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Analysis of Smallholder Farmers' Perceptions on Climate Change, Preference and Willingness-to-pay for Seasonal Climate Forecasts Information in Savelugu Municipality, Ghana

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Authors' contributions

This work was carried out in collaboration among all authors. Authors NI and KTM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HA and CAM managed the analyses of the study. Author WA managed the literature searches and final editing of manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Agricultural production is directly affected by climate change. This means that access to climate information would help the farmers' preparedness for farming activities and the decision on the types of crops to grow, when to grow them and the types of farm management activities to adopt. As such, this study analysed farmers' preference for seasonal climate forecasts and their willingness-to-pay for these information.
Place and Duration: The study was conducted in the Savelugu Municipality in the Northern region of Ghana. A single period data was collected for analysis.
Methodology: A total of 300 farmers were selected through a two stage sampling procedure and

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used for the study. From the theory of contingent valuation, a descriptive statistic and Heckman model were used in analysing the data.

Results: From the results, the majority of farmers were willing-to-pay for seasonal climate information, especially, climate forecasts on rainfall. The farmers preferred that these seasonal climate forecasts should be disseminated to them through the radio. The farmers exhibit positive willingness-to-pay for seasonal climate forecasts to about 20 Ghana cedis. A number of factors influenced the farmers' decision and amount they were willing-to-pay and these include gender, age, perception of climate change experience, ownership of radio, off-farm activity and participation in planting for food and jobs (PFFJ) program.

Conclusions: The findings of this study highlighted the need for climate information by farmers and how this can be effectively disseminated to them. Generally, government institutions and other private agencies should take up the challenge and opportunity to provide climate information, especially seasonal rainfall forecast, to the farmers at a fee. This fee must be determined at an optimal or at least a breakeven price considering the farmer's ability to pay. The study also recommended that climate information dissemination should be integrated into government's PFFJ program.

Keywords: Contingent valuation; climate perception; seasonal climate forecast; willingness to pay.

1. INTRODUCTION

In Ghana, agriculture contributes about 20% to the national Gross Domestic Product (GDP) [1] whiles providing 51% of the employment in the country [2]. Agriculture is also responsible for about 75% of foreign exchange earnings in the country [3] with crop production making up approximately two-thirds of the sector. However, like other countries in sub-Saharan Africa, Ghana's agriculture is at risk with the changing climate and its consequences. The effects of climate change are becoming noticeable through drought or floods that affect the yield of crops especially the two major food crops of the country, maize and rice. This has been reflected into a decrease of 6.3% and 9.3% in the national value of maize and rice production, respectively, over the last two decades [2]. Ultimately, there is a strong relationship between climate change and agricultural production. The Intergovernmental Panel on Climate Change (IPCC) has predicted that, rain fed crop production could decrease by 50% by 2050 [4], looking at the spate of changes in climatic conditions. According to International Food Policy Research Institute [5], Africa countries, especially, those in the sub-Saharan region are the most vulnerable group to climate change due to their high dependence on agriculture for economic growth, incomes and employment. Gradually, farmers are becoming unable to predict the patterns of rainfall in order to plan their production processes. Thus, farmers face uncertainty in their production [6]. This raised the need for seasonal climate forecasts and making these information available to the farmers.

Various scholars have highlighted the importance of seasonal climate forecasting to smallholder farmers who are the central component of food production in the country [7]. Usually, access to climatic information forms the premise upon which smallholder farmers make crucial decisions that relate to their farming activities. Accordingly, farmers use traditional means based on local knowledge to forecast rainfall patterns ahead for the crop production season. This traditional seasonal climate forecasts, operates as an endogenous system of climate information that guide farmers in making decisions relevant to the size of plots to cultivate, types of crop varieties to produce and planting dates, among others. The main factors that serve as indicators for these endogenous seasonal climate forecasts are environmental (moon, cloud, wind), biological (animals, plants), magic and religious [8]. However, according to Roncoli et al. [9], these endogenous forecasts are becoming less reliable because of climate change over the past two decades. This can be attributed to various changes such as variation in length of rainy seasons, with variation in number of rainy days from year to year [10], massive changes in agricultural calendar due to changes in seasonal rainfall quantity and the onset and ending dates of production seasons [11].

