# Rwanda Climate Services for Agriculture

## Evaluation of farmers' awareness, use and impacts

Working Paper No. 304

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# Abstract

Climate services are important in helping smallholder farmers manage climate-related risks and adapt to climate change, especially for rainfed agricultural production systems. In order to increase the resilience of farmers to the changing climate in Rwanda, the United States Agency for International Development (USAID) funded a four-year project—Rwanda Climate Services for Agriculture (RCSA) from 2016 to 2019. Through the project, climate services were disseminated directly to more than 111,000 farmers in four provinces across Rwanda through Participatory Integrated Climate Services for Agriculture (PICSA), Radio Listeners Clubs (LCs) and cell phones; as well as broadcast by a radio network accessible to about 70% of the population. This report presents analyses of the project end-line survey of 1525 households, sampled across 15 of Rwanda's 30 districts, in order to assess the influence of PICSA training and LCs on awareness, access and uptake of climate services by smallholder farmers; and their impact on household welfare (i.e., crop productivity, income, food security) on a quasi-experimental sampling design with a non-participant control sample. Analyses show that farmers use climate services to make decisions on the types of crops to grow (75%), the types of crop varieties to plant (58%), timing of planting and land preparation (75%) and when and how to prepare land (65%). Participation in PICSA and LCs, alone and in combination, is associated with a substantial increase in the proportion of farmers that report changing crop, livestock and livelihood management practices in response to weather and climate information. Relative to the control, PICSA participation increased the value of crop production by 24%, and income from crops by 30%. The combination of PICSA and LCs was associated with a 47% increase in the value of crop production, and a 56% increase in income from crops.



### Keywords

Climate services; access; use; impacts; livelihoods; food security

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# Contents

# Acronyms

| | |
|---|---|
| ABC | The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) |
| CCAFS | CGIAR Research Program on Climate Change, Agriculture and Food Security |
| GDP | Gross Domestic Product |
| HDD | Household dietary diversity |
| HDDS | Household dietary diversity score |
| ICT | Information and communication technology |
| LC | Listeners club |
| PICSA | Participatory Integrated Climate Services for Agriculture |
| RCSA | Rwanda Climate Services for Agriculture project |
| USD | United States Dollar |

# Introduction

Rwanda has been confronted by the effects of a changing climate in recent years. Hailstorms, strong winds, heavy rains leading to floods and landslides, prolonged droughts and changing weather patterns have become more recurrent, making seasons increasingly unpredictable and traditional indicators of climatic changes no longer suitable. Agriculture remains by and large the main source of subsistence for the majority of the population. About 80% of the population lives in rural areas and to some extent is engaged in agriculture. The agriculture sector employs 80% of Rwanda's population of 12 million and contributes to about 25% of the Gross Domestic Product (GDP) (National Institute of Statistics of Rwanda (NISR) 2020). Pastoralism, practiced only in small pockets of dry areas in the country, contributes to 10% of the GDP. Fishing is negligible and practiced marginally on the banks of Lake Kivu in the western part of the country bordering the Democratic Republic of Congo.

Rwanda is vulnerable to the impacts of climate change as its economy is largely dependent on rain fed agriculture. Rwanda already experiences frequent floods and droughts with some connections to the El Niño and La Niña phenomenon. The economic and financial implications of the climate change impacts are significant. The floods in 2007, for example, the most severe of recent events, are estimated to have cost a minimum of USD 4-22 million in two districts alone. The increases in temperature and changes to rainfall patterns are resulting in floods and droughts, and are significantly reducing crop yields, negatively impacting food security, export earnings and livelihoods (Mikova et al. 2015). In addition, the steep, hilly topography makes Rwanda particularly susceptible to landslides.

In the tropics it takes only 1°C of average temperature change to begin to alter the suitability of some key crops. Liu et al. (2008) predict that Rwanda will be a hotspot of food insecurity due to climate change, including many of its neighboring countries. Maize, the staple food for more than a quarter of a billion East Africans, is particularly vulnerable to changes in temperature and to water stress. Maize yield is expected to reduce by up to 45% by the end of the 21st century in East Africa (USAID 2017). Rice yields are known to rapidly decline due to temperature change, showing a 10% decline in yield for every 1ºC rise in growing season minimum temperature. Crops may be further negatively affected by new and emerging parasites, pests and diseases that thrive in the new climate.

In order to help farmers in Rwanda manage climate-related risks and improve their adaptive capacity, USAID funded a four-year project—Rwanda Climate Services for Agriculture (RCSA) from 2016 to 2019. RCSA is designed to empower Rwandan farmers in the management of climate risks with the aim of increasing resilience to climate change. The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) was the principal coordinating agency of the project, with active involvement of other international and national implementing partners. International institutions included global experts in climatology and climate services from the International Research Institute for Climate and Society (IRI) of Columbia University, the International Center for Tropical Agriculture (CIAT), the University of Reading, World Agroforestry Centre (ICRAF) and the International Livestock Research Institute (ILRI). National partners spearheaded the implementation of the project on the ground to ensure sustainability of the activities. These partners included the Rwanda Meteorological Agency (Meteo-Rwanda), Rwanda Agriculture Board (RAB), NGOs, farmer cooperatives, rural radio networks and information and communication technology (ICT) service providers. The project interventions were organized around four outcomes:

- *Climate services for farmers:* Agricultural extension and other relevant intermediary organizations and communicators (e.g. farmer cooperatives, rural radio networks, ICT providers, NGOs) provided farmers across Rwanda's 30 districts with decision-relevant, operational climate information and advisory services, and trained them to use the information to better manage risk.
- *Climate services for government and institutions:* Agricultural and food security decision-makers in the Ministry of Agriculture (MINAGRI), and in other national and local government agencies and institutions, used climate information to respond more effectively to climate-related risks and to inform decisions that build the resilience of farmers.
- *Climate information provision:* Meteo-Rwanda designed, delivered, and incorporated user feedback into a growing suite of weather and climate information products (historic, monitored and forecast) and services tailored to the needs of agricultural and food security decision makers.
- *Climate services governance:* A national climate services governance process—involving joint decision making among relevant national stakeholders—oversaw and fostered sustained co-production, assessment and improvement of climate services for agriculture and food security; and facilitated a formal interface and effective dialogue between the key agencies involved.

The main intervention of the project was to build the capacity of the national systems to generate and provide climate services to farmers and extension staff across Rwanda. The interventions were conducted through Participatory Integrated Climate Services for Agriculture (PICSA) training, radio programs, SMS, voice call back on radio and mobile phones. The implementation took place in all 30 districts of Rwanda. This evaluation study analyzes the effectiveness of the RCSA project efforts to develop climate services for farmers. In particular, it examines the effectiveness of PICSA and Radio Listeners Clubs (LC) in improving farmers' awareness, access, uptake and effective use of climate services in informing farmers' decision-making and welfare. The objective of the study was to implement an end line household survey in order to: i) Assess the effectiveness of the PICSA training and LCs to improve awareness, access and uptake of climate services by smallholder farmers; and ii) Analyze the impact of the interventions in influencing users farm management practices that improve farmers' welfare (e.g., crop productivity, food security).

# Methods

The end line survey collected benchmark information on key outcome and impact indicators through a structured questionnaire covering the reference period December 2018 to November 2019. The questionnaire was gender responsive to allow for the inclusion of gender differences with regard to access and use of climate services, and coping mechanisms against climate hazards and changes. The indicators included basic household socio-economic characteristics, climate risks, access and use of climate services, types and sources of information to inform their agricultural activities, farm management decisions, agricultural technologies adopted by households, crops, livestock, and livelihood activities and food security. The targeted individuals were the main decision makers in the household, typically the household heads or their spouses. Key outcome indicators collected at the end line had also been collected at the first year of the project implementation on the same households sampled for the baseline.

The evaluation approach was guided by the main evaluation questions the project was expected to provide answers to and included:

- What is the rate of access and use of climate information services in the rural community?

- What factors influence the use of climate information at the farm level?
- To what extent do agricultural households adapt their farm management decisions as a result of greater uptake of climate information services?
- What are the main behavioral changes in response to the uptake of climate services by farmers?
- What is the effect of training farmer promoters and peer farmers on farm management decisions?
- How do the different methods of providing climate information impact the livelihood options of the rural households?

This report mainly addresses the evaluation questions that seek to understand changes observed as a result of the project interventions. The four intervention categories included: i) Farmers who received PICSA training only (PICSA only); ii) Farmers who were members of LCs only (LC only); iii) Farmers who received PICSA training and were also members of LCs (PICSA+LC); and iv) Control group which included farmers who neither received PICSA training nor were members of LCs (No PICSA no LC).

This end line survey was conducted in 15 districts out of the 30 districts. The districts were clustered on the basis of where each of the interventions was conducted. In the case where more than one district was involved in an intervention, the district of interest was randomly selected. Fewer districts were selected in keeping within the resources available while maintaining representativeness of the samples. A multistage sampling procedure was used, where in each District, two sectors were randomly selected, and in each sector, cells and villages were randomly selected. In each village, proportional sampling was used to achieve the target sample size of 1525 households (Table 1). In the total sample, the proportion of females and males was almost equal, with females being slightly more. Southern and Western provinces had more females than males while the opposite was true in Northern and Eastern provinces.

**Table 1. Sample distribution of the surveyed households, including gender**

| Province | Number of districts | Number of sectors | Number of cells | Number of farmers | Proportion of female farmers | Proportion of male farmers |
|---|---|---|---|---|---|---|
| Southern | 4 | 8 | 11 | 421 | 59.6 | 40.4 |
| Western | 3 | 6 | 8 | 319 | 60.2 | 39.8 |
| Northern | 4 | 8 | 9 | 385 | 41.8 | 58.2 |
| Eastern | 4 | 8 | 9 | 400 | 43.5 | 56.5 |
| Total | 15 | 30 | 37 | 1,525 | 51.0 | 49.0 |

Table 2 indicates the relationship of the main respondent with the household head. About 67% of the respondents were the household head while 30% were spouses. Less than 5% of respondents were either the son or daughter of the household head.

**Table 2. Relationship of main respondent to household head (percentage)**

| Province | Number of farmers (N) | Head (%) | Spouse (%) | Son/daughter (%) |
|---|---|---|---|---|
| Southern | 421 | 56.8 | 38.2 | 5.00 |
| Western | 319 | 60.8 | 37.9 | 1.3 |
| Northern | 385 | 79.5 | 19.7 | 0.8 |
| Eastern | 400 | 72.5 | 26 | 1.5 |
| **Total** | **1525** | **67.5** | **30.3** | **2.2** |

Results in Table 3 are presented per intervention category (PICSA only, LC only, PICSA+LC and No PICSA no LC) and show the proportion of households in each of the intervention categories. The highest proportion of the respondents were from the control category (no PICSA, no LC), except in Eastern province where the highest proportion of respondents were those in the PICSA only category. The PICSA+LC category had the least respondents except for Eastern province which had less than 1% of the respondents in the LC only category. Eastern province has low radio coverage and this could explain its low usage.

**Table 3. Sample distribution by intervention category (percentages in brackets)**

| Province | PICSA only | LC only | PICSA + LC | No PICSA no LC | Total |
|---|---|---|---|---|---|
| Southern | 53 (12.6) | 131 (31.1) | 45 (10.7) | 192 (45.6) | 421 |
| Northern | 49 (15.4) | 116 (36.4) | 29 (9.1) | 125 (39.2) | 319 |
| Western | 140 (36.4) | 72 (18.7) | 12 (.1) | 161 (41.8) | 385 |
| Eastern | 153 (38.3) | 2 (0.5) | 96 (2) | 149 (37.3) | 400 |
| **Total** | **395 (25.9)** | **321 (21.1)** | **182 (11.9)** | **627 (41.1)** | **1,525** |

# Results and discussion

## General household characteristics

Household's social economic and demographic characteristics form part of the contextual environment that affect farmers' decision making and also the ability to access and use climate information. Table 4 and Table 5 show the general household characteristics and their livelihood options in each of the four provinces, respectively. As shown in Table 4, household sizes in all the provinces were relatively small with about five members. The majority of the households were headed by men, with only 24% of the households headed by women. Most of those household heads were married and living with their spouse.

The household heads were middle aged (48 years) and most of the households had relatively young members, with only 13% of the households having members who were over 64 years of age. With regard to education level, less than half of the household heads (45%) had at least 6 years of education. Southern province had the highest proportion of household heads with at least 6 years of education while Eastern province had the least. A third of the female household members and female household heads were literate, with Southern province having the highest female literacy levels and Northern province the least.

Table 5 further indicates that crop farming was the primary occupation in all the provinces apart from Western province where agro-pastoralism was the primary occupation. Off-farm activities were the least common primary occupation with about 6% of the households mentioning off-farm activities as their primary occupation. Generally, crop farming and animal rearing were the main livelihood option, with more than 97% of the households in all provinces practicing it (Table 6). In terms of access to agricultural extension services, most of the households (83%) had accessed agricultural extension services. More household heads were members of associations (71%) compared to the spouses (48%). Almost all the households owned land (Table 4).

**Table 4. General characteristics of the households**

| | Southern | Western | Northern | Eastern | Average |
|---|---|---|---|---|---|
| Mean age of household head | 47.4 | 45.9 | 47.1 | 45.8 | 46.6 |
| Mean household size | 5.2 | 4.9 | 4.6 | 5.4 | 5.0 |
| Female headed household (%) | 24.5 | 25.4 | 23.4 | 22.8 | 23.9 |
| At least 6 years of education for household head (%) | 51.8 | 47.3 | 41.0 | 41.00 | 45.3 |
| Household head is married (%) | 77.0 | 78.4 | 76.9 | 82.4 | 78.6 |
| Female literacy (%) | 75.7 | 67.8 | 55.5 | 65.6 | 66.3 |
| Household has members over 64 years of age (%) | 12.6 | 14.7 | 16.6 | 9.5 | 13.3 |
| Accessed agricultural extension services (%) | 86.9 | 79 | 79.0 | 87.8 | 83.5 |
| Membership in association for household head | 71.0 | 69.9 | 62.9 | 79 | 70.9 |
| Membership in association for spouse | 55.1 | 48.9 | 40 | 45.8 | 47.5 |
| Land ownership (%) | 91.0 | 94.7 | 95.1 | 94.8 | 94 |

**Table 5. Primary livelihood activity of the household head**

| Primary livelihood activity of household head | Proportion of households | | | | |
|---|---|---|---|---|---|
| | Southern | Western | Northern | Eastern | Average |
| Crop farmer | 61.5 | 38.6 | 59.5 | 78.5 | 60.7 |
| Agro-pastoral | 31.6 | 55.5 | 34.6 | 14.5 | 32.9 |
| Off-farm (business, wage, formal employment) | 6.9 | 6.0 | 6.0 | 7 | 6.5 |

**Table 6. Proportion of households participating in the different livelihood options by province**

| Livelihood options | Southern | Western | Northern | Eastern | Average |
|---|---|---|---|---|---|
| Farming | 98.8 | 97.5 | 98.2 | 99.5 | 98.6 |
| Processing crops or natural products (e.g. oil, honey) | 0.5 | 1.9 | 0.8 | 1 | 0.9 |
| Rearing livestock (e.g. cattle, goats, chicken, pig) | 48.7 | 51.7 | 62.1 | 28.3 | 47.3 |
| Producing livestock products (e.g. milk, eggs) | 5.0 | 8.5 | 2.6 | 1.8 | 4.3 |
| Off-farm business (e.g. shop, buying and selling) | 4.3 | 5.3 | 10.4 | 10.3 | 7.6 |
| Casual work (daily hire) | 24.7 | 14.7 | 41.8 | 43.8 | 31.9 |
| Unskilled formal paid work (e.g. farm laborer, mine worker) | 1.9 | 5.3 | 6.2 | 7.5 | 5.2 |
| Skilled formal paid work (e.g. teacher, carpenter, nurse) | 2.9 | 5.6 | 2.1 | 3 | 3.3 |

## Communication assets

Table 7 indicates the proportion of households owning communication assets (radio, television and cell phone) in each province. Eastern province had the highest proportion of households owning cell phones, radio and television while Northern province had the lowest proportion of households owning the three communication assets. The most common communication asset that households owned was a cell phone which was owned by a minimum of 71% respondents in Northern province and a maximum of 83% of respondents in Eastern province. Radio was the second, owned by a minimum of 47% of respondents in Northern province and a maximum of 57% of respondents in Eastern province. On average, less than 10% of the respondents owned a television (Table 7). This indicates that the cell phone is the most important gadget that can be used for communicating to the respondents. Radio can also be used to pass information widely given that it is shared within the households and can reach many household members at once. The cell phone currently includes radio function especially when out of homes.

**Table 7. Proportion of households owning communication assets**

| Communication asset | Percentage of households (mean number owned per household in brackets) | | | | |
|---|---|---|---|---|---|
| | Southern | Western | Northern | Eastern | Total |
| Radio | 47.5 (1.1) | 51.1 (1.0) | 46.8 (1.0) | 56.5 (1.0) | 50.4 (1.0) |
| Television | 5.0 (1.0) | 3.1 (1.0) | 3.1 (1.25) | 10.5 (1.0) | 5.6 (1.0) |
| Cell phone | 72.5 (1.7) | 77.1 (1.5) | 71.2 (1.5) | 82.8 (1.5) | 75.8 (1.5) |

Table 8 shows who owned the radios. Generally, most of the radios were owned by male spouses. However, radio ownership differed among the provinces. In Southern and Western provinces, radios were majorly owned by both females and males while in Northern and Eastern provinces, they were owned by the male spouses.

**Table 8. Radio ownership within the household (percentage)**

| Owned by | Southern | Western | Northern | Eastern | Total |
|---|---|---|---|---|---|
| Male spouse | 35 | 32.5 | 43.3 | 51.8 | 41.4 |
| Female spouse | 15 | 16.0 | 12.8 | 14.6 | 14.6 |
| Both male and female | 44 | 49.1 | 39.4 | 22.1 | 37.6 |
| Other household member | 6 | 2.5 | 4.4 | 11.5 | 6.5 |
| **N** | **200** | **163** | **180** | **226** | **769** |

## Access to markets and agricultural extension services

Table 9 describes the average distances in kilometers (km) from homestead to input and output markets, and also agricultural services. On average the market for crop outputs was 4.3 km from homesteads. Respondents from Eastern province covered the shortest distances, 2.3km, to the crop output market while those in Southern province covered the longest distance of 6 km. Livestock markets were the farthest from homesteads with an average of 6.1 km. The distances to livestock markets were a minimum of 4.1 km in Eastern province to a maximum of 7.5 km in Western province. The average distance to improved seed and fertilizers was 3.5 km and 3.2 km respectively. The distance to agricultural extension was the shortest with an average of 1.5 km. On average, the distance from homestead to all weather road was 4.6 km, with a minimum distance of 4.3 km in Eastern province and a maximum distance of 6.8 km in Southern province. Some of these distances could play a role in limiting access to markets, improved inputs and agricultural services.

**Table 9. Mean distance from homestead to market, inputs and services (km)**

| Distance | Southern | Western | Northern | Eastern | Average | N |
|---|---|---|---|---|---|---|
| Crop output market | 5.5 | 4.8 | 4.7 | 2.3 | 4.3 | 1,513 |
| Livestock market | 7.3 | 7.5 | 5.6 | 4.1 | 6.1 | 1,515 |
| Improved seed market | 3.0 | 4.2 | 4.0 | 3.0 | 3.5 | 1,524 |
| Fertilizer market | 2.7 | 3.5 | 3.9 | 3.0 | 3.2 | 1,522 |
| Agricultural extension office or officer | 1.4 | 1.4 | 1.9 | 1.4 | 1.5 | 1,520 |
| All-weather road | 3.3 | 6.8 | 4.6 | 4.3 | 4.6 | 1,521 |

Figure 1 indicates the proportion of respondents using different types of roads from homestead to access input and output markets and agricultural services. Non-levelled dirt roads were the most common road used to access all markets and agricultural extension services in all provinces apart from Eastern province where the majority of respondents use levelled dirt roads. More than 60% of the respondents in Southern, Western and Northern provinces used non-levelled dirt roads while barely 20% used levelled dirt roads (apart from Northern province which had slightly more than 20%) to access all the markets agricultural extension services and all-weather roads. Gravel and tarmac roads were rarely used in the all the provinces. In Eastern province, slightly more than half of the respondents used non-levelled dirt roads while slightly below half of the respondents levelled dirt to access all the markets agricultural extension services and all-weather roads. Figure 2 shows the most common modes of transport from homestead to different markets and to agricultural extension offices. More than 80% of the respondents walk to the output and input markets, to the extension officers and to all-weather roads. This means that there are challenges in accessing input and output markets and also extension officers given that most of non-levelled and levelled dirt roads are impassable especially during rainy seasons.

Figure 3 indicates the proportion of respondents experiencing different constraints in accessing inputs for agricultural production (fertilizer, improved seeds, agricultural labor, equipment, fodder and climate information). On average, more than half of the respondents reported no constraints in accessing agricultural labor, equipment, fodder and climate and weather information. On the other hand, the majority of respondents reported various constraints in accessing fertilizer and improved seed. The majority of the respondents who reported constraints, mentioned higher prices as the main constraint to accessing fertilizer and improved seeds while a lack of funds was the main constraint to accessing agricultural labor and equipment. Lack of adequate information was the major constraint in accessing climate and weather information followed by availability. The majority of respondents who had constraints in accessing fodder reported availability as the major constraint.

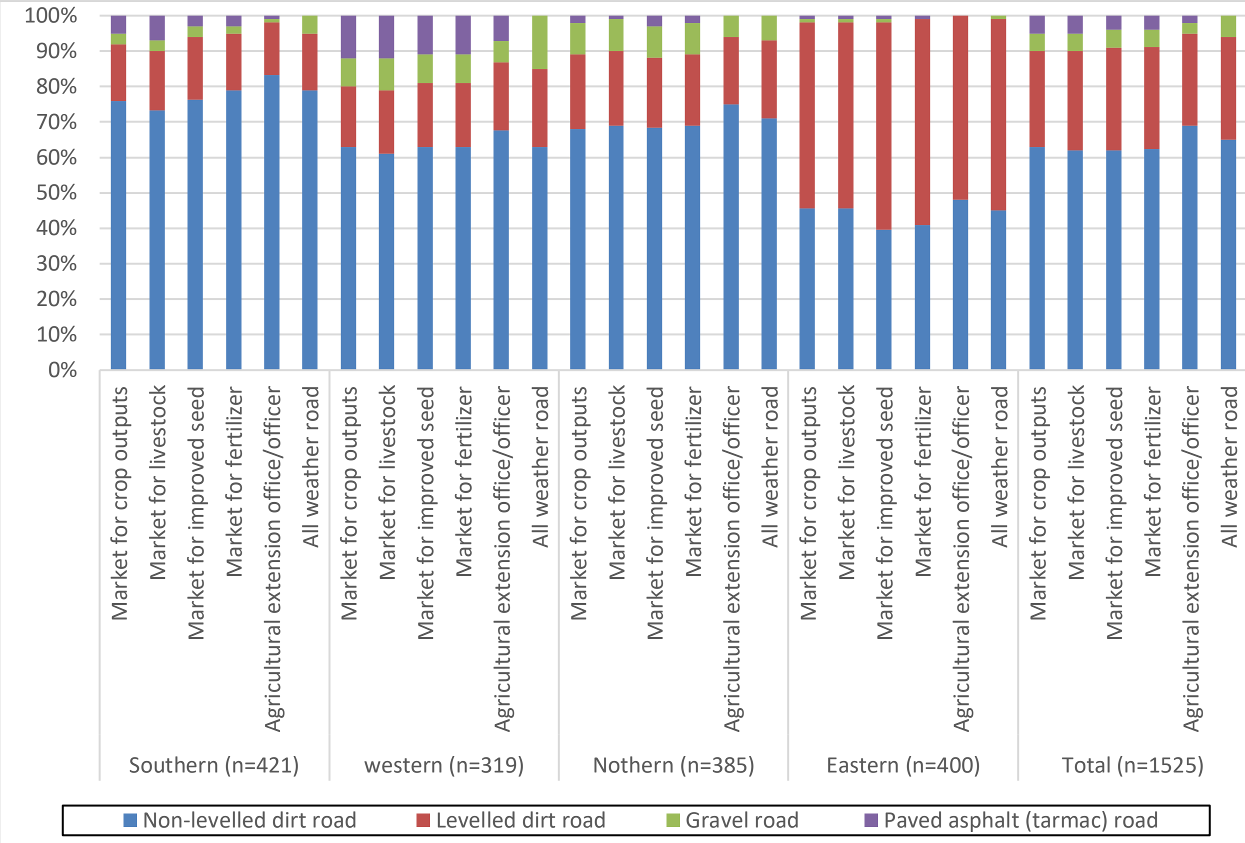


**Figure 1. Proportion of respondents using different types of roads from homesteads to access market and services**

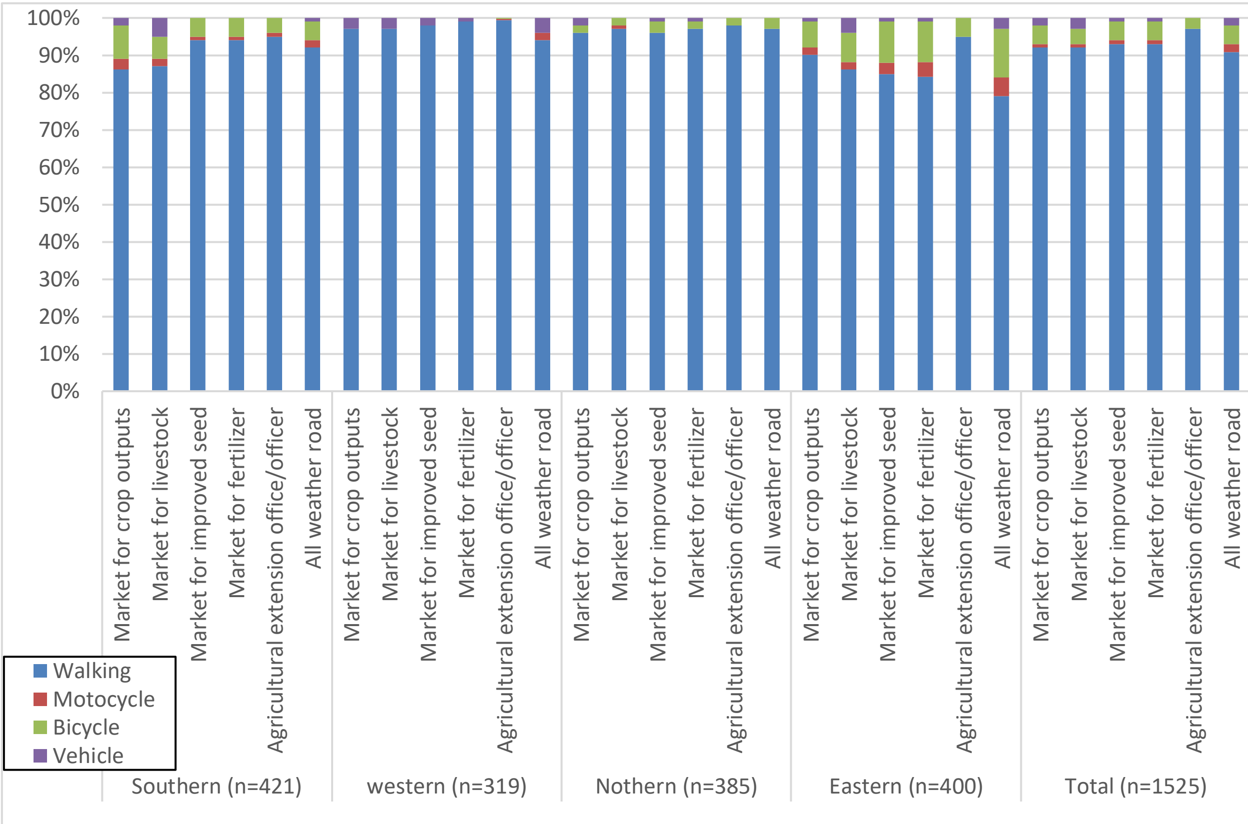


**Figure 2. Proportions of respondent using different modes of transport from homestead to different markets, agricultural officers and to all weather road.**

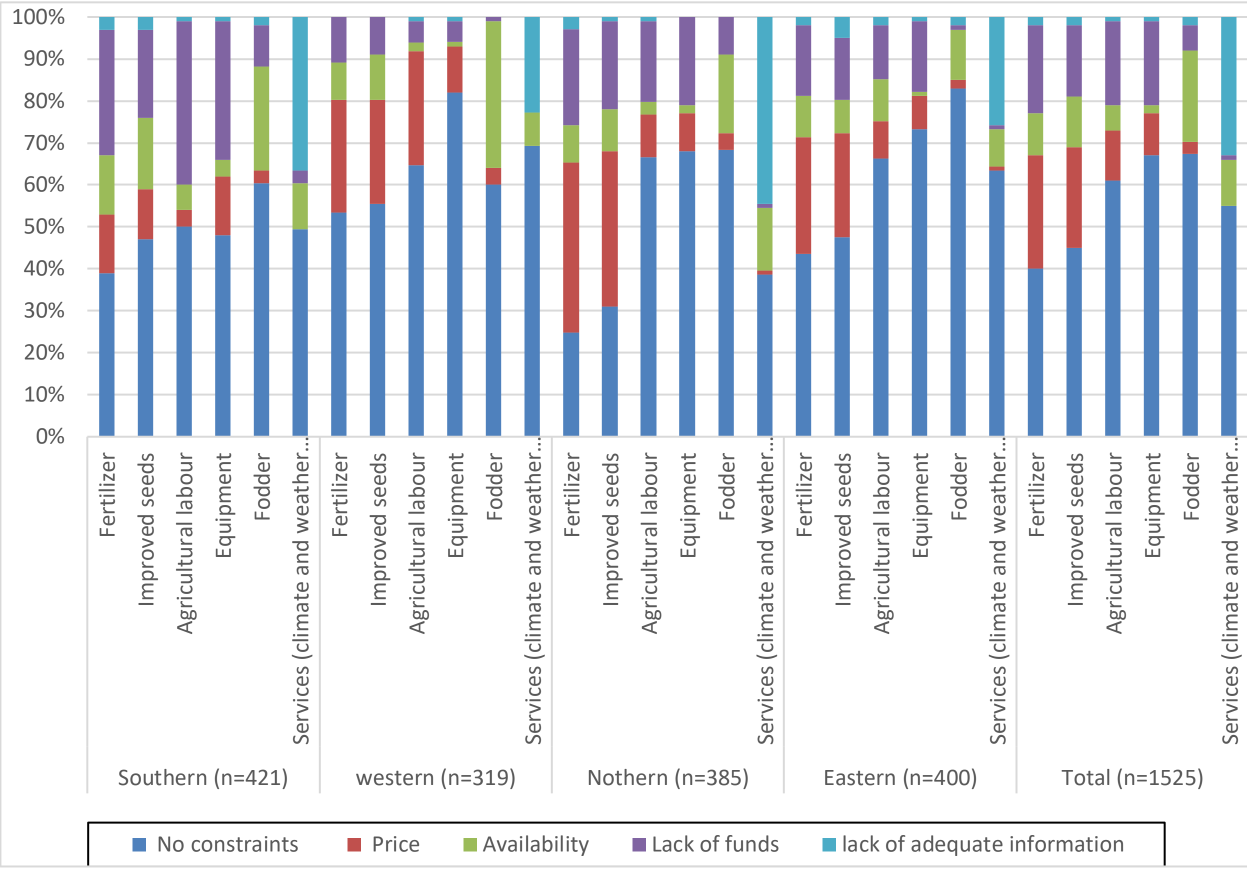


**Figure 3. Proportion of respondents with constraints in accessing and using inputs and services for agricultural production**

## Awareness and access to climate information

The respondents were asked whether they had heard about different climate information which included: i) Weather forecast for the next 10 days; ii) Seasonal weather forecast for the total rainfall; iii) Seasonal weather forecast on timing onset of rains; and iv) Historical information about seasonal rainfall from past years. In addition, they were asked if they accessed the information, when they accessed it and the frequency of access, the sources of the information, the format in which they accessed the information, the variables of weather that were included in the information accessed and any other support information they received along with the climate information.

