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Rice farmers perception of effects of climate change on rice development stages in Niger State

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Rice production is limited by many biotic and abiotic factors which are aggravated when climate change induces variation in climate patterns. Predicting effects of these variations in climate parameters on rice is not straight forward because crops in growth stage are affected in a specific manner which involves tactical adjustments of cropping calendar in order to ensure optimum production. Primary data were collected from randomly sampled 112 rice farmers in the study area using structured interview schedule on their socio-economic and farm enterprise characteristics, awareness of climate change and perception of effects of climate change on rice development stages in Niger State. More than half (67.0%) and (58.0%) of the respondents had favourable disposition towards climate change effects on rice vegetative and maturity stages, respectively while 75% had unfavourable disposition on the reproductive stage. There was inverse relationship (r-value = -0.16, p-value = 0.09) between perceived effects of climate change and farmers productivity. Farmers perception of effects of climate change on rice is hinged on irregular rainfall pattern that encourages weed growth, and excess water encourages fungal diseases spread which lowers rice yield. Rice farmers therefore, are advised to plant varieties that can withstand changes in the climate.

Key words: Rice farmers, rice development stages, climate change effects.

INTRODUCTION

Rice farming is highly dependent on environmental factors which are the most important among several factors that influence agricultural production. According to Edeh et al. (2011), rice production depends on optimum combination of production inputs in order to achieve remarkable yield. These inputs are not limited to the familiar production inputs but include the various environmental factors provided by nature. Rainfall characteristics (intensity and duration), relative humidity and temperature constitute these weather-related and environmental factors that affect rice yield and its variability. As reported by Kuta (2011), local farmers are seriously concerned about these weather variations because of the impact on food security, availability, stability, accessibility and utilisation. The change in weather affects livestock, forestry, fishery and decreases aquatic plant species including rice.

Research by Gumm (2010) has shown that rice production which is one of the world's most important

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crops for ensuring food security and addressing poverty will be thwarted as temperatures in rice-growing areas, increase with continued change in climate. However, Ramirez (2010) opined that unforeseen changes associated with global warming in temperature (as increase in temperature due to climate change adversely affect rice crop physiology which ultimately decrease crop yield and grain quality), carbon (iv) oxide and rainfall are expected to impact on rice production. Gumm (2010) reaffirms that, unless there is a change in the rice production methods or new rice strains that can withstand higher temperatures are developed, there will be a loss in rice production over the next few decades as days get hotter.

The major problems associated with rice production include drought, flooding, salt stress and extreme temperatures all of which are expected to worsen with climate change. Drastic changes in rainfall patterns and rise in temperatures will introduce unfavourable growing conditions into the cropping calendars. These changes modify growing seasons which subsequently reduce rice productivity (Ajetumobi et al., 2010). The risk of high temperature and water stress present in all rice production systems from uplands to lowlands has been identified as one of the most important production constraints in Africa. As reported by Manneh et al. (2007), rice when compared with other crops is very sensitive to drought which can reduce stand establishment, tillering, plant height, spikelet fertility and also delay flowering. The degree of impact on drought however, is dependent on the stage of growth of the crop. Nguyen (2004) also noted that the growth pattern, duration and productivity of rice crop is greatly influenced by temperature while severe moisture stress especially during rice reproductive stage may lead to complete crop failure.

In addition to these extreme events, Ifeanyi-Obi et al. (2012) reported that adverse climate effects can influence output at any stage from cultivation to the final harvest. They further stated that changes such as steady increase in night time temperature can lower rice yields. Also, irregularity in rainfall despite its sufficiency can affect yield adversely if, rains fail to arrive during the crucial growing stage of the crop.

From the above review, it is evident that many studies have been conducted on climate change, its effects on rice development stages. However, in dealing with the subject of climate change, rural farmers understanding the climate variability and change must be taken into cognizance since they produce the bulk of rice consumed locally, supply to other regions in the country as well as live with the realities of changing climate in order to manage the situation and maintaining their enterprise.

Though they are aware of the dynamics of the local climate, their perception of climate change is usually based and influenced by their personal experiences, knowledge, character, spirituality and environmental factors. In addition, the degree to which an environment is affected by climate change depends on one hand on the level of perception by individuals, and the other on mitigation and adaptive capacity to the change phenomenon. According to Odewumi et al. (2013), perceptions of farmers have the tendency of influencing their coping and adaptation strategies which ultimately determine the extent to which climate impacts on agriculture. It becomes imperative therefore, their responses are investigated in order to understand and estimate the effects of climate change on rice production for ease of adaptation. Nevertheless Ayansina et al. (2016) is of the view that, an in-depth understanding of climate changes among rural farmers would be very useful for better adaptation strategic planning, improve planning scheme in agriculture as well as in other economic sectors.

