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FEATURES OF RADIO, AUDIO, AND TEXT-BASED DISSEMINATION CHANNELS FOR EFFECTIVE CLIMATE INFORMATION SERVICES AMONG FARMERS IN KENYA AND ETHIOPIA

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Abstract: This study examined the features of radio, audio, and text-based dissemination channels for effective This study examined the features of radio, audio, and text-based dissemination channels for effective climate information services among 171 and 360 farmers randomly selected in Kenya and Ethiopia. The findings show that peculiar characteristics of the dissemination channels influenced farmers' reception of the climate information. The results further show differences in the effectiveness of IVR ($t = 4.626$, $p < 0.05$), Radio ($t = 9.097$, $p < 0.05$), newsletters ($t= 6.859$ $p < 0.05$), and SMS ($t = 7.582$ $p < 0.05$). The characteristics of dissemination channels must be properly examined before their deployment in climate service provision.

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Key words*: Climate information, dissemination, channels, Short Message Service (SMS), radio messages, Interactive Voice Response (IVR), and Newsletters*

INTRODUCTION

Farming as a weather-dependent activity has made farmers monitor and observe weather very closely with traditional knowledge and experience to adapt their agricultural practices, however, changing climates are affecting indigenous knowledge practices, because high incidence and frequency of droughts, and floods causing damage to agriculture, human health, and rural livelihoods [1].

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The innovative management of climate risks offers win-win solutions for the improvement of agricultural practices and food security as well as enhancing the resilience of production systems. The prominent innovative management includes the development of new varieties that are early maturing, drought, pest, and disease-resistant. However, the provision of climate information services enables farmers to explore the opportunities of the window of operation available despite the uncertainty of climatic variables if these are known and adequate preparedness made before the onset through a decision support system that superimposes seasonal climate forecasts, weather index, and early warning on the life cycle of crops from pre to post farm operations.

These advisory services are often through agricultural extension services. Farmers' perception that no one source of information is sufficient, [2], has led to them obtaining information from radio, television, extension agents, model farmers, friends, and relatives, and [3] stated that farmers rely on multiple external sources of information because the efficiency of economic activities in agriculture critically depends on the flow of information relating to farming decisions. There exist heterogeneous impacts of access to agricultural information considering different sources and there a is need for region-specific customization of agricultural information [4], while [5] reported that the credibility of information sources, and the usefulness of the information positively and significantly influence farmers' adoption of biofertilizers.

Globally, the rate of transfer is a greater constraint than the non-availability of technologies and low productivity among farmers [6], is associated with poor acquisition and adoption of improved inputs and technology. The timely and relevant information empowers farmers to make the right choices; because information is one of the most vital resources for awareness, knowledge, and power to increase and sustain agricultural production [7].

Information may originate from different sources [8], to assist farmers in accessing, stimulating, acquiring, and analyzing the feasibility and profitability of agricultural enterprises. Climate information helps smallholder farmers for adaptation to weather variability; thus, information must be accessible, credible, timely, and location-specific and eliminate mismatches of services and users' needs [9, 10]. Farmers' resource endowment determines the information channels used [11], while [12] and [13] stated that generated agricultural information must be presented in usable form by end users, and repackaged into audio, text, graphic, image, and video forms. Audio, audio-visual, and graphical formats of information could be made available for the farmers in various agro-enterprises [14]. Many farmers who cannot read, access agricultural information in audio formats such as radio [15]. Due to preferences for audio-based messages and other factors, phone-based voice messages were used to convert text-based information to audio messages [16]. The use of interactive voice response increased awareness and adoption of agricultural technologies [17]. The main reason for using podcasts to learn about farming practices is the ability to multi-task whilst listening [18]. A library of audio messages about diverse agricultural topics, previously recorded by extension agents, researchers, and experienced farmers, can be accessed through telephone calls [19]. The access to automated audio pre-recorded messages reduced the workload of extension agents and increased access to and active engagement with agricultural advice in Tanzania [20].