Table 10 shows the proportions of respondents that had heard about the climate information. The results are grouped by intervention categories (PICSA only, LC only, PICSA+LC and No PICSA no LC). The majority of the respondents in PICSA only, LC only and PICSA+LC intervention categories had heard about all types of climate information products except historical seasonal rainfall from past years. The majority of the respondents in the control category had not heard about the climate information products apart from short term weather forecast for the next 10 days that slightly more than a half of the respondents had heard about. The results are also categorized by gender, however there were no statistically significant differences between males and females with regard to climate information awareness. An exception is the case of those who had accessed weather forecasts for the next 10 days in the control category, where more men had accessed the information relative to women. The difference was significant at a 5% level of significance.

Table 11 shows the proportion of farmers who actually accessed the climate information, out of all those who were aware of the different climate information. The majority of all the farmers that had heard about weather forecast for the next 10 days, seasonal weather forecast for the total rainfall, seasonal weather forecast on timing onset of rains and historical information about seasonal rainfall from past years had also accessed it. This was the case for all the intervention groups including the control. In the control category, there were significant differences between the proportions of males and females that accessed climate information on weather forecast for the next 10 days, seasonal weather forecast for the total rainfall and seasonal weather forecast on timing onset of rains. More males than females accessed the climate information. More males than females in the PICSA only intervention accessed weather forecast for the next 10 days while more females than males in the LC only intervention accessed information on the historical information about seasonal rainfall from past years. Generally, there was equity in the distribution of different types of climate information between males and females in all the intervention categories except the control category, meaning that the interventions promoted equity in the distribution of the climate information.

Figure 4 shows proportions of respondents who accessed different types of climate information in the past one week, past one month, one-six months ago and seven-12 months ago. Figure 5 shows the frequency of accessing the information. The proportions are of the respondents who had accessed particular climate information. The results were grouped using the four intervention categories. In all the intervention categories, the control category included, weather forecast for the next 10 days had been majorly accessed in that last one week, and the majority accessed the information once a week. The majority of the respondents in the LC only and control group categories accessed information on the seasonal forecast of total rainfall in the past month, while the majority of the respondents in PICSA only and PICSA+LC categories had accessed the same information one-six months ago. The majority of the respondents had accessed the seasonal forecast on the timing of the onset of the rains one-six months ago. Information on season forecast of total rainfall and on the timing of the onset of rains was mostly accessed once in an agricultural season. The majority of respondents in all intervention groups, including the control, had accessed historical information on the rains seven-12 months ago, except from those in PICSA+LC who majorly had accessed the information in the past month. Most of the farmers in the PICSA only category reported to have accessed historic information on rainfall once a year while the rest of the intervention categories mostly accessed the information once in an agricultural season. The results indicate that short term climate information is usually accessed on a weekly basis, seasonal climate information is accessed within one-six months while historical climate information is usually accessed within one-12 months.

**Table 10. Proportion (%) of households aware of climate information**

| | PICSA only | | | | LC only | | | | PICSA + LC (n=182) | | | | No PICSA no LC (n=627) | | | | Total (n=1525) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total (n=395) | Female (n=197) | Male (n=198) | Diff. | Total (n=321) | Female (n=163) | Male (n=158) | Diff. | Total (n=182) | Female (n=97) | Male (n=85) | Diff. | Total (n=627) | Female (n=321) | Male (n=306) | Diff. | Total (n=1525) | Female (n=778) | Male (n=748) | Diff |
| Weather forecasts for next 10 days | 81 | 77 | 82 | -5 | 77 | 74 | 80 | -6 | 95 | 97 | 92 | 5 | 54 | 50 | 58 | -8** | 70 | 68 | 73 | -5** |
| Seasonal forecast of total rainfall | 89 | 88 | 91 | -3 | 75 | 71 | 80 | -9* | 95 | 97 | 93 | -4 | 45 | 45 | 45 | 0 | 69 | 68 | 70 | -2 |
| Seasonal forecast of onset date | 90 | 88 | 92 | -4 | 74 | 72 | 75 | -3 | 92 | 94 | 91 | -3 | 41 | 39 | 42 | -3 | 66 | 65 | 68 | -3 |
| Historical seasonal rainfall information | 46 | 43 | 48 | -5 | 30 | 26 | 33 | 7 | 45 | 49 | 40 | 9 | 12 | 12 | 13 | -1 | 29 | 27 | 30 | -3 |

Note: * p<0.1, ** p<0.05, *** p<0.01

**Table 11. Proportion (%) of households with access to climate information**

| | PICSA only | | | | LC only | | | | PICSA+LC | | | | No PICSA no LC | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Female | Male | Diff. | Total | Female | Male | Diff. | Total | Female | Male | Diff. | Total | Female | Male | Diff. | Total | Female | Male | Diff. |
| Weather forecasts for next 10 days | 91 | 86 | 95 | -9*** | 98 | 98 | 97 | 1 | 98 | 98 | 97 | 1 | 91 | 88 | 94 | -6* | 94 | 92 | 95 | -3** |
| Seasonal forecast of total rainfall | 99 | 98 | 99 | -1 | 98 | 99 | 97 | 2 | 98 | 98 | 99 | -1 | 87 | 81 | 94 | -13*** | 95 | 94 | 97 | -3*** |
| Seasonal forecast of onset date | 98 | 98 | 98 | 0 | 96 | 97 | 95 | 2 | 98 | 98 | 99 | -1 | 83 | 77 | 89 | -11*** | 94 | 93 | 95 | -2* |
| Historical seasonal rainfall information | 84 | 84 | 84 | 0 | 83 | 93 | 75 | 18** | 89 | 89 | 88 | 1 | 76 | 76 | 75 | 1 | 83 | 85 | 81 | 4 |

Note: * p<0.1, ** p<0.05, *** p<0.01

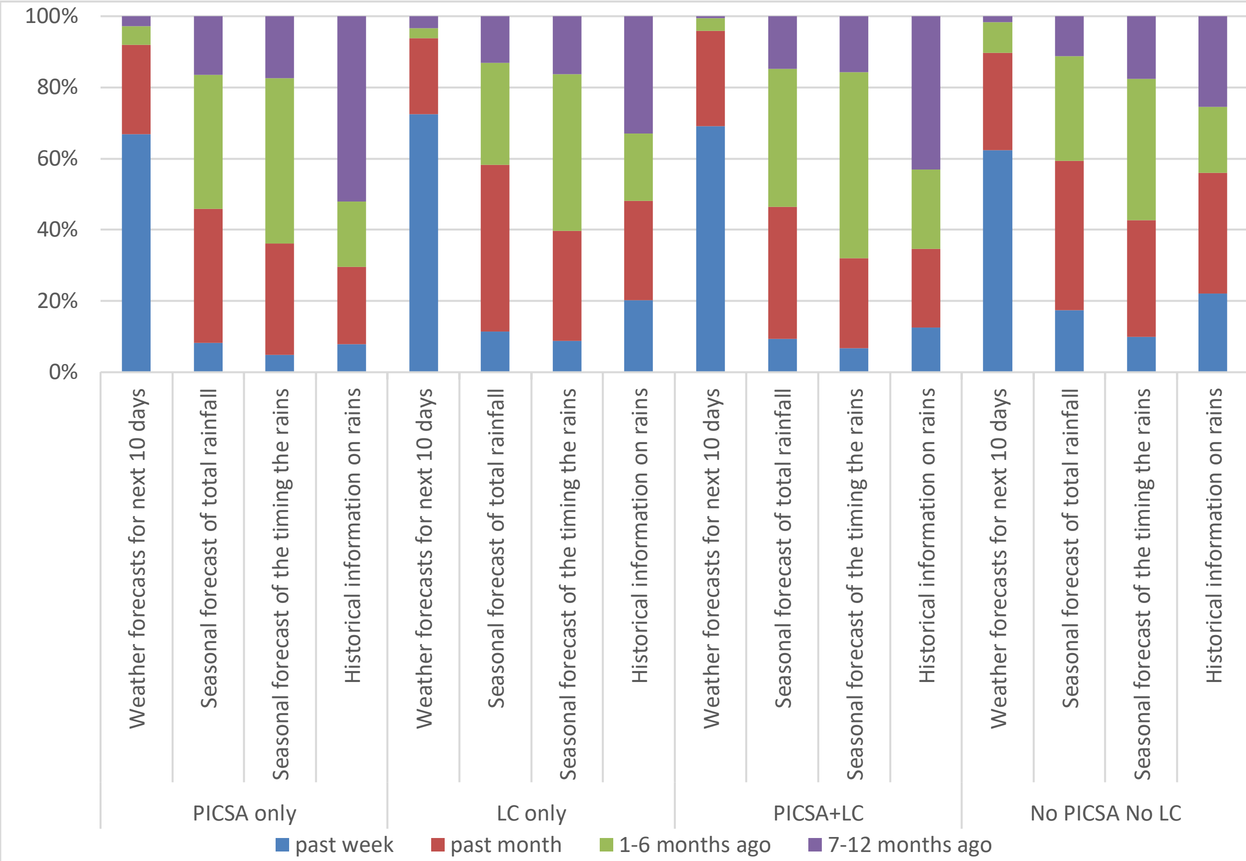


**Figure 4. Time within which climate information was accessed (% of respondents)**

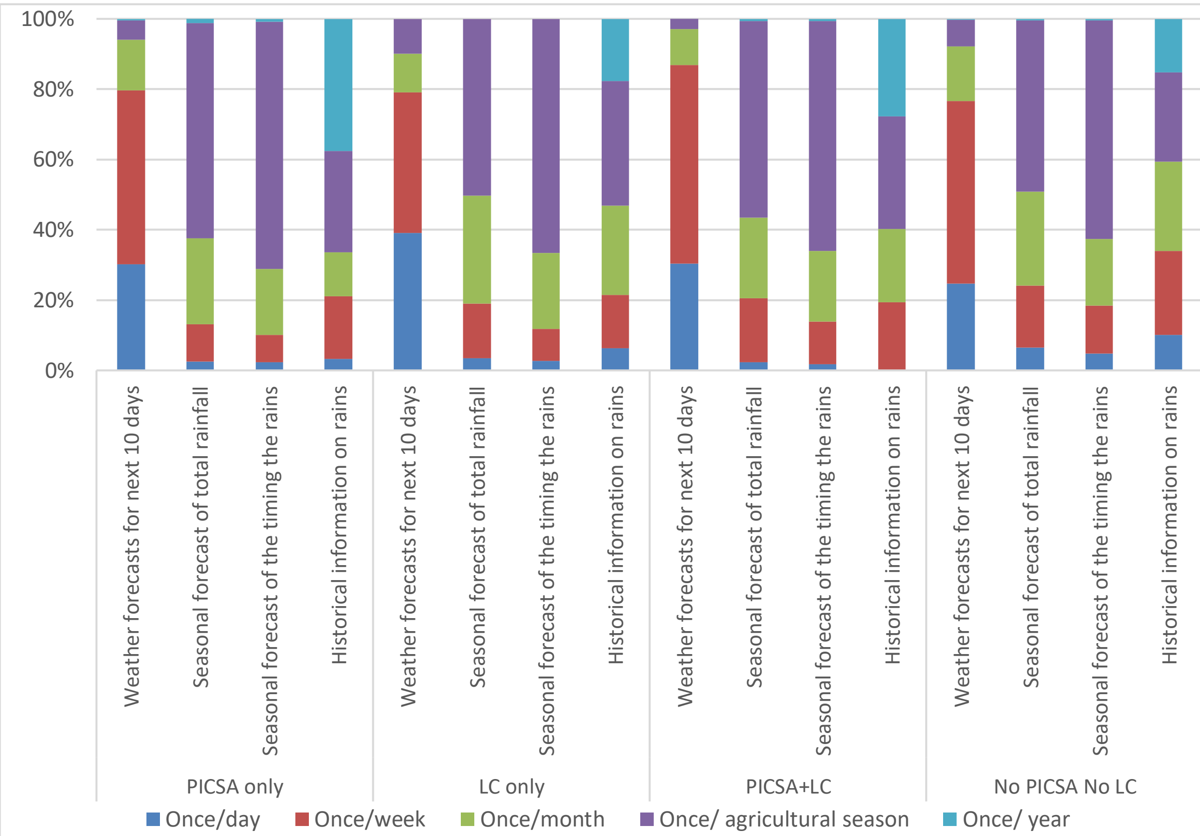


**Figure 5. Frequency of accessing the climate information (% of respondents)**

Figures 6, 7, 8 and 9 show the sources of the climate information (Figure 6), the format in which the farmers accessed information (Figure 7), weather variables that were included in the information (Figure 8) and any other support they received alongside the climate information (Figure 9). Seven main channels of information were reported. As shown in Figure 6, information on weather forecast for the next 10 days was accessed through radio in all intervention groups, and the control group. Respondents who were in LC only and the control category accessed all types of climate information mostly through the radio, with farmer promoters being their second most common source of climate information. Most of the respondents in PICSA and PICSA+LC accessed all their information (other than information on weather forecast for the next 10 days) through farmer promoters followed by radio. The control group accessed some information from farmers promoters, probably attributed to spill over.

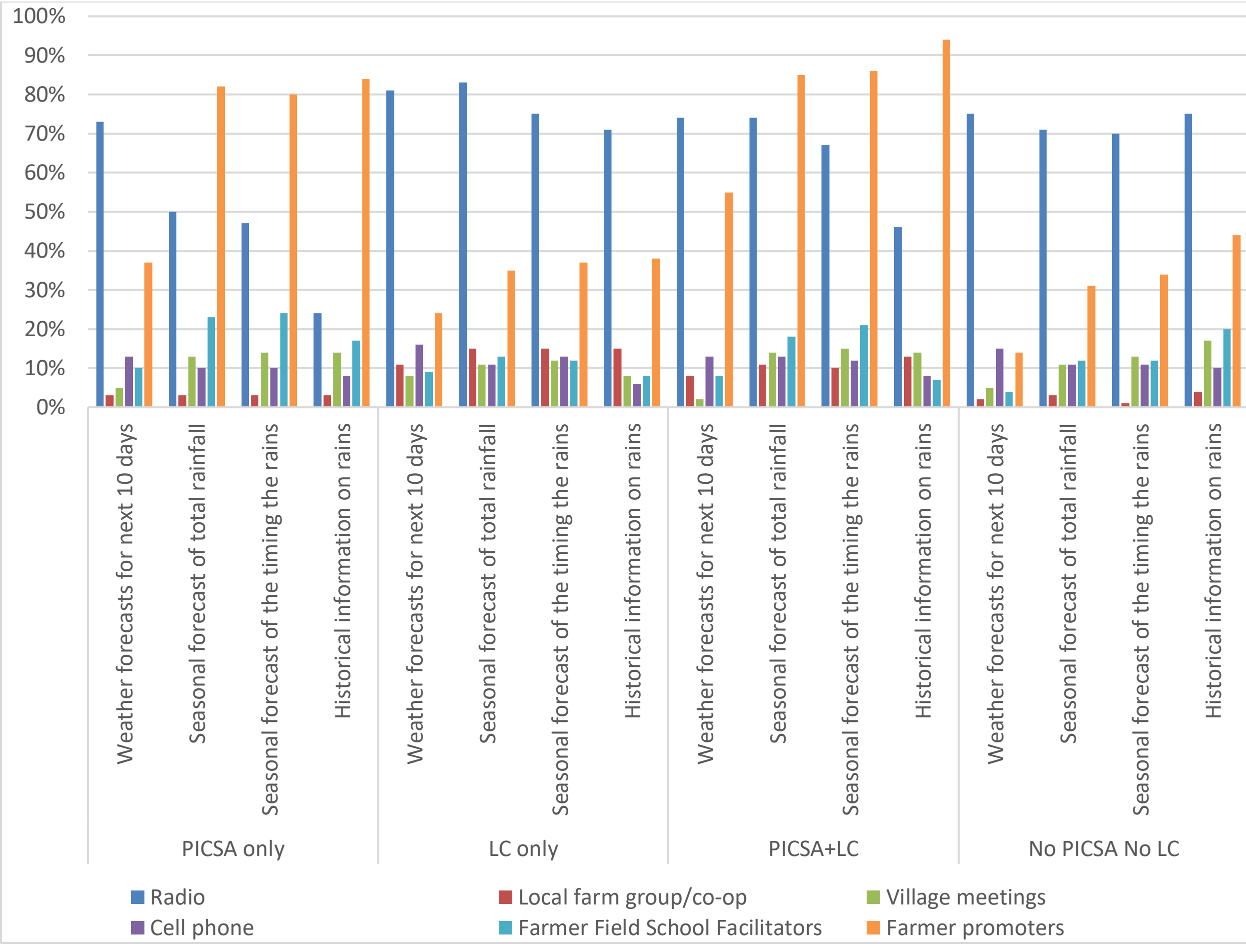


**Figure 6. Sources of climate information**

According to Figure 7, most of the respondents in PICSA only and PICSA+LC categories accessed climate information in the form of time series graphs and short statement while those in LC only and the control group mainly accessed the information as a short message. Rainfall was the most common weather variable that was included in the climate information across all the intervention categories (Figure 8). Crop and livestock management advisories were the most common support service that came along with the climate information across all the intervention categories. Additionally, a higher proportion of respondents in PICSA only and PICSA+LC categories also received training alongside the climate information, compared to the LC only and the control categories (Figure 9).

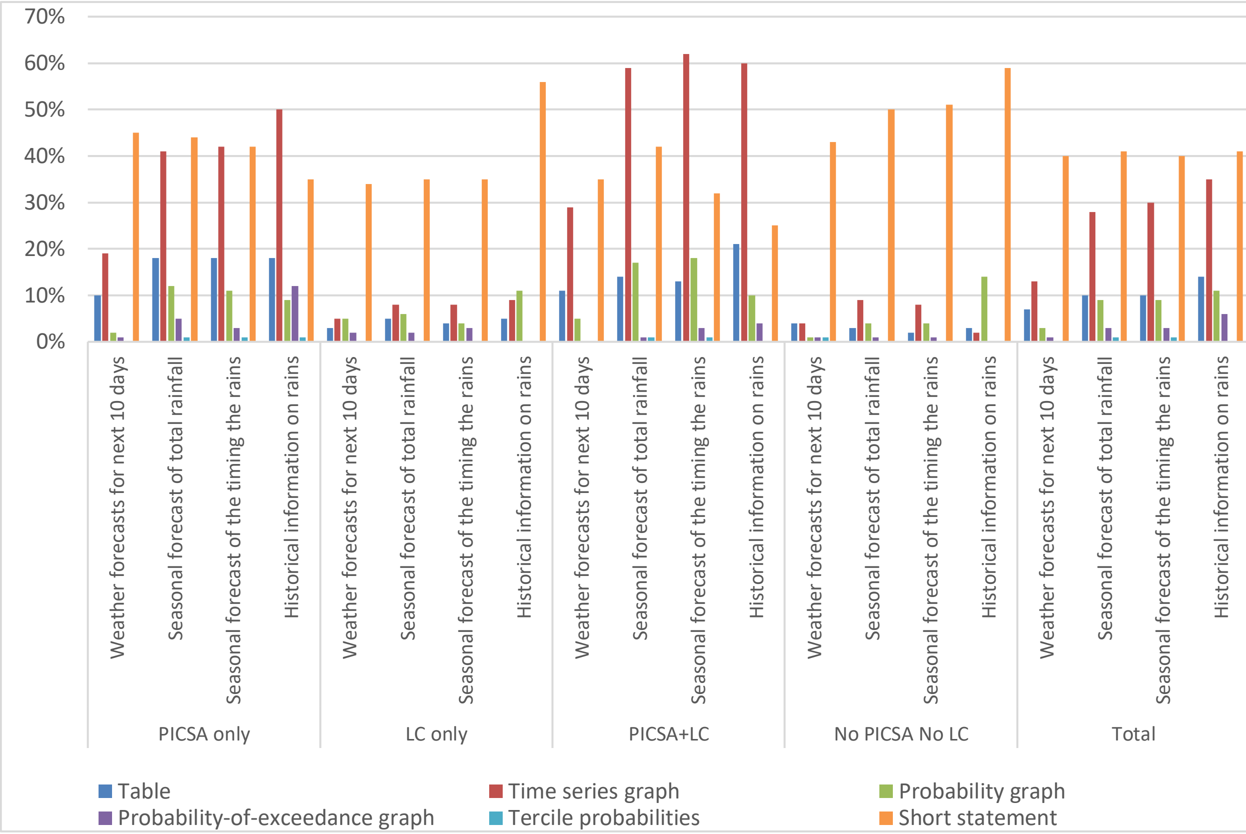


**Figure 7. Format of the information accessed**

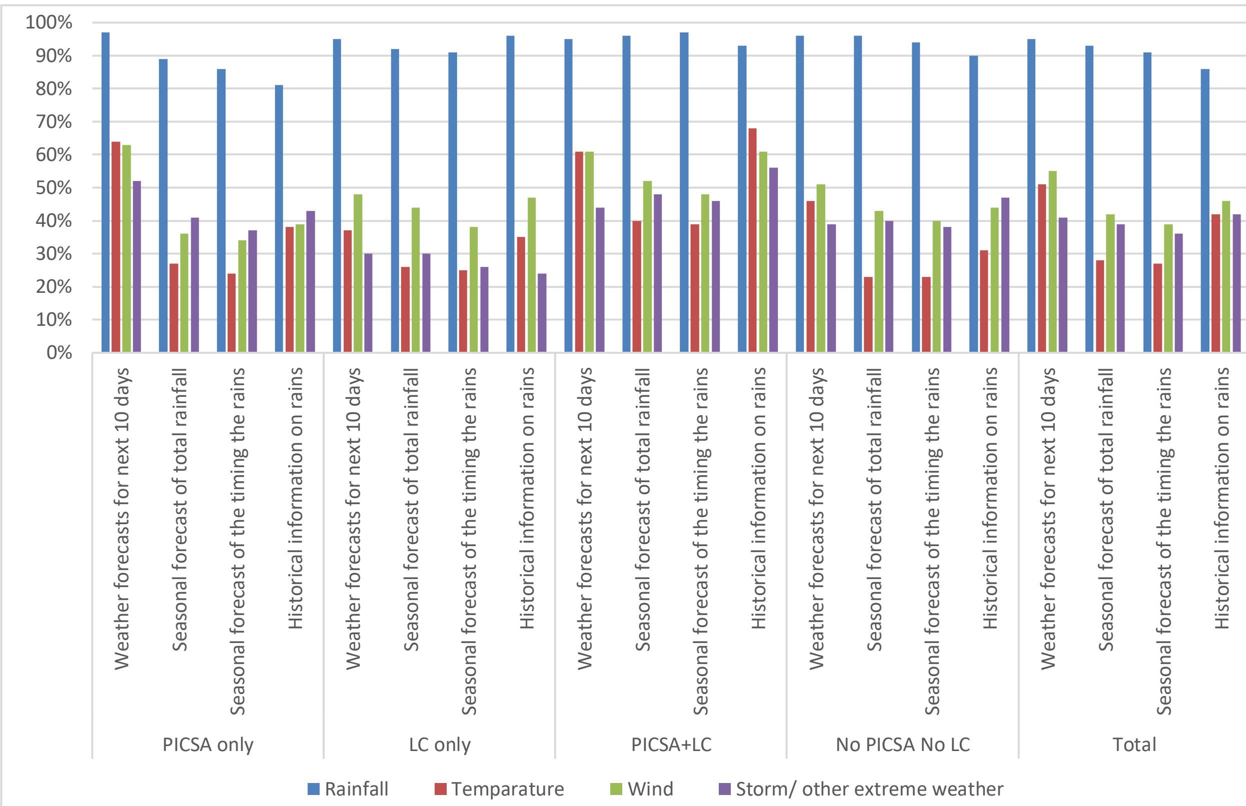


**Figure 8. Variables of climate included in the information**

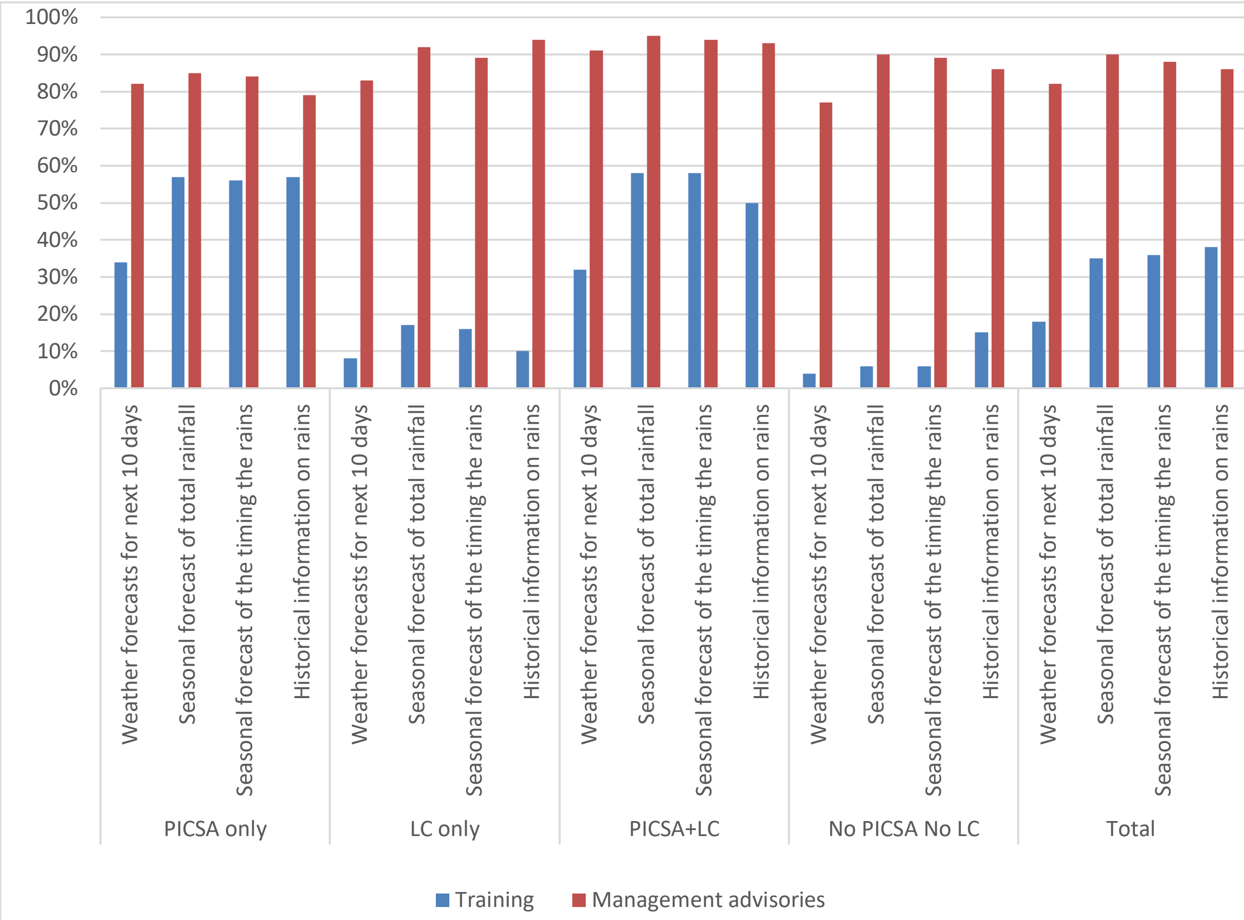


**Figure 9. Support offered along with the climate information**

## Access to climate information through radio, listeners clubs and telephones

Table 11 highlights the proportion of respondents who accessed climate information through radio, television and telephone. On average, slightly more than half of the respondents had accessed weather/climate information through the radio in the past 12 months. About 20% of the respondents had accessed the information through telephone while about 6% accessed the information through television. More male than female respondents had accessed the information through radio and telephone. Respondents in PICSA+LC had the highest proportion (81%) of respondents who had accessed weather/climate information through radio, followed by those on LC only (75%) while the control group had the least (43%). The majority of respondents accessed weather/climate information through radio. Radio is therefore the most useful communication asset in reaching out to farmers with weather/climate information. Table 12 shows that most respondents often listened to Radio Rwanda followed by Radio Huguka for weather/climate information and its application in agriculture. Most of the respondents in PICSA only, PICSA+LC and control categories listened to Radio Rwanda while the majority of those in the LC only category listened to Radio Huguka.

