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Factors Influencing Perception of Climate Variability and Change among Smallholder Farmers in Swaziland

Research Article

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Abstract

Climate change is a reality and has been confirmed by global scientific consensus to affect the productivity of agricultural ecosystems. Farmers perceive climate change differently and their perception of climate variables is key for rain-fed agriculture since farmers cope with climate change based on their perceptions of changing climate patterns. This study contributes to the emerging climate change, food security debate by investigating the factors affecting perception of climate variables and associated impact on local agriculture among smallholder farmers in Swaziland. The study drew empirical data from a household survey of 270 maize farming households in the Middleveld region of the kingdom of Swaziland. Using this data, the study analysis smallholders' perception of climate change and its associated impacts on local agriculture, crop yield and resulting food (in) security in Swaziland. Results suggest that most farmers perceived climatic changes and its negative impact on agriculture and considered climate change as a salient risk to their future livelihoods and food security. Different levels of perception were expressed in terms of climate change and the impact on traditional rain-fed agriculture. Age, education level, gender and access to climate information and extension services were found to significantly affected perception levels. Increased access to agricultural support services through extension officers is recommended along with improvement in accurate weather focusing and information dissemination to rural farmers. It is also recommended that for any policy directed at assisting farmers to perceive correctly or accurately climate variables, and rainfall in particular there is need to take on board the many years of farming experience of older farmers since they possess certain skills and indigenous knowledge that help them perceive accurately compared to their counterparts (younger farmers). Also, there is need to enhance farmers' education level, particularly to provide training for farmers on important skills that can enhance their accuracy of perception so that they can make necessary input investments and consequently get better yield hence improve their food security.

Keywords: Perception; Climate Change; Rainfed agriculture; Swaziland

Introduction

Climate change is a reality and has been confirmed by global scientific consensus to affect agricultural systems [1-3]. The fact that climate has changed in the past and will continue to change in the future underlines the need to understand how farmers perceive and adapt to climate change [4]. How farmers perceive climate change and variability is therefore crucial, particularly for rain fed agriculture since perception strongly affects how farmers deal with climate-induced risks and opportunities, and the precise nature of their behavioural responses to this perception will shape adaptation options, the process involved and adaptation outcomes [1,5] hence contribute negatively or positively to household food security.

Extensive body of literature is in existence on the climate change and food security nexus and how perception of climate change influence adaptive responses and resulting food (in) security [6-11]. Different factors have been identified to influence farmers' perception

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of climate change and variability and how these factors further influence adaptive responses, crop production and food security. Among the major factors identified to influence perception and hence adaptation include age, gender, education, access to extension services, access to weather information, household size, access to credit among others [4,12-15].

Older farmers tend to perceive accurately compared to their counterparts (younger farmers) due to their many years of farming experience and use of indigenous knowledge that help them perceive correctly climate variables such as rainfall in the beginning of each farming season. Likewise, exposure to education or training is also instrumental in improving perception of climate variables [15]. Educated farmers perceive better climate variables than those who have never been to school or underwent skills training. This may be due to their better understanding of the climate system and competence in interpretation of climate data. As such, exposure to weather information and extension services significantly influence perception of climate change [4,12,14,15] because it is based on such exposure and interpretation of these information that farmers can perceive better climate variables where again their understanding of the information become key.

The role of women in agriculture and food production has long been established in developing countries, thus the role of gender in perception cannot be underestimated. Agriculture in most patriarchal societies in the developing world is left in the hands of women (female farmers) as men migrate in search for job opportunities. Female farmers, due to increased exposure, therefore tend to perceive better climate variables such as rainfall. This is due to their farming experience, particularly in regions where agriculture relies exclusively on rainfall. For them to make investment decision, they need to first consider the behavior of the climate system and past rainfall trends.

