

Investigation and Evaluation of predominant farming system in Sokoto-Rima River Basin, Nigeria

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ABSTRACT

The study examined agricultural practices in Sokoto-Rima River Basin, Nigeria from 1970 to 2009. Clustered sampling technique was used to administer questionnaire to 450 respondents from 15 agricultural settlements in 15 Local Government Areas in the basin. Data were analyzed using frequency counts, percentages and pairwise t-test. The result showed three agricultural practices, with a variation of 13.1% to 58.3% in 1970's and 19.8% to 56.4% in 2000's for one to three practices. The most widely accepted practices were mixed cropping (1970's - 23.8%, 2000's - 18.4%), and mixed cropping/ mixed farming (1970's - 48.7%, 2000's - 54.0%). Exclusive and two agricultural practices declined by 5.0% and 1.9% while three practices increased by 6.7%. Mixed cropping and monocropping/mixed cropping reduced by 5.4% and 7.2% while in contrast, monocropping, mixed cropping/ mixed farming, and monocropping/mixed cropping/ mixed farming increment ranged from 0.4% to 6.7%. The first agricultural practice option remained unchanged; in the second option, mixed cropping reduced by 0.4% while mixed farming increased by 5.3%; and in the third option, mixed farming increased by 6.7%. The total practices varied from 24.4% to 95.1% in 1970's and 24.5% to 94.6% in 2000's. The total practices also showed that monocropping did not change over time, increased mixed cropping and mixed farming increased by 2.6%, and 12% respectively. The first option is unchanged while the second and third options increased by 4.8% and 6.7%. A pairwise t-test showed no significant difference between the agricultural practices in the 1970's and 2000s in the study period.

Key words: agricultural practices, crop cultivation, monocropping, mixed cropping, mixed farming

INTRODUCTION

Climate variability is one of the major challenges facing global agricultural production systems, and it has become one of the vital determinants of agricultural output especially in developing nations where rain-fed agriculture is mostly accomplished with heavy reliance on climatic resources and labour (Ozor, et al., 2012). Watson et al., (1996) reported that variability in climatic variables will interact with other forms of stress associated with agricultural production and affect crop yields and productivity in different ways, depending on the types of agricultural practices and systems in place.

Agriculture practices and systems are diverse, with some having world-wide applicability and others regional based. For a variety of reasons, farmers adopt specific agricultural practices including monocropping, mixed cropping and mixed farming. Monocropping allows large expanses of land to be planted, and harvested at the same; and allows a whole area to be treated the same (same fertilizer and pest and disease control among others). By growing more than one crop at a time in the same field, farmers maximize water use efficiency, maintain soil fertility, minimize soil erosion and reduce seasonal work peaks as a result of the

different planting and harvesting times of intercropping crops; and increase output per unit area (Sun et al., 2014; Gebru, 2015; Bybee-Finley and Ryan, 2018; Dodiya et al., 2018). Besides, soil under mixed cropping has higher levels of chemical properties than sole cropped plot and allows more efficient use of on-farm resources (Tolera, 2003; Adamu and Yusuf, 2014). However, farmers practice mixed farming because it offers the highest return on farm business, as the by-products of farm are properly utilized; provides work throughout year; leads to efficient utilization of land, labour, equipment and other resources; the manures available from livestock maintain soil fertility and makes intensive cultivation possible (AgriInfo, 2015; Obasi et al., 2016). Adamu and Yusuf (2014) noted land use intensification and management systems practices among farmers in the Kano Close-Settled Zone (KCSZ) and pointed out that that the use of animal manures and mixed cropping are part of the methods of improving and maintaining soil fertility in the area.

Despite the relevance of agricultural practices to agriculture, the study is yet to be carried out in the study area. This study filled the gap created by inadequate

literature on agricultural practices and help in the strategic planning of the response to food security challenges. The study aimed at examining the changes that occurred through time in agricultural practices in Sokoto-Rima River Basin, Nigeria.

METHODOLOGY

The Study Area

Sokoto Rima River Basin is situated in the Northwestern part of the country. The study area lies between latitude 10.80N and 13.58oN and longitude 3.30oE and 7.13oE, covering an estimated land area of 106, 547 square kilometers (Iliya and Kwabe, 2000; Mamman, 2000a, b). It is bounded by the Niger Republic to the north, Niger and Kaduna States to the south and southeast, the Benin Republic to the west and Katsina State to the east respectively (Figure 1). However, Sokoto Rima River Basin is not being considered here in terms of hydrological coverage because the surface area is beyond the boundary of Nigeria.