**Table 11. Access to climate information through radio, telephone and television**

| | PICSA only | | | | LC only | | | | PICSA + LC | | | | No PICSA no LC | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **Female** | **Male** | **Diff** | **Total** | **Female** | **Male** | **Diff** | **Total** | **Female** | **Male** | **Diff** | **Total** | **Female** | **Male** | **Diff** | **Total** | **Female** | **Male** | **Diff** |
| Radio | 59.24 | 51.78 | 66.67 | 14.89*** | 75.7 | 71.17 | 80.38 | -9.21* | 80.77 | 75.26 | 87.06 | -11.8** | 43.22 | 34.89 | 51.96 | 17.07*** | 58.69 | 51.8 | 65.86 | 14.06*** |
| Telephone | 24.56 | 19.29 | 29.8 | -10.51** | 23.36 | 19.02 | 27.85 | -8.83* | 37.36 | 28.87 | 47.06 | -18.19 | 11 | 7.79 | 14.38 | -6.59*** | 20.26 | 15.68 | 25.03 | -9.35*** |
| Television | 3.54 | 3.05 | 4.04 | -0.99 | 3.74 | 2.45 | 5.06 | -2.61 | 9.34 | 9.28 | 9.41 | -0.13 | 6.86 | 5.92 | 7.84 | -1.92 | 5.64 | 4.88 | 6.43 | -1.55 |
| **N** | **395** | **197** | **198** | | **321** | **163** | **158** | | **182** | **97** | **85** | | **627** | **321** | **306** | | **1525** | **778** | **747** | |

Note: * p<0.1, ** p<0.05, *** p<0.01

**Table 12. Proportion of respondents listening to different radio stations for agricultural and weather information**

| Radio stations | PICSA only | LC only | PICSA + LC | No PICSA no LC | Total |
|---|---|---|---|---|---|
| Radio Huguka (105.9 FM) | 12.41 | 66.36 | 57.69 | 7.97 | 27.34 |
| Radio Rwanda | 54.18 | 44.55 | 63.19 | 38.28 | 46.69 |
| Radio Maria | 0.25 | 0.62 | 0 | 0.16 | 0.26 |
| KFM | 0 | 0.31 | 0 | 0 | 0.07 |
| Radio Musanze | 2.53 | 0.62 | 0 | 1.12 | 1.25 |
| Others | 1.01 | 0.62 | 1.65 | 0.64 | 0.85 |
| **N** | **395** | **321** | **182** | **627** | **1525** |

Note: Others include Energy radio, Salus, KT radio

### Use of radio

Figure 10 illustrates the frequency of listening to radio among the respondents who reported to have listened to radio for weather/climate information and its application in agriculture. The majority of the respondents in all the intervention categories including the control group listened to radio for weather/climate information once a week. On average, about 20% of the respondents listened to the radio daily and barely 15% listened to the radio on a monthly basis. The majority of the respondents listened to the radio for weather/climate information either daily or on a weekly basis. This shows it is possible for information on weather/climate to get to listeners in good time since most people listen to the radio regularly.

Figure 11 indicates the time of day when respondents listen to the radio for weather/climate information. Most of the respondent listen to the radio during the morning broadcast, followed by the afternoon broadcast with the night broadcast having the least listeners. To reach the majority of the people, climate information should therefore be broadcasted in the mornings and afternoons. According to Figure 12, which shows the importance of features of weather/climate information programming on the radio, climate forecast broadcast and debate on agriculture and climate are the most important features, in that order. Most of the respondents mentioned climate forecast broadcast as the most important feature or weather/climate information programming in the radio with the highest proportion (63%) being among the PICSA+LC and the least (30%) among the control category.

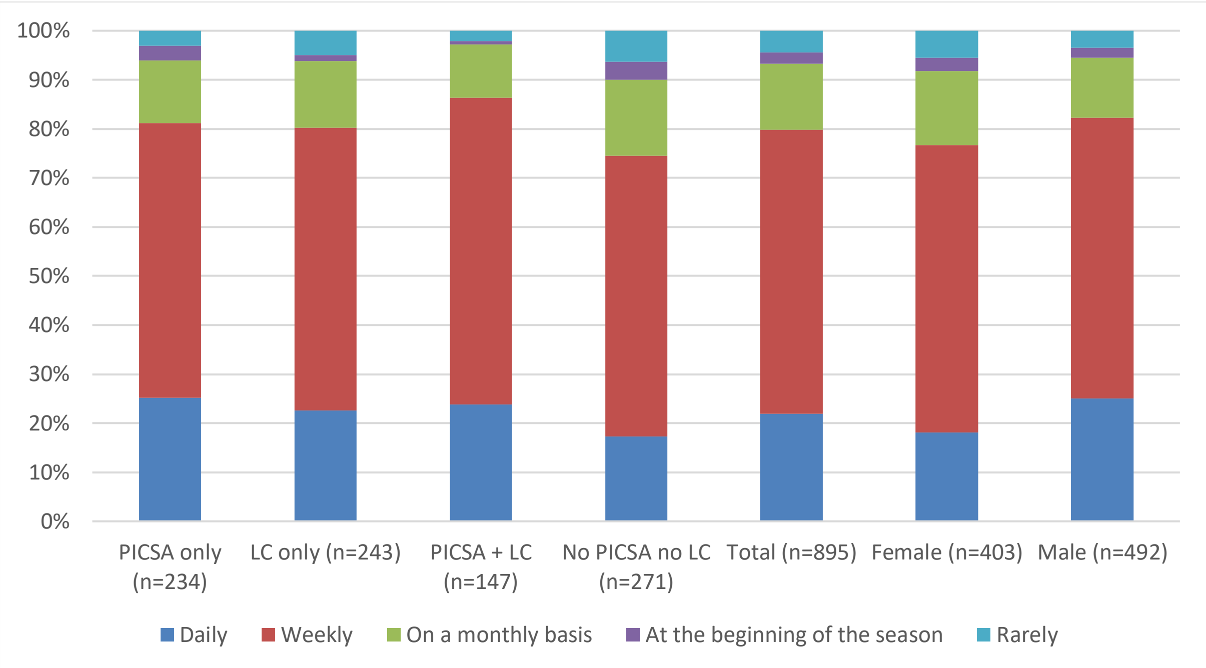


**Figure 10. Frequency of listening to weather/climate information on the radio**

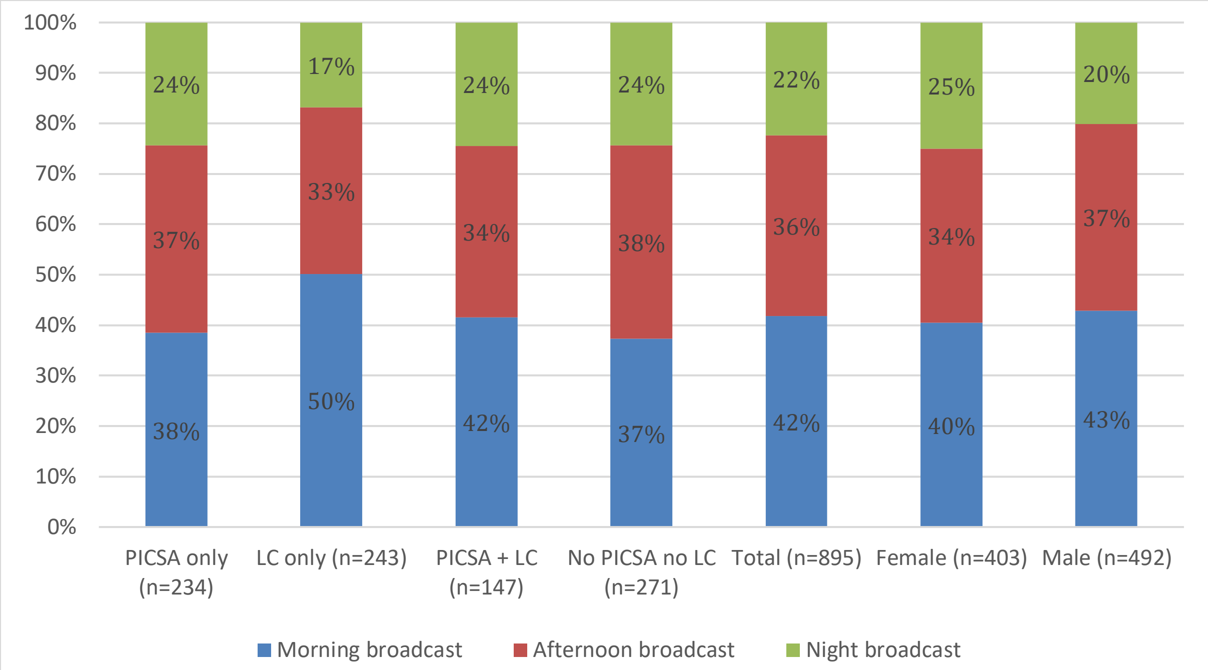


**Figure 11. Time of the day that respondents listened to weather/climate information on the radio**

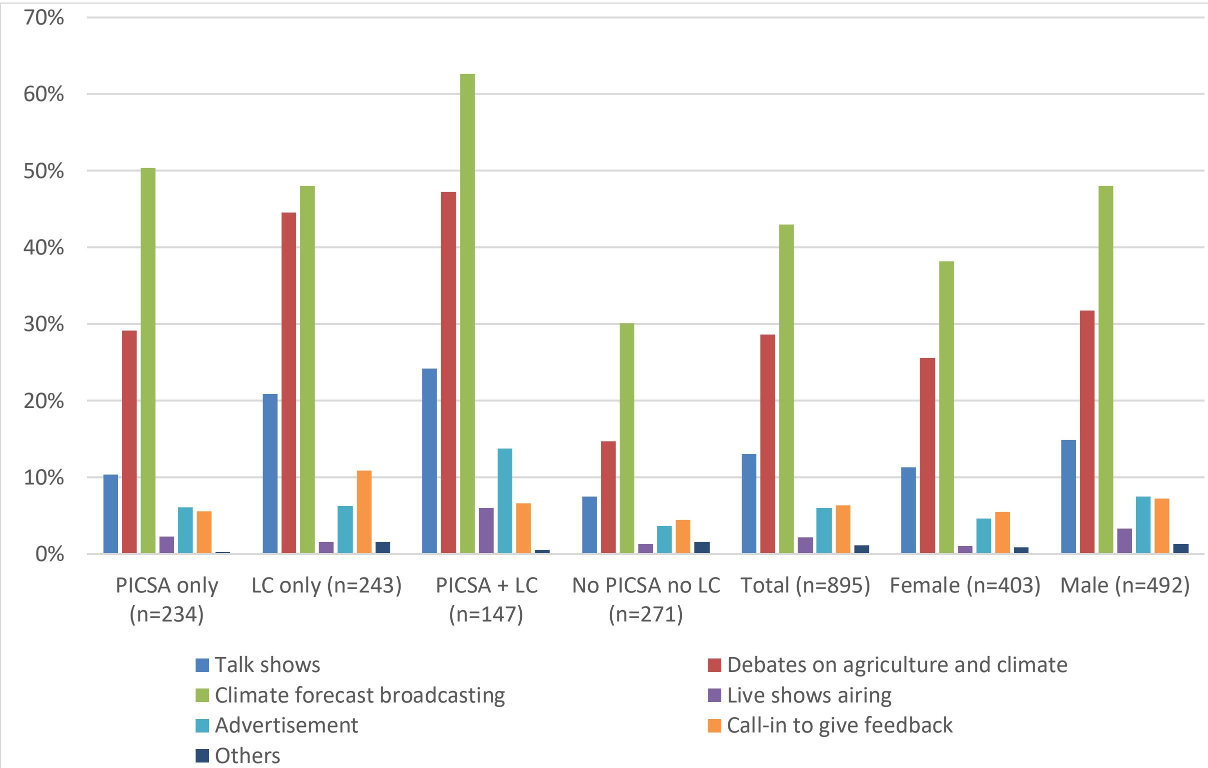


**Figure 12. Most important features of climate service programming**

## Listeners club

This section describes LC membership, radio stations and programs, followed by LC members, services offered in the club and their benefits. As shown in Figure 13, about a third of the respondents were members of the LC with slightly more females than males being members. About 90% of the respondents in the LC and PICSA+LC categories followed Radio Huguka, with only a few following Radio Rwanda (Figure 14). According to Figure 15, about 80% of members of LC only and PICSA+LC listened to occasional live debates involving experts in climate services and agriculture (*Ibiganigo bigira abutumirwa ku buhinzi igihe ni ikireke*) radio programs. About a third of respondents in LC only and PICSA+LC categories listened to daily radio talk shows on agriculture and rural development referred to as *"Huguka"* and a bi-weekly radio talk show dedicated to the application of climate information to agriculture and livestock referred to as "*Urubuto ntera talk show",* respectively. Talk shows on agriculture and climate were the most popular programs from the LCs (Table 13). About 64% and 81% of the LC members in the LC only and PICSA+LC categories respectively, liked the talk shows on agriculture and climate. Agro-climatic advisories were also popular as reported by more than half of the respondents. As shown in Figure 16, most of the LC members reported to have discussed climate information during radio LC meetings on a weekly or monthly basis with the proportion of those who discussed weekly being slightly higher than those who discussed monthly. The three most mentioned benefits of the radio talk show included the provision of detailed climate information, increased awareness of risks associated to weather and climate hazards, and easy consultation amongst club members in order of importance (Table 14).

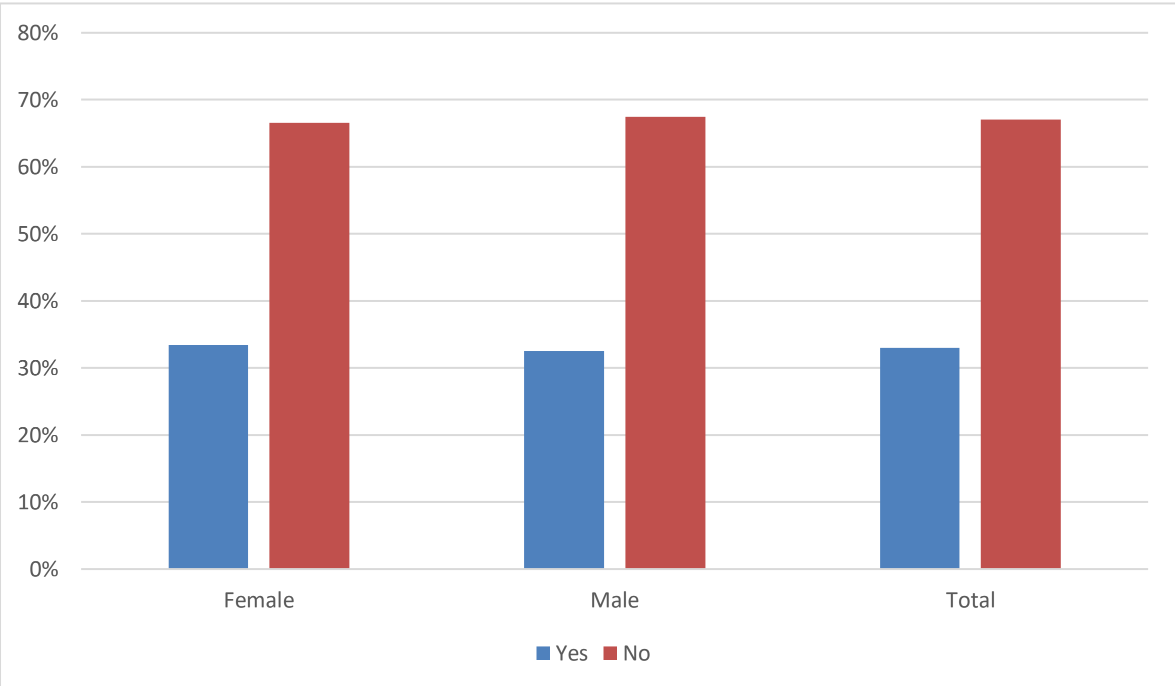


**Figure 13. Membership in radio listeners club**

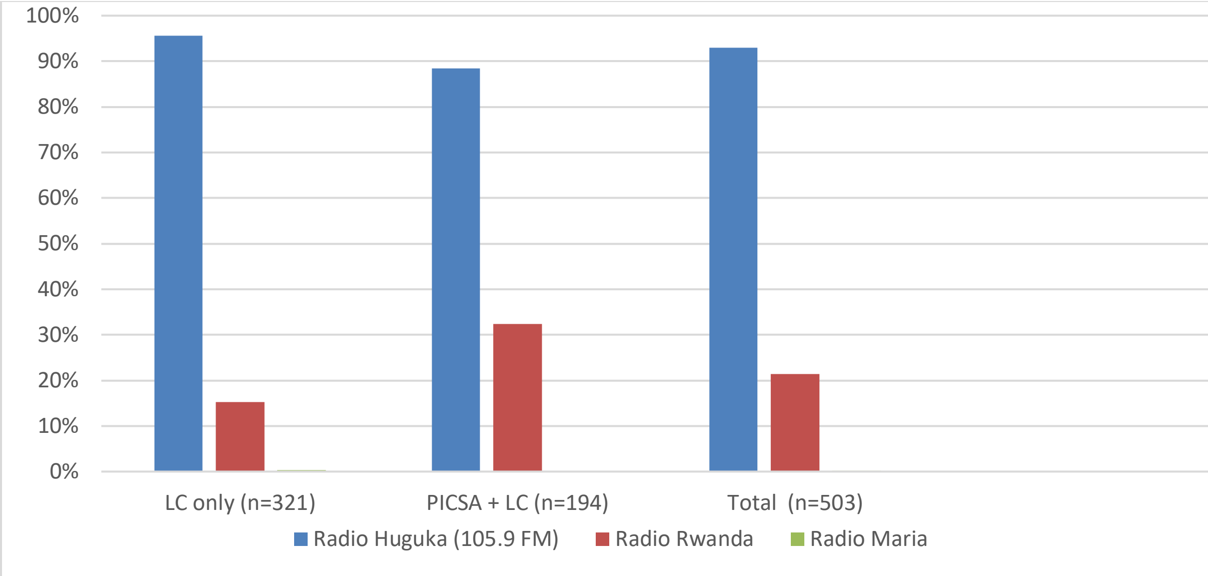


**Figure 14: Radio stations followed by the listeners club**

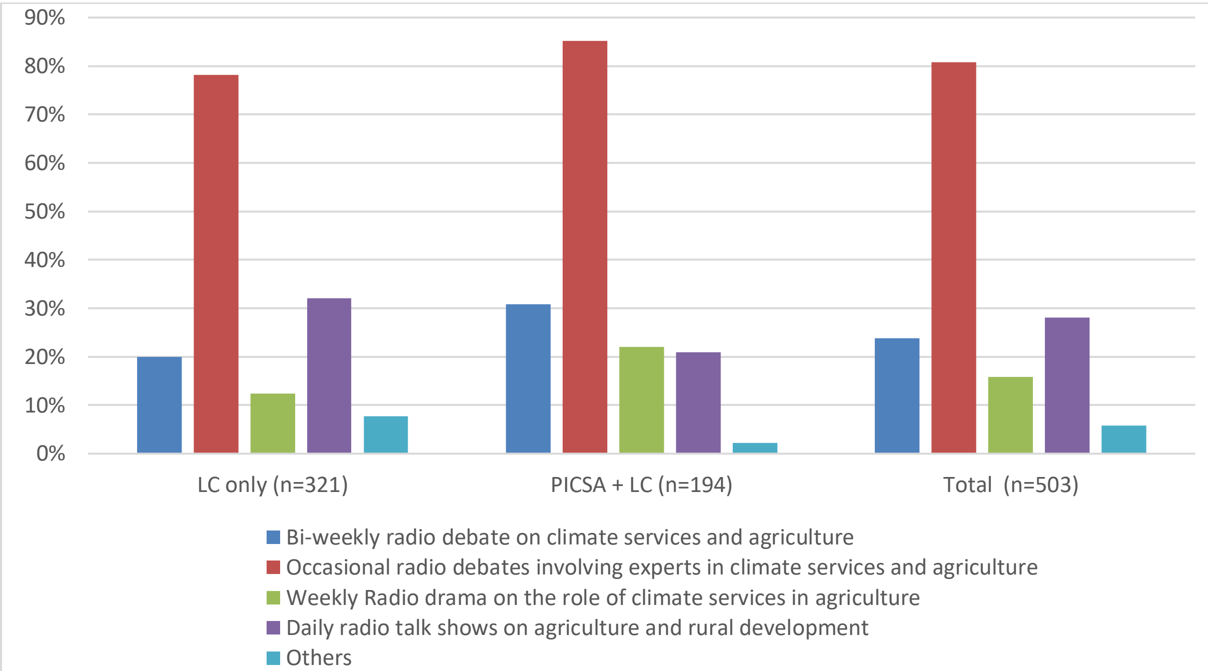


**Figure 15. Radio programs followed by listeners club members**

**Table 13. Type of services popular with respondents from listeners clubs (% of respondents)**

| Type of service | LC only | PICSA+LC | Total | Female | Male | Diff |
|---|---|---|---|---|---|---|
| Talk shows on agriculture and climate | 64.2 | 80.8 | 70.2 | 70 | 70.4 | -0.4 |
| Social and financial support amongst members | 19.9 | 25.8 | 22.1 | 22.7 | 21.4 | 1.3 |
| Agro-climatic advisories | 57.3 | 59.9 | 58.3 | 56.2 | 60.5 | -4.3 |
| Live shows airing on the radio | 9.4 | 15.9 | 11.7 | 11.9 | 11.5 | 0.4 |
| Call-in to give feedback | 18.7 | 10.4 | 15.7 | 14.2 | 17.3 | -3.1 |
| Saving groups | 16.8 | 14.8 | 16.1 | 18.9 | 13.2 | 5.7* |
| **N** | **321** | **194** | **503** | **260** | **243** | |

Note: *p<0.1

**Table 14. Benefits from the radio talk shows (% of respondents)**

| Benefits | LC only | PICSA + LC | Total | Female | Male | Diff |
|---|---|---|---|---|---|---|
| Provision of detailed climate information | 670 | 80.8 | 72.0 | 68.9 | 75.3 | -6.5 |
| Increased awareness on risks associated to weather and climate hazards | 49.8 | 63.2 | 54.7 | 55.8 | 53.5 | 2.3 |
| Increased exposure to radio presenters | 11.5 | 15.9 | 13.1 | 13.1 | 13.2 | -0.1 |
| Intensive interaction between LCs members and media | 12.2 | 20.9 | 15.3 | 13.1 | 17.7 | -4.6 |
| Consensual decision making | 14.3 | 7.1 | 11.7 | 9.6 | 14.0 | -4.4 |
| Easy consultation amongst club members | 33.6 | 34.6 | 34 | 34.6 | 33.3 | 1.3 |
| **N** | **321** | **194** | **503** | | | |

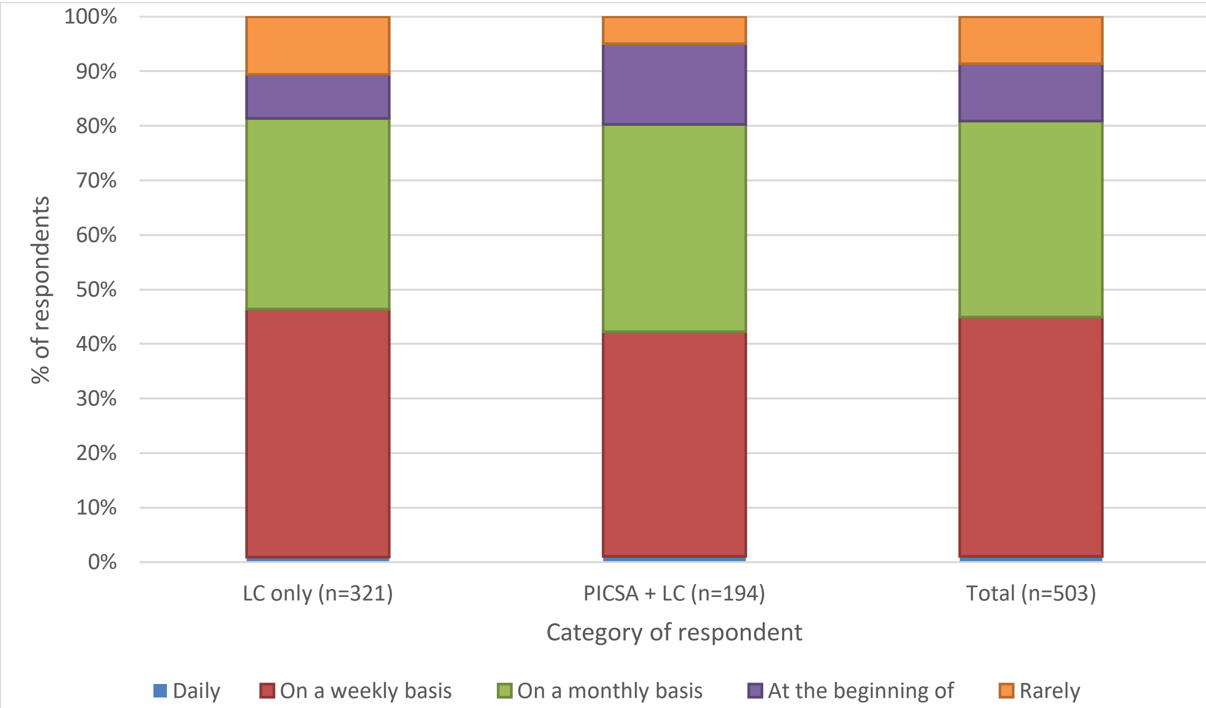


**Figure 16. Frequency of discussing climate information during radio Listeners' Club meetings**

## Use of phone

In this section, respondents were asked what functions their phones supported, whether they accessed climate information on their phones, the frequency of accessing the information on phones and the format in which they accessed the information in the last 12 months. As shown in Table 15, more than 60% of the respondents owned a phone. The highest proportion (79%) of phone owners was in the PICSA+LC intervention category while the least (62%) proportion was the control group. More males owned phones compared to females. More than half of the respondents reported that their phones supported radio and SMS functions (Figure 17). Barely a third of the respondents mentioned that their phones supported voice messages while about 2% reported that their phones supported multimedia messaging (mms) meaning that only about 2% of the respondents owned smart phones. Radio and SMS could therefore reach more people through their phones.

