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An Assessment of the Changing Pattern in Tomato Cultivation in Sokoto-Rima River Basin, Nigeria

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ABSTRACT

This study assessed the changing pattern in tomato cultivation in Sokoto-Rima River Basin, Nigeria. Questionnaire was administered to 450 respondents from 15 agricultural settlements in 15 local governments in the study area, using clustered sampling technique. Data was analyzed using frequency counts, percentage and pairwise t-test. Results show that ten varieties of tomato exist in the basin. Six of the seven varieties planted in 1970s are still being planted at the time of this investigation. Three varieties are new while a variety is no longer planted by farmers. Bahaushe was the most (41.18%) popular variety in the 1970s but Zaria variety (called 'Dan Zaria', Eka variety (Dan Eka) and Bahaushe which accounted for over 80% of tomato varieties in 2000s are the most famous, with Zaria variety accounting for 37.09 %. The farmers planting Dan Turai, Takon Mushe, Mai Soso and Bahaushe varieties decreased at the range of 3.31% to 20.71% while Dan Eka and Dan Zaria varieties increased by 8.81% and 19.44% respectively. Factors that determine choice of the varieties planted include yield, market values, consumer demand, and longer span of preservation. Farmers planting tomatoes in the basin has increased by 21.9% from 52.9% in the past to 74.8% at present.

Key words: tomato cultivation, river basin, farmers, market values

INTRODUCTION

Tomato (*Lycopersicum esculentum*) is a South American plant of the nightshade family, solanaceae and sub-family, solanoideae with a red, yellow, pink or green edible fruit eaten as vegetable or in salad (*Encyclopedia of Life, 2014;* Vicario, 2014). It is an annual crop with weak trailing, much branded stems covered with glistening yellow glandular airs. The tomato is native to western South America and Central America (Home cooking, 2013). The species originated in the South American Andes (Encyclopedia of Life, 2014) and its use as a food originated in Mexico by 500 BC. It later spread to Europe (Spain (1521), Italy (1548), Britain (1590)), North America (1710), Middle East and North Africa (1799 to 1825) (Appleton, 1876; Smith, 1994; Your archives, 2009; Gentilcore, 2010) and later to the other parts of the world.

Tomato grows from 90 to 150 days but the fastest ones including Siberia, Sub Arctic, Early Girl, Early Wonder and Prairie Fire has a growth rate ranging from 48 to 62 days. Tomato vines are covered with fine short hairs (Peel, 2008) and are perennial in its natural habitat but annual in temperate climates. It reaches 1–3 meters with a weak stem that often spread out over the ground. Tomatoes that are indeterminate are tender perennials in temperate climates and can sometimes live up to three years in a greenhouse while the determinate are annual in all climates. Tomato needs 25.4 to 38.1mm of water each week *(Downey and Media, 2001) and* daily temperature of 18 to 25ºC with night temperatures between 10 and 20ºC to fruit.

Cultivated tomatoes vary in size, from tomberries (0.5 cm in diameter), through cherry tomatoes (1- 2 cm) size as the wild tomato, up to beefsteak tomatoes 10 cm or more in diameter. The most widely grown commercial tomatoes tend to be in the 5–6 cm diameter range. Tomatoes known as 'plum tomatoes' have a lower water content and are frequently elongated from 7 to 9 cm long and 4 to 5 cm in diameter (Allen, 2008) and are grown for canning and sauces. Most cultivars produce red, yellow, orange, pink, purple, green, brown, ivory, black, or white fruit. Less common variations include fruit with stripes (Green Zebra), fuzzy skin on the fruit (Fuzzy Peach, Red Boar), multiple colors (Hillbily, Burracker's Favorite, Lucky Cross) etc.