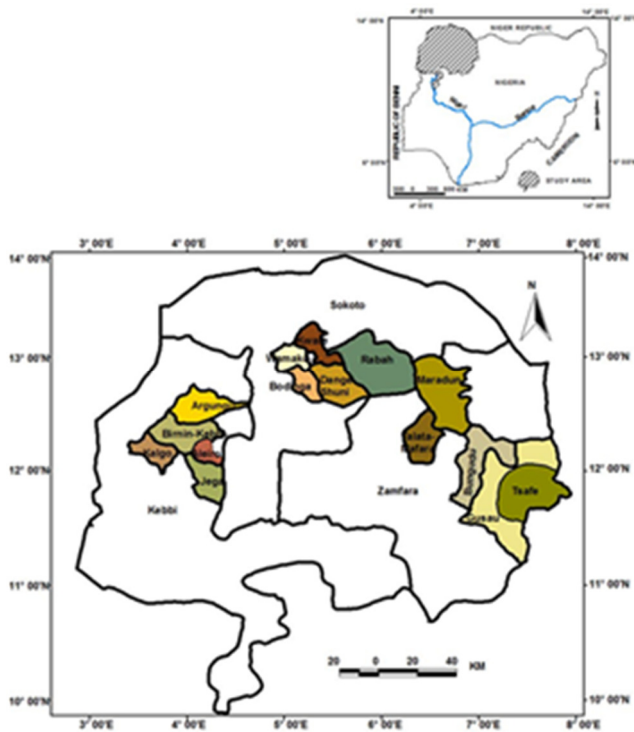


Figure 1: Map of Sokoto Rima River Basin showing selected Local Government Areas where questionnaires were administered

Sokoto-Rima Basin experiences tropical climate. The climate in this zone, as in other parts of Nigeria, is governed by the fluctuating Inter-Tropical Discontinuity (ITD). The ITD marks the boundary line between two air masses – the tropical maritime (mT) air mass from the Atlantic Ocean and the dry tropical continental (cT) air mass from the

Sahara Desert. The ITD migrates in a north-south direction and determines the zone of approximate penetration of the moist air mass. The prevailing air mass at a particular period highly influences the climate. Rain falls when an area is overlain by mT air mass while dryness prevails when an area is overlain by cT. The climate of Sokoto-Rima Basin exhibits a definite and marked wet and dry season. During the rainy season, mT dominates the entire region. On the other hand, cT air mass predominates during the dry season. The changes are in response to the pressure pattern resulting in the seasonal shifts of pressure belts associated with the apparent movement of the overhead sun. The wet season is between May and September in the southern part and June to September in the north (Iliya and Kwabe, 2000; Mamman, 2000a, b; Adejuwon, 2015). The rainfall pattern in Sokoto-Rima Basin is a good reflection of the seasonal variation of the surface location of the ITD. The rainy season lasts for 4-5 months. The rainfall is single maxima in character. Annual rainfall amount varied from about 1013 mm in the southern part to about 650 mm in the northern part (Adejuwon, 2012). The rainfall decreases in both duration and amount from the south northward. Throughout the Sokoto-Rima Basin, there are considerable spatial and temporal variations in the relative humidity. High humidity of about 80% is experienced in the wet season and less humidity of at times 30% in the dry season (Emielu, 2000; Adejuwon, 2017). Low humidity is characteristic of the dry and dust-laden northeast trade wind known as the ‘Harmattan’, which blows from the Sahara Desert under cloudless but dusty conditions. Harmattan is also marked by very low temperatures and the prevalence of thick fog of alarming intensity (Adejuwon, 2016).
Data Collection, Sampling and Analysis

Table 1: Locations of primary data collection in Sokoto-Rima River Basin

S/N	State	LGA	Community
1	Sokoto	Wamakko	Gumbi
		Bodinga	Mil Goma
		Kware	Durbawa
		Dange Shuni	Dange
		Ragah	Maikujera
2	Kebbi	Kalgo	Kalgo
		Birni-Kebbi	Gulumbé
		Aliero	Dakala
		Jega	Basaura
		Argungu	Alwasa
3	Zamfara	Talata Mafara	Tunfafia
		Gusau	Madidi
		Maradun	Dosara
		Bungudu	Tazame
		Tsafe	Tsafe

The data used in this study were basically primary data. Clustered sampling technique was used for administration

of questionnaire in the River Basin. Five agricultural settlements from five Local Government Areas each from 3 zones of Sokoto, Kebbi and Zamfara states were selected for this study (Table 1). Thirty copies of questionnaires were administered to extract information on agricultural practices in each settlement, making a total of four hundred and fifty questionnaires. Data were analyzed using the frequency counts, percentages and pairwise t-test with Statistical Package for Social Sciences (SPSS Version 16). The pairwise t-test was used to examine the difference in agricultural practices of 1970's and 2000's.