One of the major problems of climate science is predicting the probability of an occurrence, severity and duration of an extreme event, as well as when and where the event will take place and also the willingness of smallholder farmers to pay for forecasted climate information [12]. The harsh effects of climate change have continued to create massive problems among the poor households who are risk averse, leaving them more vulnerable and food insecure in many months of the year [12]. Therefore, more investment in disaster risk reduction is needed, including building the capacity to anticipate risks and as well as provision of relevant and accurate climate forecast information services as an early warning strategy. Accurate seasonal climate forecasts can also help not only to reduce climatic uncertainty, but to reduce risks to smallholder farmers' livelihoods. Studies have highlighted the significance of climate forecast. Among them is Graham et al. [13] who suggested that the reports of natural theorists were inaccurate and that, further knowledge to understand the atmosphere is required. Scientific weather forecasting which is more accurate, credible and reliable emerged in the mid-nineteenth century. Empirically, several studies have examined the factors influencing farmers' willingness-to-pay (WTP) for seasonal climate forecasts but the results from these studies are mixed and inconsistent [14,15,16,2,17]. These suggests that the factors influencing farmer's WTP are location and time specific. Again, these studies have either overlooked the need for addressing sample selection bias or failed to understand the role of the farmer's climate perception on their WTP decisions. This study addressed these limitations of previous studies and also highlighted the influence of Government's recent policy in agriculture, planting for food and jobs (PFFJ) policy on individual farmer's WTP for climate forecasts.

The introduction of this policy aimed at ensuring high output from farms, increase the productivity of farmers and improve the food security status of the country. Implicitly, this policy would move farming from largely subsistence to a business or nearly commercial venture. The success or failure of this policy would ultimately be determined by the production climate or environment, largely, rainfall and the availability of early warning systems. In addition to highlighting the influence of agricultural policies such as the PFFJ on WTP for scientific climate forecasts, this study highlight policy issues around the pricing of scientific climate information. Primarily therefore, the objective of this study was to investigate smallholder farmers' WTP for seasonal climate forecasts in the Savelugu Municipality in the northern region of Ghana. Thus, the study specifically addressed the following research questions. (1) What were the types of seasonal climate forecasts preferred by farmers? (2) What were the channels through which farmers want to receive seasonal climate forecasts information? (3) Were farmers willing to pay for seasonal climate forecast? (4) What factors influenced farmers WTP for seasonal climate forecasts?

2. METHODOLOGY

2.1 Study Area

The study was carried out in Savelugu Municipality. The Municipality was purposively selected, due to a report by Population and Housing Census, (2010) that demarcated farmers in this area to be smallholder farmers mainly into rain-fed maize production, and characterized with erratic rainfall. It shares boundaries with West Mamprusi District to the North, Karaga District to the East, Tolon/ Kumbungu District to the West and Sagnerigu District Assembly to the South. The municipality has about 149 communities with many of the communities concentrated at the southern section. The population of Savelugu Municipal, as projected by 2010 Population and Housing Census, was 139,283 representing 5.1% of Northern region's total population, with 60% of the population being rural. The municipality also has a total land area of about 1790.70 sq. km. Due to the availability of arable land and limited nonfarm economic opportunities, as high as 89.3% of households in the district are engage in agriculture. In the rural localities, nine out of every ten households (93.3%) are agricultural households. Most of these households (97.0%) are involved in crop farming [18]. The area receives an average annual rainfall of 600mm, considered enough for a single farming season. The annual rainfall pattern is erratic at the beginning of the raining season, starting in April and intensifies as the season advances, raising rainfall levels to about 1000mm sometimes. The municipality finds itself in the interior (Guinea) Savanna woodland which could sustain large scale livestock farming, as well as the cultivation of food crops such as rice, groundnuts, yams, cassava, maize, cowpea and sorghum [18].