The provision of audio messages through a hotline is most effective by focusing on knowledge-based interventions without practical demonstration activities [19], however, [21] found that there is an overall low preference for audio media, both radio and podcasts in the communication of information on nature-related topics.

This paper examined the features of dissemination channels for effective climate information services among farmers in Kenya and Ethiopia because a multi-stakeholder approach was used to develop climate information services using Decision Support System (DSS) tools that combined climatic parameters and crop management practices on specific crop yields and subsequently generate climate-smart agro-advisory. This tool integrated data from various types and sources to generate advisories along the life-cycle of crops specifying agronomic practices within a time limit for successful production that maximized the climatic conditions and physiological processes of the crop. The advisories generated were then supplied to farmers and other value-chain actors through Short Message Service (SMS), radio messages, Interactive Voice Response (IVR), and Newsletters). Several interventions in the climate services provision have deployed dissemination channels without adequate examination of the features of the channels. Similarly, several researches have focused on information sources and channels without adequate exploration of the characteristics of the channels used in climate information services. This study determined the features of dissemination channels used for climate information services from farmers' perspectives.

MATERIAL AND METHODS

The study was carried out in Ada'a district and Embu County in Ethiopia and Kenya respectively. These countries are adjacent to each other and have certain similar characteristics running across the countries. Kenya and Ethiopia have diverse topography, rainfall, and temperature, with most of the population in rural areas and engaging in smallholder farming. Kenya and Ethiopia have been experiencing extreme weather events, severe droughts, flooding high incidences. The recurrence and intensity of droughts have also increased with a lot of the populace living on famine relief and aid.

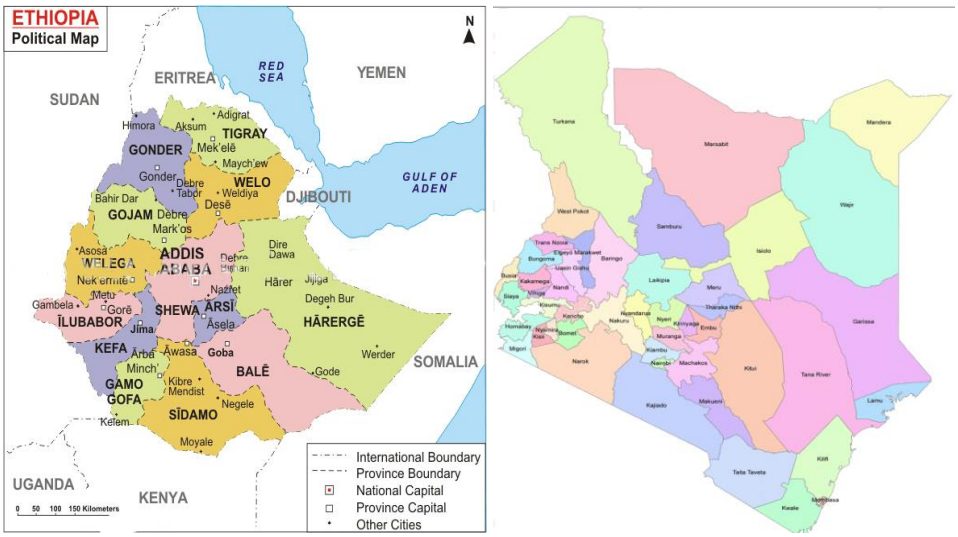


Figure 1. Map of Ethiopia and Kenya showing regions and counties respectively

The low productivity could also be attributed to the degradation of land, poor water management, and low level of technology usage Approximately, 68% of the males were engage in agricultural work compared with 48% of female [22].