The influence of farmers' perception and the factors affecting it remain crucial and cannot be overlooked if agricultural performance is to be improved in developing countries of the south where agriculture still relies heavily and almost exclusively on rainfall. With the current climate change crisis which has resulted in the shifting of farming seasons, unpredictable rainfall and increased weather variability [16-20] it is even more important to come up with strategies to help farmers to accurately perceive weather variables.

Farmers tend to invest more on input (make proper investment) when they perceive rainfall to be plenty or sufficient with the hope to get higher returns and neglect investment when they perceive rainfall to be low with the fear of making a loss (fear that their investment might go to waste) in case there is no rain (Figure 1) [21] which in turn affect crop yield and food security (Figure 2 & 3). For example, when farmers perceive rainfall to be plenty, they are not reluctant to invest more on inputs such as fertilize (apply more quantities of fertilizer per hectare as recommended) and invest less when perceiving low rainfall (Figure 1). As can be observed, majority 75 percent and 60 percent of farmers who perceived that rainfall will be plenty invested 201-250kg and 251-300kg of fertilizer, respectively as opposed to those who perceive that there will be low rainfall who invests less (Figure 1).

Poor input investment, as expected, affect crop productivity. This means that perception indirectly affect crop yield through poor input investment (Figure 2). Farmers who perceived that rainfall will be plenty (42.7%) or at least average (43.8%)obtained better yield per hectare (above 2500kg of maize) due to proper investment in input while more than half (53.4%)of farmers who perceived that rains will be low got low yield (below 500kg) due to insufficient investment in inputs (Figure 2).

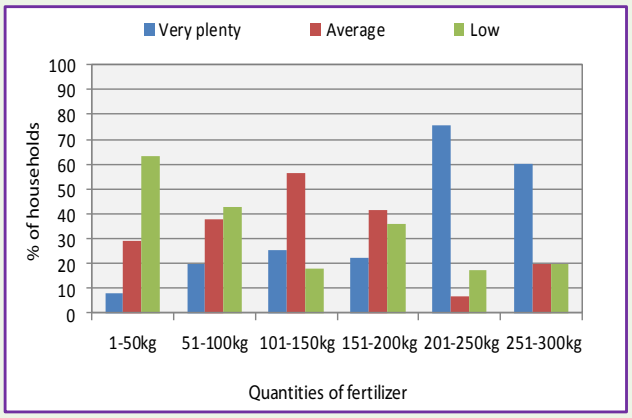

Figure 1: Quantities of input use (fertilizer) in relation to perception of rainfall. *Source:* Mamba, Salam & Peter (2015).

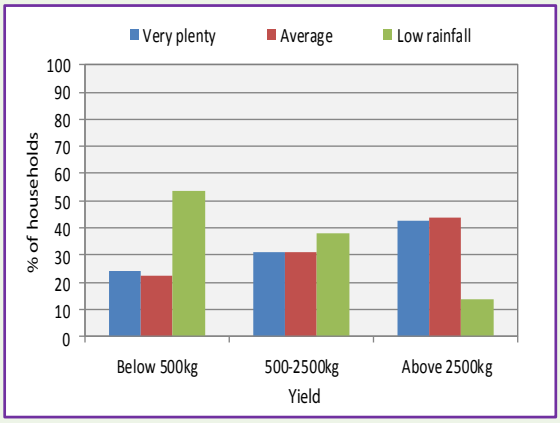

Figure 2: Crop yield by perception. Source: Mamba, Salam & Peter (2015).

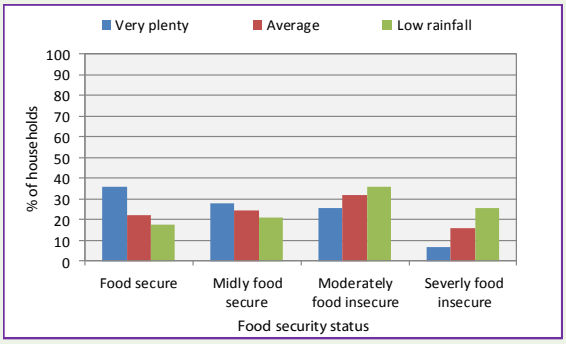

Figure 3: Food security status in relation to perception. Source: Mamba, Salam & Peter (2015).