2.2 Sampling Procedure and Data Collection

The data for the study was obtained through a cross-sectional survey of farmers solely engaged in maize production in the Municipality. The study employed two-stage sampling technique, where in the first stage, the sampling frame was the list of communities in the municipality and then random sampling was used to select ten (10) communities in the Savelugu municipality. In the second stage, the sample frame was list the farmers in each of the selected communities Pigu, Balshei, Pong Tamale, Tibala, Kpong, Kpendua, Yiworgu, Boggu, Ying and Damdu. Using the sample frame, thirty (30) respondents were selected from each community randomly using systematic sampling technique. Therefore, in all, a total of 300 maize farmers were selected for this study. Also focus group discussions were employed to collect qualitative data which gave us in-depth-information on the type of seasonal climate forecasts needed by farmers and the channels that farmers prefer to receive their seasonal climate forecasts. A consent statement was provided to the respondents and a farmer was considered as a respondent after declaration and signing the consent statement. This consent statement included preserving the privacy of the respondents.

The contingent valuation method (CVM) was used to elicit respondents WTP for seasonal climate forecast because it allowed us to obtain information on the value people assign to non-market goods such as climate information which are not paid for by consumer in a formal market [19]. A lot of studies have employed the CVM to assess farmers' WTP for climate information and these include [14,15,20,16]. Based on focus group discussions and literature, a hypothetical market was designed and presented to respondents to elicit their WTP amount. The preamble was carved to include statements such as a firm willingness to deliver seasonal climate forecasts to respondents before the planting season. The iterative bidding mechanism was used to elicit the initial and final WTP amount from the respondents because it mimic the bargaining market that exist in developing country like Ghana [21] and [22].

2.3 Data Analysis

2.3.1 Willingness to pay for seasonal climate forecast: Contingent valuation method

The theoretical underpinning of CVM is the theory of consumer behavior. This was explained in this section. Given any bundle of goods, farmers are considered as rational agents who aims at maximizing their utility. It is necessary to note that utility function and attributes of the commodity under question must be critically considered in the estimation of WTP. Thus, an individual seeks to maximize utility of a good (in this case seasonal climate forecast) subject to a given constraint. However, [23] used indirect utility function to derive WTP for drinking water in Vietnam. In equation (1), a farmer aims at maximizing utility derived from using seasonal climate forecast in agricultural production process given the quantity of the seasonal climate forecast and income.

$$U = u^*(q_1, \quad q_2 \dots \dots . . q_n) \tag{1}$$

Meanwhile, utility function defines a summary of one's preference and taste for a commodity with regard to purchases which affect the expenditure. Armah et al. [3] indicated that an individual rather seeks to minimize his or her expenditures in order to attain a certain level of utility, u^*. Therefore, the expenditure function for a farmer when the quantity (q_o) of seasonal climate forecast is delivered by any institution without charging a fee is given as:

$$e = e(P, q_o, u^*) \tag{2}$$

For a farmer to willingly source for specific quantity and quality (q_1) of seasonal climate forecast to meet his or her own need in production activities, that farmer must be prepared to increase his or her expenditure. The WTP is then derived as the difference in the farmer's expenditure. Thus:

$$WTP = e(P, q_o, u_*) - e(P, q_1, u^*) \tag{3}$$

Where $q_1 > q_0$

Therefore, the maximum amount of money a farmer was willing to pay for the improvement in the quality of the seasonal climate forecasts was equal to the difference in expenditure between the expenditure that prevails when the farmer uses the new seasonal climate information and the expenditure that prevails when the farmer uses pre-existing forecasts.

2.3.2 Determinants of willingness-to-pay for seasonal climate forecasts: Heckman two-stage selection model

Following [15], the study employed a two-step Heckman selection model because of its ability to correct sample selection bias. The two-step Heckman selection model is instituted on the main assumption that the processes that defines a producer's decision to pay or not to pay for seasonal climate forecasts are different from the processes that determines the amount the producers would pay [24]. Based on this, to examine the factors that influence farmer's WTP for seasonal climate forecasts, the Heckman two stage sample selection model was used.