The population of the study was all beneficiaries of the agroweather project in Ada'a District and Embu County in Ethiopia and Kenya respectively. The tool covered chickpea, lentils, teff, and wheat farmers in Ethiopia while in Kenya tea, coffee sorghum, and maize and beans farmers. In both countries, farmers were exposed to agricultural radio through local radio services, received bulletins, and newsletters regularly, and enrolled on Ethicom and Safaricom as the internet service provider to offer SMS and interactive voice response services (IVRs) with a total of 1720 and 4500 farmers as sampling frame in Ada and Embu respectively. A simple random sampling was used to select 171 and 360 farmers respectively. Data for the features of Short Message Service (SMS), radio messages, Interactive Voice Response (IVR), and Newsletters as dissemination channels was collected through the use of a structured questionnaire, earlier subjected to face validity among the different national stakeholders. Data was analysed by using the Statistical Package for Social Sciences (SPSS) with frequency counts, percentages used to describe the data, and t-tests to compare farmers' perspectives from the two countries. The model specifications for the t-test is:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S1^2}{N1} + \frac{S2^2}{N2}}} \quad (1)$$

Where:

X_1 = effectiveness of dissemination channels in Kenya,

X_2 = effectiveness of dissemination channels in Ethiopia,

S_1^2 = variance of X_1 variable,

S_2^2 = variance of X_2 variable,

N_1 = number of farmers in Kenya,

N_2 = number of farmers in Ethiopia.

RESULTS AND DISCUSSION

The results and discussions are organized into two sections on radio, and audio, consisting of radio and interactive voice response and text-based dissemination channels of newsletters and short-message service for effective climate information services among farmers in Kenya and Ethiopia.

Radio

Farmers in Kenya and Ethiopia rate the features of radio as a channel for disseminating climate information on a 28-item 2-point Likert-type scale of Yes (2) and No (1). The prominent features rated by many farmers were: I practice the message from the radio program (57.2), the time of the agricultural radio program is appropriate (60.3), the Agricultural radio program covers climatic elements (57.5), I have learned from the program (76.9), I want the program repeated (64.4).

This result implies that farmers are interested in the use of radio for receiving climate information as they were able to understand the messages.

It also stresses how radio has accomplished the provision of climate information among farmers. Radio is the major channel for accessing climate information [23]. Agricultural producers in Kansas use the Internet, mobile devices, and radio, as well as print and radio sources, to gain climate information [24]. Radio is the most prominent source of information in Africa and its ownership influences weather and climate decision-making in Africa [25], and according to [26], many farmers preferred radio as an important source of information due to the elimination of the literacy challenges. In Southern Ethiopia, radio is widely used to disseminate, technologies, provide market information and announce new varieties [27].