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Shortfall in food production has a direct impact on the food security status of affected households, mainly for rural households where food availability is ensured, above all things through food production. However, food security goes beyond producing food to include issues of access (linked also to purchasing power of household) utilization (which related to nutrition and diet) and stability of food supply (which alludes to seasonal variation in supply) thus the relationship between food security and perception was not a strong and not significant (when tested for significance), but does reflect the relationship between the two (Figure 3). Majority of those farmers who perceived rainfall to be plenty were either food secure (35.6%), mildly food secure (27.8%) or at least moderately food insecure (25.8%) (Figure 3).

How farmers perceive climate variables is crucial for rain-fed agriculture as it influence investment decision in relation to amount of input used. Farmers invest adequately or appropriately when they perceive rainfall to be plenty and abandon investment when they perceive rainfall to be low. Likewise, even in favorable years where rainfall is sufficient, farmers might neglect making proper investment in inputs resulting to poor crop yield amidst plenty of rainfall due to poor or wrong perception of climate change and weather variables such as rainfall in the onset of farming season. The importance of proper perception therefore cannot be overemphasized.

In Swaziland, like in many other developing countries, the agricultural sector is highly dependent on rain-fed production and therefore vulnerable to weather shocks. Maize is the primary staple crop and is widely grown by smallholder farmers throughout the country, with a dual sorghum-maize regime found in the Lowveld region and fewer parts of the Middleveld of Swaziland. Among the smallholder farmers almost all production is rain-fed with very few farmers using mechanized irrigation. Climate change therefore has significantly reduced agricultural production and exacerbated poverty and food insecurity in the kingdom [22,23].

Drought and seasonal variation and rainfall variability has been a major threat to food security, with large declines in maize yield consistently occurring in seasons with below normal rainfall [22,24]. Studies have been conducted in Swaziland to quantify the impact of climate change on agricultural yields, and how farmers are responding to such changes. Among the existing climate change and food security discussion in the country is that farmers perceive climate change and variability differently and that their perception influence investment decisions, crop yield and food security [5].

It is important therefore that farmers perceive climate change and variability correctly as this is the basis for their adaptation [1,12,13,14].

The present study makes several contributions to the existing climate change and food security debate and literature on how best to interrogate climate trends, impacts and adaptation strategies and food security amongst smallholder farmers in Swaziland by building on the existing climate change and food security literature.

Methodology

Methodologically, the study was mainly exploratory in design and utilized the use of both primary and secondary sources. Methodological triangulation was employed to collect data using a structured, pre-coded household questionnaire which was administered to the selected households. Focus group discussions (with community elders) and observation were also used to harness diverse ideas about climate change perception and factors that influence it in the study area and assisted in 'cross-checking' the results.

Farmers' perception of climate change and weather variability was established using the modified climate change and food security framework. The framework was used to establish how farmers perceived climate change and weather variability and how their perception influenced adaptive responses of food systems and food system activities.

Selection of Study Area and Subjects

The study employed multi-stage sampling. The first stage involved purposive sampling of the Middleveld (due to its wide range of agro-ecological conditions and being 'home' for most maize farmers), second stage involved the selection of three constituencies falling within the Middleveld region from which communities were then selected (both spatially selected). Spatial sampling was found more ideal since it is recommended for studies where spatial variations in the distribution of phenomena over an area are studied such as rainfall and soils to avoid sampling areas with the same physiographic characteristics [14]. A total of 270 households with 90 from each constituency were selected to be included in the study.

