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Phenotypic Characterization and Husbandry of Sudanese Native Chickens in South Kordofan State

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ABSTRACT: Local chicken populations are an important source of food in Sudan's rural areas. However, their productivity is not well studied. This study was conducted to explore the phenotypic characterization of Sudanese chickens. A total of 201 household chicken farmers were randomly selected from South Kordofan State during the period from October to Distemper 2020. A questionnaire was used to collect data that include: the household profile, production systems, flock size and composition, management practices, and challenges facing chicken keeping. A sample of 120 adult birds (10 males and 100 females) was used for phenotypic characterization. Descriptive statistics using frequency procedure was used to analyze the qualitative traits. The results revealed that women with low education owned most of the chickens, but no housing, feed, or vaccines. Disease and harsh environment are the main factors affecting the culling of chickens. overall mean flock size (23±0.81) ranged between 10 to 55/households, and it was affected significantly ($p < .05$) by Sample area. all farmers keep one ecotype. most of the birds had a single comb (54.2%). The main shank and plumage colours were: white and brown, respectively. It appears that future genetic programs will focus on the traits of the dual-purpose chicken population.

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KEYWORDS: Sudanese, native chickens, morphological, phenotypic, husbandry.

INTRODUCTION

Village poultry has many advantages for households as they are small, reproduce, and they can scavenge for food. Mahoro et al., (2017) found that in most countries, the main reasons for keeping local chicken were: egg production, income generation, meat production, and breeding stock production. Generally, Output of village poultry in terms of weight gain and number of eggs per hen per year is often low and unimproved local chickens are characterized by low egg production, late-maturing and long broodiness behavior (Chebo et al., 2022).A considerable data has been published on backyard chicken production system in most developing countries. Most of these studies noted that women's ownership and management of local chickens under home conditions (Mahoro et al., 2018; Ahmed, et al., 2021).According to Assefa et al., (2019) Flock structure and the number of chickens kept varied considerably; they pointed out that the number of chickens kept varied in time due to a combination of continuous culling for home consumption, sale for cash, in addition to diseases & predators. Ahmed et al., (2021) found that local chicken owners faced problems accessing knowledge, training, services, marketing, and financial services. Despite the vital role of native chicken, little effort had exerted towards investigating and characterizing its production system; as part of attempts for genetic and phenotypic improvement. several local chickens in Africa have been classified into breeds or ecotypes, but many remain unidentified and are facing extinction (Hassan et al., 2020). Although, traditional poultry production has been present throughout Sudanese villages and rural areas as well as in some towns, little information on production system is available. Generally, there are no reliable statistics regarding the contribution of conventional Sudanese poultry sector. Also there was little information about their genetic make-up. Limited research has been conducted on characterization of Sudanese indigenous chickens. According to the above this study aims to achieve the following objectives: To Study morphological and production performance of Sudanese indigenous chickens. To Justify husbandry practices of these breeds.

MATERIALS AND METHODS

Description of the study area:

This study was conducted in Southern Kordofan state. the state is known for the diversity of its soil, which has led to a remarkable diversity of agricultural products. The state is famous for raising livestock species due to the availability of pastures and water for drinking.

Sampling and data collection methods:

A total number of 201 households (HH) from smallholder chicken farmers based on native chicken keeping were randomly selected from the study area. namely: Abu Jubaiyah (n=30), Rashad(n=34), Alabassia (n=43), Abukarshoula (n=75), and Dilling locality (n=19). In addition to this, a total number of 120 adult birds (100 females and 20 males) (HH) depending on flock size and, easiness of catching birds was selected for body measurements and phenotypic traits were examined for phenotypic characterization according to (FAO, 2012).

Data collection technique and statistical analysis:

A survey using (face to face) questionnaire to collect data includes:

General information about the household profile, education level, income source, and livestock spices kept with chicken. Also, information with regard to production systems, breeding goals, flock size and composition, breed type, and management practices. Farmers were asked to specify major constraints and limitations facing local chicken keeping.an other questioner for phenotypic characteristics was used.