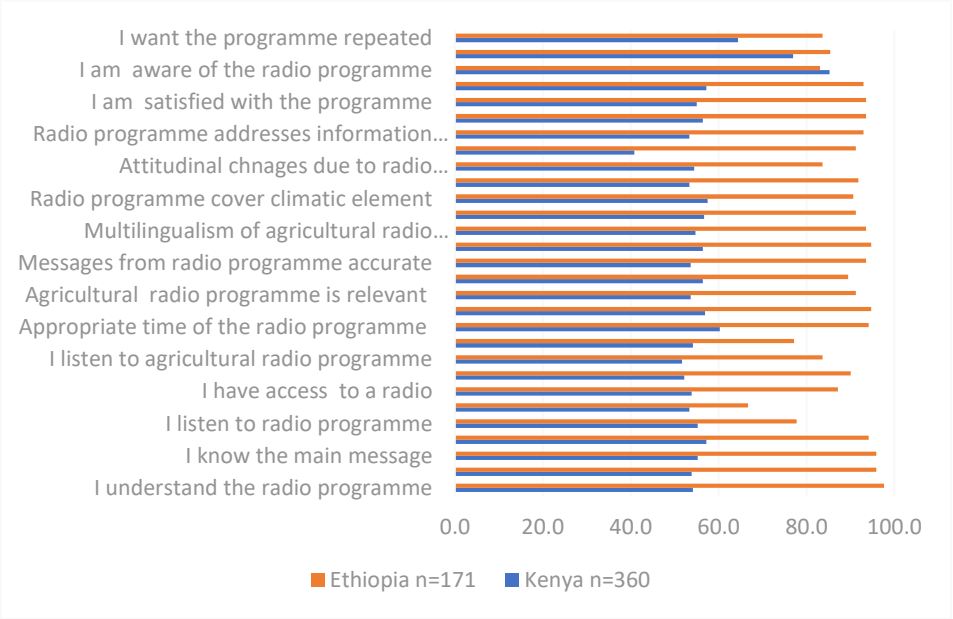


Figure 2. Features of Radio use for climate information among farmers

Interactive Voice Response

Kenyan and Ethiopian farmers' perspectives on the use of interactive voice response for climate information services provision were rated on 25 items using a 2-point Likert type scale of Yes (2) and No (1).
The prominent features rated by the majority of farmers were I am satisfied with calls on IVR (62.5), Calls to IVR are free (64.4), IVR Calls are authenticated (55.6), IVR allows frequent calls (54.4), IVR allows the use of any mobile phone (53.1), there is a lot of errors (97.1%), IVR responds to different topics made by callers at the same time(94.3%), Most queries are abandoned on IVR(97.1%) and Peak voice traffic is very frequent(94.3%).
This result implies that farmers are fascinated by the use of IVR for receiving climate information as they were able to appreciate the messages. It also emphasizes how IVR has fulfilled the role of provision of climate information among farmers.
In Uganda, many farmers used mobile phones to access agricultural inputs and market information [28].

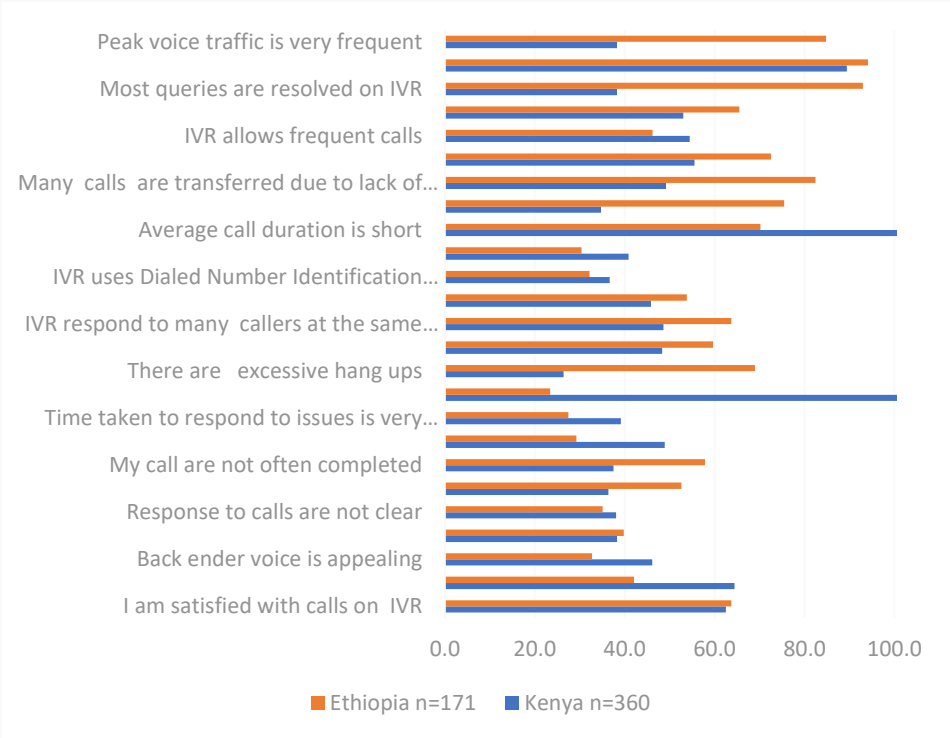


Figure 3. Features of interactive voice response use for climate information among farmers

Short Message Services

In Kenya, farmers rated the features of short message service use for climate information services on 23- items using a 2-point Likert-type scale of Yes (2) and No (1).

