

Rural Chicken Management Practices in South Sudan: Prospects for Poverty Alleviation and Socio-economic Development

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Abstract: Evaluation of management practices of rural chickens in Tonj County, Warrap State, South Sudan is imperative as chickens constitute a source of animal protein and income. Data were gathered using questionnaire, direct interviews and observations from 50 households randomly selected from various villages/Bomas. The study revealed more household aged 30-50 years old, abundant women and high illiteracy level. Total average flock size per household was 25.6 chickens with most households keeping hens and chicks. Diseases and predation were causes for annual flock losses. Households mostly depend on scavenging system of rearing chickens. Houses of different designs and materials were constructed. High fertility and hatchability rates among chickens were observed. Households accrued 2,050,000 SSP (11,388.9 USD) from the sales of live chickens to help mitigate poverty, food and nutritional insecurity. Tapping the households' attitudes and practices was recommended. Further study on chicken marketing management system is needed to enhance socio-economic development.

Keywords: Indigenous chicken, Tonj County, Scavenging system, Socio-economic development.

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I. INTRODUCTION

Indigenous chickens, *Gallus gallus domesticus* are reared in an extensive scavenging free range system in the rural areas of South Sudan. However, rural poultry production is underscored in the mainstream of national economies attributing to the lack of measurable indicators of output [1]. Evidence has shown that chickens provide rural households with scarce animal protein (meat and eggs) and being a reliable source of petty cash [2-4]. Moreover, chickens are used for traditional ceremonies and festivals in some cultures [5]. It is evidenced that intake of quality animal protein provides good health and strengthens manpower needed to alleviate poverty and ensure food and nutritional security for socio-economic development of rural households [6].

Productivity levels of rural poultry in many African countries fall far below desirable level. The average flock size per household in Ethiopia is 5 and 8 chickens that range between 2-20 chickens [7]. However, in Pakistan flock sizes of 23.1 per household [8] and of 26.1 [9] have been reported in chickens. Meanwhile, in Ethiopia, it has been revealed that the mean clutch number (the time per year hens lay group of eggs) in small scale family poultry production is

4.3±0.7 and the clutch size (the number of eggs laid per hen per clutch) is 15.1±2.5 eggs [10]. Furthermore, an annual production of 55-80 eggs in 5-6 clutches of 10-15 eggs has been reported [11].

The management of rural chickens involves housing or sheltering, feeding and health care. The main source of feeding for rural poultry is the scavenging feed resource base. It has been found that the amount and type of feed available for scavenging chickens show a wide variation per seasons [12]. Seemingly, during dry season, the scavenging feed resources base becomes wider due to the time of crop harvesting that usually leaves behind a lot of grains scattered on the threshing floor.

On the contrary, worms, insects and green forages are wet season scavenging feed resources. However it has been reported that 62 - 75 % of household provide supplementary feeds to their chickens [13]. Little effort has been made to improve village chickens housing, feeding and health care. In southern Ethiopia, it has been found that 5.3 % of households enclose their chickens during the night in a rudimentary type of separate shelters, and 2.7 % of them keep basket inside in a raised type of mud floor [12].

Indigenous chicken production, management and characterization have been neglected in research programmes involving livestock development in South Sudan. Consequently, very little is known about the management and performance of this flock. Intensive cross breeding schemes with exotic breeds in the neighboring countries to South Sudan and the influx of these foreign blood to border towns, may threaten the loss of gene pool of the indigenous chickens in the near future before they are characterized and studied. The fact that village chicken management and production vary from area to area depending on the socio-economic, cultural and biological factors, make this investigation imperative in Tonj County of Warrap State, South Sudan. This can broaden the understanding of the significance of village chickens and also outline the challenges facing the farmers. It supports the hypothesis that enhancing production of local poultry at village level can contribute to poverty alleviation and mitigate food and nutritional insecurity among poor rural population.

Therefore, this study explores the indigenous chickens' management practices by rural households and its contribution to poverty alleviation and socio-economic development in Tonj County, Warrap State, South Sudan.

II. MATERIALS AND METHODS

2.1 Study Area

This study was conducted for 18 months in Tonj County, Warrap State, South Sudan during dry and rainy seasons. Tonj County is located in north west South Sudan at latitude 7.274 °N, longitude 28.677 °E and altitude 1,440 feet. The County is approximately 525 km northwest of Juba, 100.8 km southwest of Wau town. The rainy season extends from March to November with at least rainfall of 0.5-6.6 inches and it lasts for 8.2 months. The temperature ranges between 20.5- 40.0°C. The County represents several villages in Warrap State where its dwellers preserve much of their cultural identities and traditions with limited interaction with city. Furthermore, Tonj County is the ancestral home to the Dinka and the Bongo ethnic groups along with several smaller tribal groups. Human population has been estimated at 17,340 in Tonj [14] and that indigenous chicken may reach tens of thousands, and they are reared in traditional husbandry system.