All the data obtained from the questionnaire were reviewed, organized and prepared before being coded and transformed into SPSS (version 20) software. Binomial variables from records on qualitative morphologic characters were reported as frequency and percentages. Effects of populations, sampling regions, and sex of the birds and their interactions on each of the quantitative variables were studied.

RESULTS

From the survey results, it was clear that the indigenous chicken production system in the households of the study area was based on scavenging. And most (30.9%) of chicken owners were women followed (25.9%) by children, fathers (19.4%), then (17.4%) family members, while a few (6.5%) of chickens were owned by a partnership between one or more family groups. (figure 1). This study showed that at least a quarter (25%) of chicken, owners obtained formal education (primary, secondary school levels and university) but fewer (9.5 %) of them at least had reading and writing skills. On the other hand, a considerable percentage (13.4%) of the owners were not educated (illiterate).

Table1 shows that 42.3% of households practice informal employment (Trading, daily work, labour) for their occupation and source of income, followed by a quarter (24.4%) with formal employment (government, NGOs personnel), and then 23.9% of households depend on rain-fed farming, and 5 per cent keep animals as sources of income. However, fewer (less than 3%) households have more than one occupation (agriculture, raising animals, and seasonal work).

This study showed that the overall average flock size in the study area was (23±0.81). Birds ranged between 10 to 55 per household. Sample area has been found to have a significant ($p < 0.05$) effect on flock size (table 2).

According to table 2, Abu karshoula recorded the largest flock (25.92±1.483), followed by Abu Jubaiyah (24.60 ±2.051), Alabassia (23.16 ± 1.821), and Rashad (18.26 ± 1.202); while Dilling recorded the smallest flock (17.37 ± 1.477).

Initial flock establishment revealed that the majority of households (78.6%) started chicken keeping by purchasing, indicating that chicken keeping plays an important role for households. Additionally, we observed that households often lose most of their flocks due to diseases, but reestablish them later.

Housing and flock management:

Regarding chicken housing, the results showed that all households keep their chickens in overnight small houses made of local materials. Probably because most intervened farmers believe that local chicken cannot grow well if it is kept in a small house because it restricts their freedom of movement.

Results concerning feeding practice showed that most (35.3%) farmers let their chickens search for food and scavenge with a few supplements from time to time, but there was no formulated feed (Fig. 4). This method of feeding does not maximize the use of limited feeding resources because younger and weaker birds must compete with mature birds and other scavenger animals.

In all interviews, farmers commented that chickens in the local area are not vaccinated or treated with medication. In addition to Newcastle Disease (ND), farmers describe many other symptoms affecting their flocks each year.

Regarding breeding management, we find that a considerable proportion (36.3%) of interviewed households in the different regions did not own breeding males. Most of them share breeding males with neighbours. Following this, the same percentage (31.3%) for two groups of farmers: one of them uses the same males all the time without replacing them, and the other one replaces their males regularly. On the other hand, only a fewer (1%) of farmers replace breeding males at least one time and share males with their

neighbours (Table 3). We observed that Most households use the same males for a long time and the replacement of the flock comes from inside it. Egg incubation & hatching and rearing of chicks were done naturally by mother hens.

About, more than three-quarters (80.6%) of farmers cull some birds from their flock for various reasons. Disease dominated these reasons (22.9%), followed by (15.4%) large numbers of chickens, then fewer (11.4%) cull their birds according to need (for income). But some farmers (19.4%) don't have a culling policy (Table 3).

Results regarding the use of culled birds showed that about half (43.8%) of respondent slaughter culled chicken for home consumption, followed by 28.4% of them selling them as life birds for income, while fewer (2%) gift their culled birds to friends. (Table 3).