MATERIALS AND METHODS

Study area

Niger State Nigeria is located between latitudes $8°11^1$ and $11°20^1$N and longitudes $4°30^1$ and 715^1E of the equator. It covers an estimated area of 4,240km^2. The mean annual rainfall ranges between 800 to 1000mm and the average number of rainy days ranges between 187 to 220 days. The rains start late April and end in October with the peak being in July. The dry season lasts for about six months in a year from November to April.

The average minimum temperature is about 26°C while the average maximum temperature is about 36°C. The mean relative humidity ranges between 60 (January to February) and 80% (June to September). The state falls within the Guinea Savannah vegetation belt. This vegetation supports the cultivation of grains and root crops. The predominant crops are rice, sorghum, millet, yam, groundnut and cotton (National Root Crop Research Institute (NCRI), 1997).

Data procedure and collection

A multi-stage sampling technique was used to select respondents for the study. The first stage of selection entailed purposive selection in Niger State, this is because the State is a microcosm of Nigeria which has a long history of rice production as well as the NCRI site where lowland rice technologies emanate and are disseminated. In the second stage, simple random sampling was used to select 20% of the total number of LGAs which gave rise to Bida, Kontangora, Gbako and Lavun LGAs.

A list of Rice Farmers Association of Nigeria (RIFAN) members generated through the ADPs was obtained from each LGA. The last stage involved using a proportionate sampling technique to select 20% of farmers from the RIFAN list thus, 112 respondents were sampled for the study. Data on respondents' perception on the effects of climate change on rice development stages were collected through interview schedule and Focus Group Discussion (FGD). Information was obtained on farmers socio-economic and farm enterprise characteristics, awareness of climate change and their perception of effects of climate change on rice development stages. Data collected were analyzed using descriptive and inferential statistical tools.

Reliability of the research instrument was carried out, as the scale developed for each variable was presented to experts in the field of Agricultural Extension and rural Development, University of Ibadan, Nigeria for content and construct validity. A total of 30 pre-

test instruments were administered on farmers in Lapai LGA of Niger State. A reliability coefficient of r = 0.71 was obtained and the instrument was adjudged reliable.

Respondents reacted to awareness of change in climate by responding to Yes or No if they had observed changes in listed climate parameters which attracted scores 1 for 'Yes' and 0 for 'No' response. The extent to which changes had occurred in the climate parameters were measured on a 3-point scale of Always, Sometimes and Rarely which attracted scores of 3, 2 and 1, respectively. Mean score was calculated and used to categorize awareness of change in climate parameters as high or low.

Perception of effects of climate change on rice development was measured by presenting the respondents with perception statements, which were in accordance with the different stages of rice growth and development. The stages are the vegetative, reproductive and maturity growth stages of rice. This was measured on a 5-point Likert type scale of Strongly Disagreed (SD), Disagreed (D), Undecided (U), Agreed (A), and Strongly Agreed (SA) which attracted scores of 1, 2, 3, 4 and 5, respectively for positive statements and reversed scores for negative statements. Mean score was computed from respondents' perception scores and used as a benchmark for categorising, respondents' as having favourable or unfavourable perception.

RESULTS AND DISCUSSION

Socio-economic and farm enterprise characteristics

The distribution of rice farmers according to age categories (Table 1) shows that 40.2% of the respondents were within the age bracket of 41 to 50 years which is similar to Arimi (2014) who reported majority of rice farmers to be with the age category of 31 to 50 years. Furthermore, it can be deduced from Table 1 that the population of youths is low (16.1%) which could be attributed to rural-urban migration prevalence and implies loss of labour for rice production. As further shown in Table 1, 88.4% were male, 84.8% married and 55.9% had family size of about 7 to 9 members. Findings also show that 17.9% of the respondents attended primary school, 57.1% had secondary education and 11.6% were graduates of tertiary institutions. The low tertiary education could be an impediment to perception as education has been found to be a determinant of perception (Ajibola, 2014). Table 1 further reveals that 31.6% of the respondents' estimated annual income from rice production which was more than ₦170,000 per acre.

Distribution of respondents based on their source of capital shows that 46.2% of the respondents financed their rice enterprise with their own savings, while a minimal percentage (9.8%) obtained bank loans. This implies that respondents' fund their enterprises themselves which confirms the report by Akinbode (2013) that farmers hardly obtain loans from banks due to high interest rates. International Fund for Agricultural Development (IFAD) (2010) reported that about 90% of Nigeria's food produced by smallholder farmers who cultivated small plots of land was usually less than 5 ha of land per household. This was observed in the study with 48.2% of the respondents cultivating on farmlands between 1.00 to 5.99 acres while 39.3% had 11 to 20 years rice production experience which suggests their ability to ascertain significant changes in climate.

It was observed that 97.3% (Table 2) of the interviewed respondents were aware of changes in climate and their effects on rice production. The following comments were made during the FGD to support this assertion:

In recent years, the rains do not come when we expect it. We are used to having rains from March but for some years now, we don't witness serious rains till the middle of May or even June which makes us to plant late in the season.

The sun has been too hot when we compare it to what it used to be in the past from 7 to 10 years. We will wait for a long time for the rain before it falls and when rain does not fall, crops will not do well or they may even die.

