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SOIL QUALITY AND YIELD DECLINE : PERCEPTION OF FARMERS IN THE SUDAN SAVANNAH REGION OF NIGERIA

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ABSTRACT

Assessment of farmers' perception on soil quality and crop yield decline has been carried out in the Sudan Savannah (SS) of Kebbi State Nigeria with a specific objective to provide a report on soil quality deterioration and yield decline using IPCC climate change impact report on Africa by 2020. The assessment was made using face-to-face-verbal-interview. The interview was divided into four rounds according to four questions. It is reported that the farmers are aware of climate change impact and they have considered this impact as one of the major agricultural problem that would take part in soil quality deterioration and yield decline in the SS by 2020. Generally, the fact that the climate change impact will cause yield reduction for up to 50% in Africa by 2020 remained an open debate issue for most farmers in the SS.

Keywords: Soil quality, yield, farmers, climate change, savannah

INTRODUCTION

It is well known that farmers are expert because of the daily experiences, which they have been acquiring year after year in farming activities. Their experiences are important for future agricultural management (IPCC, 2001). Farmers are known to have developed intricate systems of gathering, predicting and interpreting agricultural related problems for future management (IPCC, 2007). In the Sudan Savannah (SS) of Kebbi State Nigeria, farmers are much more concern about the soil and crop yield performances (KARDA, 1997). They are very worried about the poor soil fertility and soil quality levels because of low crop yield. Therefore, farmers in the SS are in position to contribute based on their experiences to research development in the identification of soil-crop related problems, namely soil quality deterioration and crop yield decline. Studies in Nigeria (Raji *et al.*, 2000) and Kenya (Defoer *et al.*, 2000) reported that farmers are able to use their experiences on

weather condition such as annual rainfall record, hottest season in a year, nature of wind in dry season as well as physical surface soil condition and crop yield performances to make a judgement for present and future agricultural soil and crop related problems. Farmer's experience was considered as the basis for local-level decision-making in many rural communities because of its value not only for the culture in which it evolves but also for scientists who are working to improve awareness in rural localities (IPCC, 2007). In the present study, the farmers based knowledge in agriculture was used to know and understand the level of soil quality deterioration and crop yield reduction in the SS. The general objective of this study was to provide a report on soil quality deterioration and crop yield reduction based on farmer's perception on climate change impacts using IPCC climate change impact report on Africa by 2020.

MATERIAL AND METHOD

Study area

The SS of Kebbi State Nigeria is one of the most agriculturally viable environments in northern States of Nigeria. The total landmass of northern Nigeria including the SS is 75.9% of the country (Clara *et al.*, 2003). The region lies between latitude 11° and 13°N and longitudes 4° and 15°E, bordering the Nigerian States of Sokoto to the north, Zamfara to the east and Niger to the south. In sub-Saharan Africa, the SS borders the nations

of Niger republic to the west and Benin republic to the southwest (Figure 1). The total land area of Kebbi State including the SS is 36,229 km² of which 12,600 km² is under agriculture (KARDA, 1997). The annual rainfall in the SS is variable and declining, being 600 mm to 875 mm and on average 650 mm during the period 1995-2010, against 815 mm over 1962-71; and was only 509 mm in 1993 as reported by Oluwasemire (2004). The annual monthly temperatures are between 25°C-45°C.