2.2 Household demography

Structured questionnaire and direct interview were conducted with 50 households to determine age, sex and educational background.

2.3 Study Design and Data Collection

With gender consideration among the families rearing chickens in the study area, 50 households from 6 Payams/Districts were randomly selected. A total of 1,005 chickens were owned by these households. Beside direct interview and physical observations, information pertaining to management (feeding, types of housing and identification of diseases), flock size and composition, production (eggs production per year, number of clutches per year and clutch size) and reproductive parameters (fertility and hatchability) was gathered. Simple candling method was used to determine fertile eggs among the eggs set for natural incubation and hatching. Assessment of losses due to diseases and predation were also obtained by direct interview.

2.4 Candling Process

Eggs were collected from naturally brooding hens on day14-18 of incubation, and then subjected to candling. Opaque eggs with network of veins indicating development of embryo within the eggs while the unfertile eggs were translucent. The fertile eggs were returned again to the incubating hens until the hatchment of chicks on day 21.

2.5 Fertility and Hatchability

Fertility and hatchability were determined using the following formulae:

$$\text{Fertility} = \frac{\text{No. of Fertile eggs}}{\text{No. of Total eggs}} \times 100$$

$$\text{Hatchability} = \frac{\text{No. of Hatched out chicks}}{\text{No. of Fertile eggs}} \times 100$$

2.6 Data management and analysis

Data were managed in Microsoft Excel. Descriptive statistics were used for data analysis and results were presented in frequency and percentage [15].

2.7 Ethical Considerations

Ethical considerations for conducting the study and the informed consent of respondents were obtained.

III. RESULTS

3.1 Household demography

Table-1 shows that 52% of household aged 30-50 years old, 62% of female participants are more than males (38%) and most of the households are illiterate (76%).

Table-1: Household Demography (n=50) in Tonj County, South Sudan

Variables	Frequency (Number)	Percentage (%)
Sex		
Male	19	38
Female	31	62
Age (years)		
18-30	20	40
30-50	26	52
> 50	4	08
Educational Level		
Illiterate	38	76
Read and write	12	24

3.2 Flock size

Table-2 shows a total of 1,005 chickens as the overall average flock size. Of these chickens, chicks and hens represented the highest categories (679) than pullets, cocks and cockerels. Total average flock size

per household was 25.6 while the average flock per household was 8.2 and 8.1 for chicks and hens, respectively. However, cocks, cockerels and pullets were sold.

Table-2: Flock size and Inventory (n =50) in Tonj County, South Sudan

Flock size	Flock composition					
	Hens	Pullets	Cocks	Cockerels	Chicks	Total
Frequency (Percentage)	322 (32.04)	140 (13.93)	124 (12.34)	62 (6.17)	357 (35.52)	1,005 (100)
Average flock /Household	8.1	4.1	3.2	2.0	8.2	25.6

3.3 Household’s response to provision of supplementary feeding and night shelter (housing)

Table-3 shows that 22 (44%) of the households rely on day scavenging system to rear chickens compared to 19 (38%) who provide supplementary feed and water to the flock during dry season when flock were kept indoor for fear of predation. Only 9 (18%) of household were observed to practise both scavenging and providing supplementary feeds.

With the exception of a few households 2(4%) that could not provide night shelter for their chickens,

compared to 42(84%) who were keen to do so. Some households 6 (12%) who were unable to provide such facility decided to stay together in the same room with the chickens (Table-4). This study indicates that the households have provided different types of houses with different designs and materials for construction (Table-5). Most of the households (66.67%) preferred to build the houses above the ground. The dome - and pyramidal shape roof were found on both ground and above the ground levels. Bamboo and grass roofing materials are commonly used than other materials on both ground and above the ground houses.

Table-3: Households response to provision of supplementary feeding (n =50) in Tonj County, South Sudan

Activity	Supplementing	Scavenging	Both
Supplementary feeding	19(38 %)	22(44%)	9(18%)

Table-4: Households response for provision of night shelter (housing) (n =50) in Tonj County, South Sudan

Activity	Night shelter		
	Providing	Staying together	Not providing
Housing	42 (84%)	6 (12%)	2 (4%)

Table-5: Design and materials utilized for construction of ground and above the ground chicken houses (n= 42) in Tonj County, South Sudan

Design	Shape			Materials used				
	Dome	Pyramidal	Others	Bamboo	Grass	Green bricks	Iron sheet	Mixed
Ground Level 14 (33.33 %)	5 (35.71%)	6 (42.86%)	3 (21.43%)	7 (50%)	5 (35.71%)	0	2 (14.29%)	0
Above the Ground Level 28 (66.67%)	16 (57.14%)	8 (28.57%)	4 (14.29%)	14 (50%)	5 (17.86%)	4 (14.29%)	2 (7.14%)	3 (10.71%)

3.4 Production and reproductive performance of indigenous chickens in Tonj County

Table-6 shows the productive and reproductive performance of indigenous chickens in the study area. Of the 50 households under the study, 462 hens were

found among the flock of which 350 were laying on eggs. Of the total 3,256 eggs counted at the period of study 2,930 eggs were found fertile after being candled (Fertility = 89.99%) culminating into 2,654 hatched chicks (Hatchability = 90.58%).

