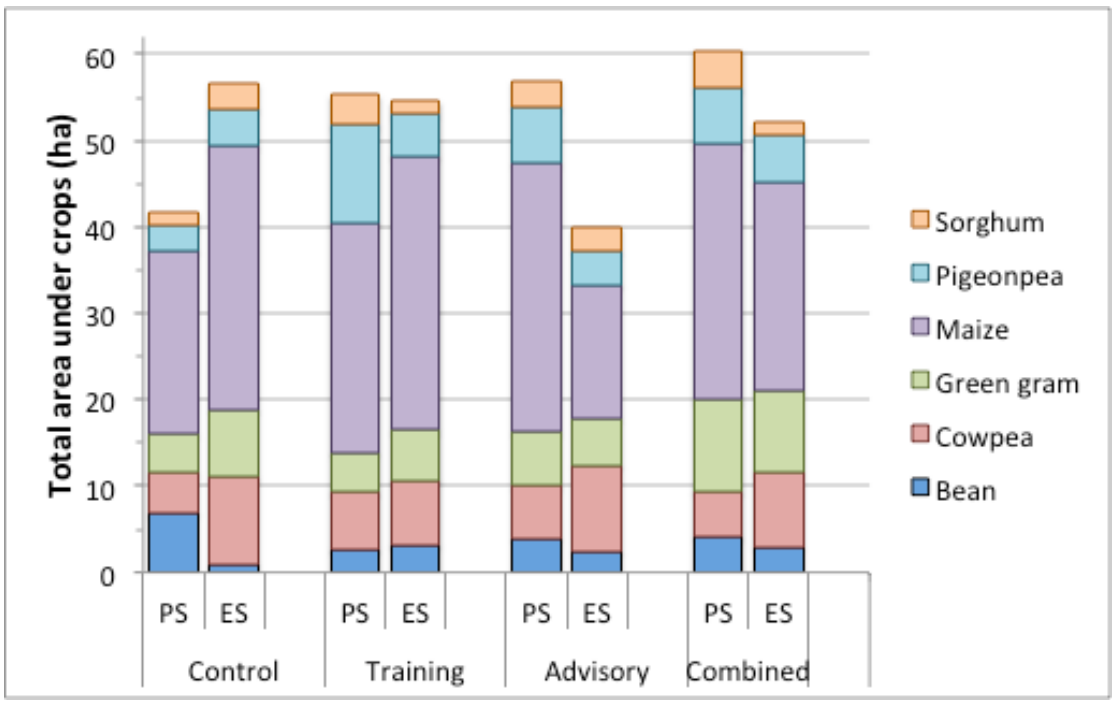

Figure 3. Change from planned to actual total area planted to different crops, by treatment. PS = pre-season survey response, ES = end-season survey response.

