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INVESTIGATION OF CHANGING PATTERN IN GOAT BREEDS IN SOKOTO-RIMA RIVER BASIN, SEMI-ARID NIGERIA

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ABSTRACT

The study examined the changing pattern in goat breeds in Sokoto-Rima River Basin, semi-arid Nigeria. Cluster sampling technique was used to administer the questionnaire to 450 farmers who were sampled from 15 agricultural settlements in fifteen local governments in the basin. Data were analyzed using frequency and percentages. Fifty-three (52.6%) percent of the farmers in the basin rear goats. Sokoto Red (Maradi) accounted for 90.71% of the goat breeds while West African Dwarf Goats (WAD), Hausawa and Sahelian (Desert) goats ranged from 0.42% to 8.02%. Sixty-nine (68.77%) percent of the farmers reared the same breed of goat in the 1970s, 10.13% changed breed while 21.10% did not rear goat in the past. Out of 10.13% farmers that changed goat breed, 7.59% reared Sokoto Red (Maradi) in the 1970s, 1.69% reared Sahelian (Desert) goats while 0.84% reared West African Dwarf (WAD). About ten percent (9.71%) farmers attributed the change in goat breed to climate variability, notably drought. Farmers were affected in the range of one to four drought impacts. The highest (38.38%) were those affected by three impacts, with a range of 0.84% to 15.19% while the least (10.12%) were those affected by four impacts. Size reduction was the greatest consequence of drought on goats while death of goats, reduction in offspring (calving) and milk yield and infertility in male goats were also important. Goats were more resistant to drought than other livestock types.

Keywords: farmers, goat breeds, drought impacts, semi-arid tropics

INTRODUCTION

The goat is a member of the genus Capra of the Bovidae family and the goat-antelope subfamily Caprinae (Matthee and Davis, 2001; New World Encyclopedia, 2008; Arif *et al.*, 2012). The domestic goat (*Capra hircus*) commonly referred to as the "poor man's cow" have the ability to flourish on scanty silage and deal with harsh environments. The goats provide consistent access to meat, milk, skins, and fibre for farmers, most especially in developing countries. The world goat population currently stands at 921 million from 861.9 million in 2008, of which over 90% are found in developing countries (FAOSTAT, 2008; Tsukahara, 2018). Africa accounted for about 35% as the second largest after Asia while Nigeria, Sudan and Kenya have the largest population of goats in Africa (Skapetas and Bampidis, 2016).

Goats have the capability to survive and reproduce in harsh environments due to their low body mass, and low metabolic requirements (Silanikove, 2000: Chukwuka *et al.*, 2010). The thermal comfort zone for goats ranges from 0-30^{o}C (Assan, 2013). Azizi (2012) reported that goats can withstand heat stress and can endure prolonged water deprivation, making them more adaptable to adverse climatic and geographical conditions, where cattle and sheep cannot survive. This ability to reduce metabolism allows goats to survive in areas where water sources are scarcely distributed and after prolonged periods of severe limited food availability. Since the kidney stores the urine, they can avoid drinking water under severe water economy and thus are able to thrive in extreme temperatures and limited water (Cain *et al.*, 2005).

Goats are flexible and selective feeders than sheep and cattle as they have greater ability to browse and to digest lower quality herbage, select high quality feed and choose from a wider range of plants including browse from trees and shrubs (Lechner-Doll *et al.*, 1995; James *et al*., 2015). Their nature of browsing allows them to eat very nutritious food from many plants regarded as weeds (McGregory, 2000; Hart, 2001; Robert *et al.*, 2008). Goats are capable of digesting the fiber component of diet and are generally superior to sheep in digesting feeds with digestibility between 50 and 60%. They are extremely useful and effective in combating undesirable bush encroachment (Maloiy *et al.*, 1979; Erasmus, 2000)

In spite of the importance of goats, no study has been carried out on the changing pattern in goat breed 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 goat breed in Sokoto-Rima River Basin, Nigeria.