RESULT AND DISCUSSION

Table 2 shows agricultural practices in Sokoto –Rima River Basin. The three agricultural practices in the basin are monocropping, mixed cropping and mixed farming. An examination of responses revealed that the combination of mixed cropping and mixed farming is the most popular and widely used agricultural practice both in the 1970's and 2000's in the basin. However, it increased by 5.2% from 48.7% in the 1970's to 53.9% in the 2000's. Although, two agricultural practices decreased slightly by 1.9% from 58.3% in 1970's to 56.4% in 2000's, the farmers who engaged in mixed cropping and mixed farming together accounted for over 80% and have increased by 12% from 83.7% in 1970's to 95.7% in 2000's. Monocropping and mixed cropping has also decreased by 7.2% from 9.6% to 2.4%. Also, the three agricultural practices are gaining more relevance, as the farmers increased by 6.7% from 13.1% in 1970's to 19.8% in 2000's.

Generally, exclusive agricultural practices have declined by 4.9% from 26.2% in the 1970's to 21.3% in the 2000's.

Mixed cropping reduced by 5.4% from 23.8% to 18.4%. This shows that the mixed cropping which accounted for 90.8% of the exclusive agricultural practices in the 1970's has decreased to 86.4% in 2000's. Most farmers engage in mixed cropping because it is used as a strategy to ensure that, if one crop fails, another crop can survive due to differences in crop cycles, rooting depths and water requirements (Raynold et al., 1995). Reduction in exclusively mixed cropping in favour of a combination of mixed cropping with other practices especially mixed farming was as a result of farmers' awareness about the importance of mixed farming. Mixed farming serves as a source of manure in revitalizing the lost soil fertility and offers the highest return on farm business (Adamu and Yusuf, 2014; AgriInfo, 2015). Besides, the overriding characteristics of extensive mixed farming systems in the arid and semi-arid environment are their sensitivity to climate variability (Raynold et al., 1995). The lower the rainfall, the more variable is production. Thus, farmers find a way of stabilizing their food supplies and income. Livestock plays an important role in achieving this and is increasingly becoming important as annual rainfall decreases and cropping is less reliable. Besides, mixed systems provide 50% of the world's meat and 90% of the world's milk, and employ 70% of the world's poor livestock producers (Thornton and Herrero, 2001). Contrariwise, monocropping increased by 0.4% from 1.8% to 2.2%. The exclusive practice of monocropping is on the increase possibly because of the recent cultivation of upland rice that needed to be planted alone (Adejuwon, 2012). This practice also enables large expanses of land to be planted and harvested at the same and treated with fertilizer, herbicide and pesticide the same.

Table 2: Agricultural Practices in Sokoto-Rima River Basin

Farming Practices	Practised in 1970s		Practised in 2000s		Difference (%)
	Frequency	Percentage	Frequency	Percentage	
Monocropping	8	1.8	10	2.2	0.4
Mixed cropping	107	23.8	83	18.4	-5.4
Mixed farming	3	0.7	3	0.7	-
Monocropping/Mixed cropping	43	9.6	11	2.4	-7.2
Mixed cropping/Mixed Farming	219	48.7	243	54	5.3
Monocropping/Mixed cropping/Mixed Farming	59	13.1	89	19.8	6.7
Total	439	97.5	439	97.5	-

Table 3: Agricultural Practices options in the Sokoto Rima River Basin in 1970's

Agricultural Practices	First Option		Second Option		Third Option		Total
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Monocropping	110	24.4	-	-	-	-	110
Mixed Cropping	326	72.4	102	22.7	-	-	428
Mixed Farming	3	0.7	219	48.7	59	13.1	281
Total	439	97.5	321	71.4	59	13.1	

Table 4: Agricultural Practices Options in the Sokoto Rima River Basin in 2000's

Agricultural Practices	First Option		Second Option		Third Option		Total
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Monocropping	110	24.4	-	-	-	-	110
Mixed Cropping	326	72.4	100	22.2	-	-	426
Mixed Farming	3	0.7	243	54	89	19.8	335
Total	439	97.5	343	76.2	89	19.8	