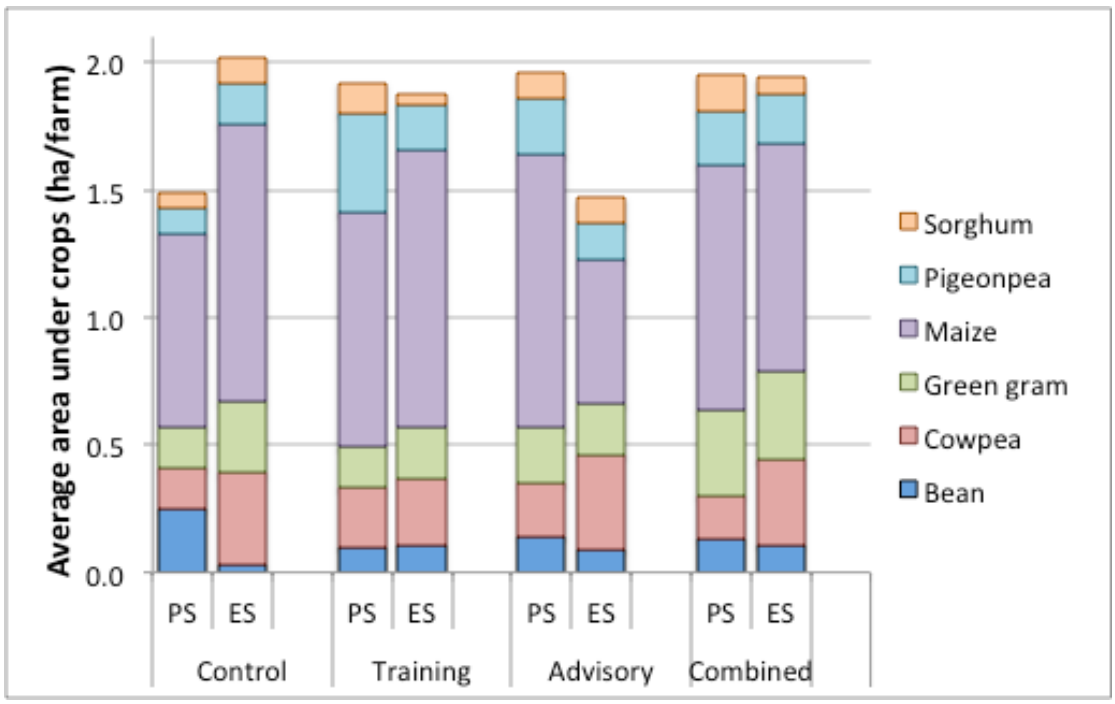

Figure 4. Change from planned to actual area planted, per farmer, under different crops, by treatment. PS = pre-season survey response, ES = end-season survey response.

Investment in agricultural inputs

Another area where climate information has the potential to contribute is in farmers' investments in production inputs and field operations. Detailed information about farmers' investments during the 2011-2012 SR season was collected in the end-season survey (Table 7). The analysis considered only those investments that the farmer sourced externally by paying cash, including hired labor, and excluded family labor which normally constitutes the major portion of overall investment by farmers in crop and livestock production. The investment profile presented in Table 7 is not crop specific, and includes all investments across the whole farm.

Treatment	Land prepara-tion	Seed	Fertilizer, pesticide	Harvesting, storage	Planting, weeding	Livestock manage-ment	Total
1. Control	273	873	303	39	309	845	2642
2. Training	332	702	288	90	631	954	2997
3. Advisory	1199	1541	657	163	2532	1045	7136
4. Combined	676	673	513	329	1208	713	4113
Total	574	907	423	151	1063	879	3997

Table 7: Average investment (KSH) per hectare of cultivated land by farmers on crop and livestock management during the 2011–2012 SR season.

Investments made by farmers on various crop and livestock production activities in treatment villages, especially in T3 and T4 villages are much higher than the ones made by farmers in control villages. In T3 and T4 villages, farmer's investment on crop production activities is two to three times higher compared to that made by farmers in control villages. Among the crop production activities, farmers in treatment villages invested more on all activities but the difference is much higher (2-6 times) in case of planting and weeding and harvesting and storage operations. Interestingly, farmers in treatment villages, with the exception of T3, invested less in seeds compared to farmers in control villages. This is difficult to explain. One possibility is that the farmers did not have enough time to the variety after the workshop and after receiving the agro-advisory, hence continued using their own variety. Another possibility is that they sought to increase yields through improved management rather than through improved seed. In case of livestock activities, farmers in T2 and T3 villages invested 13-24% more and T4 villages invested 16% less than the control farmers.

Farmers were also asked to rate their investments during 2011-2012 SR season in relation to what they normally invest. Major differences are noted in the perceptions between farmers from control and treatment villages (Table 8). Among treatments, the largest proportion of farmers that reported higher than normal investments during 2011-2012 SR season were those who received the advisory without the training. No major differences were observed between the perceptions of men and women farmers. Note that the farmer perceptions in Table 8 refer to overall investment, and don't account for changes in area under crops.

Treatment	Higher	Lower	Same	Cannot say
Female farmers				
1. Control	24%	17%	38%	21%
2. Training	23%	21%	49%	8%
3. Advisory	50%	9%	38%	3%
4. Combined	37%	11%	48%	4%
Total	34%	14%	44%	8%
Male farmers				
1. Control	27%	19%	40%	13%
2. Training	32%	17%	47%	4%
3. Advisory	40%	27%	31%	2%
4. Combined	24%	8%	53%	15%
Total	31%	17%	43%	9%
All farmers				
1. Control	25%	18%	39%	17%
2. Training	26%	19%	48%	6%
3. Advisory	46%	17%	35%	3%
4. Combined	32%	10%	50%	9%
Total	32%	16%	44%	8%

Table 8: Perception of farmers about the investments made during the 2011–2012 SR crop season compared to their normal investments.