From the survey results, we observed that all the interviewed households used traditional production systems. Hens prepare their nest and lay eggs freely. Most households (97.5%) use eggs either for home consumption (27.4%) or left to be hatched naturally by mothers. Selling eggs were rare and only (2.5%) of households sell them at local markets (table 4). In total, half of the farmers (54.7%) sell their chickens at local markets by themselves, while one in five farmers (19.4%) sell their chickens to traders and consumers directly. On the other hand, a quarter (25.9%) of farmers don't sell live birds and use them for home consumption.

As expected, disease and harsh environment are the main factors affecting the culling and loss of native chickens, (table 4).

Descriptive (Qualitative variables):

The following Results show the morphology of 120 adult birds, female (63.3 %), and males (16.7%) from five locations, as the following: Regarding types of comb, all five comb types were observed in the population, the single comb is dominant as the most prevalent (66.7%), followed by 15% for the pea comb type. (plate1)

Our results of plumage colour showed a distinguished variation between local chicken in all households (table 4). In this study, brown plumage colouration was found to be the predominant (20.8%) colour. Three-quarters of the birds tested had a white ear-lobe, followed by red ear-lobes (25.8%), whereas brown ear-lobes are observed in only 3.3% of the birds (table 4 & Plate 2). The dominancy (40%) of white shankcolourr in this study (table 5),

DISCUSSION

The Indigenous domestic chicken is an essential protein source for food production communities across the globe (Al-Jumaili et al, 2020). This reflects the important role of women in the household production system in rural farming since they spend most of their time at home and doing most of the farming activities. This was in line with Mahoro et al., (2017) who reported ownership of the women for chickens. Most (47.3%) of owners' ages were in the range of (20 to 40 years old), followed (29%) by the eldest age group (more than 40 years old), while younger groups (less than 20 years old) have a lower percentage (22.9%). We observed that the awareness of local chicken owners about modern chicken husbandry practices was too low. Based on this analysis, it appears that village chicken producers need training sessions of good chicken husbandry and management to improve their awareness and knowledge. This is in line with Ahmed et al., (2021) who noted that chicken owners faced problems accessing knowledge, training, services, marketing, and financial services. And he suggested that this can be solved by training them. Our finding in house hold it closely matched with the finding of An et al., (2022) who noted (24.79 ± 0.17/ HH) in India. The relatively high mean flock size may be explained by both the variation in flock size each year, as well as the time of the study (after the rainy season and before winter, when mortality and diseases are low). We observed that more than half (54.2%) of households kept a (3:1) hen to cock ratio in their flock. This was higher than the ratio reported by Wani et al., (2014) who noted (1:1.8) cocks to hens in Sudanese chicken farms. There were a number of households in this study that did not keep more cocks or males for breeding, so the lower percent of male to female may reflect that. Males are usually sold or slaughtered for home consumption, this was in line with Assefa et al., (2019). According to the study, native chickens were mostly raised in large-scale production systems (98.4%). Among the livestock varieties kept by households, chicken had the lowest priority. On the other hand, women on the other hand, were identified as the most important contributors to family chicken ownership, management, and decision making. The flock size and cock: hen ratio ranged from 25.4 to 37.0, and 1: 2.24 to 1: 3.34, respectively (Yousif et al, 2015). The stated objectives of native chicken keeping under this study were meat provision and cash generation. In addition to this, chicks and younger birds comprise the large portion of the flocks. The current study revealed that the greatest number (94.5%) of farmers keep one breed of local chickens, manly (83.1% small Baladi, 8.5% large Baladi). Bare-neck and dwarf types are not preferred (less than 2%). The reason for this may be due to the appearance of the birds, as most farmers don't like bare-necked birds, in addition to their aggressive behavior. This was in line with Mahoro et al., (2017) who rank dwarf type on the top list of chicken types reared in Rwanda.