As indicated in Figure 18, on average, about 20% of the respondents accessed weather/climate information on their phones. A higher proportion of the PICSA+LC category accessed the information on their phones compared to the other intervention categories. More males accessed weather/climate information on their phones compared to females. On average, less than 15% of the respondents used each of the three phone functions namely, SMS, audio messages and audio (radio in the phone), to access climate information (Figure 19). About 13% of the respondents accessed the information through the radio in the phone, 7% through SMS and 5% through audio messages. Most of the respondents in PICSA+LC, PICSA only and control categories accessed climate information through radio on their phones while those in LC only, mostly accessed the information through SMS. Most of the respondents accessed the information on a weekly basis (Figure 20) and strongly agreed that they understood the climate/weather information accessed through their phones (Figure 21).

**Table 15. Phone ownership among the study respondents (% in brackets)**

| Phone ownership | Female | Male | Diff | Total |
|---|---|---|---|---|
| PICSA only | 107 (54.3) | 148 (74.8) | -20.4*** | 255 (64.6) |
| LC only | 110 (67.5) | 122 (77.2) | -9.7*** | 232 (72.3) |
| PICSA + LC | 65 (67.0) | 79 (92.9) | -25.9*** | 144 (79.1) |
| No PICSA no LC | 175 (54.5) | 219 (71.6) | -17.1* | 394 (62.8) |
| **Total** | **457 (58.7)** | **568 (76.0)** | **-17.3*** ** | **1,025 (67.2)** |

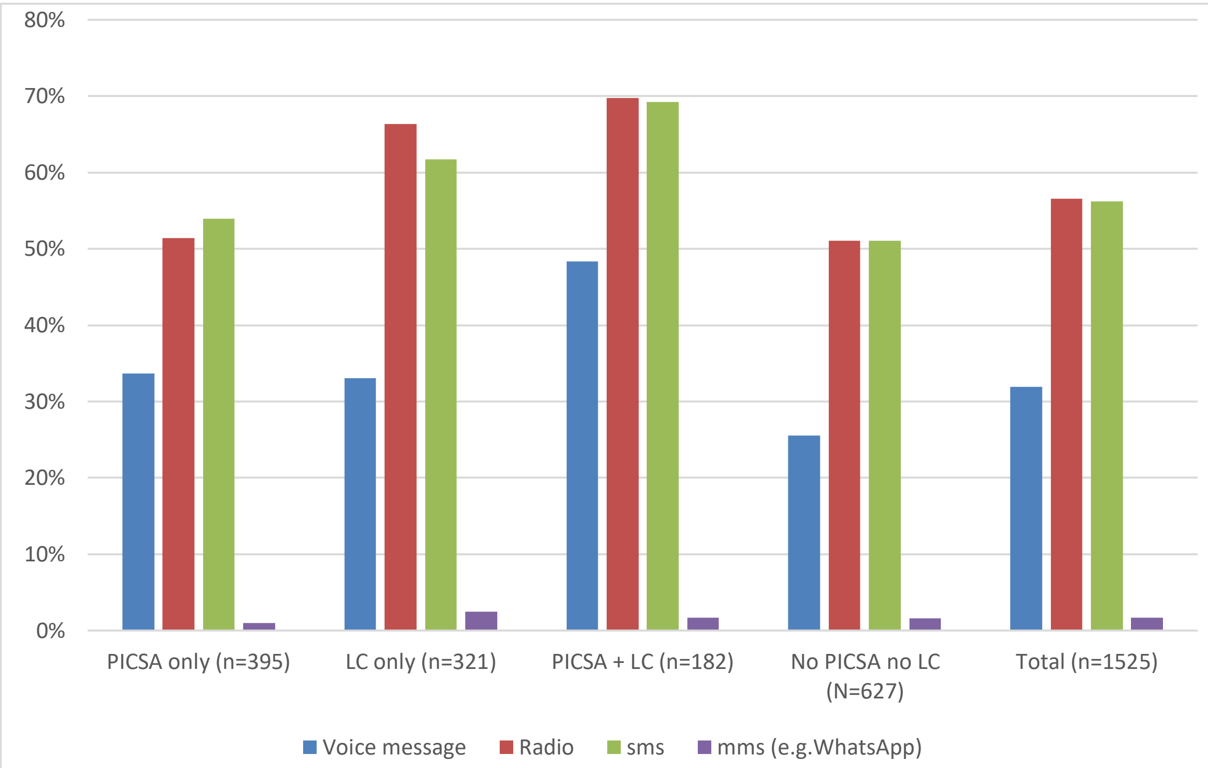


**Figure 17. Functions supported by respondents' phone**

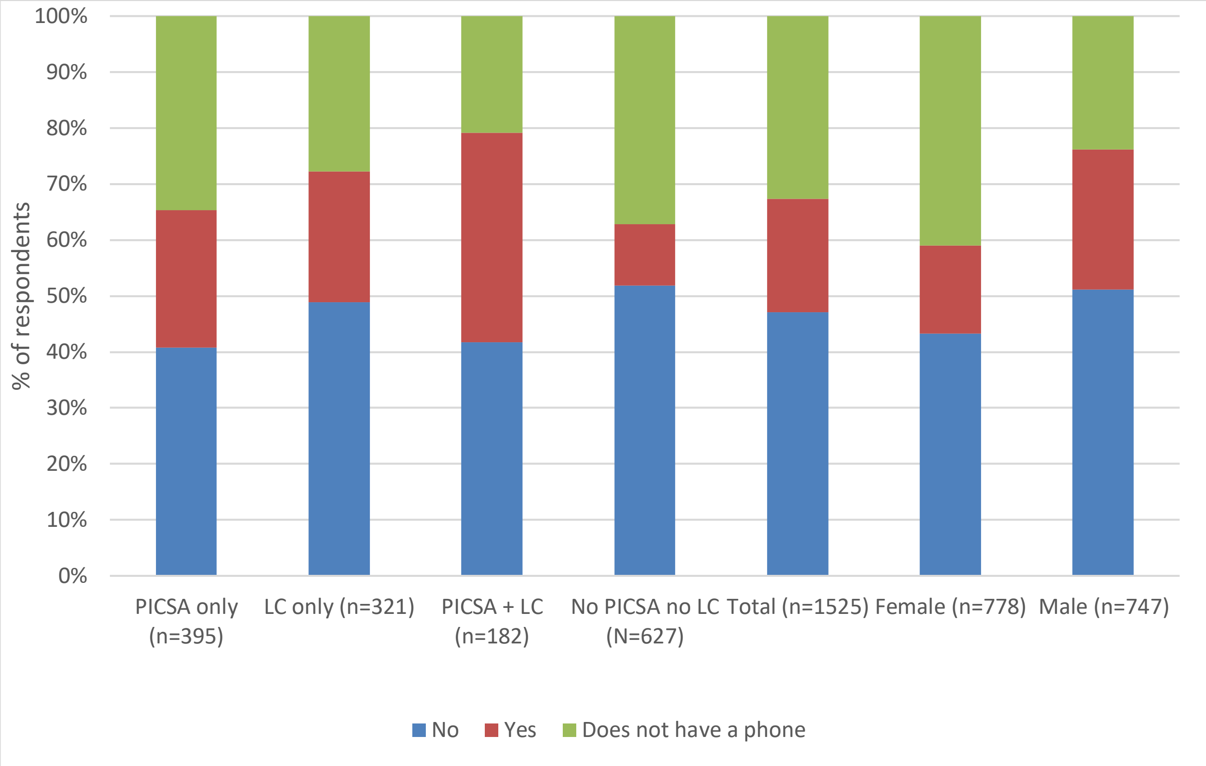


**Figure 18. Proportion of respondents who accessed weather/climate information through telephone**

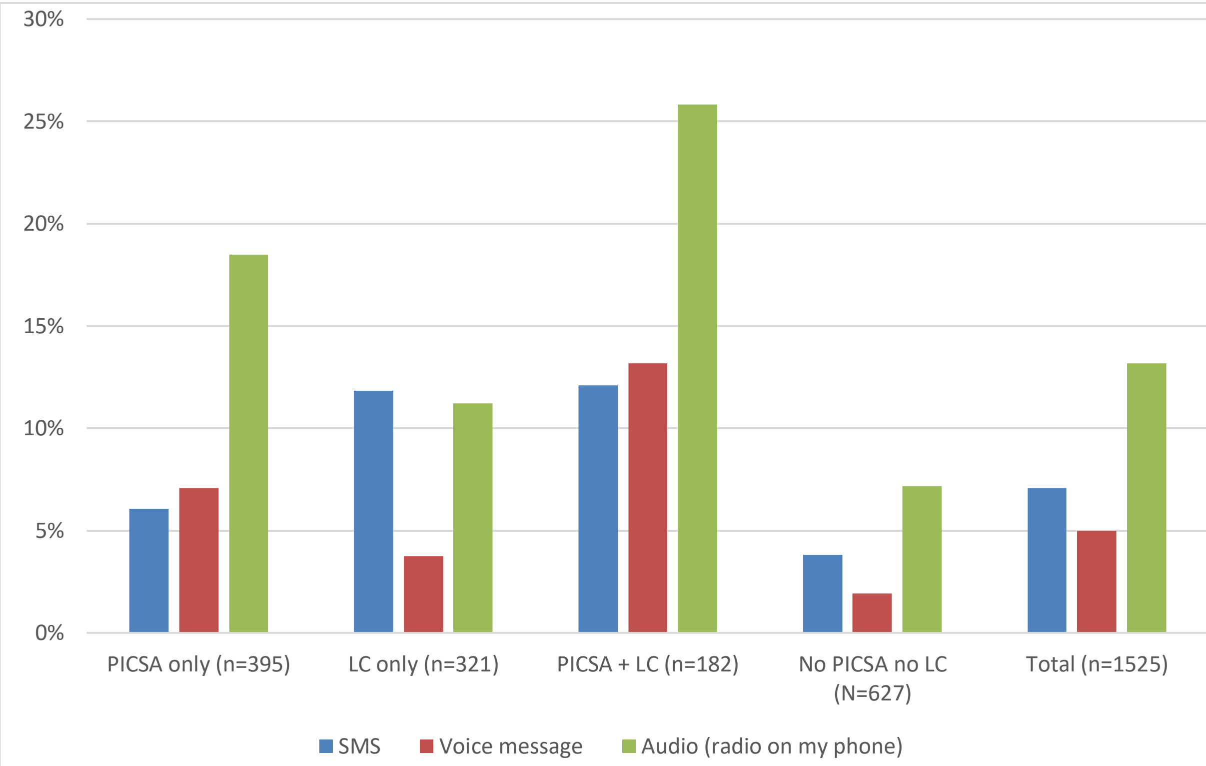


**Figure 19. Format of weather/climate information accessed through phone**

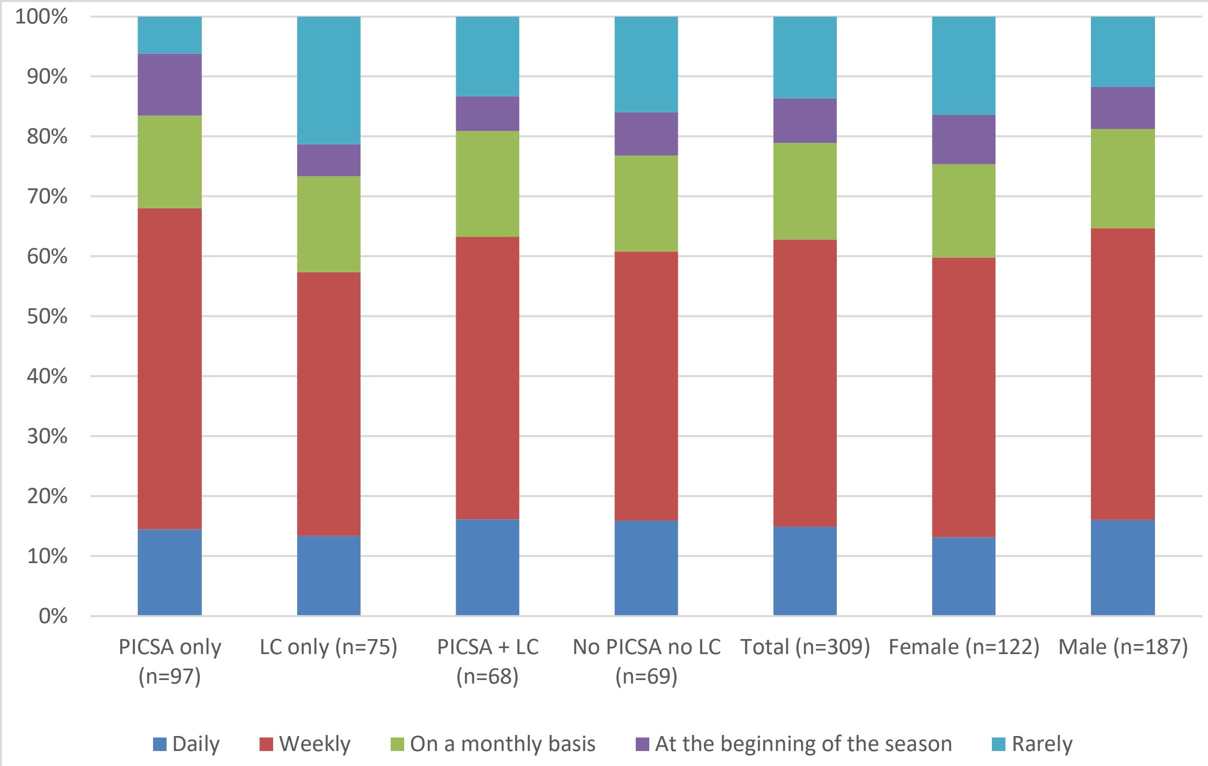


**Figure 20. Frequency of access to weather/climate information through phone**

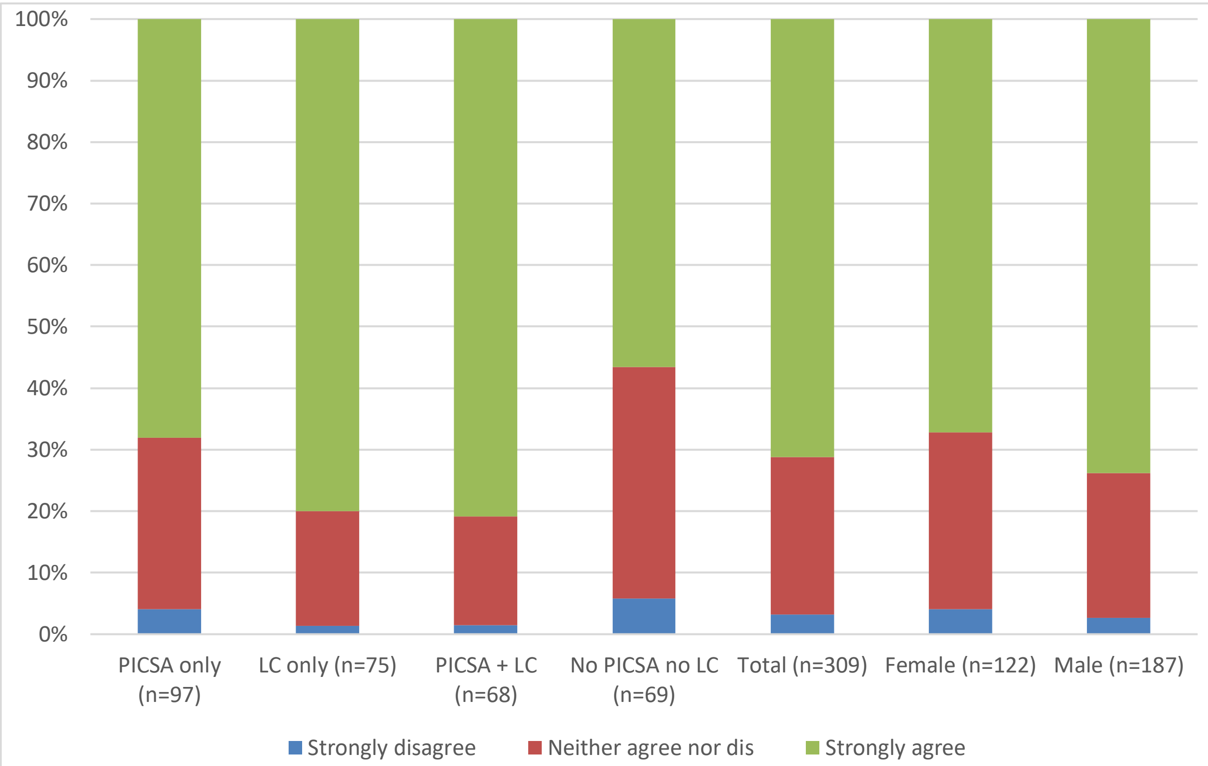


**Figure 21: Understanding of how to use the weather/climate information received through phone**

### Use of television

This section reports the proportion of respondents who accessed weather/climate information through TV in the last 12 months, the frequency of accessing the information and the level of understanding of the information accessed. Overall, relatively few respondents accessed weather information through the TV. This is consistent with the results in Table 7, where less than 6% of the households own a TV as a communication asset. As shown in Table 16, on average only about 5% of the respondents had accessed weather/climate information through TV. The PICSA+ LC only intervention category had the highest proportion (9.3%) of respondents that had accessed weather/climate information through TV while the PICSA only category had the least (3.5%). More males than females accessed weather/climate information through TV. The majority of the respondents across all the intervention categories accessed the information on a weekly basis except the LC only category. In the LC only category, a third of the respondents reported accessing on a weekly basis, while another third accessed the information rarely (Figure 22). The majority of those who accessed the information strongly agreed that they had a good understanding of the information accessed (Figure 23).

**Table 16. Proportion of respondents accessing weather/climate information through television**

| | **Frequency** | **N** |
|---|---|---|
| PICSA only | 14 (3.5) | 395 |
| LC only | 12 (3.7) | 321 |
| PICSA + LC | 17 (9.3) | 182 |
| No PICSA no LC | 43 (6.9) | 627 |
| Female | 38 (4.5) | 778 |
| Male | 48 (6.4) | 747 |
| **Total** | **86 (5.6)** | **1,525** |

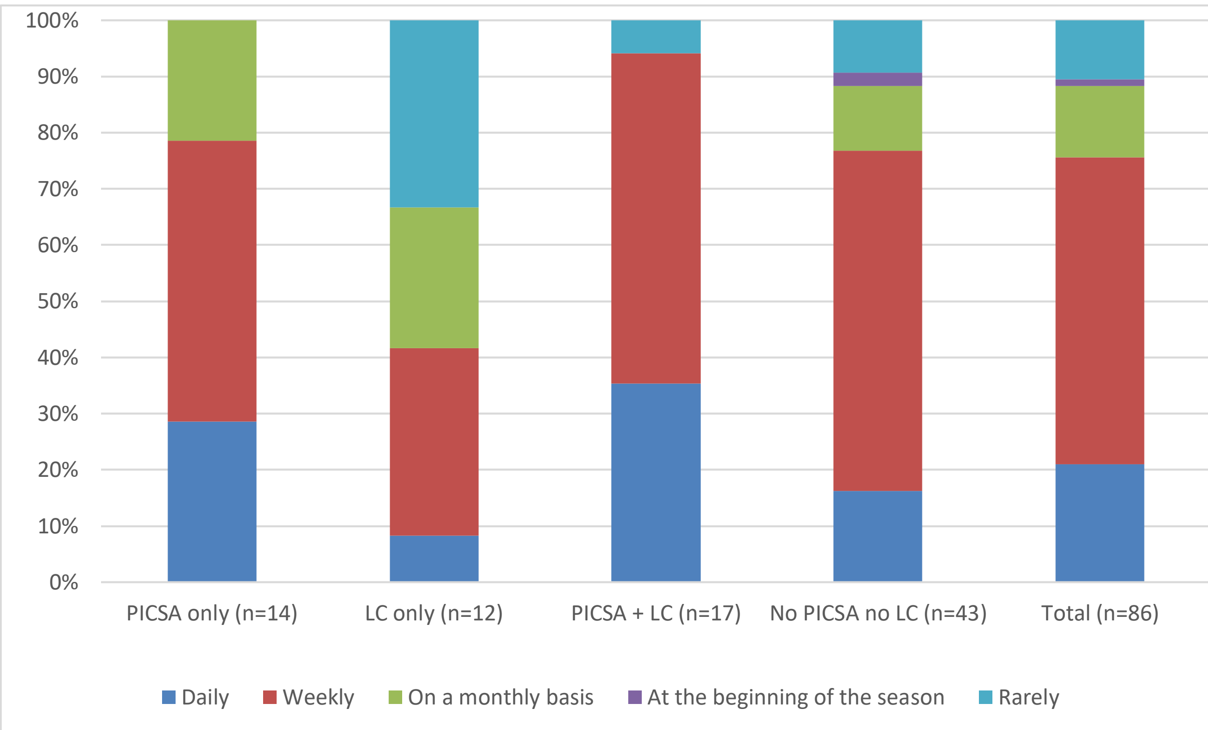


**Figure 22. Frequency of accessing climate information via television**

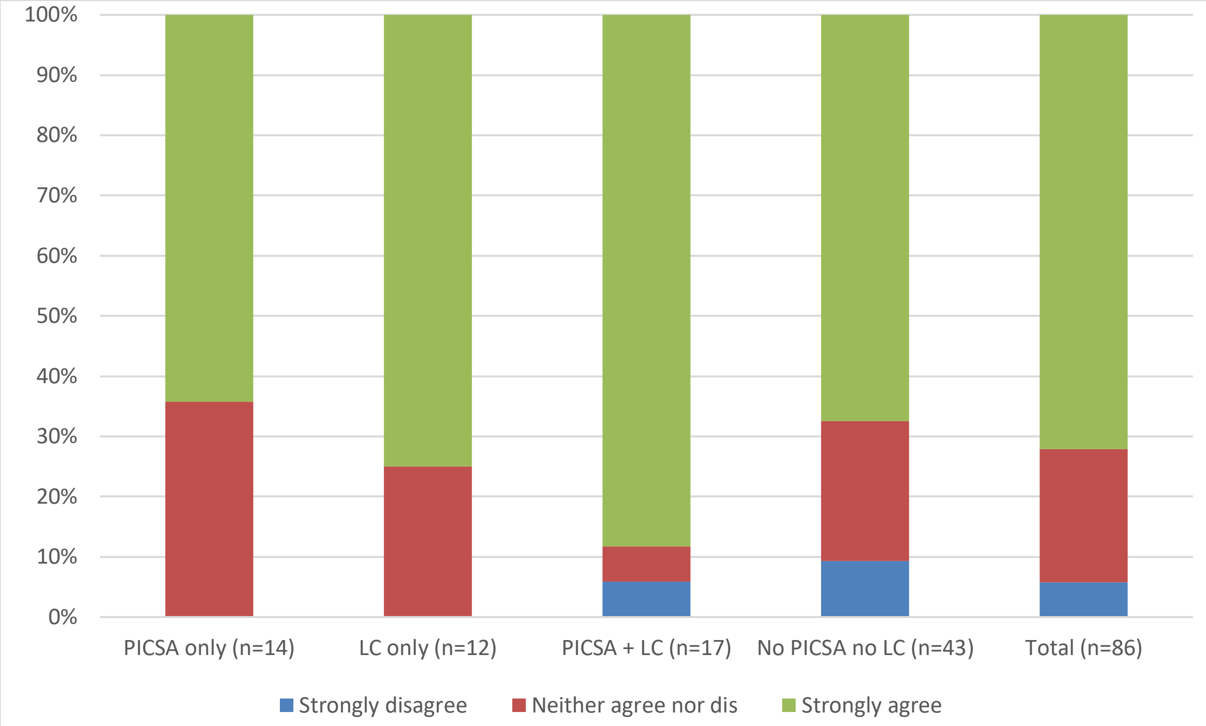


**Figure 23. Level of understanding of climate information accessed through television**

### Access to climate information through PICSA workshops

This section focuses on identifying the proportion of respondents trained through PICSA workshops, frequency and location of training, trainers involved, and information provided during the training workshops and its usefulness. About the same proportion of females (37.8%) and males (37.9%) had ever attended the PICSA trainings. Barely 20% of the respondents had attended the training more than five times. Most of the respondents had attended the trainings three to five times followed by one to two times (Figure 24). More than 80% of the respondents received the last training within their villages with the others receiving training at cell and sector levels (Figure 25). On average, 84% of the farmers were trained by farmer promoters and about 14% were trained by extension agents (Figure 26), a combination that increased access to climate information.

As indicated in Table 17, the most common information received in the PICSA training was on seasonal forecast of the start of the rains (onset), seasonal forecast of the total amount of rainfall and seasonal forecasts of cessation of rainfall, in that order. A higher proportion of respondents in the PICSA+LC intervention category accessed different climate/weather information compared to those in the PICSA only category. Similarly, a higher proportion of men reported to have accessed different climate/weather information compared to female, the differences were particularly significant for the information on seasonal forecast of rainfall distribution (frequency of dry spells) and seasonal forecasts of cessation of rainfall. The majority of the respondents rated the information accessed in the PICSA trainings as useful and about 15% rated it as very useful (Figure 26). A higher proportion of respondents in the PICSA+LC category rated the information as very useful or useful compared to those in the PICSA only category. About 70% of the respondents reported more information with advice as the improvement/change caused by information accessed through PICSA trainings (Table 18). Access to different types of climate products and accessing timely information were also reported as the change brought by access to PICSA training by 41%of the respondents. More males than females reported the changes.