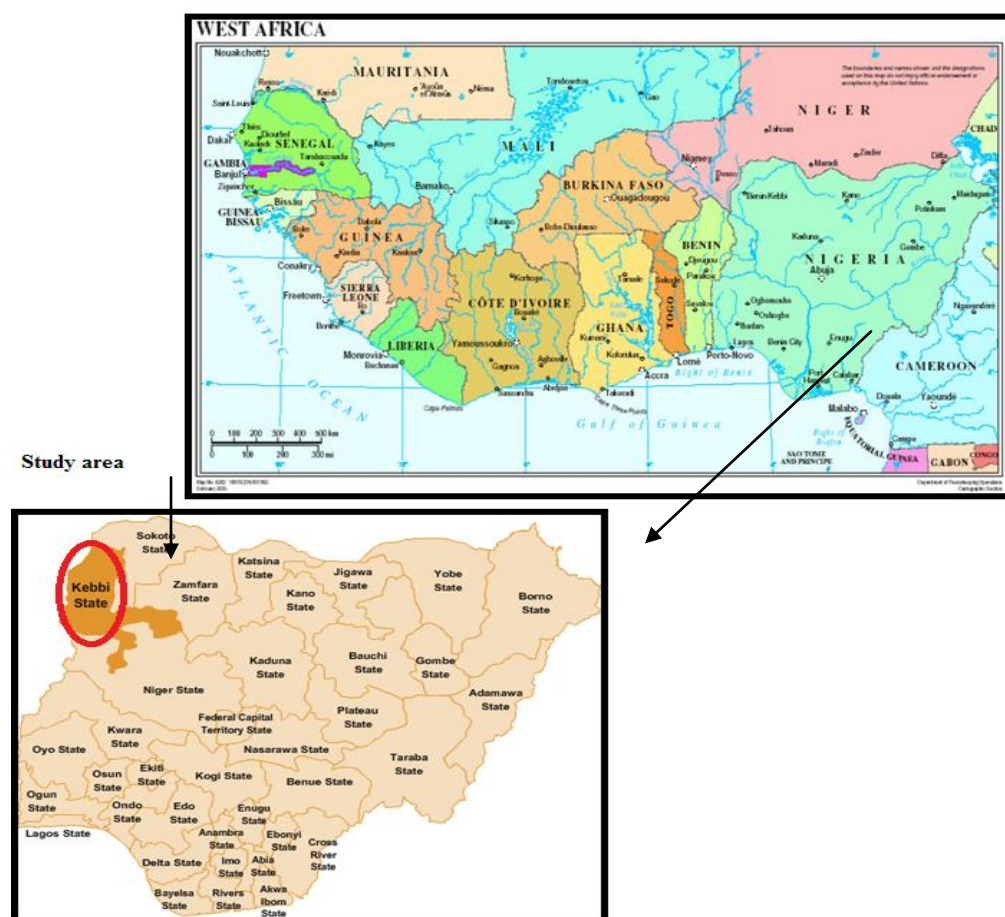


Figure 1: Location of study area in Nigeria.

Sources: <http://46.38.182.253/annualreport/2009/company-branch-kebbi.html>, <http://unowa.unmissions.org/Default.aspx?tabid=793>

IPCC (2007) report on climate change impact in Africa

The Third Assessment Report of the IPCC working group on climate change impact in Africa

have identified and highlighted a range of impacts and problems associated with climate change and its variability in African continent (IPCC, 2007). These range of climate change impacts as

identified by the working group include decreases in grain yields, changes in runoff, increased droughts and floods, as well as significant plant and animal species extinctions and associated human livelihood impacts (IPCC, 2007). However, in line with these climate change impacts, the present study has focussed on two important factors that are physically and socially daily news among the farmers in the SS namely: soil quality deterioration and annual crop yield reduction. Therefore, the third assessment report was used as complete materials to develop and formed the questions, which have been used to collect the necessary information from farmers on climate change impact as related to soil and crop in the SS. The questions are grouped into four. First, 'Have you notice climate change in your locality?' Second, 'Is climate change affecting your agricultural farms?' Third, 'What major agricultural problem has climate change caused so far?' and Fourth, 'What do you believe would happen to your farms by 2020 in term of soil-yield quality?'. These four questions were developed based on assumption that farmers in the SS are very aware with the climate change and its impact but not knowing that the local name they have been using (i.e. "chanjin yanayi or damana") to describe or define the context is the same as 'climate change' as strictly understood by global environmental scientists.

Interview format

Face-to-Face-Verbal-Interview was carried out in rural areas of Argungu, Bagaye, Birnin Kebbi, Bui, Fakon-Sarki, Kangiwa and Tungar-Dangwari villages. Farmers were selected randomly. The respondents are all males. The total size of the participants in each village is one hundred (i.e. $100 \times 7 = 700$ individual farmers). The interview was divided into four rounds according to the first, second, third and fourth questions, consecutively. In the first round, one hundred participants in each village were given chance to answer the first question. In the second round, the numbers of

positive respond from the first question were considered for the second round. In the third and fourth rounds, the number of individuals positively responded to question been asked in the second round were considered, accordingly. Each interview was recorded using pen and exercise book, lasted between 55 and 95 minutes for a period of 1 day in each village.