Crop yields

Farmer estimates of crop yields, elicited during the end-season survey, are summarized in Table 9. No pigeonpea yield data were available, since the crop was not ready for harvest at the time of the end-season survey. In general, crop yields were low but reflected the yields that farmers in this area normally achieve. Averaged across all crops, yields were 14 to 59% higher in treatment villages than in control villages. Yields were highest in T3 villages, although these villages had the lowest area under the main crop, maize. Maize in T3 villages occupied 35% of the total cropped area, more than 50% of the cropped area in T1 and T2

villages, and 46% in T4 villages. Maize yields were highest (30% increase relative to the control) in T4 villages, followed by T3 with 24% increase and T2 with 19% increase. At the 2012 price of maize grain (39 KSH/kg, or 3500 KSH per 90 kg bag), this increase in maize yield provides a good return on the extra investment made by these farmers. Sorghum yields were also higher in T2 (48%) and T3 (89%) villages than the control villages, but similar to control in T4 villages where the yield was found to be 5% lower. The trend is mixed in the case of legume crops. Green gram yields in treatment villages were 22-33% lower than control villages, cowpea yields were higher in T2 and T3 villages, and bean yields were highest in T3 villages. Except for the substantially higher bean and cowpea yields reported in T3 villages, the difference among treatments was quite low (<50 kg/ha). Generally, yields of legume crops showed higher variation than the cereal crops due to their higher susceptibility to pests and diseases, and high spatial variability in their intensity and resulting damage.

Treatment	Beans	Cowpea	Greengram	Maize	Sorghum	Total
Average yield achieved (kg/ha)						
1. Control	181	267	244	683	183	387
2. Training	148	307	181	816	271	447
3. Advisory	353	1019	164	849	346	614
4. Combined	168	208	190	885	173	441
All Villages	235	403	201	818	245	473
Percent change from Control						
2. Training	-18%	15%	-26%	19%	48%	16%
3. Advisory	95%	282%	-33%	24%	89%	59%
4. Combined	-7%	-22%	-22%	30%	-5%	14%

Table 9: Crop yields (kg/ha) achieved by participating farmers in the target villages.

Farmer assessment of the season and climate information

It was hypothesized that the improved understanding and insights gained through training workshop and other information provided would assist the farmer in making much more realistic assessment of the season compared to those not exposed to this information. The survey tried to capture this by asking how farmers felt about the season and to what extent it met their expectations. While most farmers responded with a definite “yes” or “no” answer, the responses of the few who responded with “somewhat” or “cannot say” were added to the group that responded with a “no”.

Overall, 55% of the farmers from all groups felt that the season was below their expectations (Table 10). However, major differences existed in the perceptions of farmers from control and treatment villages. Nearly 82% of the farmers from control villages felt that the season was below their expectations compared to 34% of farmers from treatment villages. Relative to the control villages, the proportion of farmers satisfied with the season increased to 41% in T2 villages, to 48% in T3, and to 70% in T4 villages. The differences in perceptions between the treatment and control were similar for men and women farmers. These results suggest that all methods for communicating climate information were effective, and contributed to positive change in the farmers' attitudes towards climate variability. The training workshop along with agro-advisory was found to be more effective than training or agro-advisory alone.

	Women farmers		Men farmers		All	
Treatment	No	Yes	No	Yes	No	Yes
1. Control	14 (82%)	3 (18%)	9 (82%)	2 (18%)	23 (82%)	5 (18%)
2. Training	10 (63%)	6 (38%)	7 (54%)	6 (46%)	17 (59%)	12 (41%)
3. Advisory	8 (53%)	7 (47%)	5 (42%)	7 (58%)	13 (52%)	12 (48%)
4. Combined	4 (27%)	11 (73%)	4 (33%)	8 (67%)	8 (30%)	19 (70%)
All Villages	36 (57%)	27 (43%)	25 (52%)	23 (48%)	61 (55%)	50 (45%)

Table 10: Number of farmers who said that the 2011–2012 SR season met their expectations (Figures in parenthesis indicate %).