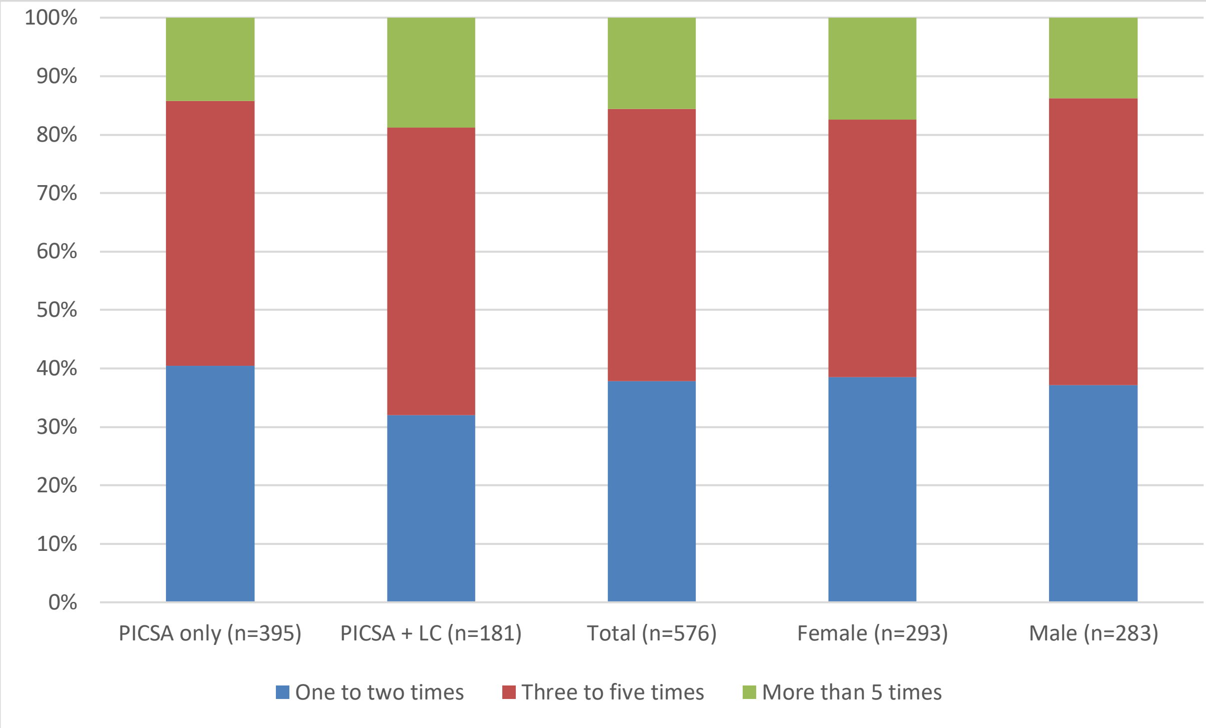


**Figure 24. Number of times respondents attended PICSA training since the first one**

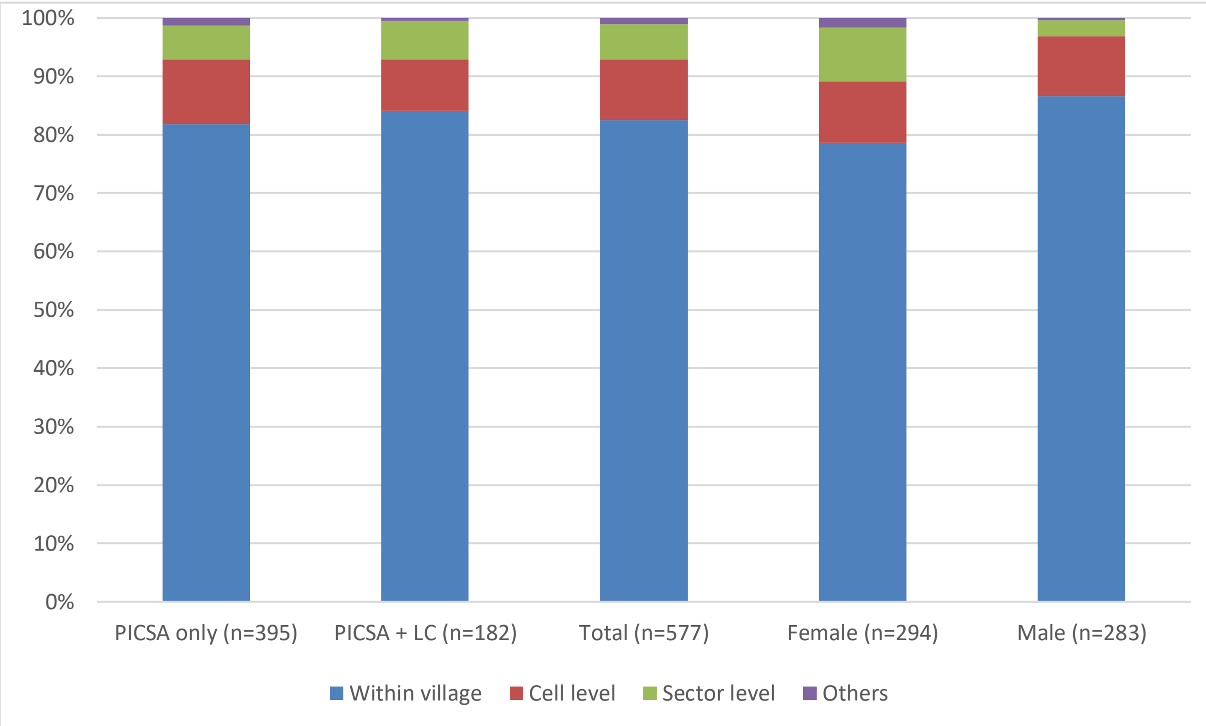


**Figure 25. Location of the last PICSA training attended**

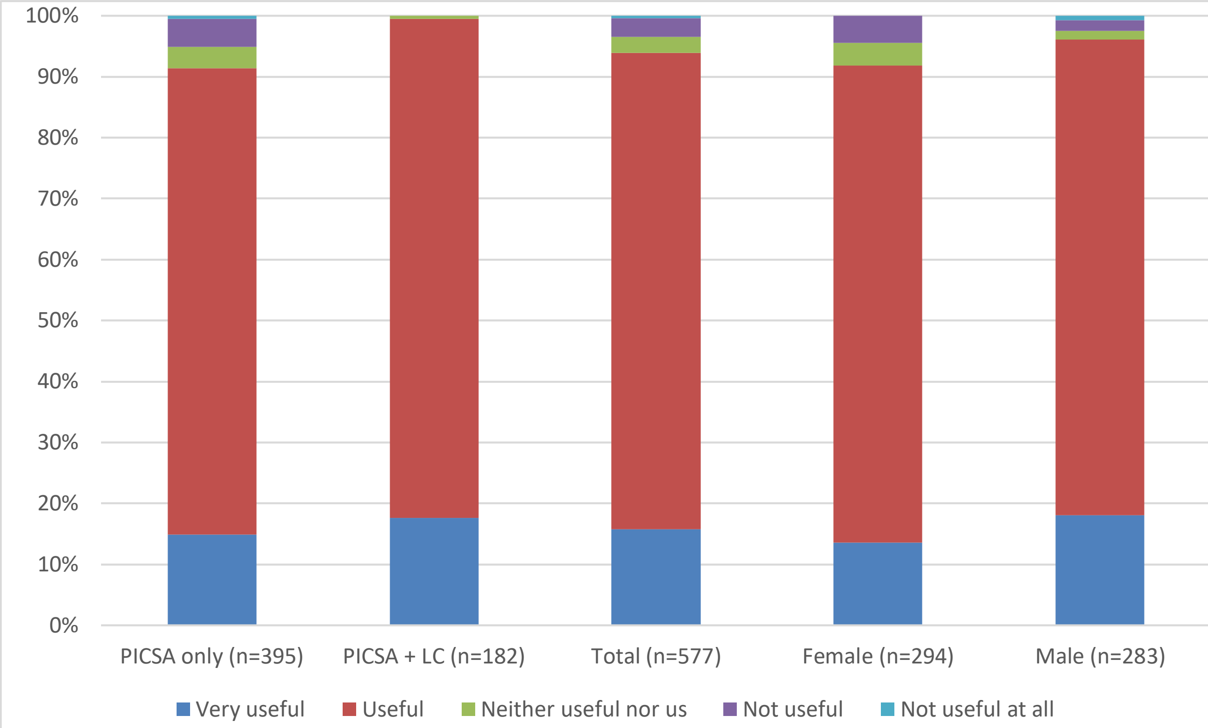


**Figure 26. Usefulness of the information from PICSA training**

As indicated in Table 19, 41% and 21% of farmers who never attended a training on climate information in the PICSA+LC and PICSA only category respectively, were trained by other farmers who got the training (peer trainers). The peer trainers mainly came from the same cell with about a quarter of the proportion being trained by peer trainers from their village (Figure 28). Most of the respondents in all the intervention categories did not receive any other training on climate information other than the PICSA training (Table 20). The proportion of the respondents who received other trainings ranged from a minimum of 1% for the control group to a maximum of 10% for the PICSA+LC category.

**Table 17. Type of climate information received during PICSA trainings (%)**

| Type of information | PICSA only | PICSA + LC | Total | Female | Male | Diff (Gender) |
|---|---|---|---|---|---|---|
| Seasonal forecast of onset | 90.1 | 91.2 | 90.5 | 88.8 | 92.2 | -3.5 |
| Seasonal forecast of total rainfall | 81.5 | 83.0 | 82.0 | 81.0 | 83.0 | -2.1 |
| Seasonal forecast of cessation | 55.7 | 73.6 | 61.4 | 56.1 | 66.8 | -10.7*** |
| Seasonal forecast of rainfall distribution (frequency of dry spells) | 46.8 | 64.8 | 52.5 | 48.6 | 56.5 | -7.9* |
| Forecast of the weather for today and/or next 2-3, 10 days | 35.7 | 47.4 | 39.3 | 36.4 | 42.4 | -6.0 |
| **N** | **395** | **182** | **577** | **294** | **283** | |

### Table 18. Improvements in access to information following PICSA training

| Improvements in access | PICSA only | PICSA + LC | Total | Female | Male | Diff |
|---|---|---|---|---|---|---|
| More frequent information | 30.9 | 47.3 | 36.1 | 32.7 | 39.6 | -6.9* |
| Different types of climate products | 41.0 | 42.9 | 41.6 | 44.2 | 38.9 | 5.4 |
| Variety of sources | 17.7 | 22.0 | 19.1 | 16.7 | 21.6 | -4.9 |
| More timely information | 38.0 | 48.4 | 41.3 | 35.4 | 47.4 | -12.0*** |
| More information with advice | 67.1 | 76.9 | 70.2 | 68.7 | 71.7 | -3.0*** |
| My access to information has not increased as a result of PICSA training | 7.6 | 2.2 | 5.9 | 7.1 | 4.6 | 2.6 |
| Others | 3.0 | 2.8 | 3.0 | 3.4 | 2.5 | 0.9 |
| **N** | **395** | **182** | **577** | **294** | **283** | |

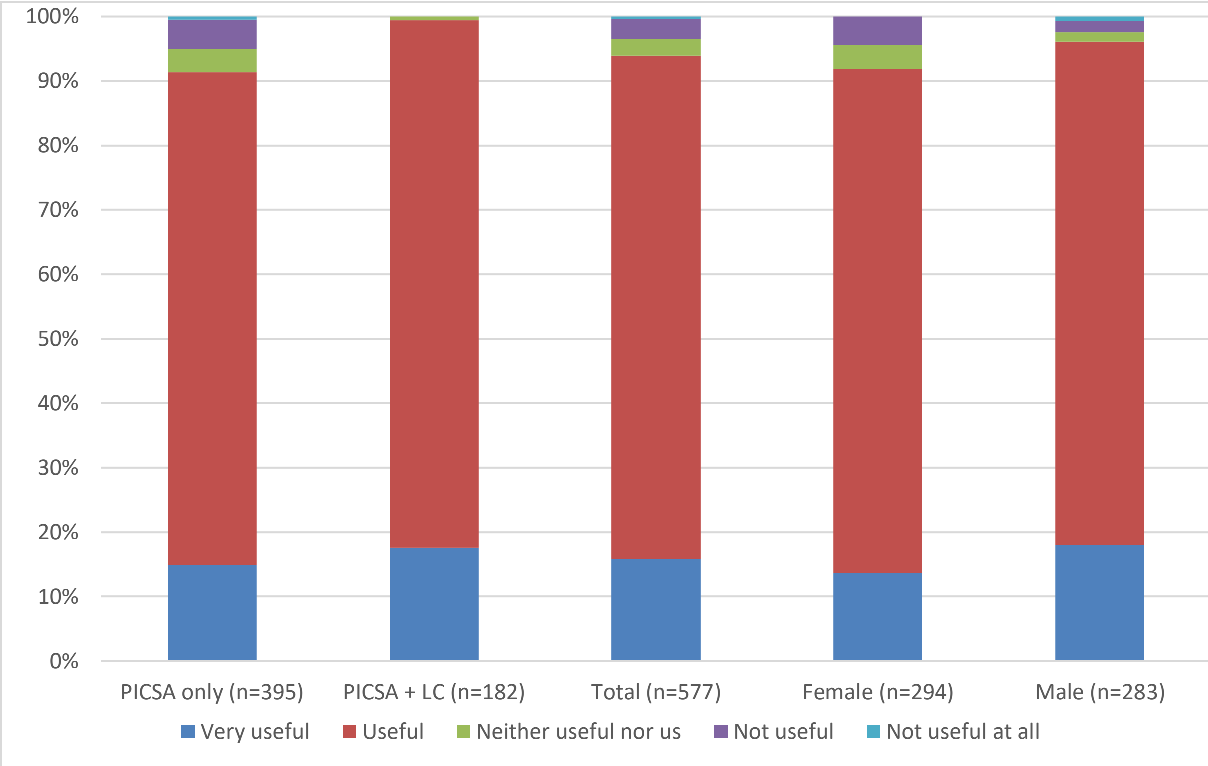


**Figure 27. Usefulness of the information from PICSA training**

### Table 19. Information accessed from peers for non-PICSA trained farmers*

| | Yes | | No | | Total |
|---|---|---|---|---|---|
| | Frequency | % | Frequency | % | Frequency |
| LC only | 134 | 41.7 | 187 | 58.3 | 321 |
| No PICSA no LC | 136 | 21.7 | 491 | 78.3 | 627 |
| Female | 149 | 30.8 | 335 | 69.2 | 484 |
| Male | 121 | 26.1 | 343 | 73.9 | 464 |
| **Total** | **270** | **28.5** | **678** | **71.5** | **948** |

*If you have never attended a training on climate information, have you ever received the information from someone who has been trained?"

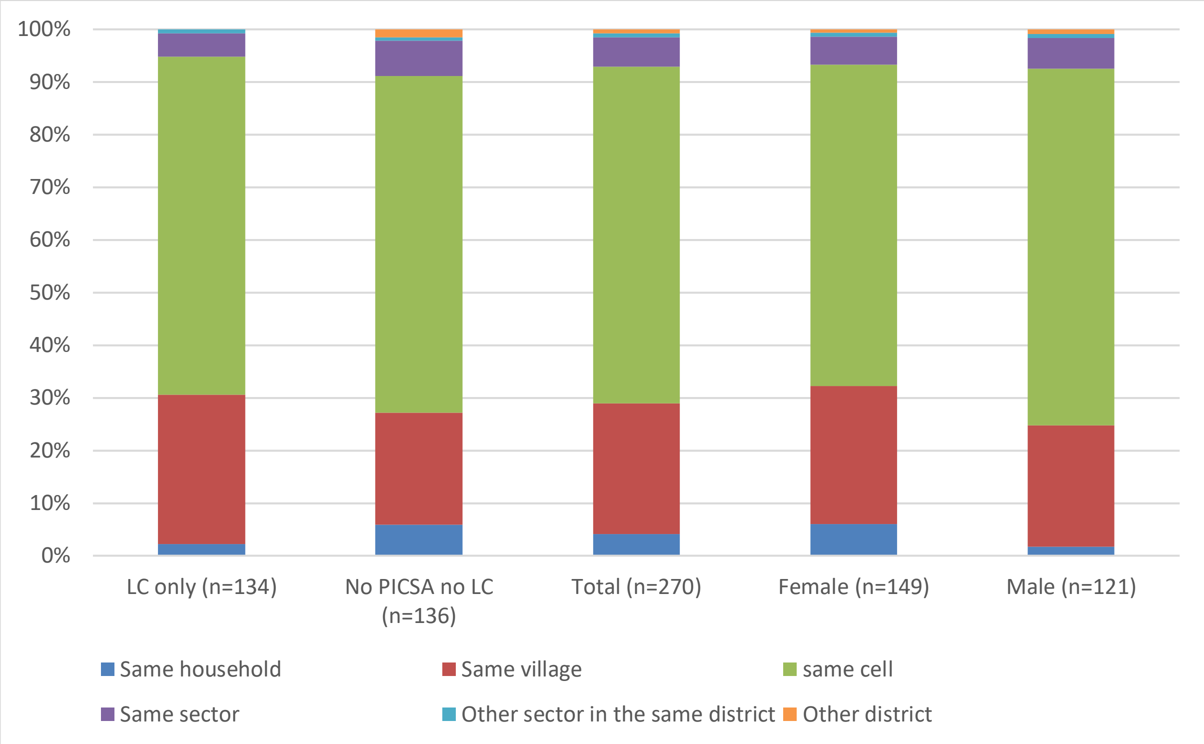


**Figure 28. Location of peer trainer**

**Table 20. Proportion of respondents who attended another training other than PICSA on climate information**

| | | PICSA only | LC only | PICSA+LC | No PICSA no LC | Total | Female | Male |
|---|---|---|---|---|---|---|---|---|
| No | Frequency | 380 | 311 | 163 | 619 | 1,473 | 755 | 718 |
| | % | 96.2 | 96.9 | 89.6 | 98.7 | 96.6 | 97.0 | 96.1 |
| Yes | Frequency | 15 | 10 | 19 | 8 | 52 | 23 | 29 |
| | % | 3.8 | 3.1 | 10.4 | 1.3 | 3.4 | 3.0 | 3.9 |
| Total | Frequency | 395 | 321 | 182 | 627 | 1,525 | 778 | 747 |
| | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

## Use of climate information to inform agricultural decisions

In this section respondents were asked whether they used climate information to inform decisions on different agricultural practices. These practices included land preparation, types of crop and crop varieties grown, use of organic and inorganic fertilizers, land allocation for crops and timing of activities involved in crop production and marketing. The respondents also reported the member(s) of the households who made the decision. Figure 29a, b and c illustrate the proportion of respondents who used the climate information to make decisions on different agricultural practices. Only agricultural practices where more than 10% of the respondents reported that their decisions on the activities were influenced by the climate information are reported. A higher proportion of respondents in PICSA+LC used all types of climate information accessed in making decisions on agricultural practices compared to other intervention categories. Those in the PICSA only category had the second highest category while the control group had the least proportion of respondents who used climate information to make decisions for different agricultural practices. The majority of the respondents used the information to mostly make decisions on the types of crops to grow, types of crop varieties to plant, timing of planting and land preparation and how to prepare land.

Figure 30a and b show who makes decisions regarding agricultural practices. The highest proportion of respondents in all intervention categories reported that the decisions were jointly made by the household head and spouse.

## Impact of climate information

In this section, respondents were asked whether they made any changes in crop and livestock production and also their livelihood enterprises as a result of using climate information. The kind of changes were also reported and the extent to which income/social standing of the respondents increased due to the changes. Figure 29 indicates the proportion of respondents that made crop/livestock and livelihood enterprise changes due to the climate information accessed. The majority of the respondents from all intervention categories made crop changes as a result of the use of climate information, followed by livestock change and livelihood changes in that order. The highest proportion of respondents who made crop and livestock production changes were from the PICSA+LC category, while the highest proportion of respondents who made livelihood changes were from the LC only category. The control category had the lowest proportion of respondents who made crop, livestock and livelihood changes.

Changing the way of managing crops was the major crop production change implemented by respondents from all the intervention categories (Figure 30). Additionally, about a third of the respondents reported an increased scale of enterprise while a quarter of the respondents mentioned new crop enterprises as the crop changes made. Similarly, the major change in livestock production was changing the way of managing livestock followed by an increased scale of enterprise and new livestock enterprises (Figure 31). The most commonly reported livelihood enterprise was increased scale of enterprise. More than half of the respondents in the LC only category reported the change, while barely 40% of the respondents in other categories reported the change. Getting new livelihood enterprises was also reported by about 20% of the respondents in all the intervention categories (Figure 32).

On a scale of zero to five (0 = no change, 5=great change), most of the respondents in all the intervention categories indicated that they would rate the extent to which their income/social standing increased due to the changes in crop and livestock production and livelihood enterprises as three. About a quarter of the respondents rated the extent to which their income/social standing increased due to the changes in crop and livestock production and livelihood enterprises as four (Figures 35, 36 and 37).

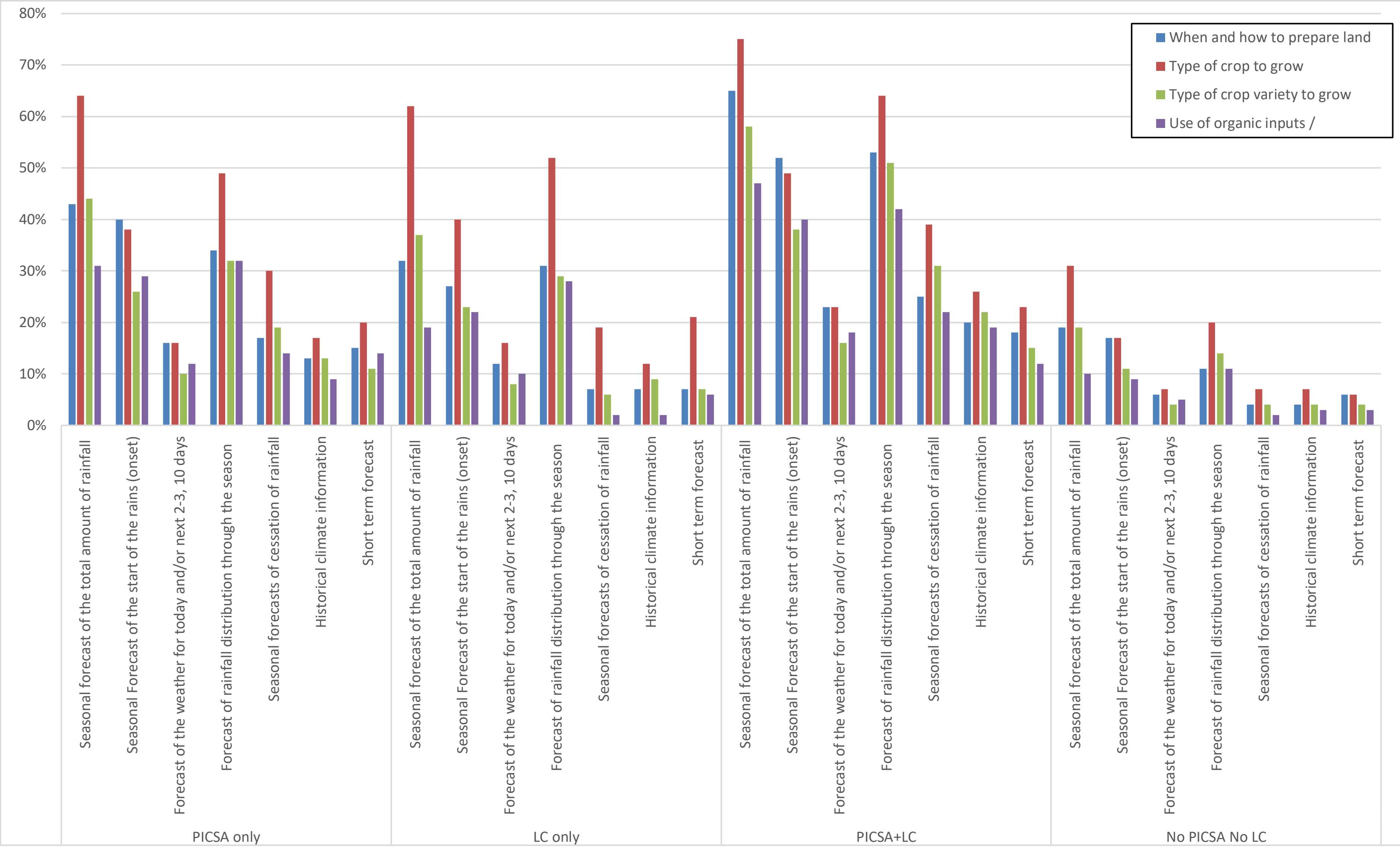


**Figure 29a. Proportion of respondents who used climate information to make decision of different agricultural practices**

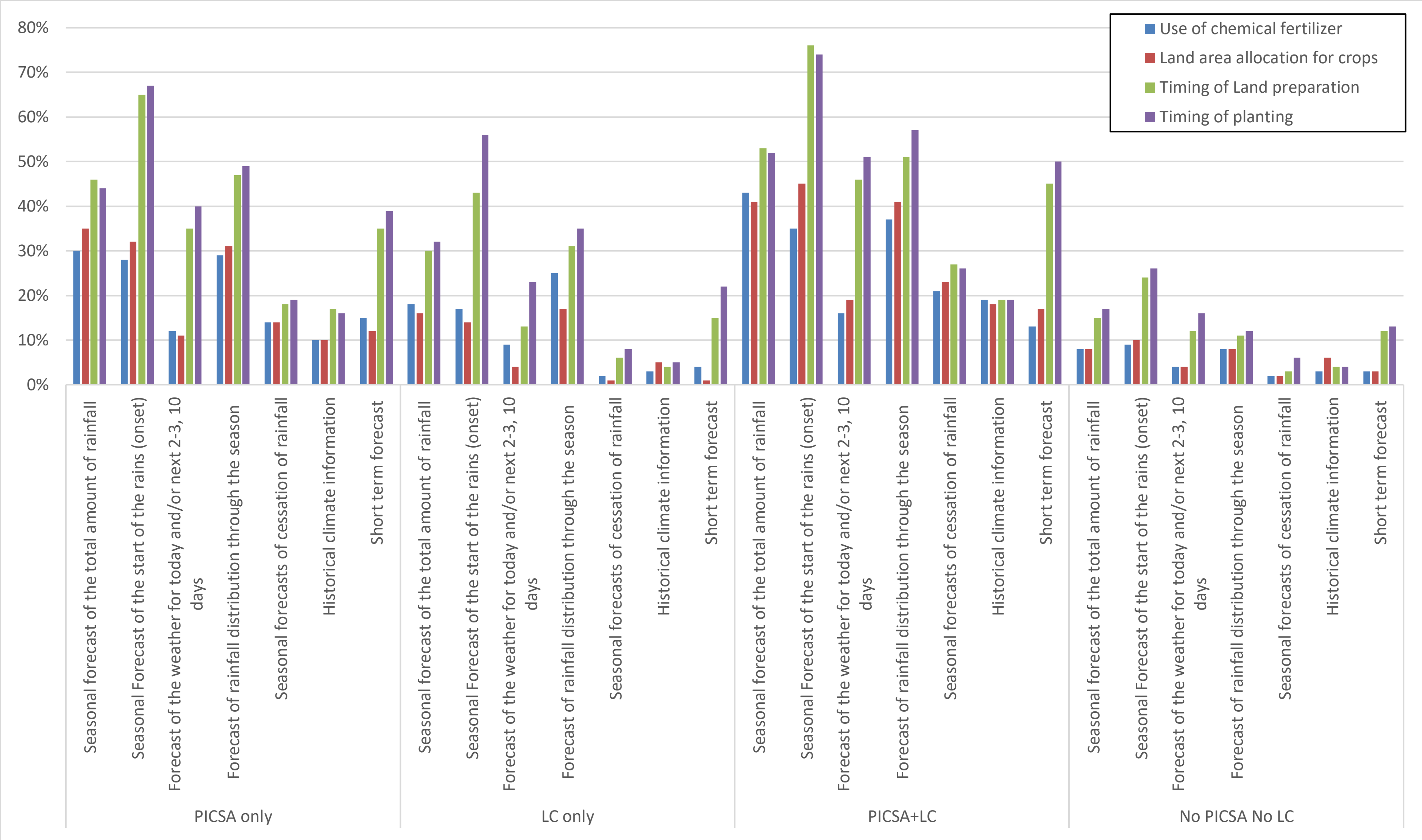


**Figure 29b. Proportion of respondents who used climate information to make decision of different agricultural practices**