RESULTS

The results of this study are presented in Tables 1, 2, 3 and 4. The total numbers of farmers who respond positively and negatively as well as those who have not responded were presented in Table 1. The percentage analyses of the overall results are given in Tables 2, 3 and 4. In the first round of the interview there were significant responses (Table 1). At Argungu, Bagaye, Birnin Kebbi, Bui, Kangiwa and Tungar-Dangwari more than 50% of the farmers have responded positively but varied in numbers of negative respond and numbers of no respond, accordingly (Table 1). In the second round, where the percentage numbers of positive respond from the first round were considered for the next question, there were also variations in terms of positive and negative responses. In the 3rd round of the assessment, the data show significant farmer's respond to erosion and yield reductions (Table 3). By comparison, the percentages farmer's responded to erosion are high in Argungu, Birnin-Kebbi, Bui, Kangiwa and Tungar-Dangwari. Reasonably, there were only high percentages (49% and 58%) of farmer's respond to yield reduction against soil erosion (34% and 35%) in Fakon-Sarki and Bagaye, accordingly (Table 3). Considerably, all the farmers in Kangiwa responded significantly to both erosion (61%) and yield reduction (39%). Table 4 shows the farmer's opinion to soil quality and yield decline by 2020 in the SS. Majorities of farmers in Argungu (66%), Bagaye (59%), Birnin Kebbi (45%) and Bui (66%) agreed that by 2020 yield would be decline by 30% due to soil quality deterioration. However, this is contrary to farmers

in Fakon-Sarki, Kangiwa and Tungar-Dangwari agreed that the agricultural production will (Table 4). Generally, only few of these farmers reduced to 70% by 2020.

Table 1: Responses of farmer's perceptions on soil erosion impact in Kebbi State. Questions are based on IPCC climate change projections of yield reduction by 50% in 2020 in Africa

1st Round		Q1. Have do you notice climate change in your locality						
(%)	Argungu	Bagaye	Birnin Kebbi	Bui	Fakon-Sarki	Kangiwa	Tungar-Dangwari	
Positive respond	53	59	62	68	38	70	76	
Negative respond	21	26	18	9	33	3	24	
No respond	26	15	20	23	29	27	0	
2nd Round		Q2. Is climate change affecting your agricultural farms?						
(%)	Argungu	Bagaye	Birnin Kebbi	Bui	Fakon-Sarki	Kangiwa	Tungar-Dangwari	
Positive respond	43	46	55	68	35	59	50	
Negative respond	6	8	6	0	3	8	23	
No respond	4	5	1	0	0	3	3	
3rd Round		Q3. What major agricultural problem has climate change caused so far?						
(%)	Argungu	Bagaye	Birnin Kebbi	Bui	Fakon-Sarki	Kangiwa	Tungar-Dangwari	
Erosion	19	16	26	33	12	36	19	
Yield reduction	13	27	21	25	17	23	18	
No respond	11	3	8	10	6	0	13	
4th Round		Q4. What do you believe would happen to your farms by 2020 in term of soil-yield quality?						
(%)	Argungu	Bagaye	Birnin Kebbi	Bui	Fakon-Sarki	Kangiwa	Tungar-Dangwari	
SQD+YR by 70%	3	0	7	2	6	11	1	
SQD+YR by 50%	14	19	23	21	19	33	27	
SQD+YR by 30%	26	27	25	45	10	15	22	

[@]SQD+YR = SQD means Soil Quality Deteriorating and YR means Yield Reduction: Field work: S. Usman

Table 2: Analytical data on percentages respond of farmers on question 2 in 2nd round

%	Argungu (%)	Bagaye (%)	Birnin Kebbi (%)	Bui (%)	Fakon-Sarki (%)	Kangiwa (%)	Tungar-Dang. (%)
Positive	81	78	88	100	92	84	66
Negative	11	14	10	0	8	12	30
No-respond	8	8	2	0	0	4	4

Data source – Field work: S. Usman

Table 3: Analytical data on percentages respond of farmers on question 3 in 3rd round

(%)	Argungu (%)	Bagaye (%)	Birnin Kebbi (%)	Bui (%)	Fakon-Sarki (%)	Kangiwa (%)	Tungar-Dang. (%)
Erosion	44	35	47	48	34	61	38
Yield reduction	30	58	38	37	49	39	36
No respond	26	7	15	15	17	0	26

Data source – Field work: S. Usman

Table 4: Analytical data on percentages respond of farmers on question 4 in 4th round