The survey also sought to assess the extent to which farmers were convinced about the usefulness of climate information for farm planning. This was captured by asking whether they are convinced by the usefulness of the information, and if so whether they were willing to pay to cover the costs associated with generating and distributing the information regularly. Most farmers responded with a "yes" or "no" answer but some indicated that they were undecided. This group of undecided farmers are added to the "No" group. In case of farmers from control villages, the enumerator explained the climate information that can be provided and its potential use while seeking their responses. About 93% of all farmers expressed willingness to pay (Table 11). The highest percent of farmers (18%) unwilling to pay for the service were from control villages. The amount they indicated they were willing to pay varied from about 150 shillings to 368 shillings, with lowest offer coming from control villages, and the highest from the two treatments that included training. No major differences were observed between men and women farmers, except that in the villages that received training women are willing to pay 258 shillings which is 100 shillings less than that by men.

Treatment	Amount willing to pay (KSH)			Women		Men		All farmers	
	Female	Male	All	No	Yes	No	Yes	No	Yes
1. Control	176	125	150	3	14	2	9	5	23
2. Training	258	357	313	0	16	0	13	0	29
3. Advisory	228	204	211	1	14	1	11	2	25
4. Combined	385	364	368	1	14	0	12	1	26
All villages	262	263	261	5	58	3	45	8	103

Table 11: Willingness to pay, and amount (KSH) they are willing to pay.

Conclusions

From the findings of this study, it is clear that forecast information, when presented appropriately, can contribute to significant change in the way smallholder farmers operating in high risk environments plan and manage their farms. The evidence collected suggests that farmers understood and utilised the probabilistic seasonal climate forecast information by making adjustments to their plans, which resulted in significant benefits. Important messages emanating from this study are as given below.

Farmers tend to have optimistic expectations about the coming season, yet they tend to be conservative when making actual investments. This may be due to uncertainty about the risks associated with those investments in the face of uncertain rainfall. Farmers also tend to adopt risk coping strategies such as cropping more area and using drought tolerant crops than investing on improved management of crops as evidenced by the differences in the way farmers in control and treatment villages managed their farms.

Improved understanding of climate variability and seasonal climate forecast information provided a basis for farmers to plan and implement strategies that can contribute to increased productivity and profitability. Although farmers in this area have access to climate information (Ngugi et al. 2011), their lack of understanding of the forecast information and uncertainties associated with it lead to low levels of utilisation of that information. The training and support received by farmers under this study helped them in better understanding the potential value of this information and make use of it.

A certain change in the attitude of farmers about climate was evident. Farmers who went through the training were found to be more realistic in their assessment of the season and

more satisfied with the outcome of their management. Farmers showed keen interest in receiving climate information, and perceived the value of this information in planning farm operations. Their willingness to pay for the service is an indication of the value they attached to this information. No major differences were observed in the way men and women responded to climate information.

Although this study indicates that improved understanding of the probabilistic seasonal climate forecasts can help smallholder farmers in planning and managing farm activities, the findings are constrained by the small size of the sample, particularly when disaggregated by village and gender. The sample size and sampling design were not adequate to provide conclusive evidence of the impact on yields, investments or livelihoods. It is therefore suggested that the study may be repeated with more villages and more farmers, covering at least two different biophysical environments.

The study has clearly established the need for enhancing the understanding of farmers and their support agents about climate variability and potential role probabilistic seasonal climate forecasts can play in managing them. To this end there is a need to develop and implement well- structured training modules aimed at making farmers and extension agents better understand the variability in climate, probabilistic seasonal climate forecasts, reliability and uncertainties associated with forecast information and potential applications of forecast information.

One of the assumptions made in this study's design was that rainfall is similar across all study villages. This may not be true especially considering the significant variation in the timing, amount, and distribution of rainfall that normally occurs in this area. It is therefore suggested that efforts be made to measure rainfall in the study villages to ensure that the observed differences between treatments are due to provision of climate information and not due to the spatial variability in rainfall.