Animal history in general and Goat's history in particular dated back to God's creation of the earth (Holy Bible-Genesis 1: 24-25). Goats (*Capra hircus*) was one of the first domesticated animals from the wild goat *Capra aegagrus* from 10,000 to 11,000 years ago when Neolithic farmers in the Near East began to keep small herds of goats for their milk and meat, and for their dung for fuel, as well as for materials for clothing and building: hair, bone, skin and sinew (Hiendleder *et al*., 1998; Luikart *et al.*, 2001; MacHugh and Bradley, 2001; Hirst, 2010). Specifically, animal domestication began with goats and followed by sheep and this happened at *ca.* 10,000–9,500 B.P. (Before Present), which is 1,000 years after the domestication of crop plants in the southern Levant **(**Bar-Yosef and Meadow, 1995). Goats (*Capra hircus)* are a subspecies of goat domesticated from the wild goat of southwest Asia and Eastern Europe (Nader, 2007; Nomura *et al.,* 2013). Dating of goat remains in archaeological sites in western Asia shows goat existence in about 9,000 years ago (Roets, 2004). In particular, the location of the goats' ancestors took place in southwestern Asia from the eastern Mediterranean to Turkey and the adjacent eastern regions (Roets, 2004). Except for Angora, Cashmere, and Damascus goats, which descended from the Markhor (*Capra falconeri*), domestic goats are primarily descended from the Bezoar goat (*Capra aegagrus) (*MacHugh and Bradley, 2001).

The mtDNA investigation showed that all goats descended from a small number of animals and may have been domesticated in a few different places (Giuffra *et al*., 2000; Luikart *et al.*, 2001; Vilà *et al*., 2001). Archaeological findings showed that there was domestication in the Euphrates river valley at Nevali Çori, Turkey (11,000 bp), and the Zagros Mountains of Iran at Ganj Dareh (10,000 bp) (Zeder, 2006, Gallego-Llorente *et al.,* 2016**)**. Other important archaeological sites with evidence for the initial process of goat domestication include Indus Basin in Pakistan at (Mehrgarh, 9,000 bp) and perhaps central Anatolia and the southern Levant, Cayonu, Turkey (8500-8000 BC), Tell Abu Hurevra, Syria (8000-7400 BC), Jericho, Israel (7500 BC), and Ain, Jordan (7600-7500 BC) (Hirst, 2010).

The history of goats in North America began with the arrival of Spanish explorers and settlers in the 1500's. English settlers brought a few goats to New England beginning in the 1600s. These two types accounted for most of the goats found in North America until the time of the Civil War. Importation of several European dairy breeds, including the Nubian, began about 1900

Goats (*Capra hircus*) reached Australia with the first fleet in 1788 as they were a suitable food source for the first European settlers. They were small, ate most plants and provided the settlers with meat and milk. Later the goats were released or escaped and established feral herds in the Australian bush (Commonwealth of Australia 2011; Sustainable living festival, 2012). The first records of domestic goats in Africa can be found in Egypt and North Africa where pictures of goats, goat herders and husbandry practices that are found in tombs, dates back to the 5th Dynasty, around 2400 years ago. Little is known about the actual breeds but differences in their horn shapes indicate that two or more breeds could have been present (Boessneck, 1988). Based on the bones found in archaeological

deposits, the early goats were related in physique to the indigenous goats of today (Anteneh *et al.*, 2004). The earliest recorded goats in Africa were brought to western Uganda by the Black Nations as early as AD 1200.

Today there are more than 300 breeds of goats, and they live in climates ranging from high altitude mountains to deserts (Hirst, 2010). The *Gwanda-Tuli* goats found in Zimbabwe are similar to Tswana goats of Botswana. They have long, pendulous ears, with turned up tips short and erect horns and could be white, black or brown in colour. *Nguni* goats come from Swaziland and Zululand. Their horns are twisted and their ears flabby, and of medium length, these goats are crosses between small East Africa goat and the lop-eared types. They may be of any colour (Roets, 2004). The *Damara* or *Herero* goats of Namibia tend to have medium length horns, with a straight or convex profile, and long wide dropping ears. The coat is short and usually white, red and white or brown and white. They can also be red or grey (Anteneh *et al.,* 2004).