About 7,500 tomato varieties exist, with the recognition of 13 wild species of *Solanum lycopersicum* namely *S. cheesmaniae, S. galapagense, S. pimpinellifolium, S. chmielewskii, S. habrochaites, S. neorickii, S. pennelli, S. arcanum, S. chilense, S. corneliomulleri, S. huaylasense, and S. Peruvianum*. Tomato varieties are divided into

several categories, based mostly on shape and size. These include slicing or globe, beefsteak, oxheart, plum, paste, roma, pear, cherry, grape and campari tomatoes. Tomatoes are also commonly classified as early tomatoes and cool-summer tomatoes, determinate or indeterminate varieties (Allen, 2008). **Some varieties are fast growing**, mature in the early season range, mature in late season range, produce fruit mid-season, Hot Weather and Early Tomato.

Economically, fresh-market tomato is the most important fresh vegetable (United States Department of Agriculture-National Agricultural Statistics Service (USDA-NASS), 2013) and a source of revenue to farmers. In addition to its economic value, tomato provides nutritional value in terms of vitamin C and pro-vitamin A (β-carotene) to the human diet (Rouphael *et al*., 2010). An average 100 grams tomato is made up of 95% water and 5% of other nutrients. It consists of 74 kJ (18 kcal) energy, 0.2 grams of fat, 5 mg of sodium, 3.9 grams of carbohydrate, 1.2 gram of dietary fiber, 2.6 grams of sugar, 0.9 gram of protein, beta-carotene 449 ug (4%), 123 ug lutein axanthin, 0.037 mg (3%) Thiamine (B_1), 0.594 mg (4%), Niacin (B_3), 42 ug (5%) vitamin A, 0.08 mg (6) vitamin (B_6), 14 mg (17%) vitamin C, 2% Calcium, 0.54 mg (4%) vitamin E, 7.9 µg(8%) vitamin K, 11 mg (3%) magnesium, 0.114 mg (5%) manganese, 24 mg (3%) phosphorus, 237 mg (5%) potassium, 94.5 g water and 2573 µg lycopene (USDA National Nutrient Database for Standard Reference Release 28, 2016).

In terms of medicinal importance, it is a powerful antioxidant, good for cancer (lung, prostate, stomach, cervical, breast, oral, colorectal, esophageal, pancreatic, and many other types of cancer) prevention, lower biomarkers of oxidative stress and carcinogenesis in healthy and type II diabetic patients, improve the skin's ability to protect against harmful UV rays that causes sunburn, help in managing human neurodegenerative disease, has detoxification effect in the body and good for liver health, reduce the risk of cardiovascular diseases, prevents hardening of the arteries hence reduce high blood pressure and prevents LDL oxidation (BBC News, 2008; Maccrae, 2008; Rao, and Balachandran, 2002; Valero *et al.,* 2011; Basu and Imrhan, 2007). Tomato juice is known as good energy drink, restores from fatigue and sleepiness, rejuvenates the health of patients on dialysis and can be used for healing sunburn because of its unique vitamin C. Tomato is an excellent fruit or vegetable for rapid skin cell replacement (Takano, 2010). Freeman and Reimers (2010) reported that consumption of tomato also includes other protective mechanisms such as antithrombotic and anti-inflammatory functions, hence, better health.

Despite the usefulness of ripe tomato fruit, the leaves, stems, and green unripe fruit of the tomato plant contain small amounts of the toxic alkaloid tomatine and solanine (Mcgee, 2009; Barceloux, 2009). Use of tomato leaves in herbal tea has been responsible for at least one death (Mcgee, 2009; Barceloux, 2009). Tomato plants can be toxic to dogs if they eat large amounts of the fruit, or chew plant material (Brevitz, 2004). Tomatoes were linked to seven salmonella outbreaks between 1990 and 2005 (Food Safety Network, 2006) and may have been the cause of a salmonellosis outbreak causing 172 illnesses in 18 U.S. states in 2006 (CBS News, 2006).