The approach and methodology used in this study, although effective, is difficult to replicate or up-scale. There is a need to develop appropriate mechanisms to enhance the capacity of extension agents and farmers, especially those operating in risk prone semi-arid areas, through training and technical assistance. Extension of climate information, unlike other technologies, requires timely access to up-to-date information at regular intervals. There is a

need to develop a communication system that ensures timely and cost effective delivery of downscaled location specific climate information.

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Annex 1: Agro-advisory for 2011-2012 short rains season

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 — International Crops research institute fro the Semi-Arid Tropics

Kenya Agricultural Research Institute

Ministry of Agriculture

Kenya Meteorological department

University of Nairobi

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, DLC1, 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 growplus.
- 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.

Annex 2: Pre-season survey

The objective of this study is to test methods for communicating seasonal forecasts and advisories with farmers, assess and document farm-level management responses to the information, and elicit farmers' perspectives of benefits or disbenefits. The survey will elicit farmers' production and livelihood strategies prior to and after obtaining the seasonal forecasts and/or advisories.

Interview information

Name of Interviewer: _____ Date of Interview: _____

Starting Time: _____ Ending Time: _____

Status of Questionnaire: (a) Complete_____ (b) Not complete_____

Checked By Supervisor: _____ Date: _____

Division: _____ Location: _____

Sub-location: _____ Town/village: _____

Respondent's information (respondent number _____)

Name: _____

Phone #: _____

Relationship of respondent to household head: _____

Household head's information (if not the respondent)

Name: _____

Permanent residence: (on this farm or another farm)

_____

Informed consent

The purpose of this study has been explained to me. I agree to participate in this questionnaire, meetings where I will be presented with information about climate, and a follow-up questionnaire by February 2012. I understand that my responses will be shared for research purposes, but that no information that could identify me will be shared. I understand that information about climate and management that will be provided is experimental and has uncertainties, and that any changes in management based on this information could have either positive or negative effect on my production or income. I accept full responsibility for any management decisions that I make in response to that information, and any risks that might result.

(Signature) (Date)

Land use

1. Do you plan to rent out land this season? Yes [ ] No [ ]

2. If "yes," how much (units)? _____ Acres

3. Do you plan to rent in land this season? Yes [ ] No [ ]

4. If "yes," how much (units)? _____Acres. How will you use the land you rent?

Credit

1. Do you intend to borrow money to invest on the farm? Yes [ ] No [ ]

2. If “yes,” for what purposes?

3. From where will the money be borrowed?

4. When will the loan become due?

5. What is the interest rate or terms of repayment?

6. What collateral will you use to secure the loan?

7. Do you intend to get any other form of credit? Yes [ ] No [ ]

8. If yes, what form?

9. What will be the form of repayment?

Other Income Sources

How much money do you expect your household to make from off-farm labor during the short-rain season?

How much money do you expect your household to make from working on other farms during the short-rain season (Sept – Feb)?

Land Preparation

Have you already begun clearing your fields? Yes [ ] No [ ]

If ‘yes’ what have you done?

If ‘no’, when do you intend to begin?

Crop Management (Short rains 2011)

Plot	Crop	Variety	Area	Inputs											
				Seeds		Fertilizer		Pesticide/herbicides		Hired equipment		Labor (days from land preparation to harvesting)			
												Men		Women	
				Source	Amount used	Type	Amount used	Type	Amount used	Type	Amount used	family	hired	family	hired

Rate of hired labor: _____ Men (Ksh)

_____ Women (Ksh)

Seed sources: 1 = Agrovet 2 = Market 3 = Friends 4 = Own saved

5 = Gov't institutions (research institutes, extension) 6 = NGOs 7 = Other (specify)

Use of technologies

Technology	Area Under Technology
Soil and water management	
Tied ridges	
Water harvesting	
Reduced tillage	
Terracing	
Mulching	
Others (Specify)	
Soil fertility management	
Animal manure	
Green manure	
Compost	
Chemical fertilizer	
Others (Specify)	
Crop management practices	
Row planting	
Seed priming	
Pest control	
Herbicides	
Intercropping	
Others (Specify)	

Storage

Have you of late renovated/expanded your store to improve storability of your produce for the short rain season? Yes [ ] No [ ]

If "yes," please explain what you have done.