As in any other village poultry systems in developing countries, there was no specialized egg or meat type among Sudanese native chickens. we observed that most households keep chicken as a reserve to support home food security and as an easy source of income during emergencies. This study showed that most (39.3%) of households slaughter their chickens for ceremonies or sell them to earn money. Similar results were obtained by Mahoro et al., (2017). Regarding chicken housing, Good agreement was found when comparing results from this work against published data by An et al., (2022) when the knowledge of farmers with Newcastle Disease (ND), symptoms affecting their flocks and vaccinated. This result was in contrast with the finding of An et al.,

(2022) in India who noted that overall 52.79% of the farmers vaccinated their flocks against ND regularly. Generally, most of studies mention similar culling strategies for the flock (Mahoro et al., 2017; An et al., 2022). This is reasonable in the absence of vaccination and treatment programs oriented to indigenous chickens in Sudan. In addition to the lack of extension services for poultry production in most of rural areas. Results of the present study indicated that most of local chicken production in the study area is suitable for dual production system. This is in line with Mahoro et al., (2017). This result of morphology is in line with Habimana et al., (2021); Patrick et al., (2022) who found single type was the dominant in Rwanda and Sierra Leone respectfully. Walnut comb type was observed in 10% of the sample, while rose and duplex type were 5% and 3.3% respectively. (picture 1& table 5). Likewise, our result agreed with Birteeb and Boakye, (2020) who found that the majority of Ghana's chicken had single comb type, followed by pea combs. On the other hand our finding was not in agree with Odah et al., (2019) who observed pea comb type as a dominant type in Nigeria. An et al., (2022), who noted brown and dull in color in females, but it was differ than the variegated plumage color reported by Patrick et al., (2022) in Sierra Leone. The different plumage color obtained in this study might be explained by the fact that preference of people towards red, yellow and brown plumage and less interest in white, which accounted for the largest occurrence of these plumage colors across the population. The results obtained in the current study (dominance of normal feather) were in line with the results noted by Habimana et al., (2021); Patrick et al., (2022) regarding the rarity of naked necks (2%) in Rwanda. The dominancy is contrary to the findings of Habimana et al., (2021) and An et al., (2022), who found yellow was the min shack color.

CONCLUSION

This study showed that the overall average flock size in the study area ranged between 10 to 55 birds per household. Disease and harsh environment are the main factors affecting the culling and loss of native chickens. The morphology regarding types of comb, all five comb types were observed in the population, the single comb is dominant as the most prevalent followed by the pea comb type. plumage colour showed a distinguished variation between local chicken in all households. This brown plumage colouration was found to be the predominant colour. Three-quarters of the birds tested had a white ear-lobe, followed by red ear-lobes, whereas brown ear-lobes were less. It appears that future genetic programs will focus on the traits of the dual-purpose chicken population

CONFLICT OF INTEREST

The authours certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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Table 1. Occupation and income source of chicken owners.

Items	N	%
Farming	48	23.9
Animal keeping	10	5
Formal employment	49	24.4
Informal employment	85	42.3
Housewife	5	2.5
Farming & Formal employment	2	1
Farming & Informal employment	1	0.5
Animal keeping & Informal employment	1	0.5
Total	201	100