The *Pafuri* goats (Boer goat) of Mozambique are found only on the Limpopo. The origins of the "Boer goat" are somewhat vague, and are most probably rooted in the animals as kept by the *Namaqua Hottentots* and migrating tribes of the "Southern Bantu" people (Campbell, 1984; In: Roets, 2004) as stock farmers became more settled and began selecting animals adapted to the distinct characteristics of the Eastern Cape (1800 to 1820), the common Boer or farm goat evolved. The *Savanna* goat is an arid indigenous, white, registered breed similar to the Boer goat. *Savanna* goats were bred from a mixture of coloured indigenous does and white bucks (Campbell, 2003; Mdladla, 2016). The Kalahari red breed was selected from red-and-white indigenous African goats and has been selected and bred as a separate breed for the past 25 years (Roets, 2004). They are known for their hardiness, colour, size and mothering abilities (Anteneh *et al.*, 2004)

"Indigenous goat" is the collective term used for all varieties of native South Africa goat breeds. The indigenous goats of South Africa can be classed into; Speckled goats, *Loskop* South indigenous goats, KwaZulu-Natal, *Nguni* goats and *Delftzijl* goats (Campbell, 1995). However, this classification system does not accommodate the thousands of indigenous goats found outside these specific locations throughout South Africa. The indigenous goats of South Africa vary in horn and coat types, colour, ear length and size. They are mostly of medium size (Porter *et al.*, 2016). Environmental extremes are mainly responsible for the variation in size between goat types. It is possible to find different variations in the same region and even in the same flock (Anteneh *et al.*, 2004; Roets, 2004).

There were no wild goats in Africa. Long legs and a short body are attributes of primitive goats, pre-adapting these animals to the semi-arid zone (RIM, 1992). The dwarf goat is relatively recent in origin, presumably because dwarfing confers the survival advantage in the humid zone. There are three main varieties of goats recognized in Nigeria, namely the Sahel (Desert) or West African long-legged goats, the Sokoto Red and the West African Dwarf (Ngere *et al.*, 1984). The Sahel is found along the northern border of Nigeria, particularly in Bornu State. The Sokoto Red, Kano Brown or Maradi (Maradi is a Department of the Niger Republic) goat is probably the most widespread and well –known type in Nigeria. According to Ngere *et al.*, (1984), Sokoto Red gave rise to Kano Brown. Though WAD was stereotypically said to be native to the forest belts, the presence of WAD in Borno State, Republic of Cameroon and Chad suggests that they were far more widespread until recently (RIM, 1992). It was noted that WAD must have once been the main race of goat over most of Nigeria (Blench, 1999). They correspond to the West African Grassland Dwarf in Cameroon (Ndamukong *et al.*, 1989). Chang and Landauer (1950), and Epstein (1971) attributed the distorted forms and extremely short legs to achondroplasy.

The Nigerian Dwarf goat is one of the two miniature goats breed of West African ancestry (Chiejina and Behnke, 2011). There are several recognized breed of small and dwarf goats in West Africa, and it is from these native African herds that the first miniature goats were imported into the

United States. Although illegal imports were suspected earlier, the first documented import arrive the country in the 1930's and 1940's, for the benefit of several public and private zoos and preserves (Goat Information, 2007). There were two distinct types of small goats imported, one being short, Cobby, with short legs and the other being more slender, with a longer body and proportionally longer legs and a more streamlined appearance. In the earlier years, in fact, until about 1960's and 1970's, little distinction was made between the Cobbier type that became the African Pygmy goat and the more diary type goat that became known as the Nigerian Dwarf (Goat Information, 2007).

MATERIALS AND METHOD

Study Area

The study area, Sokoto Rima River Basin lies between latitude 10.8^{o} N and 13.58^{o} N and longitude 3.30^{o} E and 7.13^{o} E (Figure 1), covering an estimated land area of 106, 547 square kilometres (Iliya and Kwabe, 2000; Mamman, 2000). Sokoto-Rima Basin experiences a tropical climate, governed by the 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 (Adejuwon, 2016). The mT dominates during the wet season while the cT air mass predominates during the dry season. The climate exhibits a definite and marked wet season between May and September in the southern part and June to September in the north and dry season for the rest of the year (Bello, 1996; Adejuwon, 2012). Annual rainfall amount varied from about 1013 mm in the southern part to about 650 mm in the northern part and is single maxima in character while the mean annual temperature is 34.5^{o}C (Adejuwon, 2015). The highest temperatures are in March to April while the minimum temperatures are usually recorded in January to February. High humidity is experienced in the wet season while low humidity is experienced in the dry season (Emielu, 2000). The dry season is characterized by dry and dust-laden northeast trade winds called 'Harmattan' (with a very low temperatures and a thick fog) that blows from the Sahara under cloudless but dusty conditions.