The prominent features rated by at least 50 percent of the farmers were Push-type eWarnings SMS (59.7%), Cost of SMS is right (57.2%), SMS is from the reliable source of data (58.3%), SMS gives an accurate source of data (55.6%), I can read SMS (58.9%), I understand SMS (57.0%), The user needs no further information (58.3%). In Ethiopia, farmers' responses were 94.3 percent each for the cost of SMS is right, Period SMS started is adequate, SMS is from a reliable source of data, SMS is timely and SMS is reliable. These results imply that farmers can maneuver the use of SMS for receiving information as they may not encounter many difficulties with the use of SMS. It is also a reflection of how SMS has fared among farmers in its use for the provision of climate information to farmers. Mobile phone-enabled agricultural information provision services have revolutionized agriculture and rural livelihoods in Africa [29] and [30] found that in response to the rapidly expanding demand for information, mobile phone-based weather and market information should be current and provide client-specific information.
Information dissemination through mobile phones is enhanced through cascaded information to farm level, location-specific and reliable forecasts; embedded in existing local networks, use of local language and available channels [31], while [32] indicated that the majority of farmers use SMS for agricultural marketing prices in Karnataka State. The application of internet-based radio and mobile phone systems has revolutionized weather forecast dissemination [33].

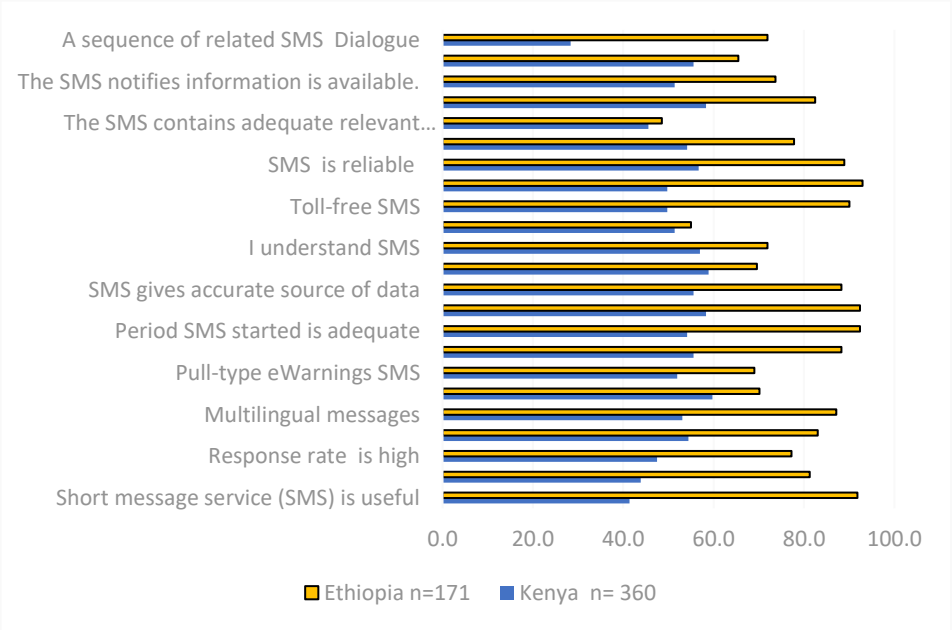


Figure 4. Features of short message service use for climate information among farmers

Newsletters

Farmers' perspectives on the use of newsletters for climate information services provision were rated on 23 items using a 2-point Likert-type scale of Yes (2) and No (1).

The prominent features rated by farmers were my practices have changed due to information in the newsletter (92.22%), farmers of different crops are covered (56.7%), farmers of different age groups are covered (57.2%), male and female farmers are covered (56.9%), many people read a copy of the newsletter (55.8%), the paper has been strong enough to hand around without disintegrating (55%) in both Kenya and Ethiopia. These results imply that farmers are receptive to the use of newsletters for receiving climate information as they can handle and interpret the content. It also echoes how newsletters have performed among farmers in their use for the provision of climate information to farmers. An iterative loop of information products, efficient information delivery, use, and enhanced knowledge would help overcome climate change challenges [34].
The use of newsletters as a dissemination channel promotes the scale and reliability of the source of climate forecasts, which serve as determinants of adoption and [35] found that the Coffee Wilt Programme (RCWP) utilized newsletters in several languages in addition to radio broadcasts to disseminate information.