Initially (in the first or decision stage), respondents were queried if they were willing to pay to access scientific seasonal climate forecast or prefer to dwell in their traditional method of predicting climatic conditions. This tends to allow for dichotomous responds from respondents that is Yes (1 if willing to pay) or NO (0 if not willing to pay). Thus, the probability of responding Yes or No is expressed in probit regression model as:

$$P_i = \vartheta + \beta_i x_i + \varepsilon_i \quad (4)$$

where β_i = is a vector of parameters to be estimated , x_i= is a vector of observed factors such as socioeconomic factors and institutional factors (Table 1), ε_i = error term which is independently and identically distributed with a normal probability distribution function.

At the final stage (the second or outcome stage), upon the willingness of respondents to pay for seasonal climate forecast, farmers were asked the amount they are willing to pay to access the information. The amounts expressed for those willing to pay are positive while the amounts expressed by those not willing to pay are zero. In the second stage of the Heckman's model, the outcome equation is expressed for those with the decision to pay for climate forecasts. This can be expressed as:

$$WTP_i = \varphi + \beta_i x_i + \gamma IMR + \mu_i \quad (5)$$

WTP is the outcome variable (i.e. the amount farmers are willing to pay in Ghana cedis). The Inverse Mills Ratio (IMR) is a proxy variable for the probability of using seasonal climate forecasts and is added to the outcome equation as an additional independent variable. The IMR measures the sample selection effect. μ_i is the error term which is independently and normally distributed. Again, the vector of x_i variables is shown in Table 1.

3. RESULTS AND DISCUSSION

3.1 Demographic and Socio-economic Characteristics of the Farmer

Based on the survey, most of the respondents (93.33%) were males and 6.67% were females. The small percentage of females could be attributed to the fact that, women do not own land as a result of the gender discriminations that prevail in the communities, thus women have less entitlement to lands in the area. The ratio of men to women is not different from other studies in Ghana. The analysis showed that the average age of the respondents in the study area was 38.71 years. Furthermore, the study area has a relatively large average household size of about 12 persons per household, an indication of high labour availability for adoption of labour intensive technologies. With regards to education, the mean years of formal education was 4.80 years which is consistent with Heckman [24]. In terms of years in maize farming, 77.71% of the farmers have more than 20 years of experience in maize farming with a mean years in maize farming of 21.32 years. Finally, about 16.33% of the respondents participated in PFFJ program and 83.67% were non-participant. The farmers' perception on climate change was based on a five-point likert scale that ranged from 1 (strongly disagreed) to 5 (strongly agreed). The estimated mean value of 4.45, indicated that the farmers agreed that there are changes in the climatic conditions such as temperature and rainfall.

3.2 Perception about Climate Change, types and Channel of Receiving Seasonal Climates Forecasts

Farmers' perceptions on climate change are crucial in reducing the impacts of climate change. In this section, the respondent's opinions on climate change were provided. From Table 2, the study found out that majority of the maize farmers (85.33%) perceived that the climatic conditions have changed over time while the rest 14.67% perceived that there was no change in the climate. However, those who believed it exist perceived it in diverse ways, some perceive climate change being evidence through irregular rainfall pattern (70%) and believed strongly that bush burning causes climate change (30%). The farmers who actually believed in the existence of climate change adopted certain adaptation strategies that included the following, early planting (10%), changing of planting date (40%), short term crop planting(15%), creating fire belts around farms(5%), adopting improve seed varieties (20%) and fertilizer application (10%). Also, about 94.67% of the respondents indicated that they need seasonal climate forecast for planning farming activity while the rest 5.33% of respondents indicated no need for seasonal forecasts information. It is important to emphasize that farmers interviewed engaged in rain-fed maize farming system, and as such, the success of the agricultural season depends to a larger extent on the nature of the rainy season. Hence the central role played by rainfall in the success of the agricultural venture justifies the high interest of farmers wanting to receive seasonal climate forecasts related to rainfall (onset, distribution and amount).