Livestock

Do you plan to buy animals (between now and the end of the season)? Yes [ ] No [ ]

Do you plan to sell animals (between now and the end of the season)? Yes [ ] No [ ]

Have you taken any health preventive measures for livestock diseases that might increase at the onset of rains? Yes [ ] No [ ]

Explain:

Climate Prediction and Access to Information

Do you expect the next season to be good, bad or normal?

Reason for this expectation?

Have you received any climate information? Yes [ ] No [ ]

If "yes," what type of climate information?

From what source?

Thank you

Ending Time:

Annex 3: Mid-season survey

Land use

1. Have you rented out land this season? Yes [ ] No [ ]
2. If "yes," how much (units)? _____ Acres
3. Have you rented in land this season? Yes [ ] No [ ]
4. If "yes," how much (units)? _____Acres. How will you use the land you rent?

_____

Credit

1. Have you borrowed money to invest on the farm? Yes [ ] No [ ]
2. If "yes," for what purposes? _____
3. From where did you borrow the money? _____
4. When will the loan become due? _____
5. What is the interest rate or terms of repayment? _____
6. What collateral will you use to secure the loan?

_____

7. What will be the form of repayment? _____

Other Income Sources

How much your household earned from off-farm labor during the short-rain season?

_____

How much your household earned from working on other farms during the short-rain season (Sept – Feb)?

_____

Harvesting

Have you already begun harvesting your fields? Yes [ ] No [ ]

If 'yes' how do you rate the harvest? Good/Average/Poor

If 'no', when do you intend to begin? _____

Crop Management (Short rains 2011)

Plot	Crop	Variety	Area	Inputs								Labor (days from land preparation to harvesting)			
				Seeds		Fertilizer		Pesticide/herbicides		Hired equipment		Men		Women	
				Source	Amount used	Type	Amount used	Type	Amount used	Type	Amount used	family	hired	family	hired

Rate of hired labor: _____ Men (Ksh)

_____ Women (Ksh)

Seed sources: 1 = Agrovet 2 = Market 3 = Friends 4 = Own saved

5 = Gov't institutions (research institutes, extension) 6 = NGOs 7 = Other (specify)

Use of technologies

Technology	Area Under Technology
Soil and water management	
Tied ridges	
Water harvesting	
Reduced tillage	
Terracing	
Mulching	
Others (Specify)	
Soil fertility management	
Animal manure	
Green manure	
Compost	
Chemical fertilizer	
Others (Specify)	
Crop management practices	
Row planting	
Seed priming	
Pest control	
Herbicides	
Intercropping	
Others (Specify)	

Storage

Have you of late renovated/expanded your store to improve storability of your produce for the short rain season? Yes [ ] No [ ]

If "yes," please explain what you have done.

Livestock

Have you bought any animals (between beginning of the season and now)? Yes [ ] No [ ]

Have you sold any animals (between beginning of the season and now)? Yes [ ] No [ ]

Have you taken any health preventive measures for livestock diseases? Yes [ ] No [ ]

Explain:

Climate Prediction and Access to Information

Did the season go as you expected it to be?

Reason for this expectation?

Is the season similar to what you normally experience?

If not, how is it different from others?What type of climate information was received by you?

Did you find the climate information useful? Yes [ ] No [ ]

If “yes,” how?

Thank you

Ending Time:

Annex 4: End-season survey

Respondent and general household information

Name of the respondent (confidential, not to be made public)	
Gender of interviewee	Male/Female
Age of interviewee	18-25/25-35/35-45/45-55/Above 55
Marital status	Single/Married/Divorced/Widowed
Level of education	Standard 6/Grade 7/ZJC/O Level/A Level/Certificate/Diploma/Degree
Employment status	Employed/ Self Employed/Farmer/Other
Is the respondent household head?	Yes/No
If not, relationship to household head	
Name of household head	
Gender of household head	Male/Female
Age of interviewee	18-25/25-35/35-45/45-55/Above 55
Level of education	Standard 6/Grade 7/ZJC/O Level/A Level/Certificate/Diploma/Degree
Employment status	Employed/Self Employed/Farmer/Other
Type of Household	Nuclear/Extended

Household Composition (including respondent)

	Male	Female
Number of household members aged ≥17 years		
Number of household members aged 10-16 years		
Number of household members aged <10 years		
Number of household members working on farm		
Number of household members working off farm		
Number of household members migrated		

Dependence on agriculture

What are the various sources of your income and what is their contribution to total income?