(%)	Argungu (%)	Bagaye (%)	Birnin Kebbi (%)	Bui (%)	Fakon-Sarki (%)	Kangiwa (%)	Tungar-Dang. (%)
SQD+YR by 80%	7	0	13	3	17	19	2
SQD+YR by 50%	33	41	42	31	54	56	54
SQD+YR by 30%	66	59	45	66	29	29	44

Data source – Field work: *S. Usman*

DISCUSSION

The presence study noted that there are some evidences of soil quality and yield decline in the SS as perceived by farmers in the region (Table 1). Also, there would be expectations of yield reduction between 30%, 50% and 70% by the year 2020 in the SS (Table 4). These two areas of observations are worth of consideration. The baseline data on farmer's perception indicates an important response to questions asked throughout the interview (Tables 2, 3). More importantly, in the third and fourth rounds, it is clear that the farmers are very aware of the problems of soil erosion and yield reduction (Table 3). However, majority of the farmers in all the villages agreed that climate change affects their agricultural lands (Table 2). Farmers in these villages are very aware of climate change because of the seasonal variations in terms of annual rainfall, monthly temperature and wind. Historically, farmers in the SS are aware of climate change and they considered it as 'chanjin yanayi' in their native language. Farmers in this part of Africa are very aware of the problems associated with agricultural, soil and environmental conditions (Usman, 2007). Traditionally farmers in the SS used common term in their native language to differentiate between good and bad season as 'damana tayi kyau' or 'damana batayi kyau ba', accordingly. One of the potential traditional measures in respect to farmer's indigenous knowledge on climate change in the SS is available annual data record based on number of monthly rains (e.g. IPCC, 2007). Another potential traditional measure might be related to decrease in annual yield reduction because most of the farmers have complained much about drought and flooding due to shortage

of rainfall in the first three or four months of the rainy season but more rainfall than normal in the last two months of the same season (Bai and Dent, 2008). It is well known that rainfall are highly needed during the first few months of plant growth and has less important in the last 1 month, because at this time the farm produces are well matured ready for the harvest.

However, with farmer's perception as pointed out in this paper, it is clear that the soil erosion impact on land and people reported by KARDA (1997) are in many ways associated with the issues related to climate change and environmental problems such as erosion in the SS. However, the underlying assumption is that the farmers have only used their daily experiences in term of farming and history of annual yield reduction to answer the questions, while some of the future projected data in relation to soil quality deteriorating (Put *et al.*, 2004; Bai and Dent, 2008) and yield reductions (Schmidhuber and Tubiello 2007; IPCC, 2007) were based on scientific models and scientific evidences. Therefore, it is important to note that the results of this assessment is based on the fact that the SS is part of Africa and that the farmer's perception on soil quality deteriorating and yield reduction by 2020 was assessed based on IPCC report. Thus, the impact of climate change in the SS should be given a special consideration in future soil management decision making (Murwira *et al.*, 2001).

CONCLUSION

The farmer's perception on soil deteriorating and yield reduction projected by IPCC on Africa by 50% in 2020 was assessed in the SS (Tables 1–4). The assessment was made using face-to-face-

verbal-interview. The interview was divided into four rounds according to four questions. In the first round, more than 50% of the farmers in Argungu, Bagaye, Birnin Kebbi, Bui, Kangiwa and Tungar-Dangwari responded positively to the question been asked. In the second round, 60% to 100% responded positively in all the villages, and in the third round, erosion and yield reduction were considered as the two major agricultural problems in all the villages (Tables 1, 2, 3). In fourth round, majority of the farmers in Argungu, Bagaye, Birnin Kebbi, and Bui agreed that by 2020 the agricultural production in Kebbi State would be affected by 30% yield reduction while in Fakon-Sarki, Kangiwa and Tungar-Dangwari 54%, 56% and 54% of the farmers, respectively, agreed that by 2020 the total agricultural yield production will go down by 50% (Table 4). Overall, it can be conclude that the farmers in the SS are very aware of climate change impact but the fact that this impact would be up to 50% in Africa by 2020 remained an open debate issue for most farmers in the SS. Absolutely, it is believe that some farmers have considered climate change impact as one of the major agricultural problems, which could take part in deteriorating soil quality and yield reduction by 30%, 50% and 70% by 2020 (Table 4). Therefore, a similar research investigation in the SS will provide additional information of climate change impact in future.

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