Data Analysis and Presentation

Data collected through use of questionnaires was analyzed through the use of Statistical Package for Social Sciences (SPSS) version 20. The climate parameters, that is, temperature and rainfall from the department of meteorological service was used to determine accuracy of famers perception of climatic variables such as rainfall. Frequencies and cross tabulations were used to find relationships amongst the variables. Thematic coding was used to analyze data collected from the focus group discussions and graphical techniques (with some form of narrations) were used to present data.

Results and Discussion

While farmers are able to note that the climate is changing and rightly observed significant changes in mean rainfall, frequency, intensity and duration of droughts in Swaziland [22,5], majority of farmers face a serious challenge in perceiving correctly the amount of rainfall to expect in the beginning of each farming season, when this is the most crucial thing for most rural farmers relying on rainfall for their farming activities. In a study conducted in the Middleveld region of Swaziland, it transpired that among 270 farmers studied, majority (66%) wrongly perceived the amount of rainfall in the beginning of the farming season (Figure 4) to be below average when the rainfall for that farming season was actually plenty and above average (Figure 5) (any amount of rainfall above the median indicate plenty and vice versa) (Figure 5).

It was very important, therefore, to conduct a survey to determine the different factors that influence farmer's perception in Swaziland. It has already been established that perception of climate variables such as rainfall, influence investment decision and consequently crop yield and food security among farming households in Swaziland [5].

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Determining factors that influence perception was therefore crucial not only to help farmers perceive correctly (which is key for Swazi maize farmers and every famer relying on rain-fed agriculture) but also for agriculture extension officers and policy makers to make sure that efforts directed to improving the performance of the agricultural sector could not be misplaced but be correctly directed to such factors in an effort to improve crop productivity and enhance food security among rural (and urban) households in Swaziland.

Education level and perception of climate change and variability

Education levels of farmers were cross tabulated with perception to determine if the level of education of the farmers has an influence on how they perceive the amount of rainfall in the start of a farming season. The survey found that education level influence perception. Farmers who perceived correctly (plenty) the amount of rainfall expected in the beginning of the farming season are those who either have training in certain skills (28.9%), or those who went up to tertiary level in their education (25.5%) or at least secondary level (25.6) (Figure 6). It was interesting to note that majority of those without any form of education wrongly perceived the amount of rainfall as low (32.2%) or average (24.4) (Figure 6) when the rainfall was actually plenty or above average (Figure 5).

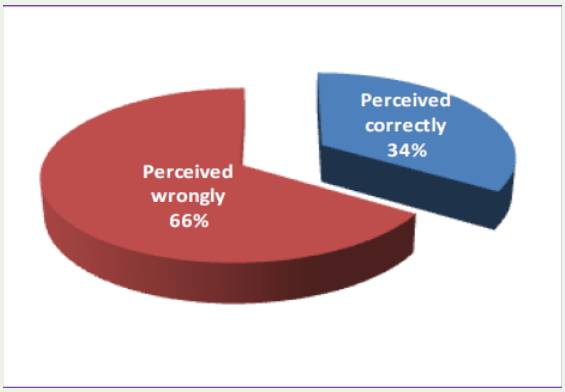

Figure 4: Perception of rainfall at the start of farming season.

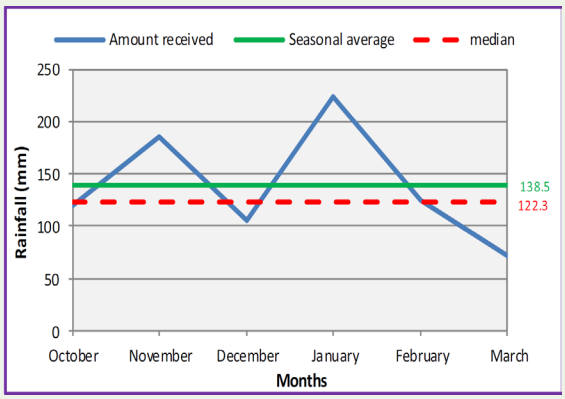

Figure 5: Amount of rainfall received in the start of farming season. Source: Swaziland Meteorological Department.