Tomato is one of the most widely grown vegetables in the world. It is the second most important vegetable crop next to potato. The world dedicated 4.8 million hectares in 2012 for tomato cultivation and the total production was about 161.8 million tones (FAOSTAT, 2014). The average world farm yield for tomato was 33.6 tonnes per hectare, in 2012 (FAOSTAT, 2012). In 2013, world production of tomatoes was 163.4 million tonnes, with China accounting for 31% of the total, followed by India, the United States and Turkey (FAOSTAT, 2015). Tomato has been in cultivation in Nigeria for a very long time. Nigeria is the largest producer of tomatoes in Sub-Saharan Africa. It is an important component of the daily diet, consumed both fresh and in paste form. FAO (1983) estimated the national yield average to be 114 tones/ha. In Nigeria, tomato is regarded as the most important vegetable after onions and pepper (Fawusi, 1978). It is consumed in diverse ways, including raw, as an ingredient in soup, many dishes, sauces, salads, and drinks. It is also used in producing pastes, and dehydrated or frozen products (Adetoro *et al*, 2015).

In spite of the importance of tomato, no study has been carried out on the changing pattern in tomato cultivation in Sokoto-Rima River Basin, Nigeria. This study intends to fill the gap created by lack of literature in the study area. The study aimed at assessing the changing pattern in tomato cultivation in Sokoto-Rima River Basin, Nigeria.

METHODOLOGY

The Study Area

The study area, Sokoto-Rima River Basin lies between latitude 10.8° N and 13.58° N and longitude 3.30° E and 7.13° E (Iliya and Kwabe, 2000; Mamman, 2000) (Figure 1) exhibits a tropical climate, with a definite and marked wet and dry season while the tropical maritime air mass dominates the entire basin during the rainy season, whereas the tropical continental (cT) air mass predominates during the dry season. The wet season is between May and September in the southern part and June to October in the north (Bello, 1996; Iliya and Kwabe, 2000; Mamman, 2000a, b). The rainfall pattern in Sokoto-Rima Basin is a good reflection of the seasonal variation of the surface location of the inter-tropical discontinuity (ITD); the rainfall is single maxima in character. Annual rainfall

amount varies from about 500 mm in the northern part to about 1250mm in the sourthern part (Oguntoyinbo, 1978; Emielu, 2000; Mistry, 2000) and the rainfall decreases in both duration and amount from the south northward. High humidity is experienced in the wet season and lower humidity of about 30% in the dry season (Oboli, 1967; Emielu, 2000) with the humidity reaching an average of 80% in the southern area during the wet season (Iliya and Kwabe, 2000); this decreases to a mean values of 20 or 25% in January and April. Diurnal values may fall from 50% at dawn to 10% in the afternoon. This is characteristic of the harmattan when the dry and dust-laden North East trade winds are blowing from the Sahara under cloudless but dusty conditions. This period is marked by very low temperatures and dust-laden winds often accompanied by thick fog.