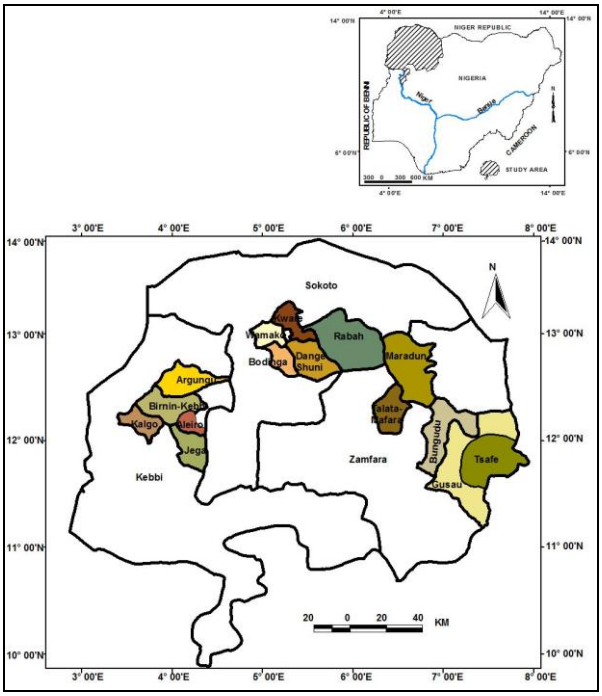

Figure 1: Selected local governments where the questionnaire was administered

Data collection and analysis

Data obtained for this study was the result of field investigations (primary sources), involving direct interaction with the respondents. A total number of four hundred and fifty copies of the questionnaire were administered to farmers in fifteen agricultural

settlements in fifteen Local Governments (Table 1). Cluster sampling technique was used for the study. Agricultural settlements and the local government areas were selected by purposive sampling technique. Thirty copies of questionnaires were administered in each of the settlements. This was because the settlements were small, hence the number of farmers. Data was analysed using frequency counts and percentages.

RESULTS

Table 2 shows the breed of goats reared in Sokoto-Rima River Basin. In 2000's, 52.6% of the farmers in Sokoto-Rima River Basin rear goats. Sokoto Red (Maradi) accounted for 90.71% of the goats reared while West African Dwarf Goats (WAD), Hausawa and Sahelian (Desert) goats ranged from 0.42% to 8.02%. Sixty-nine percent (68.77%) of the respondents reared the same breed of goat in the 1970's, 10.13% respondents have changed breed while 21.10% respondents did not rear goats in the past (Table 3). Out of 10.13% respondents that changed goat breed, 7.59% reared Sokoto Red (Maradi) in the 1970's, 1.69% reared Sahelian (Desert) goats while 0.84% reared West African Dwarf (WAD) (Table 4). Not less than 9.7% respondents attributed the change in goat breeds to climate variability, notably drought.

Table 1: **The states, local government areas and communities where data were sourced in Sokoto-Rima River Basin**

State	Local Government	Communities
Sokoto	Wamakko	Gumbi
	Bodinga	Mil Goma
	Kware	Durbawa
	Dange Shuni	Dange
	Rabah	Maikujera
Kebbi	Kalgo	Kalgo
	Birni-Kebbi	Gulumbe
	Aliero	Dakala
	Jega	Basaura
	Argungu	Alwasa
Zamfara	Talata Mafara	Tunfafiya
	Gusau	Madidi
	Maradun	Dosara
	Bungudu	Tazame
	Tsafe	Tsafe

Table 2: Breeds of Goats reared in Sokoto-Rima River Basin

S/No.	Goats breed	Number of Respondents	Percentage
1	Sokoto Red (Maradi)	215	90.71
2	Sahelian (Desert Goats)	19	8.02
3	West African Dwarf Goats	1	0.42
4	Hausawa	2	0.84
	Total	**237**	**100**

Table 3: Farmers that reared the same breed or changed breed in 1970's in Sokoto-Rima River Basin

S/No.	Goats breed	Number of Respondents	Percentage
1	Reared the same breed of goat	163	68.77
2	Change breed	24	10.13
3	Did not rear goat in the past	50	21.10
	Total	**237**	**100**

Table 4: Goats breed changed in Sokoto-Rima River Basin

S/No.	Goats breed	Number of Respondents	Percentage
1	Sokoto Red (Maradi)	18	7.60
2	Sahelian (Desert Goats)	4	1.69
3	West African Dwarf Goats	2	0.84
	Total	**24**	**10.13**