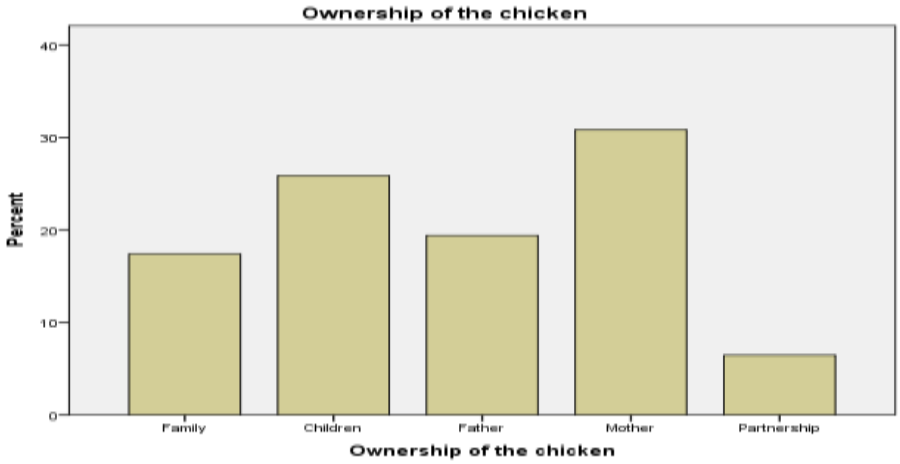

Figure 1. Ownership of local chicken in the study area

Table 2. Flock size by household for different areas (mean ± SE).

Region	N	Mean	STD	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
Rashad	34	18.26 ± 1.20 $_{b}$	7.00	15.82	20.71
Abu Jubaiyah	30	24.60 ± 2.05 $_{a}$	11.23	20.41	28.79
Alabassia	43	23.16 ± 1.82 $_{a,b}$	11.94	19.49	26.84
Dilling	19	17.37 ± 1.48 $_{b}$	6.44	14.26	20.47
Abu karshoula	75	25.92 ± 1.48 $_{a}$	12.84	22.97	28.87
Total	201	23.03 ± 0.81	11.47	21.43	24.62

a,b Means with different superscript letters are significantly (P < 0.05) different.
SE, standard error of the mean. Std. Dev = standard deviation of means.
N= number of birds.