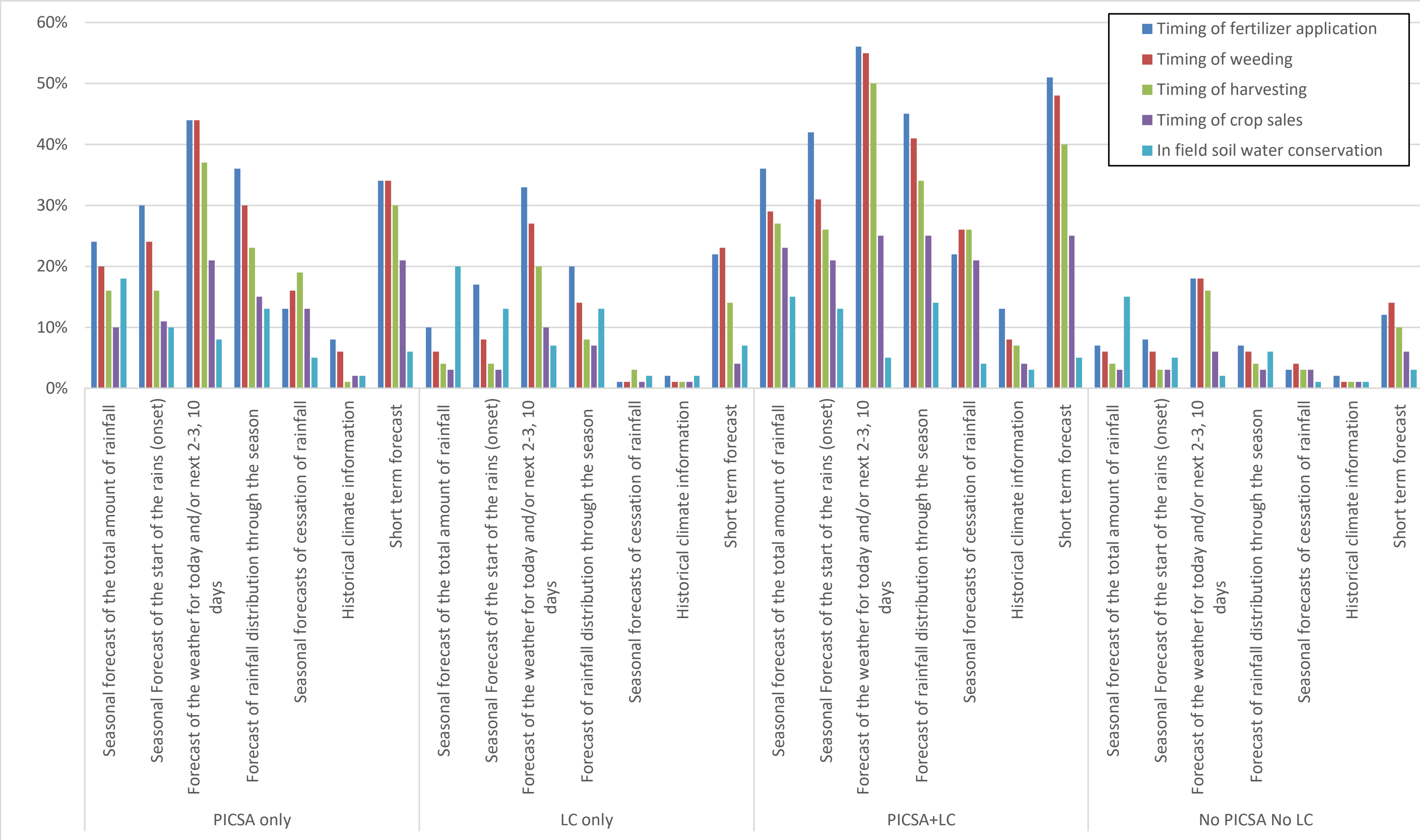


**Figure 29c. Proportion of respondents who used climate information to make decision of different agricultural practices**

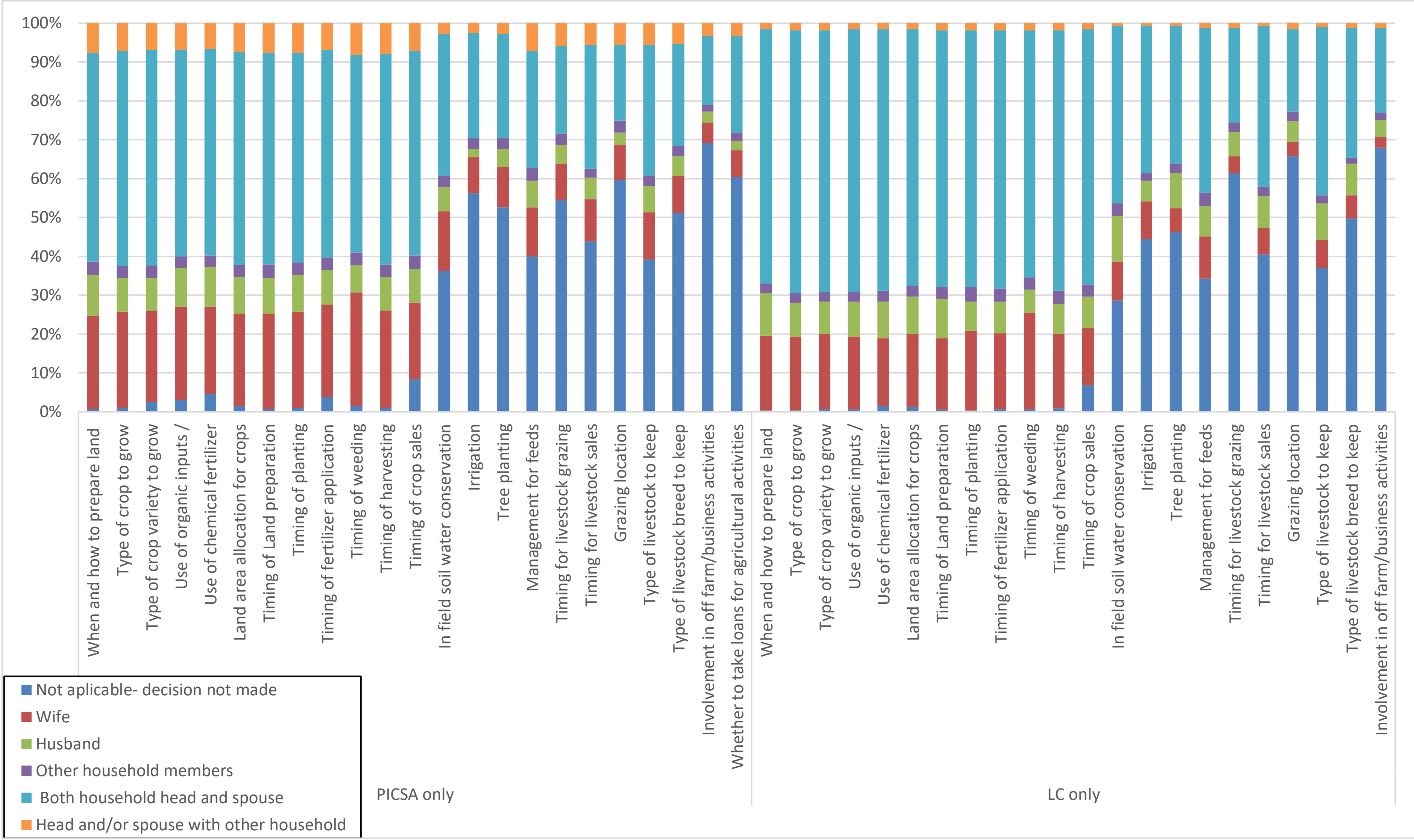


**Figure 30a. Decision makers on different agricultural practice as informed by climate information**

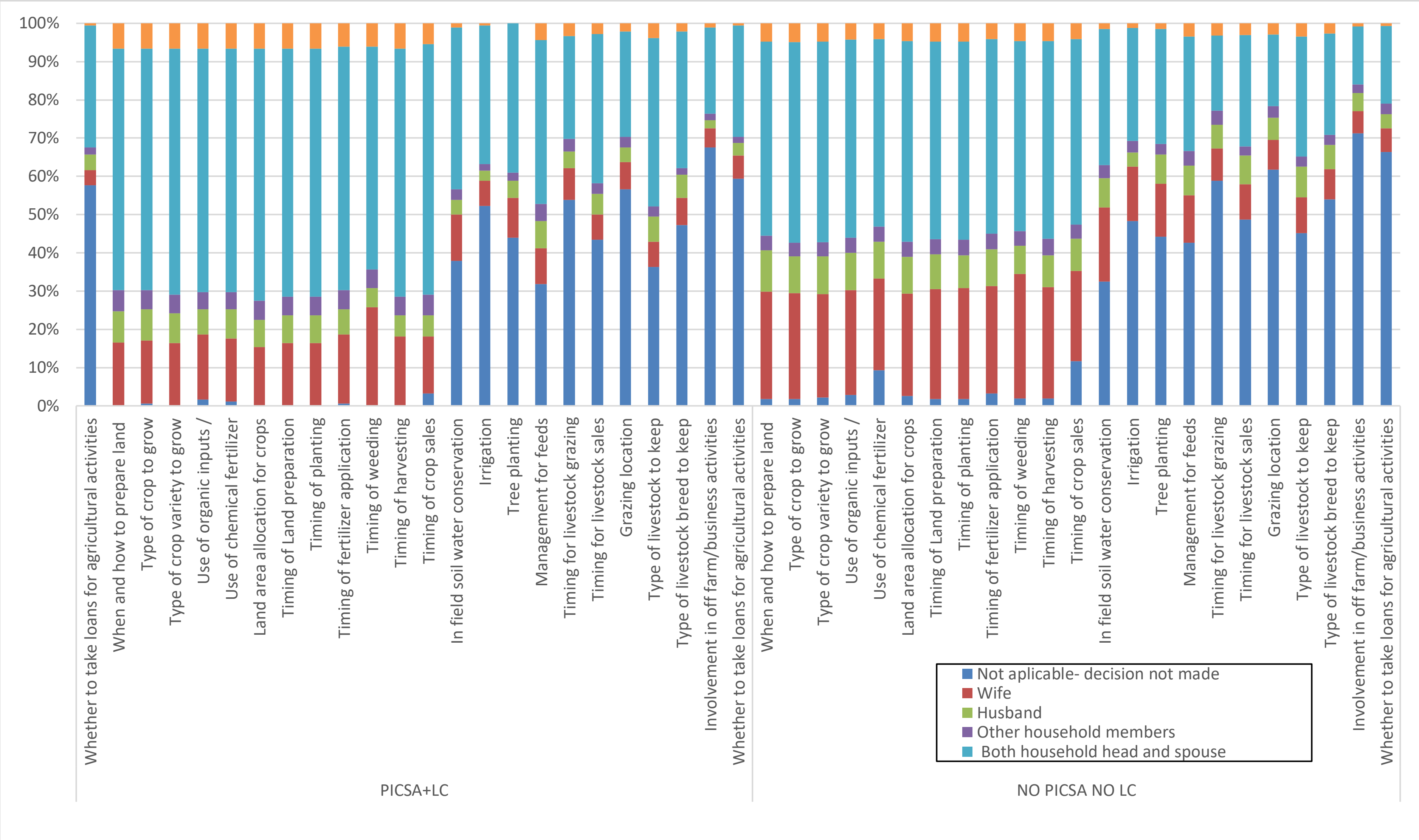


**Figure 30b. Decision makers on different agricultural practice as informed by climate information**

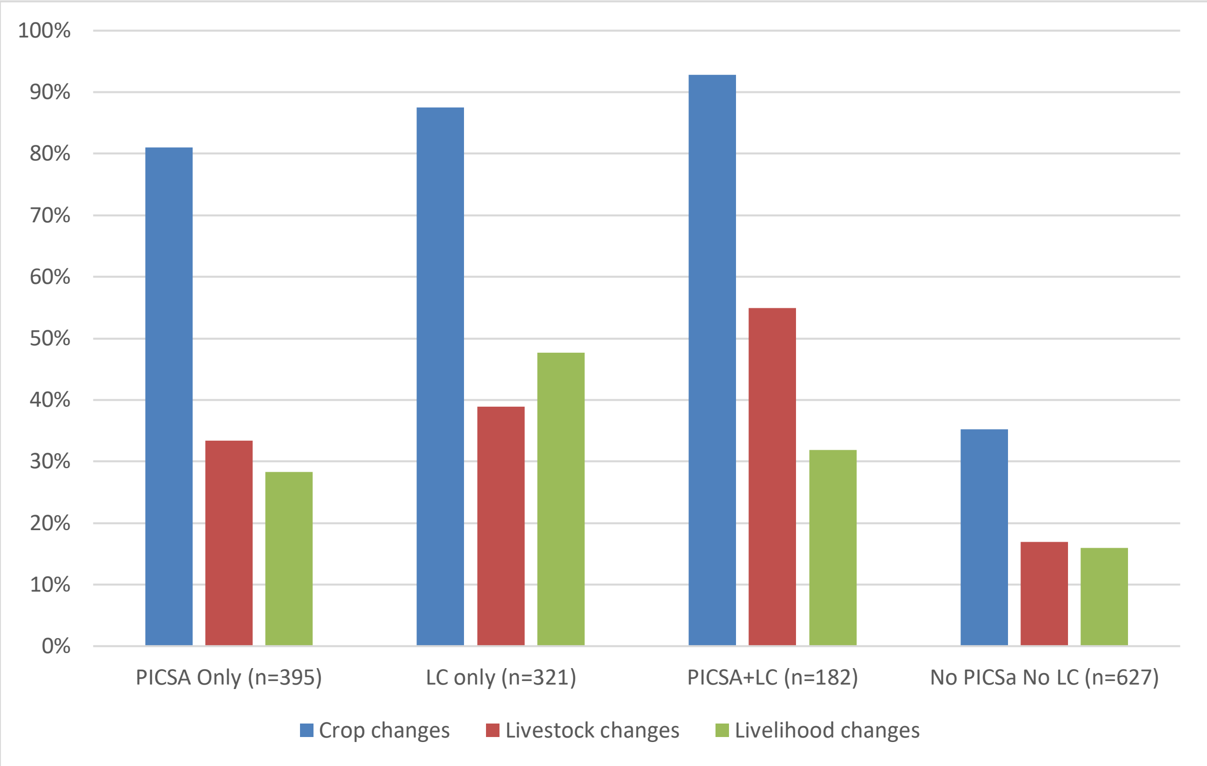


**Figure 31. Proportion of respondents making changes as a result of using climate information**

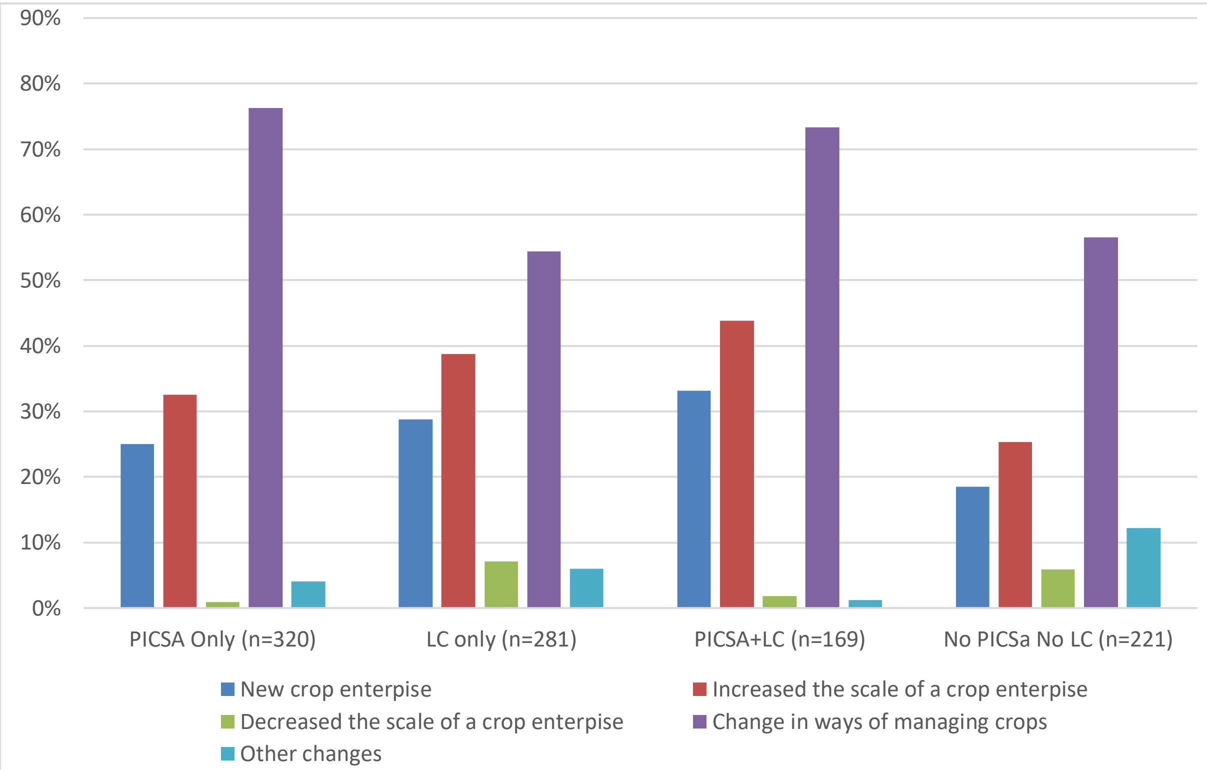


**Figure 32. Changes made on crop production due to use of climate information**

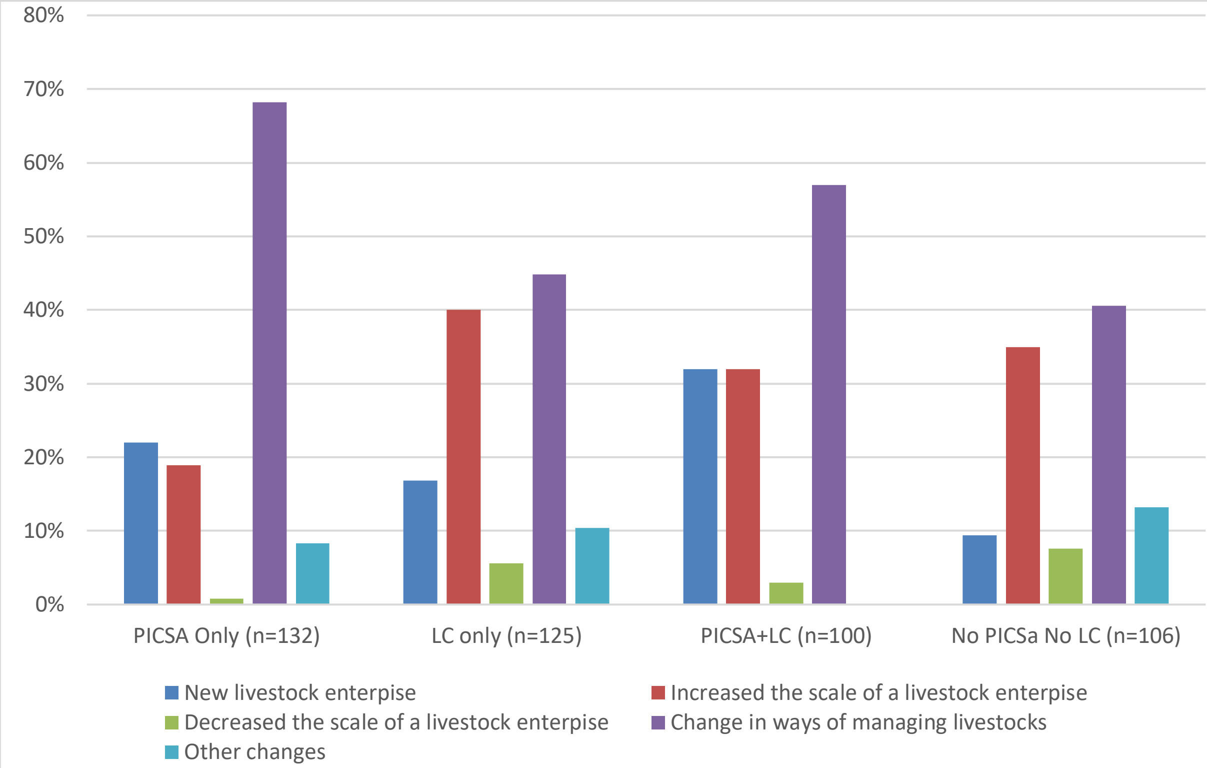


**Figure 33. Changes made on livestock production due to use of climate information**

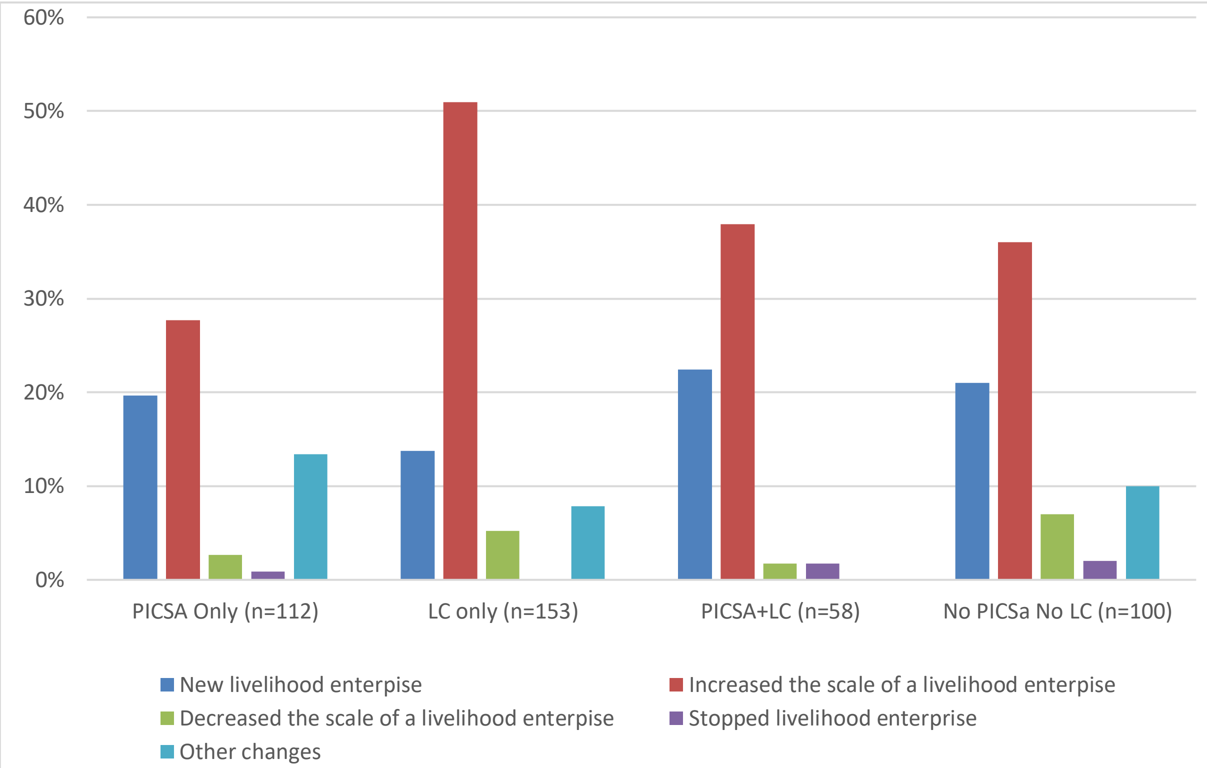


**Figure 34. Changes made on livelihood enterprises due to use of climate information**

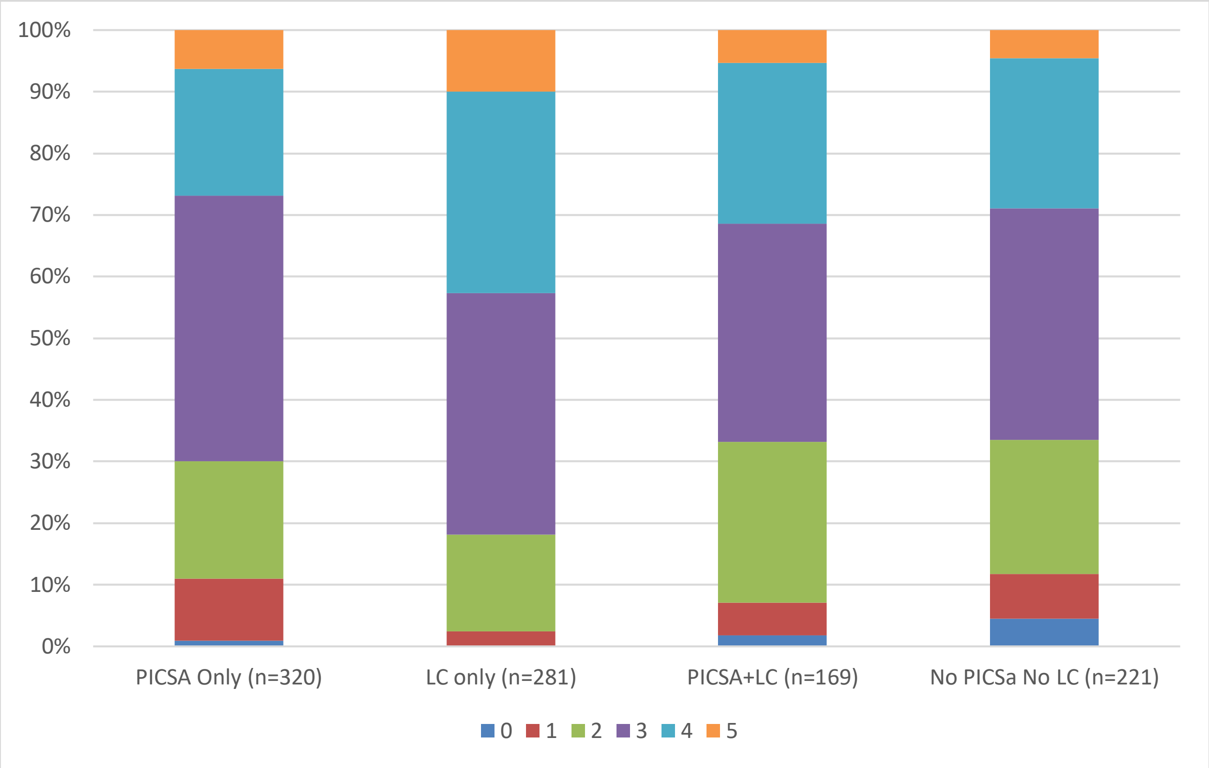


**Figure 35. Extent to which income/social standing improved due to the changes in crop production as a result of using climate information.** **Note: 0=No change; 5= Great change**