Age and perception

The survey also found how farmers perceive climate variables and the amount of rainfall in particular is also influence by the age of the farmer. Majority of farmers who perceived correctly (46.7%) happen to be those above the age of 55 (Figure 7) and below 34 years were not that accurate in their perception as majority (15.6%) perceived wrongly in the age group 15-34 years and none perceived correctly below the age of 15 years.

From the results above, it is clear that age and education level of farmers influence how they perceive climate variables. These findings are consistent with Dhaka et al. findings who also observed that farmers' education level and, age influence their perception of climate variability and change. Dhaka observe that age is directly linked to farming experience. Old farmers possess indigenous knowledge on how to perceive climate variables, particularly the amount of rainfall in the beginning of each farming season. Such knowledge, as the results indicate, is not possessed by the younger farmers but the older ones, and need to be passed on to the young generation to help them perceive correctly important climate variables such as rainfall, and that should be the focus of agricultural policies aimed at improving food production.

With respect to education, it can be observed that education also has a role to play in influencing the way farmers perceive climate change and variability, which is consistent with Kamruzzaman [15], findings who also observed that farmers with higher level of education perceived environmental factor and climate variables correctly and vice versa. This means that an effort to help farmers perceive correctly needs to also focus on improving the level of education of farmers, particularly to equip then with skills relating to farming as it could be observed that farmers who possess skills or has been trained in certain skills perceive climate variables better followed by those with tertiary or at least secondary education. This suggests that to help improve how farmers perceive of climate variables, education (both formal and informal) must be emphasized.

Farmers' perception and access to weather data and extension services

Another factor that was found to influence farmers' perception of climate change and variability was access to extension services. Majority of farmers who correctly perceived rainfall to be plenty (79.9%) in the start of the farming season are those with access to extension services and majority of those who perceived rainfall to be either average (66.2%) or low (78.2%) and happen to perceive wrongly are those without access to extension services (Figure 8). Similarly, access to weather information also shapes farmers' perception climate variables. Majority of farmers with access to weather information (78.6%) perceived correctly the amount of rainfall in the beginning of the farming season compared to those with no access (Figure 9) while majority of those who lack such access (59.2%) wrongly perceived the amount of rainfall.

The findings indicate that access to extension services and weather information affects how farmers perceive climate variables. Those farmers with access to extension services and weather data tend to perceive correctly the amount of rainfall at the start of a

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farming season. These findings mirror those by Legesse [12] in a study conducted in Doba district in Ethiopia who also found that frequency of extension contact and training are the determinant factors influencing perception and adaptation strategies which is also similar to Kamruzzaman [15] findings in a study conducted in Sylhet Hilly Region in Bangladesh who also observe that access to weather information influence farmers' perception. This means that access to extension services needs to be improved as a step towards improving farmers' perception of climate change and variability.

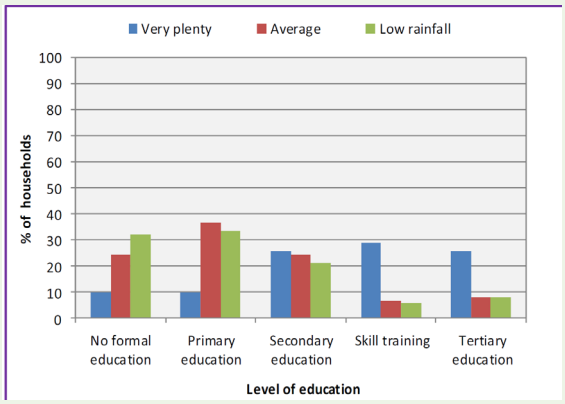

Figure 6: Perception by education level.