Table 1. Variable definition and their descriptive statistics

Independent variables	Description	Mean	Std Dev.
Gender	1 if household head is male, 0 if female	94.56a	0.23
Age	Age of household head in years	38.71	13.17
Experience	Years of farming	21.2	13.58
Household size	Number of persons living in the household	14	10.85
PFFJ	1 if farmer participate in planting for food and job programme, 0 if otherwise	19.39a	0.40
Extension	1 if farmer has access to extension service, 0 if otherwise	39.40a	0.32
Farm size	Size of the farm in acres	5.52	7.66
Yield	Production of maize in bags per unit area (100kg bag/acre). Used as a proxy for previous year output.	3.56	6.17
FBO	1 if farmer is a member of farmer based organization (FBO), 0 if otherwise	18.03a	0.39
On-farm	1 if main economic activity is farming , 0 if otherwise	65a	0.48
Climate perception	1 if a farmer perceived there are changes in climatic conditions, 0 if otherwise.	4.45	1.20
Off-farm	1 if engaged in off-farm activities, 0 otherwise	63.44a	0.42
Radio	1 if a farmer owns radio, 0 if not	80.00a	0.40

Source: Field survey, (2018). Note: Mean values with 'a' are proportions and not means

To reveal the types of seasonal climate forecast needed by farmers, the study sought the respondents' opinion on their preference for seasonal climate forecasts. Thus, the respondents were presented with various seasonal climate forecast components that theoretically farmers must have knowledge or information on in order to enhance their agricultural activities. From Table 2 it was revealed that about 94% of farmers preferred seasonal climate forecasts on rainfall, followed by temperature (3%), sunshine and lastly humidity (0.67%). This preference order by the farmers can be explained by the fact that rainfall was considered as the primary climatic condition in crop production. Consistently, farmers would prefer seasonal information on rainfall than the other climate variables. A similar result was obtained by Mabe et al. [16] and Amegnaglo et al. [15]. Farmers' high interest for information about the onset of the rainy season can be attributed to the fact that maize is a weather sensitive crop, specifically during the germination. Thus, information about the onset of the rainy season aids farmers in making their choice regarding crop cultivars that are more favorably to the season. Farmers can choose late or early maturing cultivars depending on the rainfall pattern.

One priority factor to consider was the medium for delivering seasonal climate forecast. The communication channels used to deliver seasonal climate forecasts to end-users are vital because it can influence the use or non-use of the information and significantly reduce the verification costs [26]. Therefore, three channels were provided to the respondents to indicate their preference. As shown in Table 2, the highest percentage (49.67%) of farmers preferred to receive seasonal climate forecasts through radio, whilst 26.33% and 24% preferred receiving seasonal forecasts through mobile phones and television, respectively. This could be due to the presence of a radio channel or station in the Savelugu town ship. This provides a major source of information to the members of the Municipality in a local language. With the recent upsurge of mobile phones, one would expect that farmers would prefer to receive seasonal climate forecasts through the mobile phones. However, from a focus group discussion, it was revealed that information provided through the mobile phones are done in English language and most of the farmers could either not read or could read with minimal understanding of English text. This is consistent with the low educational level of the farmers as in Table 1. Consistently, [15] found that about 75% of their respondents preferred radio as medium for receiving climate information.

3.3 Farmers' WTP for Seasonal Climate Forecast Information

Table 3 showed the result on the WTP for seasonal climate forecasts by the farmers. This involved the WTP decision, the minimum or first amount and the maximum or final amount a farmer is willing to pay for a forecast.

The survey depicts that majority of the farmers were ready to contribute financially to benefit from seasonal climate forecast in order to reduce climate risks on agricultural productivity (Table 3). Thus, 73.67% of the farmers showed a strictly positive WTP. This was consistent with the finding of Amegnaglo et al. [15]. However, 26.33% of the farmers need climate information but were not willing to pay for it. Thus, although these farmers indicated that they need scientific seasonal climate forecasts, they were not willing to pay for these forecasts, hence, would rely on indigenous knowledge in predicting the weather events.

As shown in Table 3, the initial mean WTP was about GH₵17.59 (USD3.53), which averagely increased to GH₵20.40 (USD 4.09) as the final amount a farmer was willing to pay for a weather forecast. Compared to the study by Amegnaglo et al. [15] in Benin, the mean WTP value was lower than what farmers were willing to pay in Benin (USD 19).