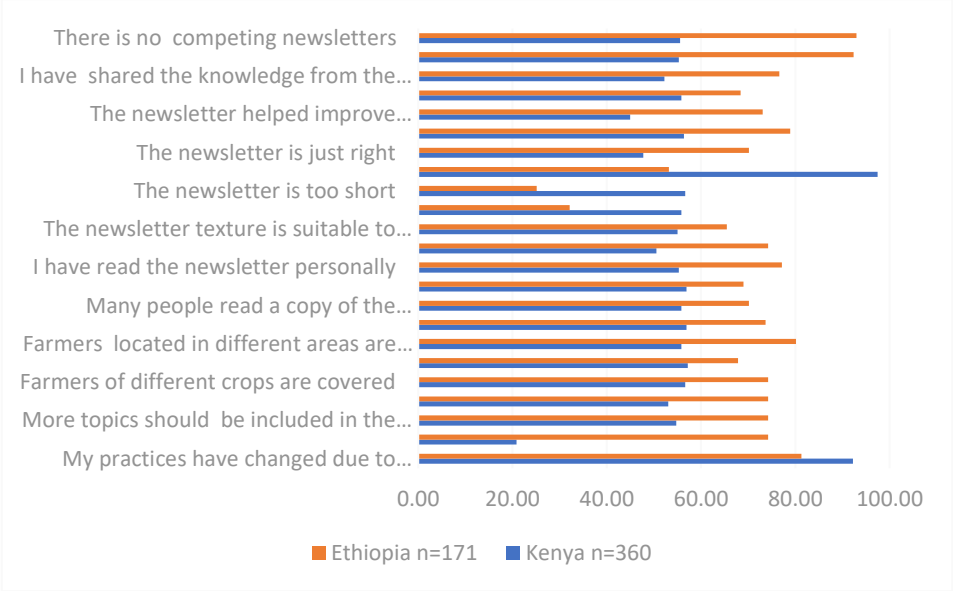


Figure 5. Features of newsletters use for climate information among farmers

Impact of use climate information

The results on the impact of the use of climate information were presented in the figure 6 from Kenya and Ethiopian 2farmers perspectives. The results state that improved use of farm resources (90%), changes in planting practices (85%), changes in harvesting practices (83%) prevention of pest and disease attacks (88%). All the impacts listed received at least an 80% percent positive rating by the farmers, including prevention of crop field losses, improved use of farm resources, prevention of pest and disease attacks, effective utilization of natural resources, increased productivity, environmentally friendly practices, changes in planting practices, changes in weeding practices, changes in harvesting practices and information content are useful.

Farmers' adaptation strategies to climate change include diversifying crops, use of new varieties, and changing the dates of farm operations [36].