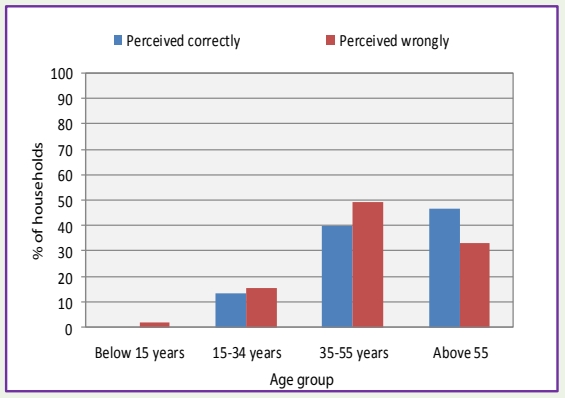

Figure 7: Perception by age.

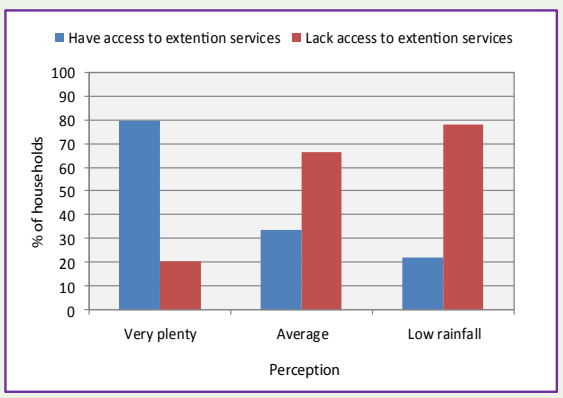

Figure 8: Perception by access to extension service.

It was also interesting to note that a radio plays a major role in disseminating information on weather and quite instrumental in shaping farmers' perception of climate variables, particularly in Swaziland. Majority of those who correctly perceived rainfall as plenty (71.3%) accessed weather information through radios or at least newspapers (42.1%) (Figure 10). Although some farmers rely on their relatives or neighbours for weather information, this practice is not recommended since this information is not always reliable.

It is not surprising that radios play a major role in weather information dissemination in Swaziland because majority of farmers have access to radio hence are able to access weather information on a daily basis. Although newspapers are also a good source of weather information (which is also disseminated daily) in Swaziland, most rural farmers do not have daily access to newspapers and others cannot read English (language used by main newspapers in Swaziland).

Farmers' perception and gender

Gender was also analyzed to determine if it influences perception. The results indicate that female farmers tend to perceive correctly since majority (66.3%) of the female farmers interviewed perceived rainfall as plenty which was correct perception compared to their counterparts (33.7%) (Figure 11).

These findings are similar to Deressa et al. findings who also observed that gender influence how farmers perceive climate change and variability [4]. This was not surprising for Swaziland because women are the most active in farming compared to men. It is expected, therefore that based on their level of engagement in farming activities which gives them experience, they are well positioned to perceive correctly the amount of rainfall in the beginning of each farming season, which is what they do every year.

Conclusion

There is a global consensus about the reality of climate change and its harmful effects on the agricultural sector, and for rain-fed agriculture in particular. Scholars observe that climate change is not a feature of the world that we might end but one that we need to live with. As such, there is need for proactive strategies that can help us adapt to the fast changing climate. One way to deal with the effects of climate change on agricultural productivity is to improve the way small holder farmers perceive climate change and climate variables, particularly the amount of rainfall expected in the start of every farming season in order to make appropriate investment decisions.