3.4 Determinants of Smallholder Farmers' WTP for Seasonal Climate Forecasts

As indicated in the study methodology, a two-step Heckman analysis was used to examine the factors that influence farmer's WTP decision for seasonal climate forecasts and the maximum WTP amount. The estimated results are presented in Table 4. The coefficient of the inverse Mill's ratio (IMR) was statistically significant at 10%. This depicted the presence of selection bias in the dataset and an indication that the estimates in the outcome equation appropriately explain the WTP amount of the farmers. The results of the WTP decision model indicated that gender, FBO membership, perception of climate change experience, and ownership of radio significantly influenced smallholder farmers' decision to pay for seasonal climate forecasts. Also, the WTP amount for seasonal climate forecast was significantly influenced by age, off-farm activities, PFFJ, and farmer's perception of climate change.

Table 2. Perception about climate change, types and channel of receiving seasonal climates forecasts

Variable	Frequency	Percentage
Existence of climate change		
Yes	256	85.33
No	44	14.67
Need for seasonal forecast		
Yes	284	94.67
No	16	5.33
Type of seasonal climate forecasting knowledge needed for farming		
Rainfall	282	94.00
Temperature	9	3.00
Sunshine	7	2.33
Humidity	2	0.67
Channel for receiving seasonal climate forecast		
Mobile phone	79	26.33
Radio	149	49.67
Television	72	24.00

Survey field work, 2018

Table 3. The WTP, initial and final WTP amount GH₵ (USD)

Variable	Frequency	Percentage (%)
WTP decision		
Yes	221	73.67
No	79	26.33
Amount WTP (mean)		
Initial bid	17.59 (3.53)	
Final bid	20.40 (4.09)	

Note: 1USD= GH₵ 4.99 Ghana Cedis (18th December, 2018 exchange rate); Source: Field Survey (2018)

Gender of respondents had a positive influence on WTP decision and this was significant at 5%. This suggests that households headed by males have higher probability of showing a positive decision to pay for seasonal climate forecast than female heads. This can be partially due to the fact that the men are the main decision makers in the households of the Municipality. Therefore, the females may have to consult a male adult in the household before taking a decision. This could mask the females WTP declaration and could explain the insignificance of gender in the outcome model. Fonta et al. [27] found that WTP for weather index-based insurance was high for male heads than female heads. Mabe et al. [16] also found that males were willing to pay more for climate information than females. Contrary, [28] estimated a negative relationship between male farmers and WTP for drought insurance.

From the result, ownership of radio had a positive significant effect on the WTP decision but a negative insignificant effect on the WTP amount. Thus, although radio owners had a higher probability of showing positive WTP for seasonal weather forecasts, they were also not willing to pay higher amount for the same service. The finding from Zongo et al. [20] also showed that farmers expected a free climate information if the information was broadcasted on radio channels. Our findings can be explained in the sense that majority of the farmers were illiterate and as such preferred to receive climate information by radio broadcast in their local dialect rather than phone messages which were communicated in English. This corroborated the result in Table 2 where the farmers indicated high preference for receiving seasonal forecasts through the radio set.

Consistent with expectations of the researcher, the perception on climate change had a positive significant effect on both the decision and the WTP amount for seasonal climate forecasts. This means that farmers who perceived that climate change exist have a higher WTP than those who perceived that there are no changes in the climatic conditions. This is reasonable as perceived existence of climate change serve as a motivation for farmers to pay more to receive seasonal climate information which will enable them adapt well to the changing climate. Jellason et al. [29] explained that farmers were more likely to integrated adaptation into farming if there perceived climate change as occurring. Contrary, [28] found that the WTP for drought insurance by farmers decreased as the farmers perceived changes in climate.