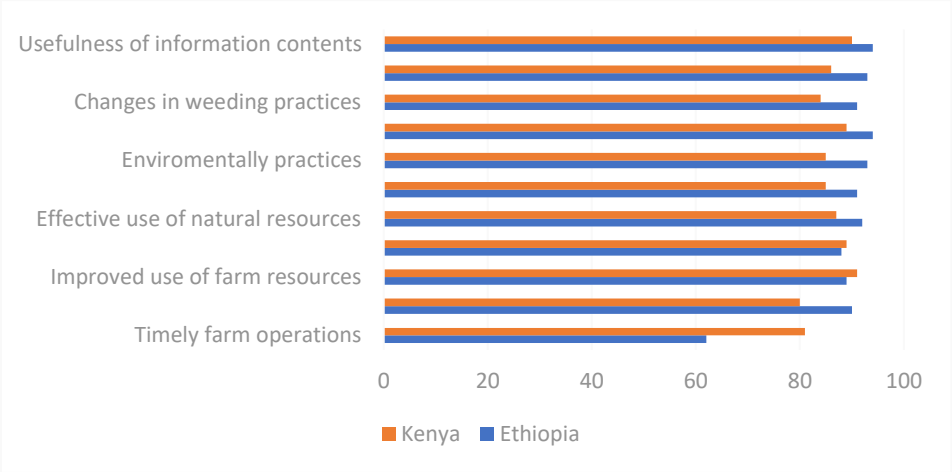


Figure 6. Impacts of climate information

Constraints to the use of climate information

Farmers from Kenya and Ethiopia expressed constraints to the use of climate services with at least 50 percent proportion as technical ability of the farmers, associated cost, availability of inputs Difficulty index, and Time lag of the messages. The constraints indicated by farmers have implications for the nature and level of technical language used on climate messages, and the provision of means or links to credit sources for farmers to be able to afford the associated cost and inputs that will be jointly demanded for the adoption of climate messages. The use of information communication technologies devices enhances delivery and adoption of agrometeorology information [37] and [38] found that poor infrastructure has limited the functionality of ICT in rural areas.

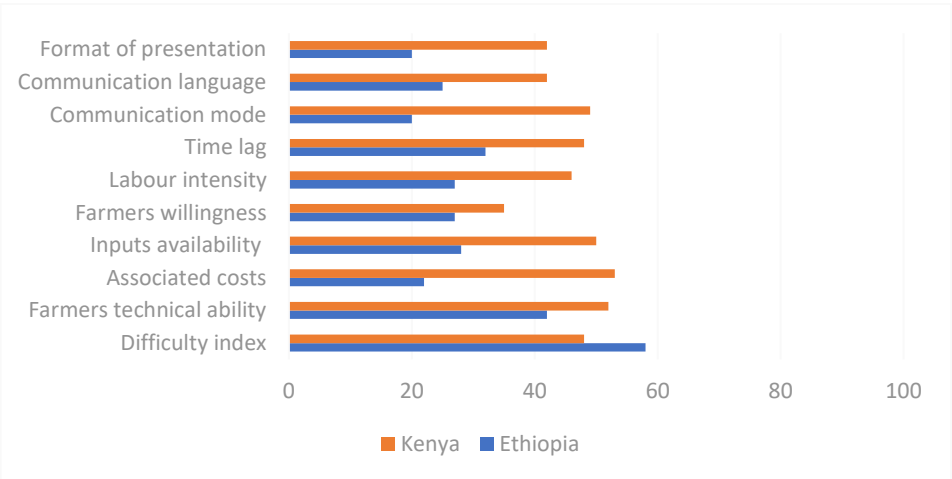


Figure7. Constraints to use of climate information

Table 1. Effectiveness of dissemination channels

	Countr.	N	Mean	Std. Deviat.	Std. Error Mean	t	Df	p	Cohen's d Standard. (Point Estimate)	Hedges' correct. (Point Est.)	Glass's delta (Point Estimate)
IVR	Kenya	25	193.00	98.77	19.75	4.626	48	0.001	74.47 (1.31)	75.66 (1.28)	36.55 (2.66)
	Ethiopia	25	95.56	36.54	7.31						
Radio	Kenya	29	204.13	28.01	5.20	9.097	56	0.001	21.49 (2.39)	21.78 (2.36)	11.78 (4.36)
	Ethiopia	29	152.79	11.78	2.18						
Newsletter	Kenya	23	203.34	51.57	10.75	6.859	44	0.001	41.01 (2.02)	41.73 (1.98)	26.54 (3.12)
	Ethiopia	23	120.39	26.53	5.53						
SMS	Kenya	23	186.60	25.44	5.30	7.582	44	0.001	23.29 (2.24)	23.70 (2.19)	20.93 (2.49)
	Ethiopia	23	134.52	20.93	4.36						
Impacts	Kenya	11	86.09	3.56	1.07	0.93	20	0.183	6.92 (-.39)	7.18 (-.38)	9.10 (-.29)
	Ethiopia	11	88.81	9.10	2.74						
Constra.	Kenya	10	46.50	5.46	1.72	4.00	18	0.001	9.16 (1.79)	9.57 (1.71)	11.75 (1.39)
	Ethiopia	10	30.10	11.75	3.72						