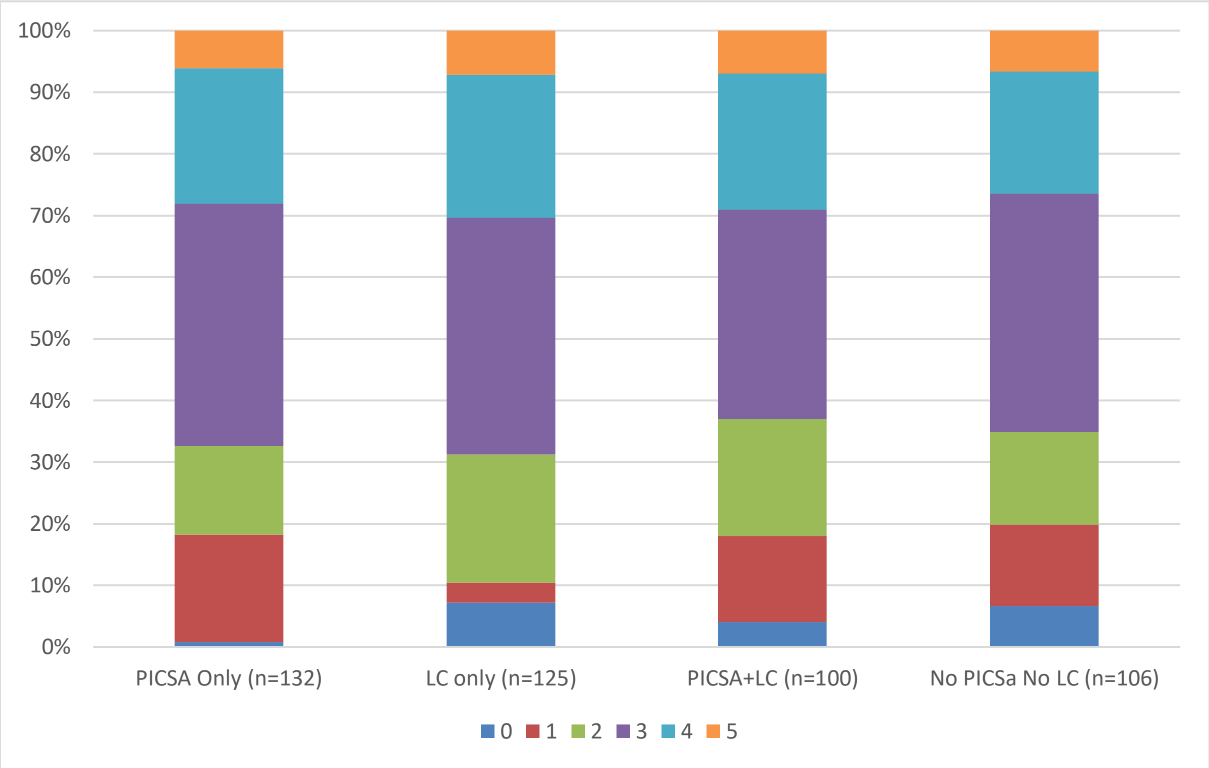


**Figure 36. Extent to which income/social standing increased due to the changes in livestock production.** **Note: 0=No change; 5= Great change**

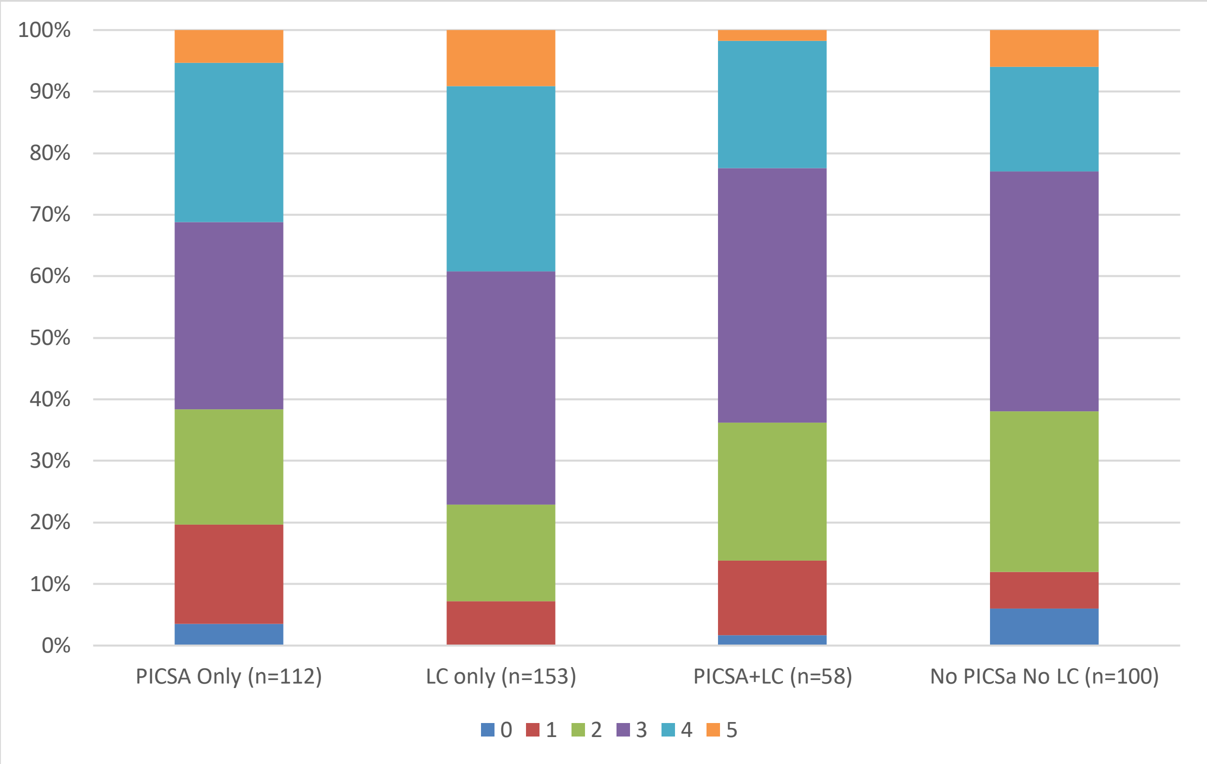


**Figure 37. Extent to which income/social standing increased due to the changes in livelihood enterprises resulting from using climate information.** **Note: 0=No change; 5= Great change**

### Perceived impact of climate information

To capture the perceived impact of climate information, respondents were asked to rate their level of agreement or disagreement with a given statement. The statements captured the respondents perception on improvement in crop and livestock production, reduction in cost of crop and livestock production, improvement in ability to cope with climate risks, improvement in household food security status and income, improvement in social standing as a result of the changes and willingness to pay for climate information. Figure 38 shows the respondents rating of the given statements. The majority of the respondents in all the intervention categories, including the control, either agreed or strongly agreed that there was significant improvement in: crop and livestock, production, ability to cope with climate risk, household food security status, household income and social standing due to the changes. However, most of the respondents disagreed or strongly disagreed with the statements that cost of crop and livestock production had significantly reduced. This could be due to the costs of accessing climate services and investment costs required to adopt and implement the climate-smart production practices.

### Land tenure and crop production

This section describes the land tenure, main crops grown, inputs use and PICSA practices on crops within the intervention categories in Season A (September-January) and Season B (February-May). As shown in Table 21, more than 80% of the plots cultivated in both Season A and B were owned through a land title. The other land tenure systems which accounted for less than 15% of the respondents included, customary rights, rented and a case where a household was permitted to occupy the land. The majority of the plots had title deeds in every intervention category (Table 22). The LC only category had the lowest (77%) proportion of plots with land title while PICSA only had the highest proportion (83%).

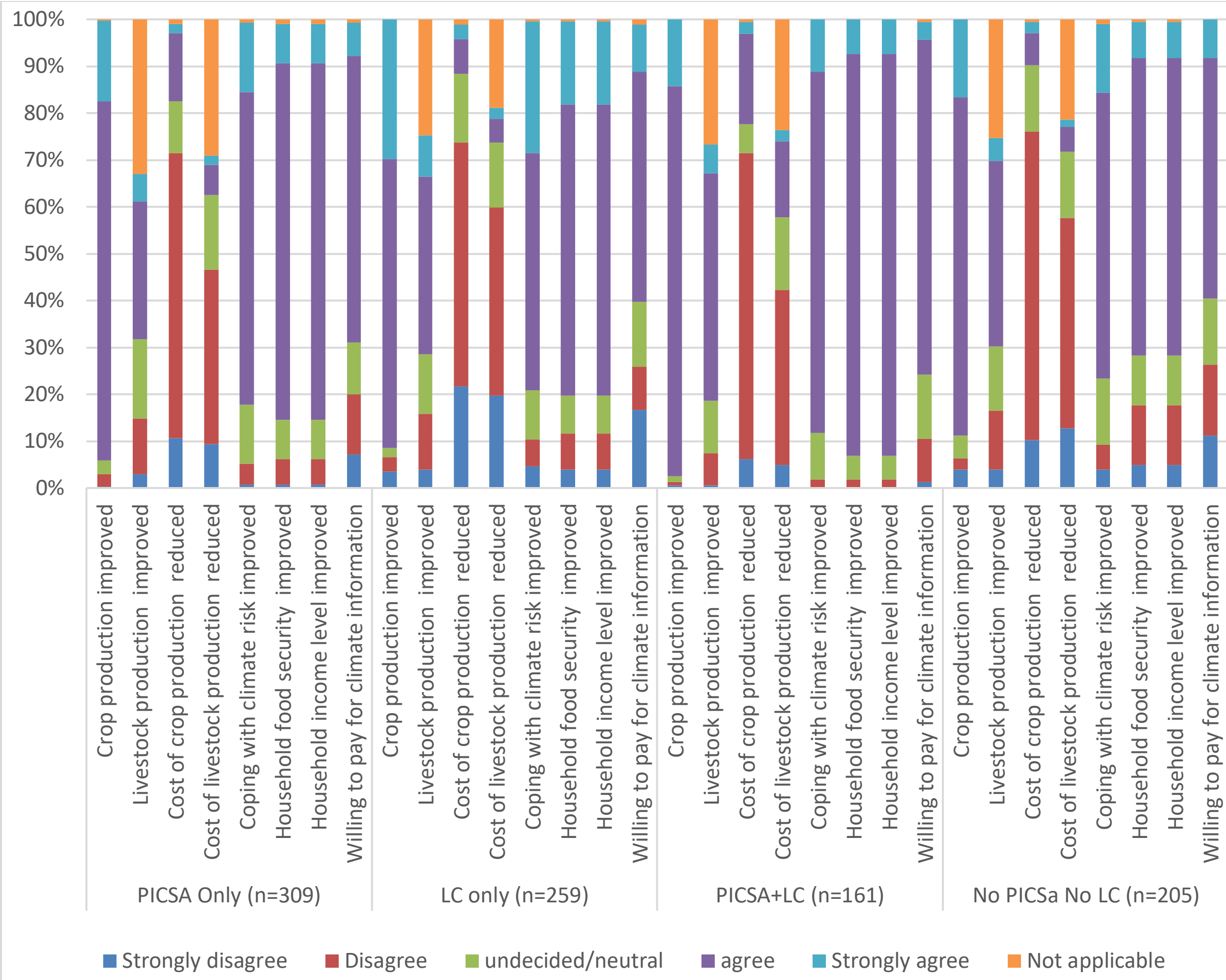


**Figure 38. Proportion of respondents with different level of agreement on the indicated statements**

### Table 21. Land tenure of cultivated plots by season

| Land tenure | Number of plots cultivated season A (% in brackets) | Number of plots cultivated season B (% in brackets) |
|---|---|---|
| Land title | 2,158 (80.8) | 2,524 (79.7) |
| Customary right | 39 (1.5) | 48 (1.5) |
| Rent | 316 (11.8) | 392 (12.4) |
| Permitted to occupy | 158 (5.9) | 204 (6.4) |
| **Total** | **2,671 (100)** | **3,168 (100)** |

### Table 22. Land tenure of cultivated plots by intervention

| Land tenure | Number of plots cultivated both seasons (% in brackets) | | | | |
|---|---|---|---|---|---|
| | PICSA only | LC only | PICSA + LC | No PICSA no LC | Total |
| Land title | 1353 (83.6) | 972 (79.2) | 581 (76.6) | 1772 (79.4) | 4678 (80.2) |
| Customary right | 26 (1.6) | 12 (1.0) | 6 (0.8) | 43 (1.9) | 87 (1.5) |
| Rented in | 178 (11,0) | 151 (12.3) | 124 (16.3) | 255 (11.4) | 708 (12.1) |
| Permitted to occupy | 61 (3.8) | 92 (7.5) | 48 (6.3) | 161 (7.2) | 362 (6.2) |
| **Total N** | 1618 | 1227 | 759 | 2231 | 5835 |

According to Figure 39, bean was the major crop grown by most respondents in Season B. Maize was the second most grown crop followed by sweet potato in Season B in all the intervention categories. Most respondents in PICSA only and PICSA+LC grew beans and maize compared to the other categories. In season A, most of the respondents in all intervention categories reported to have grown beans as the main crop followed by maize (Figure 40). Maize production was done by a higher percentage of the respondents in PICSA only and PICSA+LC categories compared to LC only and control categories.

Purchased seed was the most used input on crop plots in all the intervention categories, followed by purchased fertilizer, in both seasons (Figure 41 and 42). Purchased seed was used on more than half of all plots owned by respondents in all intervention categories but was used more in plots owned by respondents in PICSA only and PICSA+LC compared to other categories. Purchased fertilizer was used on more plots owned by respondents in LC only compared to other categories. Pesticide was the least used input in all categories. Use of farm-yard manure was the most implemented PICSA practice in all the categories (Figure 46). Farm-yard manure was applied on more than 60% of the plots from all categories. LC only categories used all the PICSA practices in most of their plots compared to other categories. Inorganic fertilizer was the second most used PICSA practice, followed by improved seed while mulching and lime were the least used practices in all intervention categories.