Different Farmers perceive climate change and climate variables differently. Among the factors identified to affect their perception include education levels, age, gender, famers' access to weather information and extension services. Farmers who perceived rainfall to be plenty and happen to perceive correctly were mainly those who are educated either with skills training, tertiary or secondary education. Majority of farmers who perceived rainfall to be average or low and happen to perceive wrongly were those with no formal education. Age was also found to significantly influence perception. Majority of farmers above the age of 55 years perceived correctly the

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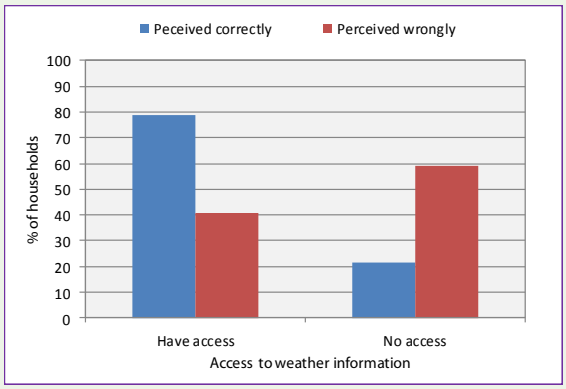

Figure 9: Perception by access to weather information.

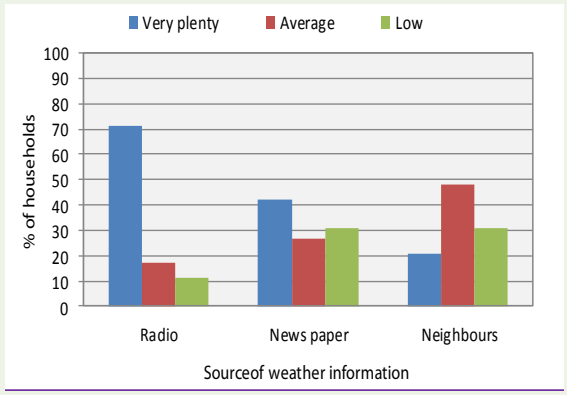

Figure 10: Perception by source of weather information.

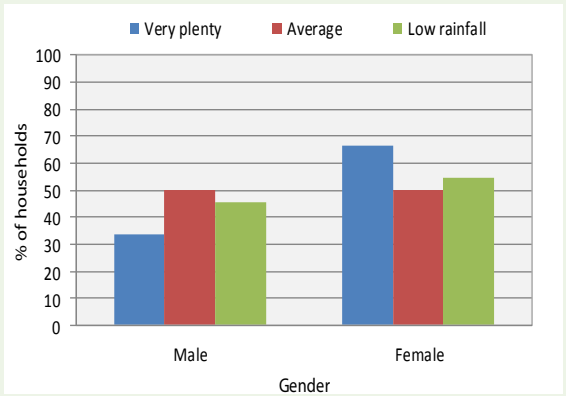

Figure 11: perception by gender.

amount of rainfall expected in the start of the farming season, while majority in the other age groups: 15-34 and 35-55 perceived wrongly with no one who perceived correctly among the youngest farmers (age below 15 years).

Older farmers are, therefore seen to perceive better than their counterparts, which alludes to the importance of age which is directly linked to farmers' farming experience and use of indigenous knowledge which help them perceive not only the onset of rains but also the expected amount. These findings are consistent with Dhaka et al. findings in their study conducted in Bundi district in India on factors affecting farmers' perception of climate change that identified education level, age and farming experience to affect perception. This means that based on farming experience, old farmers possess knowledge that can help young farmers to be able to perceive correctly thus there is need to utilize this knowledge and there is also need to educate farmers to help them improve their perception of climate and other farming-related phenomena.

Gender also plays a major role in enhancing farmers' perception. Females, due to their exposure and involvement in farming activities tend to perceive climate variables better than males. Efforts to help males perceive correctly are needed and more programs are also needed to enhance female perception as the back born of the agricultural sector

Access to extension services and weather information is also crucial in shaping perception. Those farmers with access to extension services and weather information tend to perceive correctly alluding to the importance of improving farmers' access to weather data and agricultural extension services through improved weather focusing and information dissemination. It is therefore important that all the factors influencing farmers perception are taken into consideration to improve their perception because these factors further influence households' choice of adaptation strategies to climate as scholars have rightly observed [12,25,14,26,27].

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