The total number of individual drought impact on goats in Sokoto-Rima River Basin varied from varied from 27.0% of the reduction in milk to 74.26% of size reduction goats (Table 5). The nature of drought impact on goats in Sokoto-Rima River Basin is shown in (Table 6). Out of 10.12% respondents that were affected by four drought impacts, 9.28% were affected by the death of goats, reduction in offspring (calving), infertility in male goats and size reduction. The drought had three impacts on 38.38% farmers, with a range of 0.42% of the death of goats, reduction in milk yield and infertility in male goats to 15.19% of the reduction in offspring (calving), reduction in milk yield, and size reduction. The respondents affected by two drought impacts varied from 0.42% of the reduction in offspring (calving) and infertility in male goats to 6.33% of the reduction in milk yield and size reduction totaling 25.31%. The one drought impact namely death of goats, reduction in calving rate, reduction in milk yield, infertility in male goats and size reduction made up of 26.16 % and ranged from 0.84 % to 16.88 % respondents.

Table 5: Total number of individual drought impact on goats in Sokoto-Rima River Basin

S/No.	Drought impact	Number of Respondents	Percentage
1	Death of goats	92	38.82
2	Reduction in offspring (calving)	118	49.79
3	Reduction in milk yield	64	27.0
4	Infertility in male goats	79	33.33
5	Size reduction	176	74.26

Table 6: Nature of drought impact on Goats in Sokoto-Rima River Basin

S/No.	Goats	Number of respondents	Percentage
1	Death of goats/Reduction in offspring (calving)/Infertility in male goats /Size reduction	22	9.28
2	Reduction in offspring (calving)/Reduction in milk yield/Infertility in male goats /Size reduction	2	0.84
3	Death of goats /Reduction in offspring (calving)/Reduction in milk yield	2	0.84
4	Death of goats /Reduction in offspring (calving)/Infertility in male goats	2	0.84
5	Death of goats /Reduction in offspring (calving)/Size reduction	14	5.91
6	Death of goats /Reduction in milk yield/Infertility in male goats	1	0.42
7	Death of goats /Reduction in milk yield/Size reduction	2	0.84
8	Death of goats /Infertility in male goats /Size reduction	14	5.91
9	Reduction in offspring (calving)/Reduction in milk yield/Size reduction	36	15.19
10	Reduction in offspring (calving)/Infertility in male goats /Size reduction	18	7.59
11	Reduction in milk yield/Infertility in male goats /Size reduction	2	0.84
12	Death of goats /Reduction in offspring (calving)	5	2.11
13	Death of goats /Infertility in male goats	4	1.69
14	Death of goats /Size reduction	14	5.91
15	Reduction in offspring (calving)/Infertility in male goats	1	0.42
16	Reduction in offspring (calving)/Size reduction	12	5.06
17	Reduction in milk yield/Infertility in male goats	2	0.84
18	Reduction in milk yield/Size reduction	15	6.33
19	Infertility in male goats/Size reduction	7	2.95
20	Death of goats	12	5.06
21	Reduction in offspring (calving)	4	1.69
22	Reduction in milk yield	2	0.84
23	Infertility in male goats	4	1.69
24	Size reduction	40	16.88
	Total	**237**	**100**

DISCUSSION

The result of this study showed that four breeds of goats; Sokoto Red, Sahelian goats (Desert Goats), West African Dwarf Goats (WAD), and Hausawa were identified in Sokoto-Rima River Basin. Characterising the traditional varieties of goats in Nigeria, Ngere *et al.* (1984) earlier recognized three main breeds of goats in Nigeria, namely the Sahel (Desert) or West African long-legged goats, the Sokoto Red and the West African Dwarf. These breeds were reared in the entire northern Nigeria and particularly in Sokoto-Rima River Basin (RIM, 1992). About fifty-three percent of the farmers in the River Basin rear goats in 2000s. Sokoto Red which accounted for 91% of goat breeds is the most widespread and popular breed in the basin.