Source	Share of total income (%)
Agriculture (crops)	
Livestock	
Other products eg. Firewood, manure etc.	
Regular employment	
Casual employment	
Business	
Remittances	
Others (specify)	

Changes in land holding

Short Rain Season 2011-2012

Ownership	Total land[1] (ac)	Rental value per acre	Cultivated land (ac)	Fallow land (ac)	Land purchased (ac)	Land sold (ac)
Owned						
Rented in						
Rented out						

Long Rain Season 2012: (Changes if any)

Ownership	Total land (ac)	Rental value per acre	Cultivated land (ac)	Fallow land (ac)	Land purchased (ac)	Land sold (ac)
Owned						
Rented in						
Rented out						

[1]Specify unit if local unit for land is not acre

Changes in livestock ownership

Livestock	Number bred on farm	Number sold during season	Amount received during season	Number purchased during season	Amount invested during season
Local cattle					
Crossbred cattle					
Donkey					
Local sheep/goat					
Improved sheep/goat					
Local Chicken					
Improved chicken (Broilers)					
Improved chicken (Layers)					
Others (Specify)					

Investment profile

How much you invested on the following during 2011-2012 short rain season and how do you rate this investment compared to what you normally do?

Item	Amount	Is this higher, same or lower than what you normally do?
Land preparation		Higher/Same/Lower
Seeds		Higher/Same/Lower
Planting		Higher/Same/Lower
Weeding		Higher/Same/Lower
Fertilizer		Higher/Same/Lower
Plant protection		Higher/Same/Lower
Harvesting		Higher/Same/Lower
Livestock management (purchase of fodder, health care etc.)		Higher/Same/Lower

What is the source of your investment?

Item	Amount received	Rating in relation to previous season	Conditions (rate of interest, collateral requirements etc.)	Mode of repayment
Own savings		Higher/Same/Lower		
Borrowed from friends		Higher/Same/Lower		
Loan from input suppliers		Higher/Same/Lower		
Borrowed from local cooperative, thrift society etc.		Higher/Same/Lower		
Borrowed from banks		Higher/Same/Lower		
Others (specify)		Higher/Same/Lower		

Crop Management (Short rains 2011-2012)

Plot	Crop	Variety	Area	Inputs											
				Seeds		Fertilizer		Pesticide/herbicides		Hired equipment		Labor (days from land preparation to harvesting)			
												Men		Women	
				Source	Amount used	Type	Amount used	Type	Amount used	Type	Amount used	family	hired	family	hired

Rate of hired labor: _____ Men (Ksh)

_____ Women (Ksh)

Seed sources: 1 = Agrovet 2 = Market 3 = Friends 4 = Own saved

5 = Gov't institutions (research institutes, extension) 6 = NGOs 7 = Other (specify)

Crop yields during short rain season 2011-2012

Crop	Area planted	Quantity harvested (bags)	Rating in relation to previous season	Quantity sold (bags)	Rate (Ksh/bag)
			Higher/Same/Lower		
			Higher/Same/Lower		
			Higher/Same/Lower		
			Higher/Same/Lower		
			Higher/Same/Lower		

What have you done differently this season?

Activity	Previous SR season	This SR season	Reason for change
Land preparation			
Soil and water conservation			
Crops grown			
Varieties used			
Fertilizer applied			
Crop protection			
Harvesting			
Storage			
Marketing			
Others (Specify)			

Climate Information

Did the season go as you expected it to be?

Reason for this expectation?

Is the season similar to what you normally experience?

If not, how is it different from others?

What type of climate information was received by you?

Did you find the climate information useful? Yes [ ] No [ ]

If "yes," how?

Do you think farmers in your area can benefit from the seasonal climate forecast information? (yes/No)

If "yes," how? If "no" why not?

Which of the following you consider important to make farmers understand and use climate information in planning and managing farm activities?

1. Make climate information available to all farmers

2. Train farmers to understand and use climate information
3. Interpret and present climate information

What are the key lessons that you learnt with this interaction?

Ending Time:

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