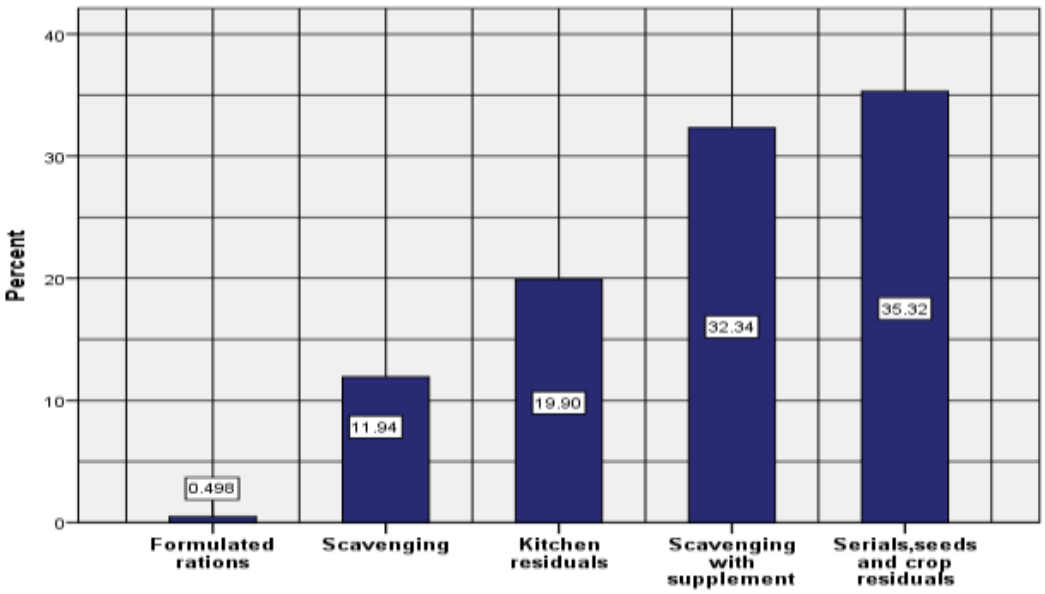

Figure 2. Feeding system of local chicken in the study area

Table 3: Management and husbandry of local chicken

Items	N	%
Culling reasons of chicken		
low productivity	22	10.9
Low production, diseases and ageing	9	4.5
Disease	46	22.9
Diseases, flock size & ageing	8	4
Aged birds	14	7
Edging & flock size and After rainy season	10	5
Large number of chicken	32	15.9
According to needs	23	11.4
No culling system	37	18.4
Total	201	100
Source of breeding males in the flock:		
Using the same males all the time	63	31.3
Replace males regularly	63	31.3
Sharing males with neighbors	73	36.3
Replace and share with neighbors	2	1
Total	201	100
Using of the culled birds:		
Home consumption	88	43.8
Home consumption & sale	16	8
Sale for income	57	28.4
Sale & Gift	6	3
No culling	34	16.9
Total	201	100

Table 4: challenges facing local chickens

Items	N	%
Diseases and health Management	140	69.7
Diseases and natural Enemies	8	4.0
Environmental conditions	5	2.5
Housing problems	3	1.5
Feeding and Nutrition	4	2.0
Chickens Natural Enemies	7	3.5
No problems	34	16.9
Total	201	100

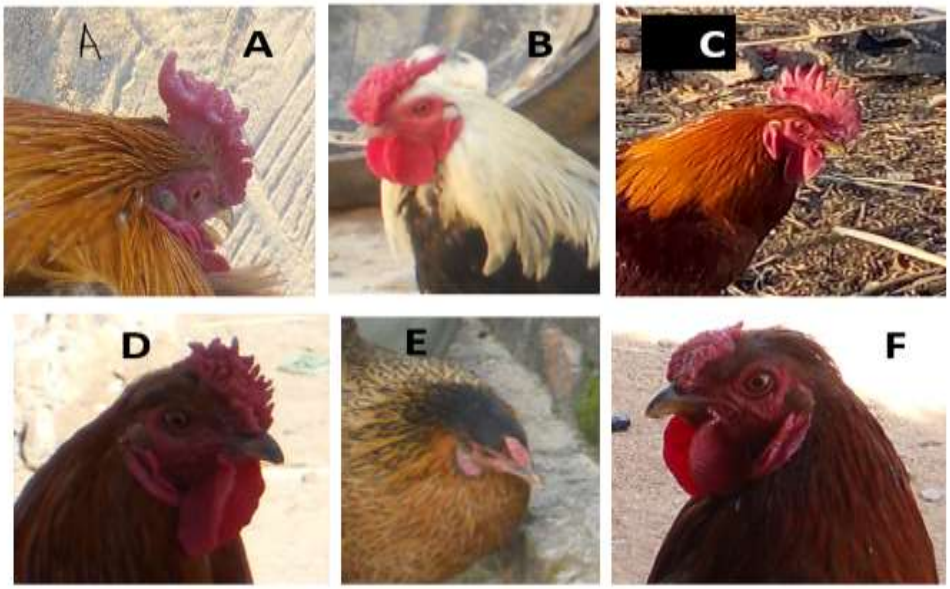

Plate.1. Different comb type and shape of sample areas

**Brown write, white, and white to radish ear-lobe color Picture 2:* Plate.2.Different Ear-lobe colors in male and female chickens:

Table 5: Phenotypic characteristics of native chickens in the study area

Items	**N**	**%**
Comb type		
Single	65	54.2
Single Bick size	1	0.8
Single Small size	14	11.7
Rose	6	5
Pea	18	15
Walnut	12	10
Duplex	4	3.3
Total	120	100
Plumage color		
Black	17	14.2
White with Black parts	4	3.3
Yellow	12	10
Yellow with other colors	8	6.7
Black and White, Black with other colors	13	10.8

Brown	25	20.8
Brown with other colors	4	3.3
Red	18	15
Red with Black tail	6	5
White	13	10.8
Feather distribution		
Normal	116	96.7
Naked neck	4	3.3
Shank color		
White	48	40
Black	37	30.8
Yellow	24	20
Gray	11	9.2
Ear-lobe color		
White	85	70.8
Red	31	25.8
Brown	4	3.3