Table 5: Differences in the options practiced in the Sokoto Rima River Basin between 1970's and 2000's

Agricultural Practices	First option	Percentage	Second option	Percentage	Third option	Percentage
Monocropping	0	0	-	-	-	-
Mixed Cropping	0	0	-2	-0.4	-	-
Mixed Farming	0	0	24	5.3	30	6.7

Table 6: Total number of farmers engaged in each of the Agricultural Practices in Sokoto-Rima River Basin

Farming Practices	Practised in 1970s		Practised in 2000s		Difference (%)
	Frequency	Percentage	Frequency	Percentage	
Monocropping	110	24.4	110	24.4	-
Mixed cropping	428	95.1	426	94.6	-2 (0.5%)
Mixed farming	281	62.5	335	74.5	54 (12%)

Table 7: Pairwise t-test for agricultural practices 1970's and 2000's in the Sokoto-Rima River Basin.

Crop cultivation method	95% Confidence interval of the difference						
	Mean	Std. Deviation	Lower	Upper	T-value	df	Significant (2-tailed)
Agricultural practices	0	24.81935	-26.04631	26.04631	0	5	1

About three-quarters (72.4%) of the farmers in the basin engaged in mixed cropping as the first agricultural practice option in both 1970's and 2000's, while about a quarter (24.4%) engaged in monocropping (Tables 3 and 4). Mixed farming that was less than 1% as the first option accounted for over two-thirds of the second agricultural practices option while the rest engaged in mixed cropping. The farmers that engaged in first option remain unchanged over time, mixed cropping decreased by 0.4% while mixed farming increased by 5.3% in second option (Table 5). Only mixed farming was practiced as the third option but increased by 6.7% from 13.1% in 1970's to 19.8% in 2000's.

The total of each of the three agricultural practices in the basin varied from 24.4% to 95.1% in the 1970's and 24.5% to 94.6% in 2000's (Table 6). Monocropping did not change, mixed cropping decreased by 0.4% while mixed farming increased by 12% over time. Most of the farmers (81.4%) retained their agricultural practices over time while 16.2% changed it. Those that attributed the change to climate change were 3.8%. Others attributed it to other

reasons including avoidance of time wastage, sources of income, production of more crop yield and livestock, land tillage, usage of cattle dung as manure, means of transportation, improved knowledge on animal usage and the recent introduction of upland rice. These reasons were responsible for the increment in the total number of farmers involved in mixed farming from 62.5% in the 1970's to 74.5% 2000's. In addition, the introduction of upland rice encouraged monocropping, since the crop is planted solely in the field.

Table 7 shows the result of the pairwise t-test for the study. It is stated as follows: $t(5) = 0.000$, $p = 0.05$, $CI_{0.95} = -26.05, 26.05$. This indicates that there is no significant difference between the agricultural practices in the 1970's and 2000s as observed during the study period.

CONCLUSION AND RECOMMENDATION

The study has shown that farmers engaged in monocropping, mixed cropping and mixed farming agricultural practices in the Basin; and that farmer engaged

in one to three of monocropping, mixed cropping and mixed farming both in 1970's and 2000's. The study has also shown that all the farmers engaged in the first agricultural practices option (monocropping, mixed cropping and mixed farming), a decreased number in the second option (mixed cropping and mixed farming) while the third option (mixed farming) is the least practiced in both periods. The total of farmers practicing these agricultural practices varied from 24.4% to 95.1% in 1970's and 24.5% to 94.6% in 2000's. Monocropping practice is unchanged over time while mixed cropping and mixed farming increased by 2.6%, and 12% respectively. The first agricultural practice option (monocropping, mixed cropping and mixed farming) is unchanged while the second (mixed cropping and mixed farming) and third options (mixed farming) increased by 4.8% and 6.7%. Those that engaged in one and two practices decreased by 5% and 1.9% while three practices increased by 6.7%. Out of the 16.2% respondents that changed their agricultural practices, only 3.9% affirmed that the change was due to climate change. The pairwise t-test has shown that there is no significant difference between the agricultural practices in the 1970's and 2000s.

The type of agricultural practices the farmers engage in has implications for food security. Less food will be produced if more farmers engage in monocropping. Therefore, the study recommends that the policy makers should be involved in the provision of incentives to farmers to enable them engage in two or more agricultural practices in order to aid food production and ensure food security.

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