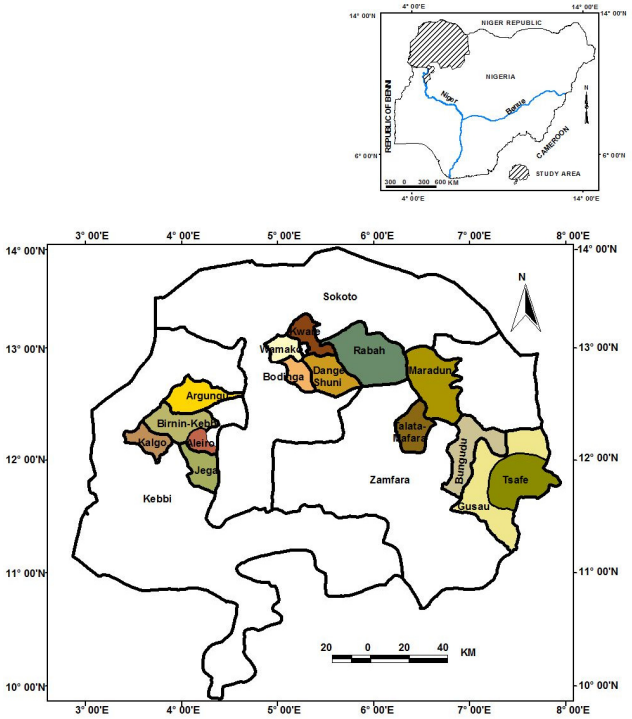

Figure 1: Selected local governments where questionnaire was administered

Data Collection, Sampling and Analysis

The data used in this study are basically primary data. Clustered sampling technique was used for administration of questionnaires in the River Basin. Five agricultural settlements from five Local Governments each from 3 zones of Sokoto, Kebbi and Zamfara were selected for this study (Table 1). Thirty copies of research questionnaires were administered in each settlement, making a total of four hundred and fifty. Data was analyzed using descriptive frequency counts, percentage and pairwise t-test with Statistical Package for Social Sciences (SPSS Version 16) constituted the software used for data analysis.

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

S/N	STATE	LOCAL GOVERNMENT	COMMUNITY
1	Sokoto	Wamakko	Gumbi
		Bodinga	Mil Goma
		Kware	Durbawa
		Dange Shuni	Dange
		Rabah	Maikujera
		Kalgo	Kalgo
2	Kebbi	Birni-Kebbi	Gulumbe
		Aliero	Dakala
		Jega	Basaura
		Argungu	Alwasa
		Talata Mafara	Tunfafiya
3	Zamfara	Gusau	Madidi
		Maradun	Dosara
		Bungudu	Tazame
		Tsafe	Tsafe

RESULT AND DISCUSSION

Tomato is an important vegetable consumed worldwide (Brown *et al*., 2005). It is a highly perishable fruit vegetable of the nightshade family, solanaceae with a red, yellow, pink or green edible fruit eaten as vegetable or in salad, and has many varieties, which vary in plant and fruit size, shape and taste (Ezekiel *et al*., 2011). The total of 10 varieties of tomatoes is planted in Sokoto-Rima River Basin (Table 2). Seven varieties were planted in the 1970s. Nine varieties are being planted in 2000s, including six of the 1970s varieties.

Table 2: Tomato varieties planted in Sokoto-Rima River Basin

Varieties	Planted in 1970s		Planted in 2000s	
	Number of Respondents	Percent	Number of Respondents	Percent
Dan Turai	22	9.24	20	5.93
Dan Eka	32	13.45	75	22.26
Bahaushe	98	41.18	69	20.47
Takon Mushe	11	4.62	3	0.89
Mai Soso	29	12.18	26	7.72
Dan Zaria	42	17.65	125	37.09
Kanana	4	1.68	-	-
Dan Kasa	-	-	11	3.26
Dan Karda	-	-	7	2.08
Dan Kwali	-	-	1	0.3
Total	238	100	337	100

Farmers no longer plant a variety while 3 new varieties were recently introduced. In 1970s, 52.9% of the farmers in

the basin planted tomato, while74.8% plants it in 2000s. Bahaushe, a major variety, accounted for 41.18 % of the varieties planted by farmers in the River Basin in the past, while Zaria variety known as 'Dan Zaria' (37.09%) followed by Eka variety (Dan Eka) (22.26%) and Bahaushe (20.47%) are the most popular varieties planted at present. The planting of Bahaushe reduced by 20.71% in favour of Dan Zaria and Dan Eka varieties which increased by 19.44% and 8.81% (Table 3) respectively, but is still being planted because of market value and consumer demand. Dan Zaria took the lead from Bahaushe because it has tick back for easy preservation, hence does not decay easily.

Table 3: Differences in the percentage of farmers' planting tomato varieties in Sokoto-Rima River Basin

Varieties	Percentage of farmers' in 1970s	Percentage of farmers' in 2000s	Difference (%)
Dan Turai	9.24	5.93	-3.31
Dan Eka	13.45	22.26	8.81
Bahaushe	41.18	20.47	-20.71
Takon Mushe	4.62	0.89	-3.73
Mai Soso	12.18	7.72	-4.46
Dan Zaria	17.65	37.09	19.44
Kanana	1.68	-	-
Dan Kasa	-	3.26	-
Dan Karda	-	2.08	-
Dan Kwali	-	0.3	-
Total	100	100	