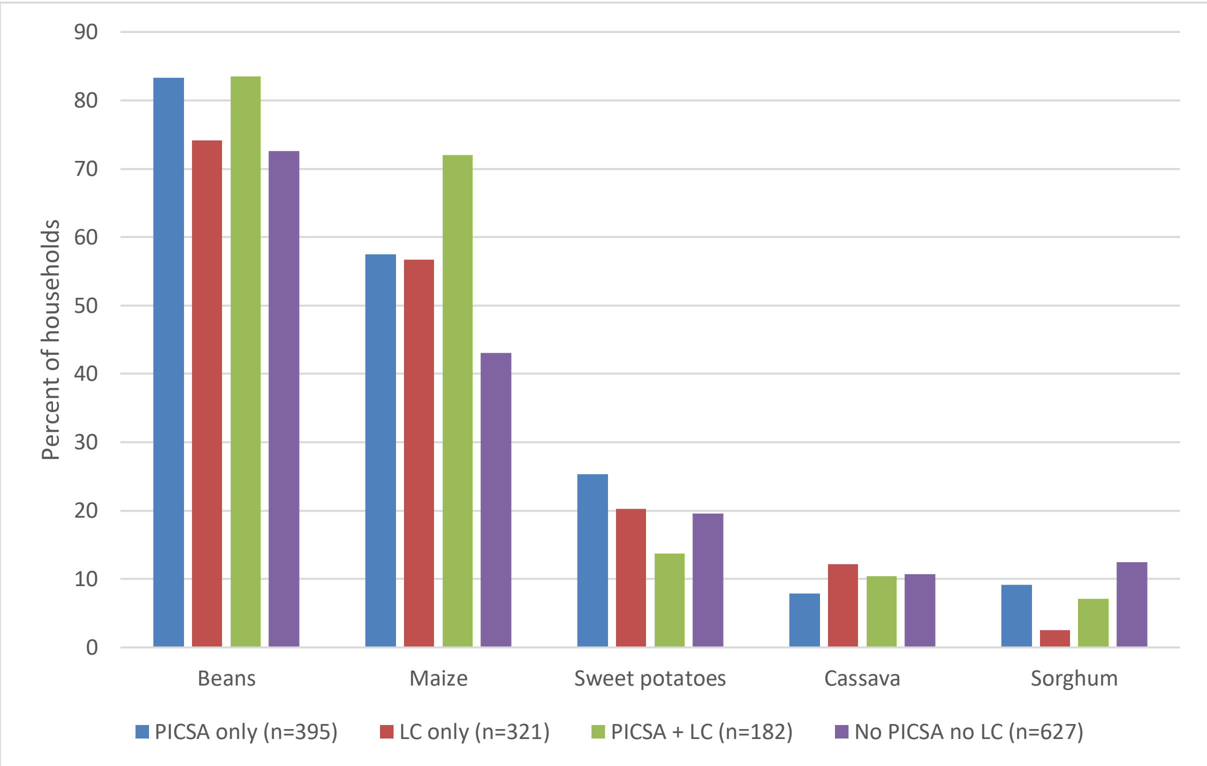


**Figure 39. Main crops grown in Season B 2019 by intervention (% of households)**

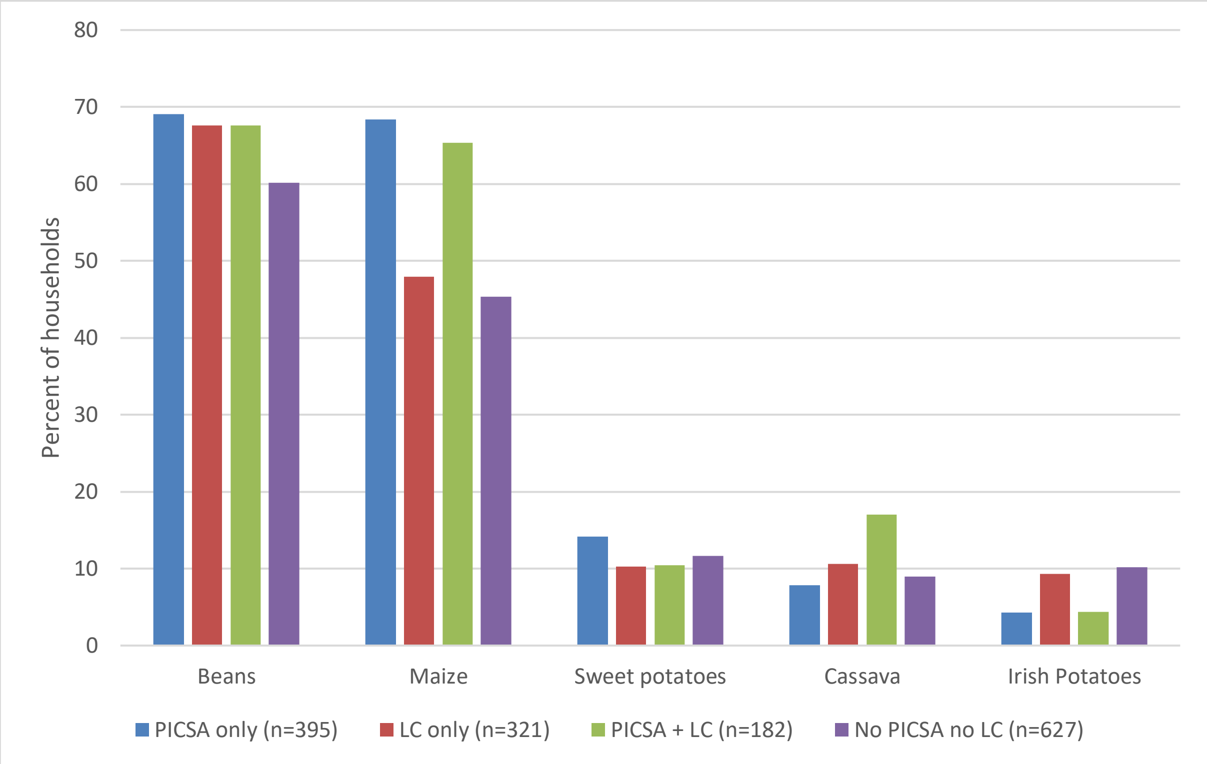


**Figure 40. Main crops grown in Season A 2019 by intervention (% of households)**

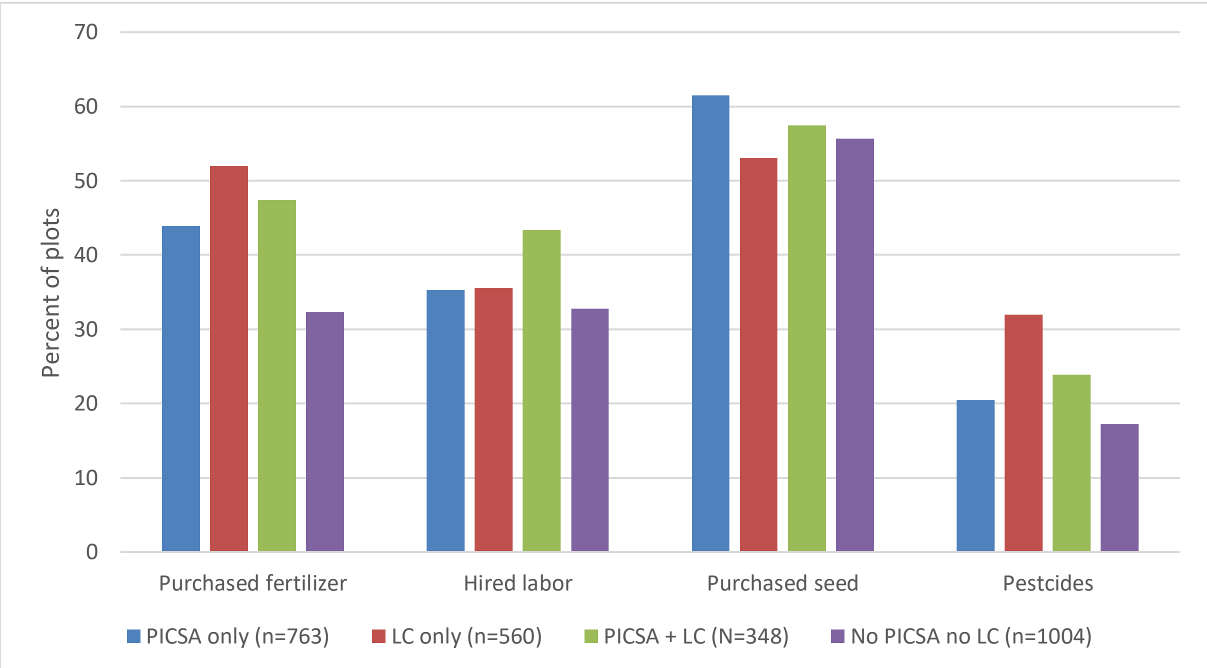


**Figure 41. Input use on cultivated plots by intervention in Season A (% of plots)**

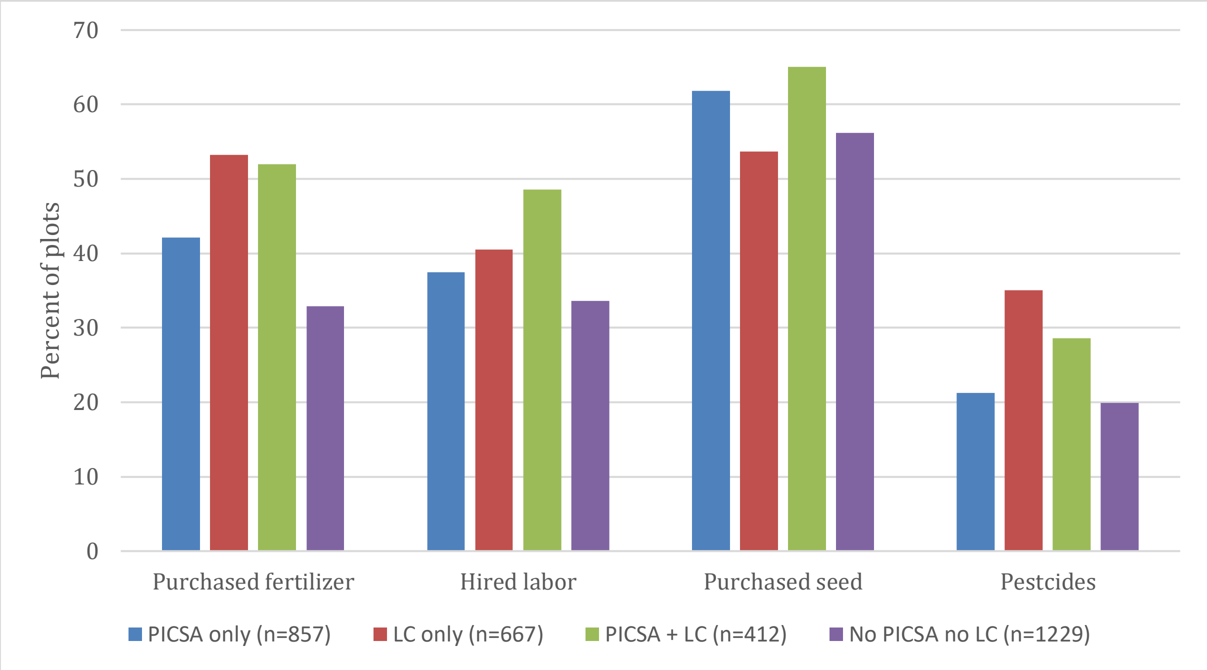


**Figure 42. Input use on cultivated plots by intervention in season B (% of plots)**

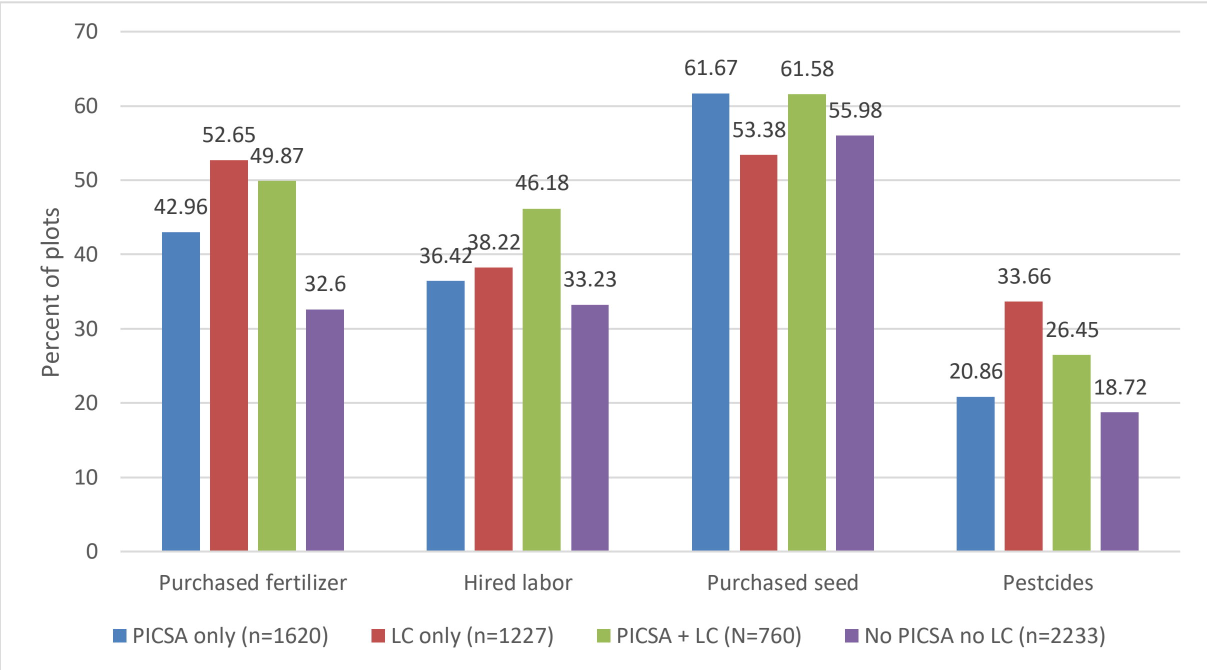


**Figure 43. Input use on cultivated plots by intervention in Season A and B combined (% of plots)**

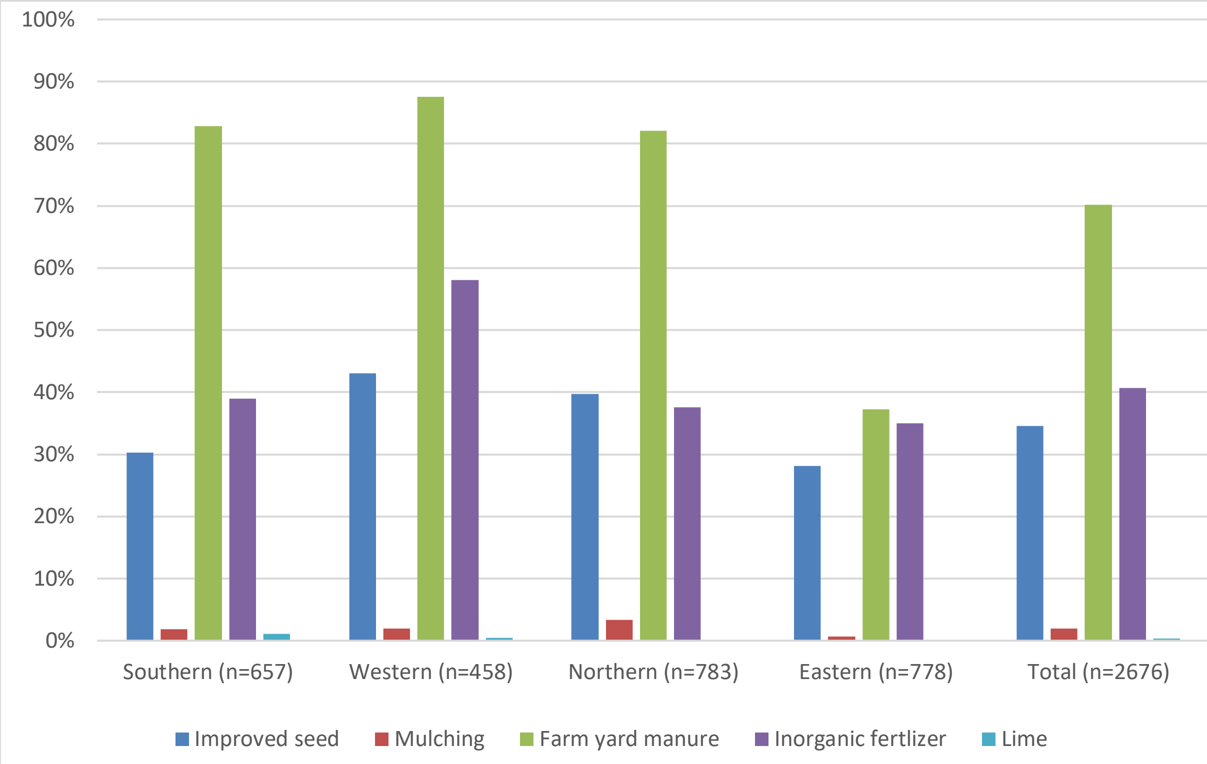


**Figure 44. PICSA practices on cultivated plots in Season A (% of plots)**

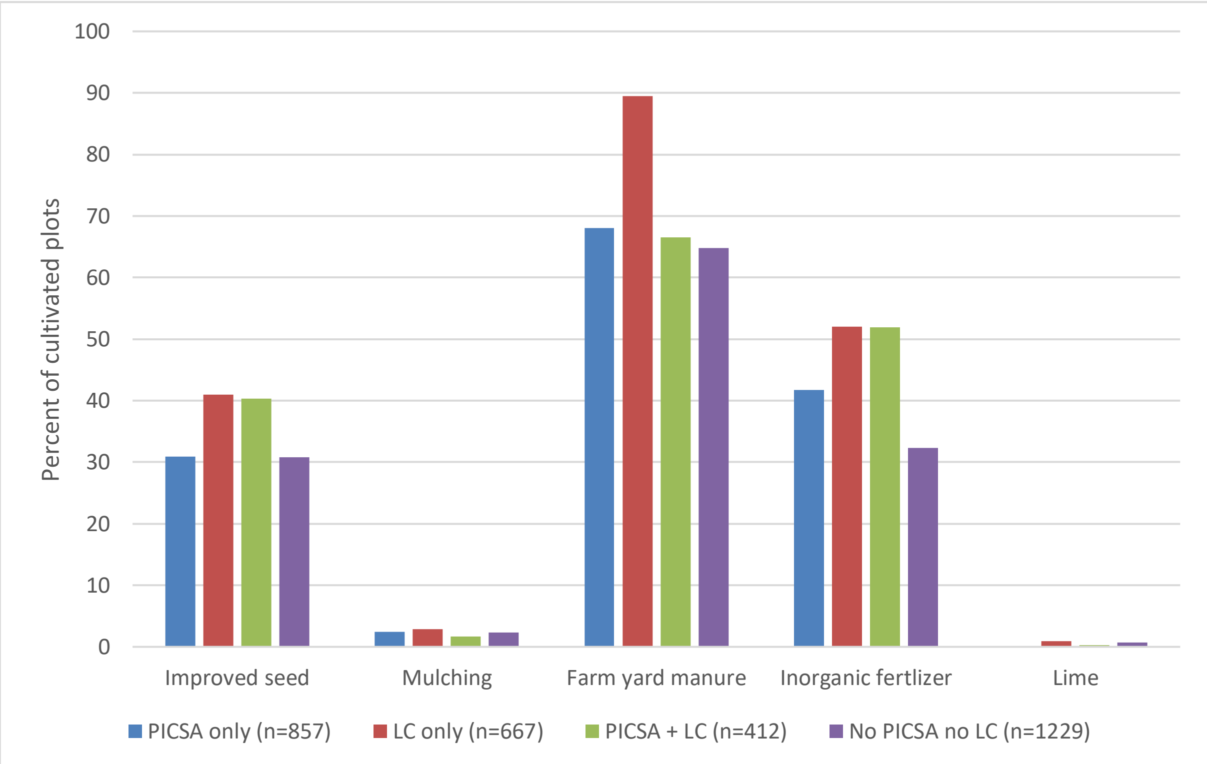


**Figure 45. PICSA practices on cultivated plots in Season B (% of plots)**

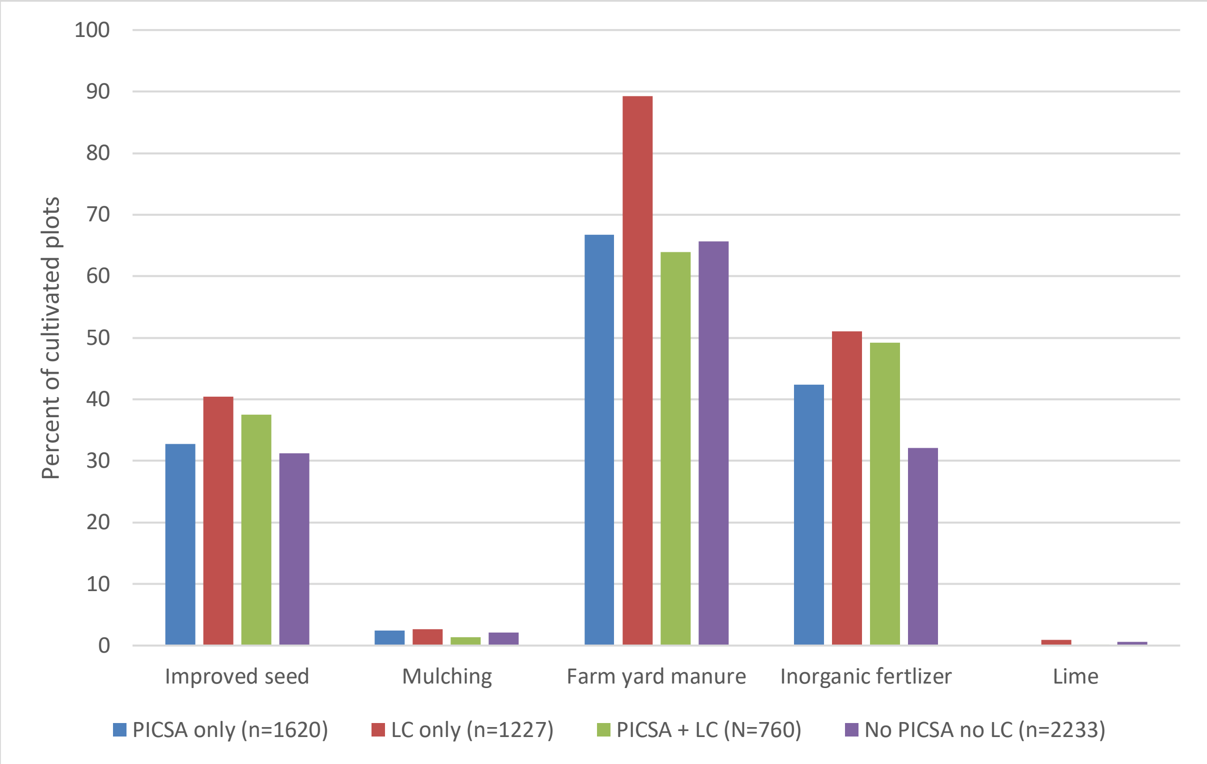


**Figure 46. PICSA practices on cultivated plots in season A and B combined (% of plots)**

Table 23 shows the annual value of crop output (quantity produced * price). The average annual value of crop output per household was 191 USD. Respondents in the PICSA+LC intervention category had the highest (242 USD) average annual value of crop followed by the PICSA only category which had an average of 205 USD. The control group had the lowest average annual value of crop output of 165 USD. Total average annual crop income per household was 137 USD (Table 24). Just as the case of the value of annual crop output, respondents in the PICSA+LC category had the highest average annual income of 178 USD, followed by the PICSA only category (149 USD). The control group had the lowest average crop income of 115 USD. The high average value of crop output and crop income per household among farmers who received the interventions as compared to the control group could mean that farmers receiving climate information are using it to make better decisions, thus maximizing/increasing their production.

**Table 23. Annual value of crop output in USD**

| | Mean | Std. Dev. | Min | Max | Obs |
|---|---|---|---|---|---|
| PICSA only | 205.1 | 159.1 | 20.6 | 799.3 | 348 |
| LC only | 192.3 | 169.6 | 22.2 | 778.3 | 299 |
| PICSA + LC | 242.5 | 171.2 | 22.5 | 786.7 | 160 |
| No PICSA no LC | 164.8 | 160.8 | 20.1 | 786.1 | 516 |
| Total | 191.0 | 165.4 | 20.1 | 799.3 | 1323* |
| **ANOVA test of significance among group means** | | | **F(3, 1319)=10.55 ; p=0.00** | | |

*Households that did not produce any crops and those with outlier values not included in the analysis

**Table 24. Annual crop income (USD)**

| Income | Mean | Std. Dev. | Min | Max | Obs |
|---|---|---|---|---|---|
| PICSA only | 149.0 | 123.8 | 2.2 | 529.5 | 351 |
| LC only | 140.8 | 123.1 | 1.6 | 527.5 | 298 |
| PICSA + LC | 178.6 | 134.3 | 5.5 | 549.8 | 156 |
| No PICSA no LC | 114.7 | 114.4 | 1.3 | 546.6 | 512 |
| Total | 137.3 | 123.0 | 1.3 | 549.8 | 1317* |
| **Anova test of significance among group means** | | | F(3, 1313)=13.08 ; p=0.00 | | |

*Households that did not produce any crops and those with outlier values not included in the analysis

## Household food security

This section describes the household food security status in the cropping year (2018-2019) season and explores any differences between the intervention categories. The focus is on the length of time that the harvest lasted, whether the household had enough food throughout the season, coping mechanisms and household dietary diversity (HDD).

Table 25 shows the length of harvest for the main cereal and legume and also the alternate cereal and legume. On average, the main cereal's harvest lasted 3.5 months, alternative cereal 2.6 months, main legume 3.8 months, and alternative legume 2.6 months. The harvested legumes lasted longer than cereals. Cereals' and legumes' harvest lasted longer for the LC only category compared to the other intervention categories while that of the control group lasted the shortest time. The main cereals harvest lasted longer in male headed households while the alternative legume harvest lasted longer in female headed households. The harvest for both legumes and cereals lasted slightly longer than the households thought it would last (Table 26). The majority of the households reported having enough food to cater to the family's needs. The proportion of respondents who reported enough food ranged from a minimum of 60% from the LC only category to 70% from the PICSA only category. A higher proportion of female headed households reported having enough food compared to the male headed households (Table 26). About 80% of the respondents who reported that they did not have enough food in the past 12 months had enough food in all the months (Figure 47). This means that only a small percentage of the respondents didn't have food in any given month.

To understand the HDD, households were asked if they had consumed any of 12 food groups (cereals, roots and tubers, vegetables, legumes/pulse/nuts, fruits, eggs, meat/poultry/organ meat, fish/seafood, milk/milk products, sugar/honey, oil/fat/butter and condiments/tea/coffee) that were listed, in the last 24 hours. The average household dietary diversity score (HDDS[1]) was 4.3 (Table 26). The PICSA+LC intervention category had the highest HDDS of 4.8 while the control category had the lowest HDDS of 4.1. On average, the HDDS for the households was still low given that on average the households consume about four food groups out of the 12 food groups, however the interventions could have helped in improving the HDDS since the control group had lower HDDS compared to respondents who received the interventions. There were statistical differences in the mean of HDDS among the intervention categories. Some of the results in Table 27 appear to contradict in terms of expectations on food security compared to their HDDS, due to subjective evaluations underlying the frequencies (Figure 47).

[1] Household dietary diversity score was computed by summing the total number of food groups consumed by a household out of 12 food groups each household was asked whether they had consumed in the last 24 hours.

Roots and tubers and vegetables were the most consumed food groups by more than 80% of the respondents in all intervention categories (Figure 48). This was closely followed by legumes/pulse/nuts (which serve as an alternate source of proteins) which was consumed by more than 60% of respondents in all intervention categories. Barely 10% of the respondents consumed meat, poultry and organ meat, eggs, fish and seafood. Meat, poultry and organ meat was the least consumed food group in all the intervention categories.

Figure 49 shows the use of different coping mechanisms among the respondents. The coping mechanisms include borrowing money to buy food or getting food on credit, reducing the number of meals, the mother/father eating less food, substituting commonly bought foods with cheaper types of food, modifying cooking methods, mortgaging/selling assets, borrowing from neighbors and food for work programs. Most of the respondents mention that they had never or have seldom used the coping mechanisms. Only about a quarter of the respondents used the coping mechanisms regularly or all the time.

**Table 25. How long did your harvest of the main cereal and legume crops last?**

| | PICSA Only | LC only | PICSA+LC | No PICSA No LC | Average | Female n=(616) | Male (n=531) | Difference between sex | Significance (p-value) | N |
|---|---|---|---|---|---|---|---|---|---|---|
| Main cereal | 3.5 (3.4) | 4.4 (4.2) | 3.8 (4.2) | 3.0 (2.9) | 3.5 (3.5) | 3.3 (3.4) | 3.7(3.6) | -0.4** (-0.2) | 0.00 (0.00) | 1147 |
| Alternative cereal | 2.1 (1.9) | 3.5(3.3) | 2.2 (2.2) | 2.0 (1.8) | 2.3 (2.2) | 2.4 (2.3) | 2.3 (2.0) | 0.1 (0.3) | 0.00 (0.00) | 945 |
| Main Legume | 3.9 (3.6) | 4.6 (4.4) | 4.4 (4.5) | 3.1. (3.0) | 3.8 (3.6) | 3.8 (3.7) | 3.8 (3.6) | -0.2 (0.0) | 0.00 (0.00) | 1147 |
| Alternative legume | 2.3 (1.6) | 3.7 (3.0) | 2.4 (2.1) | 2.4 (2.0) | 2.6(2.1) | 2.9(2.4) | 2.3 (1.8) | 0.5***(0.7***) | 0.00 (0.00) | 944 |

*Note: Figures in brackets represent the number of months the household thought the food the harvest will last

**Table 26. Proportion of food secure respondents* and average household dietary diversity score**

| | PICSA Only | LC only | PICSA+LC | No PICSA No LC | Female | Male | Difference between sex | Significance (p-value) |
|---|---|---|---|---|---|---|---|---|
| Frequency | 278 (70) | 194 (60) | 115 (63) | 419(67) | 550 (71) | 456(61) | 10 | - |
| Mean HDDS | 4.2 | 4.4 | 4.7 | 4.1 | 4.2 | 4.4 | -0.2 | 0.01 |
| N | 395 | 321 | 182 | 627 | 778 | 747 | | |

* Those who had enough food to meet their family's needs in the last 12 months

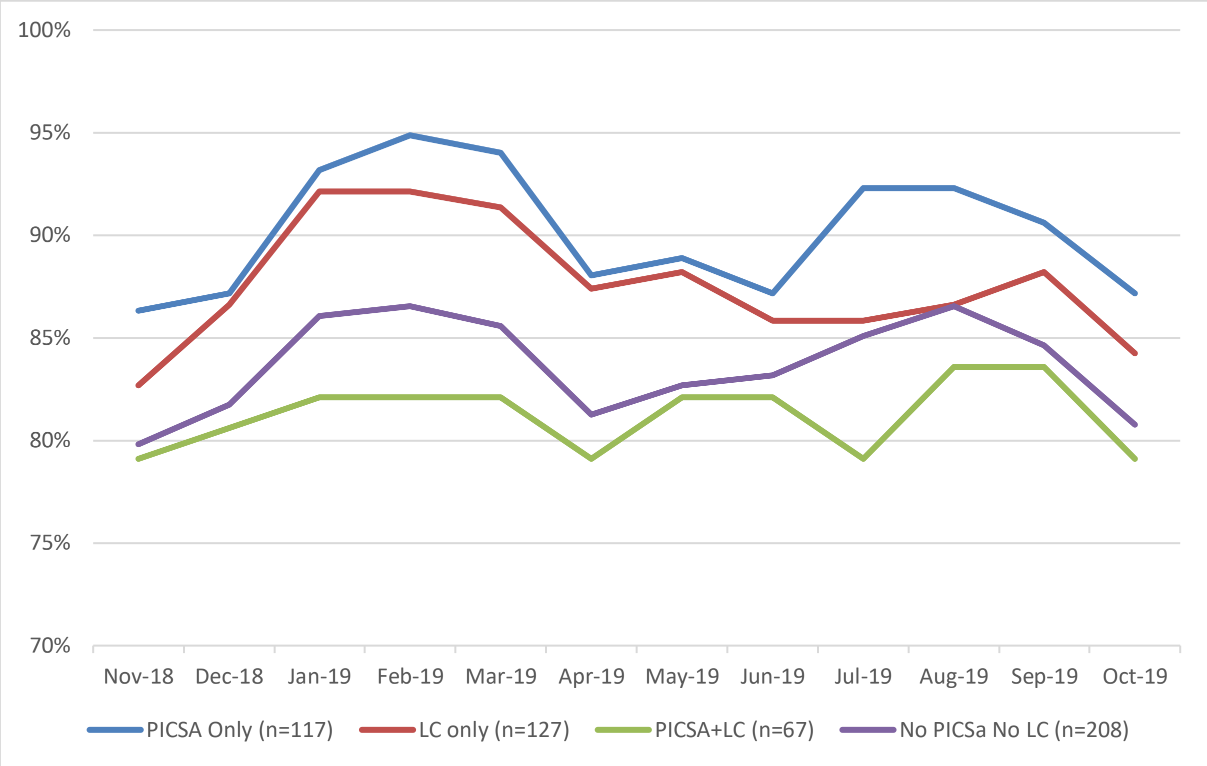


**Figure 47. Proportion of food secure respondents by month**

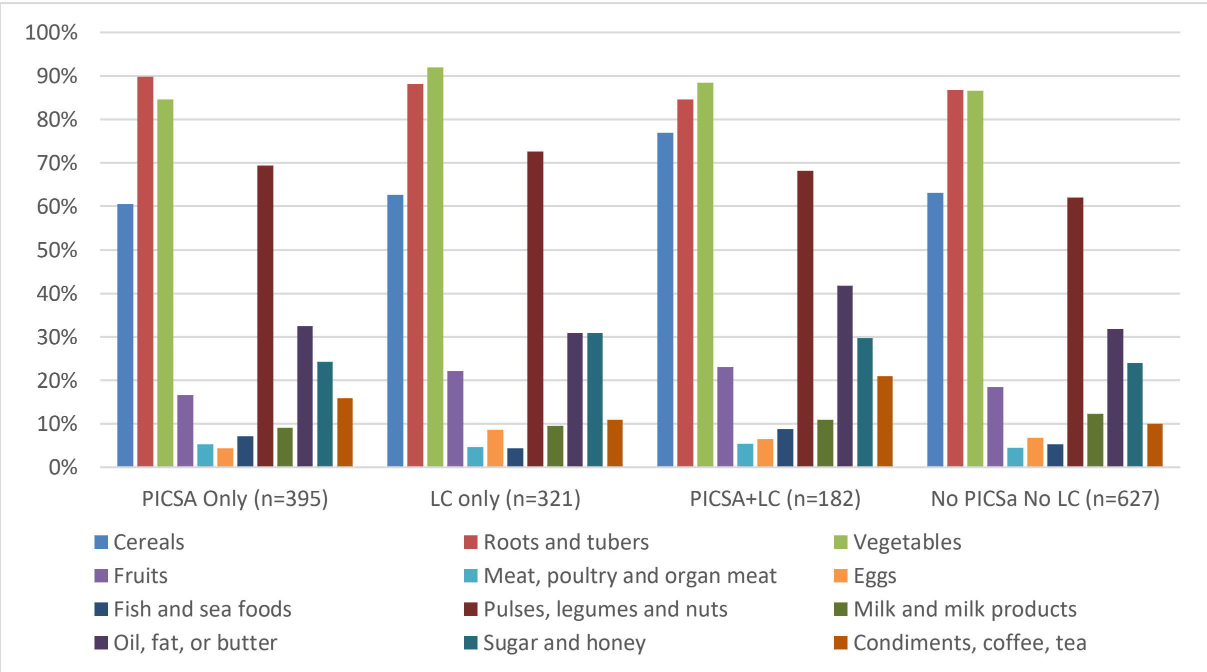


**Figure 48. Proportion of respondents consuming each food group**

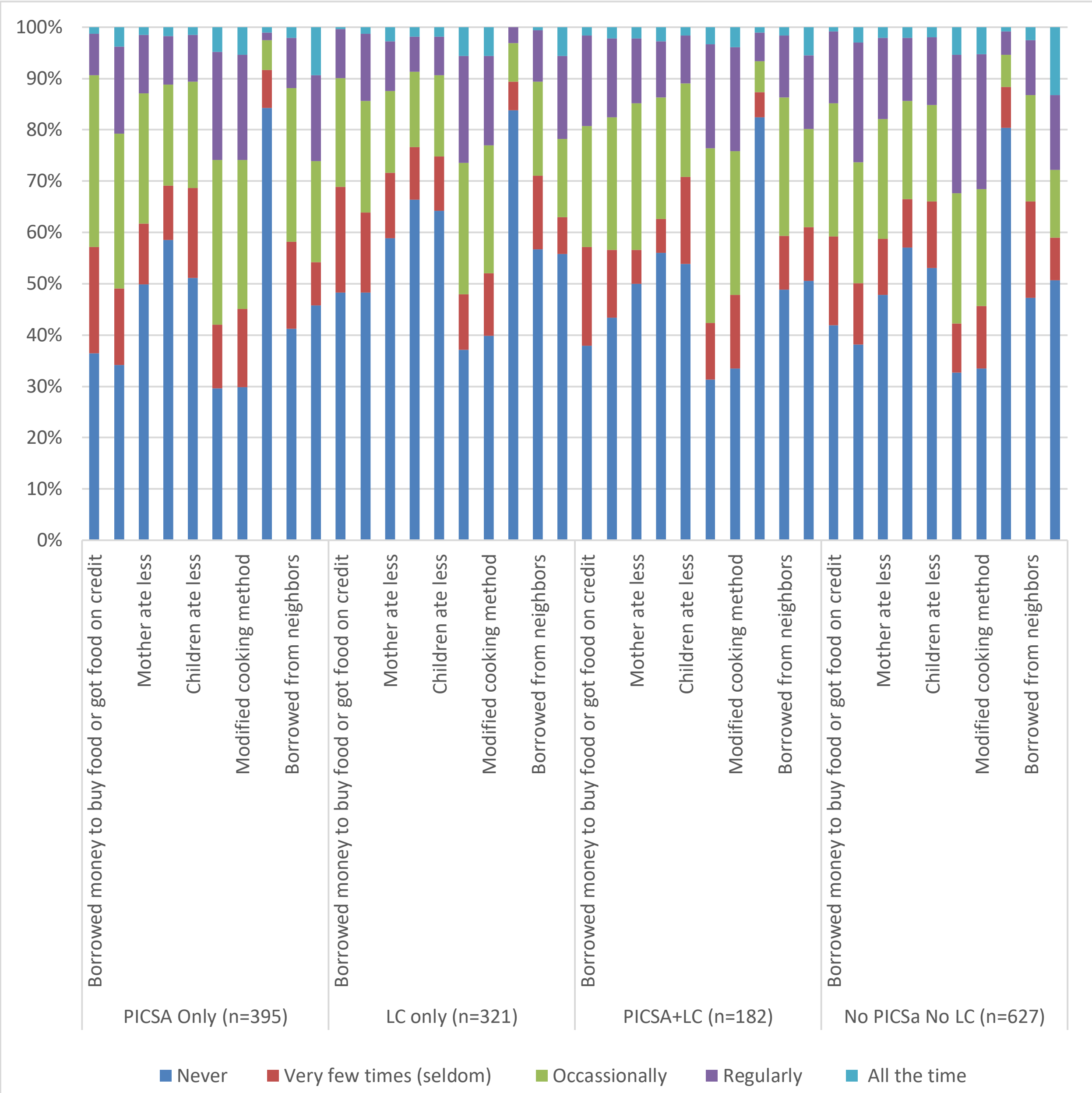


**Figure 49. Frequency of using coping mechanisms when faced with food shortages**

# Conclusion

This end line evaluation focused on assessing the effectiveness of the PICSA training and LCs to improve awareness, access and uptake of climate information services among smallholder farmers; and also assessing the impact of PICSA training in influencing farm decisions and management practices that improve farmers' welfare (e.g., crop productivity, food security).

The data were collected in 15 out of the 30 districts where the interventions were carried out. Results were disaggregated by the intervention categories, namely PICSA only, LC only, PICSA+LC and No PICSA no LC (control), while also exploring gender and regional differences.

The report highlights access and use of climate information, types of climate information accessed, sources and channels of the information, the ability of the respondents to use it and the impact of the use of climate information on household welfare indicators such as food and nutrition security. Most of the respondents had heard information on: weather forecast for the next 10 days, seasonal weather forecast for the total rainfall and seasonal weather forecast on timing onset of rains. However, most had not heard about historical seasonal rainfall information, meaning more sensitization for this kind of climate information is still needed. The majority of the farmers who had heard about the climate information had also accessed it. The project interventions promoted equity in the distribution of climate information as indicated by insignificant differences between proportions of males and females who accessed climate information.

Radio was the major source of climate information for all the intervention categories including the control group. However, more males than females accessed climate information through radio. Farmer promoters and PICSA trainings were also important sources of climate information, particularly for the LC only and PICSA+LC categories. Climate information was not majorly communicated through telephone although the majority of the respondents owned mobile phones. The majority of those who were in the LC only and PICSA+LC categories preferred talk shows on agriculture and climate and agro-climatic advisory programs compared to social and financial support amongst members, live shows airing on the radio and call-in to give feedback programs.

The most common information received in the PICSA training was on seasonal forecast of the start of the rains (onset), seasonal forecast of the total amount of rainfall and seasonal forecasts of cessation of rainfall, in that order. There was equity between females and males in attending PICSA trainings. The farmer promoters' strategy was successful with over 80% of the farmers getting their PICSA training through farmer promoters. A higher proportion of respondents in the PICSA+LC intervention category accessed different climate/weather information compared to those in the PICSA only category.

The majority of the respondents used the climate information to mostly make decisions on which crops to grow, types of crop varieties to plant, timing of planting and land preparation and when and how to prepare the land. There is a need to include more climate information within the extension service packages shared to farmers. This will enable the farmers to use the information in making decisions on more agricultural practices and adopt more climate-smart agricultural practices.

On the impact of the climate information, changing the way of managing crops and livestock enterprises were the major changes made on crop and livestock production as a result of using climate information. The main change in livelihood was increased scale of enterprises. These changes led to increased income/social standing for the respondents. The respondents also perceived significant improvement in: crop and livestock, production, ability to cope with climate risk, household food security status, household income and social standing due to the changes and use of climate information. However, the majority of the respondents did not perceive a significant reduction of costs of production as a result of using the climate information.

Most of the households had enough food to cater to the family's needs. However, the harvested cereal and legumes lasted the households an average of three months. The HDDS was still low with an average of 4.3 food groups. Respondents in the PICSA+LC intervention category had the highest HDDS of 4.8 while those in the control category had the lowest HDDS of 4.1. Roots and tubers and vegetables were the most consumed food groups, while meat, poultry and organ meat was the least consumed food group. There seem to be some positive impacts of the use of climate information on food security, but focus is also needed on how the information could help in achieving consumption of more diversified diets to improve the nutrition status of the respondents.

In conclusion, the project promoted equity in distribution of climate information among females and males. Conveying climate services through radio enables wider reach among the target farmers as most households own a radio or use a radio on their phone. Farmers who accessed climate information had higher crop output value and income as well as food security compared to those who did not receive any intervention. This suggests that climate information services inform decision making among farmers which enhances their productivity as well as their food and nutrition security.

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