into the popular 'Morocco' leather (RIM, 1992).
The Morocco leather is known in Europe from
This breed is mostly reared because it is well adapted to the Savanna climate and its skin tanned the medieval period onwards. The breed is still known for its suitability for fine leather. The skin has coarse, thinly-spaced outer hairs and small sweat and wax glands and lacked fat (Burns, 1965).
Sokoto Red is more prolific and the most common village goat in the River Basin. The Sokoto Red is the only Nigerian breed for which there is a record of systematic attempts to establish a particular type. Henderson (1929), reviewing the work of the Veterinary Services in Sokoto province, described, how in 5 years, 219,688 non-red male goats were castrated resulting in the replacement of the non-red

skins by the more valuable red in the local markets. Besides, physiological experiments have shown that the WAD goat is not particularly adapted to high ambient temperatures (Montsma *et al.*, 1985). These reasons must have been responsible for the extinction of the WAD goats in the River Basin and also possibly responsible for the rearing of WAD by only 0.42% of the farmers

The WAD goat is the most common indigenous goat breed in the 18 countries of West and Central Africa (ILCA, 1987). Though WAD was stereotypically said to be native to the forest belts, the presence of WAD in Borno State, Republic of Cameroon and Chad suggests that they were far more widespread until recently (RIM, 1992). It was noted that WAD must have once been the main race of goat over most of Nigeria. They correspond to the West African Grassland Dwarf in Cameroon (Ndamukong *et al.,* 1989). Chang and Landauer (1950), Epstein (1971) attributed the distorted forms and extremely short legs to achondroplasia. In case of the Sahelian goats, they were preferred by pastoralists in Nigeria and are mostly found along the northern border of the country (RIM, 1992). The Hausawa is relatively a new breed which must have emerged as a result of cross-breeding. This breed is not yet widespread.

When the farmers were asked whether the breed of goats they rear presently was the same with those of the past, 68.77% affirmed rearing the same breed of goats. Only 10.13% admitted they rear different breed. This is an indication that changes in the breed of goats are not common among the farmers in the River Basin. Seventy-five percent of this group reared Sokoto Red. Out of 10.13% of those that changed breed, Sokoto Red accounted for 7.60%. The 9.71% out of 10.13% that rear different breed attributed the change to climate variability. Therefore most farmers changed to Sahelian goats because of its ability to withstand drought. Environmental factors have little influence on the body weight, age at first conception, litter sizes and productivity to year-round breeding (Wilson and Durkin, 1983; Wilson, 1987; Wilson and Sayers, 1987). Besides, the Sokoto Red has a much higher mortality than the Sahel (RIM, 1992). No wonder this breed is preferred by pastoralists in Nigeria.

An examination of responses showed that all the farmers were affected by drought. The nature of the drought impact on goats includes the death of goats, reduction in offspring (calving), reduction in milk yield, infertility in male goats and size reduction. The nature and the number of the impact vary from one farmer to another and ranged from 10.12 to 38.38% for one to four impacts. The farmers were mostly affected by three impacts, which accounted for about two-fifth (38.38%) of all the impacts. Size reduction (64.52% of one impact); reduction in milk yield and size reduction (25.0% of two impacts); reduction in offspring (calving), reduction in milk yield and Size reduction (39.56% of three impacts); and death of goats, reduction in offspring (calving), infertility in male goats and size reduction (91.67% of four impacts) are the most common impacts that affected farmers rearing goats in the river basin.

Considering the individual impact on the farmers, reduction in the size of goats is the most common problem, even though, the death of goats, reduction in offspring (calving) and infertility in male goats were major problems. Farmers were least affected by the reduction in milk yield during drought periods.

CONCLUSION

The study has shown that four breeds of goats were reared in the 2000s as against the three breeds reared in the 1970s in the study area. WAD goats were replaced by Sokoto Red which accounted for about 90% of the goats in the River Basin. Size reduction was the greatest consequence of drought on goats. Fifty-three (52.6%) percent of the farmers in the basin rear goats, with Sokoto Red (Maradi) accounting for 90.71% of goat breeds reared. About sixty-nine percent of the farmers reared the same breed of goat in the 1970s, 10.13% farmers (Sokoto Red - 7.59%, Sahelian goats - 1.69% and WAD - 0.84%) have changed breed while 21.10% respondents did not rear goat in the past. Not less than 9.7% farmers attributed the change in goat breed to climate variability, notably drought. Farmers were affected in the range of one to four drought impacts. The highest (38.38%) were those affected by three impacts, with a range of 0.84% to 15.19% while the least (10.12%) were those affected by four impacts. Size reduction was the greatest consequence of drought on goats. Goats

were more resistant to drought than other livestock types.

The goat breed the farmers engage in has implications for food security. The author recommend cross-breeding between the Sahelian and Sokoto Red goats for better adaptation to the arid environment so as to aid meat production and ensure food security.

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