Table 1 presents the results of the comparison of the effectiveness of dissemination channels by farmers from Kenya and Ethiopia. The results show significant differences in the effectiveness of IVR ($t = 4.626$, $p < 0.05$), Radio ($t = 9.097$, $p < 0.05$), newsletters ($t = 6.859$ $p < 0.05$), and SMS ($t = 7.582$ $p < 0.05$). This may be attributed to the timeliness, elimination of message distortion, the scope, coverage, and clarity of messages obtained by farmers through the channels. **F**armers rely on multiple external sources of information because the efficiency of economic activities in agriculture critically depends on the flow of information relating to farming decisions [39], and [40] stressed that there exist heterogeneous impacts of access to agricultural information considering different sources and there is a need for region-specific customization of agricultural information. Farmers in Sri Lanka, information availability is the most important factor for information access, and is followed by social relationships, easy access, distance to agriculture officers and cultural proximity [41]. The adopted technology could not only depend on how efficiently the information flows among farmers, but also on the available information sources [42]. Table 1 further shows that a significant difference exists in terms of the constraints, farmers experience in the use of climate information in Kenya and Ethiopia, whereas no significant difference was recorded for the impacts of climate information between the two countries.

CONCLUSIONS

This paper provides large-scale evidence of the features of dissemination channels for effective climate information services among farmers in Kenya and Ethiopia to facilitate the deployment of appropriate dissemination channels for climate information. The results show that in the use of Short Message Services, cost should be low, content to be adequate, reliable, timely, and in local languages; while newsletter should be illustrative, and the distribution should cover all demographic classes of farmers. Similarly, radio programs on climate information should be on appropriate timing for broadcast and duration, and cover all climatic elements with repeated broadcast; while IVR responds to different topics made by callers at the same time not abandon queries and manage peak voice traffic. Climate information has improved the use of farm resources, changed planting practices, and harvested practices, and prevented pest and disease attacks. The constraints to the use of climate services are farmers' technical ability, associated cost, availability of inputs, messages' difficulty index, and time lag. It was found that significant differences in the effectiveness of IVR, Radio, newsletters, and SMS exist, as well as the constraints farmers experience in the use of climate information whereas no significant difference was recorded for the impacts of climate information between the two countries.

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KARAKTERISTIKE RADIO, AUDIO I TEKSTUALNIH KANALA DISTRIBUCIJE EFIKASNIH SERVISNO KLIMATSKIH INFORMACIONIH USLUGA ZA POLJOPRIVREDNIKE U KENJI I ETIOPIJI

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Apstrakt. Ova studija je ispitivala karakteristike radio, audio i tekstualnih kanala distribucije informacija zbog efikasnog pružanja klimatskih informacionih usluga za uzorak od 171 i 360 nasumično odabranih poljoprivrednika iz Kenje i Etiopije.

Rezultati pokazuju da su specifične karakteristike ovih kanala distribucije informacija uticale na efikasnost prijema klimatskih informacija kod poljoprivrednika.

Rezultati dalje analize pokazuju razlike u efikasnosti IOG (Interaktivni odgovori glasom*, eng.,* IVR-Interactive Voice Response) ($t = 4{,}626$, $p < 0{,}05$), radio emisija ($t = 9{,}097$, $p < 0{,}05$), biltena ($t = 6{,}859$, $p < 0{,}05$) i SMS poruka ($t = 7{,}582$, $p < 0{,}05$).

Karakteristike kanala distribucije informacija moraju biti pažljivo ispitane, pre njihove praktične primene u pružanju klimatskih usluga korisnicima .

Ključne reči: *Klimatske informacije, distribucija, kanali, usluga kratkih poruka (SMS), radio poruke, interaktivni odgovori glasom (IVR) i bilteni.*

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