It was also found to be sweeter in stew, soup and in preparation of other food varieties. The farmers planting Dan Turai , Mai Soso and Takon Mushe varieties also decreased by the range of 3.31% to 4.46%. Kanana variety, though planted by few farmers in the past is no longer in existence, while Dan Kasa, Dan Karda and Dan Kwali, which are newly introduced varieties, have not gained much recognition among farmers. The introduction of new varieties which are found to be better displaces the old varieties. The choice of tomato varieties planted by farmers is determined by factors including personal preference, yield, colour, appearance, taste, spiciness, flavor, sweetness, seasonal variation as well as resistance to pests and diseases. The pairwise t-test was used to examine the difference in tomato varieties between the past and the present (Table 3). The t-test result showed that t(9) = -0.998, $p \geq 0.05$, $CI_{0.95}$ -32.35, 12.55. This means there is no significant difference between the 1970s and 2000s varieties as observed during the study period. Marketable tomato yields are governed by cultivar selection, cultural practices, and environmental constraints (Ortiz *et al*., 2007). According to Ortiz *et al*. (2007), considerable variation existed among 15 genotypes marketable yield and fruit size responses to climatic factors, soil conditions, and cultural practices in multi-environment trials with tomato. As a result, selecting an ideal cultivar for production within a given region and using well-established best management practices (McGraw *et al*., 2007) are essential for achieving acceptable levels of productivity (Snider, *et al*., 2012). Apart from these, the environment encountered during plant development will strongly influence yield. Plant development is strongly linked to temperature (Reeves and Coupland, 2000) Climate, soil, moisture condition and fertilizer affect the yield, quality and price of tomato. It thrives well in temperature 10^{o}C to 30^{o}C with optimum range of temperature is 21-24^{o}C. Tomatoes do very well on most mineral soils, but they prefer deep, well drained sandy loams. Deep tillage can allow for adequate root penetration in heavy clay type soils, which allows for production in these soil types. Tomato is a moderately tolerant crop to a wide pH range. A pH of 5.5- 6.8 is preferred though tomato plants will do well in more acidic soils with adequate nutrient supply and availability. Soils extremely high in organic matter are not recommended due to the high moisture content of this media and nutrient deficiencies. But, as always, the addition of organic matter to mineral soils will increase yield. Erratic moisture conditions can cause radial and concentric cracking on fruit. This is a serious physiological disorder that leaves the affected tomatoes unmarketable and quickly deteriorating. Cat facing, blossom scar and puffiness can be related to soil moisture variability.

Tomato producers often face production problems related to soil-borne diseases and abiotic stresses that can reduce the yield and quality of fruit (Cramer *et al*., 2011; Hasna *et al*., 2009; McAvoy *et al*., 2012). Abiotic stresses including temperature (high or low), drought, light, atmosphere, nutrients, and salinity limit production of many crops (Criddle *et al*., 1997; Cramer *et al*., 2011; Morejon, 2013).

Table 4: Pairwise t-test for tomatoes planted in 1970s and 2000s in the Sokoto-Rima River Basin

Crop	Paired Differences				T-value	df	Significant (2-tailed)
	Mean	Std. Deviation	95% Confidence Interval of the Difference				
			Lower	Upper			
Tomato	-9.9	362.65	-32.349	12.549	-0.998	9	0.345

CONCLUSION AND RECOMMENDATION

The study has shown that ten varieties of tomatoes were planted in Sokoto-Rima River Basin, Nigeria. Six of the seven varieties planted in 1970s are still being planted in 2000s. Three varieties are new while a variety is no longer existed. Four varieties decreased at the range of 3.31% to 20.71% while 2 varieties increased by 8.81% and 19.44% respectively. Bahaushe was the mostly planted variety in the 1970s but Dan Zaria is mostly planted in the 2000s. Farmers planting tomatoes in the basin has increased by 21.9% from 52.9% in the 1970s to 74.8% 2000s. This study recommends that more farmers should be encouraged in the production of tomato, especially the marketable varieties that are high yielding and has longer span of preservation.

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