Table 4. Determinants of farmers' WTP for seasonal climate forecasts

Variable	WTP Decision (Decision model)		WTP amount (Outcome model)	
	Coefficient (Std. Err.)	P-value	Coefficient (Std. Err.)	P-value
Gender	0.2131** (0.1107)	0.054	0.4313 (0.3390)	0.203
Age	-	-	-0.0053 (0.0065)	0.409
Education	-	-	0.1111 (0.2171)	0.024
Experience	0.0005 (0.0022)	0.829	-	-
Phone	-	-	-0.5955 (0.4356)	0.172
Off-farm	-	-	0.4000** (0.2123)	0.059
PFFJ	0.0784 (0.0872)	0.369	0.0340** (0.0151)	0.024
FBO	-0.0356 (0.0751)	0.635	-	-
Farm size	-	-	-0.0125 (0.0101)	0.215
Yield	0.0022 (0.0042)	0.602	-	-
Climate perception	0.2814** (0.1160)	0.015	0.3949* (0.2167)	0.062
Radio	0.1959** (0.0827)	0.018	-0.1253 (0.2057)	0.543
Constant	0.5507*** (0.2076)	0.008	0.8592 (0.7038)	0.222
Mills lambda	-0.4452* (0.2575)	0.084		
Rho	-0.8825			
Sigma	0.5045			

*Wald chi2 (8) = 20.27; Prob > chi2 = 0.0094; *, ** and *** denote 10%, 5% and 1% significant level*

The result established that PFFJ had a positive effect on both the decision and the WTP amount. However, the effect was significant for only the amount WTP. This implies that farmers who are participant of the PFFJ program were willing to pay higher amounts for seasonal climate forecasts than those who are non-members of the program. This clearly demonstrated the effectiveness of agricultural program in enhancing farmers' preparedness and willingness to have relevant climate information.

The effect of off-farm activity was also positive and significant in explaining the WTP amount by the farmers. Thus, farmers who engaged in off-farm activities such as trading were WTP higher amounts for climate forecasts than those engaged solely in agriculture. Possibly, farmers who engaged in off-farm activities were willing to offer incomes from these non-farm activities to pay for the climate forecasts. This can be fixed to the notion that farmers invest income from non-farm activities into their farms. This confirmed the results of Zongo et al. [30]. Although Mabe et al. [16] also estimated a positive effect of off-farm income on WTP, their estimated coefficient was statistically insignificant.

4. CONCLUSIONS AND RECOMMENDATIONS

Information such as seasonal climate forecast are among the important information employed by farmers when making crucial decisions that relate to their farming activities. The empirical findings of this study established that the majority of farmers were willing to pay for seasonal climate information. However, the most preferred seasonal climate forecast by the farmers was on rainfall (onset, distribution and amount). Again, the study concluded that for the farmers to accept to pay for seasonal climate forecasts, especially on rainfall, it must be communicated through the radio. This ultimately offers a greater opportunity for the dissemination of climate forecasts to a larger group of farmers within a shorter possible time. On the average, farmers were willing to pay about 18-20 Ghana cedis for climate forecast. The study also established a number of factors that influenced both the decision and WTP amount for seasonal climate forecasts. These factors include gender, FBO membership, perception of climate change experience, and ownership of radio. Furthermore, the factors determining WTP are age, trading, participant of planting for food and jobs (PFFJ), and perception of climate change. This study highlighted a number of policy implications.

Firstly, there is need for government institutions and other private agencies to take up the challenge and opportunity to provide climate information, especially seasonal rainfall forecast, to the farmers. Farmers indicated WTP for such services. Therefore, these agencies must determine an optimal or at least a breakeven price to charge the farmers for the forecasts. This should be done considering the farmer's ability and WTP. For example, national extension packages must make it a priority to integrate seasonal forecast via radio stations and put emphasizes on such issues during visitation to such farmers. Secondly, it must be emphasized that numerous farming activities depend greatly on climate events hence the role of climate information in farming cannot be underestimated, fortunately, the farmers are willing to pay to have such information. Therefore, given that such vital information are at the disposal of farmers, it would help in the management of on-farm and non-farm risks, and improve farm productivity as well as farmers' welfare. Lastly, climate information dissemination should be be integrated into government's PFFJ program. This is essential since the production climate can have a negative effect on the success of the program and the fact that membership of the program enhances farmers WTP decision and amounts for seasonal climate forecasts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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