We experience appearance of strange pests and diseases which attack our crops and are difficult to control.

Respondents affirmed the occurrence of climate parameters such as heavy rainfalls, high temperature, reduction and fluctuation in rainfall pattern (Table 2). The result however is in conformity with the findings of Egbe et al. (2014), who reported that respondents are aware of alterations in climate parameters and the regularity in their manifestations.

Table 3 shows farmers' perception on climate change effects on rice growth and development stages. The result reveals a favourable disposition by 67.0 and 58.0% of the respondents of climate change effects on the vegetative and reproductive stages, respectively. This indicates a positive impact on rice yield while 75.0% of the respondents were unfavourably disposed to the effects of climate change on rice reproductive stage, indicating a negative impact on rice yield.

The inconsistency in respondents' disposition to the different stages of rice development is, predicting the impact of climate change scenarios on crops is not straight forward as they affect crops in a growth stage specific manner which involves tactical adjustments of cropping calendars by the farmer. This must be taken into cognizance to ensure optimum production. This assertion is corroborated by Ifeanyi-Obi et al. (2012) who stated that positive or negative effect of climate change on rice crop is dependent on the stage of development. For instance, irregularity in rainfall despite its sufficiency can affect yield adversely if rains fail to arrive during the crucial growing stage of the crop. Also, draining plots or stopping irrigation once the dough stage has positively reached affects yield because, it homogenizes maturation and facilitates harvesting (Wopereis et al., 2009). The result further indicates an inverse relationship between perceived effects of climate change and farmers productivity ($r = -0.16$, $p>0.09$), which suggests that climate change has an influence on rice farmers productivity hence the need for adaptation.

Table 1. Socio-economic and farm enterprise characteristics of respondents in Niger state (n =112).

Variable description	Frequency	Percentage
Age (years)		
≤30	13	11.6
31-40	18	16.1
41-50	45	40.2
51-60	26	23.3
>60	10	8.9
Marital status		
Single	7	6.3
Married	95	84.8
Widowed	7	6.3
Divorced	3	2.7
Family size		
1-3	15	13.4
4-6	17	15.2
7-9	62	55.4
≥10	18	16.1
Educational attainment		
Non-formal (vocational training)	15	13.4
Primary	20	17.9
Secondary	64	57.1
Tertiary	13	11.6
Estimated annual income (₦)/acre		
<10,000	0	0.0
10,000-49,000	7	15.6
50,000-89,000	16	20.4
90,000-129,000	13	18.0
130,000-169,000	3	14.4
>170,000	73	31.6
Source of capital		
Own savings	104	46.2
Bank loan	22	9.8
Cooperative *(esusu)*	73	32.4
Family and friends	26	11.6
Farm size (ha)		
1.00-5.99	47	42.0
6.00-10.99	42	37.5
11.00-15.99	7	6.3
>16.00	16	14.3
Years of experience		
1-10	16	14.3
11-20	44	39.3
21-30	35	31.3
>30	17	15.2

Table 2. Awareness of change in climate and occurrence of climate parameters.

Awareness of change in climate	Frequency	Percentage
Yes	109	97.3
No	3	2.7
Occurrence of climate parameters		
High temperature	109	97.3
High humidity	94	83.9
Reduction in rainfall pattern	108	96.4
Increased dry spell intensity	108	96.4
Evidence of sand dune	97	86.6
Decrease in yearly amounts of rainfall	108	96.4
Intense harmattan period	108	96.4
Fluctuation in rainfall pattern	66	59.1
Prolonged dry season	77	68.8
Stormy rainfall	95	84.8
Heavy and windy rainfall	108	96.4

Table 3. Respondents perceived effects of climate change on rice development stages in Niger State (n=112).

Variables	Score	Frequency	Percentage
Vegetative perception			
Favourable	13-49	75	67.0
Unfavourable	50-80	37	33.0
Mean±SD	-	50.8±6.3	-
Reproductive perception			
Favourable	18-56	28	25.0
Unfavourable	57-80	84	75.0
Mean±SD	-	57.8±5.3	-
Maturity perception			
Favourable	10-38	65	58.0
Unfavourable	39-60	47	42.0
Mean±SD	-	39.8±6.2	-

CONCLUSION AND RECOMMENDATION

It is established from the study that rice farmers are aware of the alterations in climate parameters and the irregularities in their manifestations. Farmers inconsistent dispositions towards climate change effects on rice development stages denotes that these effects are not peculiar to the entire rice development cycle, but are dependent on the particular stage of development which will bring about a dramatic decline or increase in grain yield.

They are also aware that there is a decrease in their production over the years which they adduced to climate change. However, farmers' perception of effects of climate change on rice hinged on irregular rainfall pattern encourages weed growth, high temperature which increases spikelet fertility and spread of fungal diseases due to excess water subsequently lowers rice yield. Rice farmers therefore, are advised to plant varieties that can withstand changes in climate.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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