Table-6: Productive and reproductive performance of indigenous chickens in Tonj County South Sudan

Parameter	Minimum	Maximum	Average
No. Clutch/year	2	4	3
Clutch size	10	20	15
No. Eggs / year	20	80	50
Age at first egg laying	5	8	6.5

3.5 Household recognition of diseases causing high mortality rate and annual flock loss

Table-7 shows that 84% of the households are able to recognize Newcastle Disease (N.D) as a major disease causing high mortality rate among chickens in Tonj County. However, 90% of households were able to recognize other diseases of importance in chicken

production. Households 24 (48%) identified diseases as the major causes of flock loss especially during rainy season (66.67%) and that predation significantly (75%) occurs during dry season. However, both diseases and predation were considered by other households (80%) as flock loss during dry season (Table-8).

Table-7: Households recognition of diseases causing greater loss (n =50) in Tonj County, South Sudan

Suspected Disease	Respondents	
	Agreed	Disagreed
Newcastle Disease (ND)	42 (84 %)	08 (16 %)
White Bacillary Diarrhoea (WBD)	20 (40 %)	30 (60%)
Other diseases	05 (10%)	45 (90%)

Table-8: Causes and season of annual flock loss identified by households (n =50) in Tonj County, South Sudan

Cause	No. Respondents	Season	
		Rainy	Dry
Diseases	24 (48 %)	16 (66.7%)	08 (33.3%)
Predation	16 (32 %)	04 (25 %)	12 (75 %)
Both	10 (20%)	02 (20 %)	08 (80%)

3.6 Financial return from average annual sales of live chickens

Live chickens are mostly displayed to the market than eggs, as most eggs are reserved for brooding. The total average annual monetary returns

from the sale of live chickens per household at gate price are SSP 2,050,000 equivalent to USD 11,388.9 and SSP 99,500,000 equivalent to USD 552,777 (Table-9).

Table-9: Average annual sales of live chickens per household and average financial return from the sales (n =50) in Tonj County South Sudan

Inventory	Average number/ Household	N =50	Price unit	Average amount/ household (SSP)	N =50 (SSP)
Cocks	250	11,500	3,000	750,000	34,500,000
Cockerels	375	18,750	2,200	825,000	41,250,000
Hens	125	6,250	2,300	287,500	14,375,000
Pullets	75	3,750	2,500	187,500	9,375,000
Total	825	40,250		2,050,000 (11,388.9 USD)	99,500,000 (552,777.8 USD)

IV. DISCUSSIONS

This study has indicated that rearing and keeping of chickens is widely practised in Tonj County. This is justifiable in the sense that chickens constitute a source of income for immediate household to meet the needs of essential food commodities, clothes, medication and school fees. In South Sudan among

pastoralists and agro-pastoralists and even agriculturalists, married women usually profess rearing chickens attributable to the norms and socio-cultural aspects of life. Evidence shows that chicken flocks have been managed by individuals above 60 years old in South Africa [16]. The high level of illiteracy of community was revealed in Ethiopia [17] and Kenya [4]

as well as South Sudan. This could be explained mostly by decades of protracted civil wars in the country.

Flock sizes are generally low with relatively high mortality rates compared to commercial poultry production [18, 19]. The average flock size of chicken per household in this study was comparable to 23.1 [8] and 26.1 of [9]. However, it is higher than flock sizes of 8.7 in Punjab [20]; 11 in Morocco [21]; 16.2 in Tanzania [22]; 7.2 and 7.13 in Ethiopia [17, 23]. In this study the flock structure was higher than the inventory reported by [7]. Apparently, the discrepancy could be due to tendency of households in Tonj County in keeping hens and chicks and selling cocks, cockerels and pullets as a primary means of replenishing and increasing flock size.

It seems that scavenging has affected nutrition and exposed chickens to predation, diseases and parasites as supported by [24]. In addition, chickens at different stages of growth were left to compete for the same feed [25]. It is clear however, whether the chickens got enough nutrients through scavenging and supplementary feeding. The practice of scavenging system in Tonj County as a sole means for rearing chickens was supported by the findings of [12] that the main source of feeding for rural poultry is the scavenging feed resource base and that the amount and type of feed available for scavenging chickens showed a wide variation per seasons. During dry season, the scavenging feed resources base was wider to meet crop harvesting that usually leaves behind a lot of grains scattered on the threshing floor. On the other hand, worms, insects and green forages are wet season scavenging feed resources.

Ostensibly, village chickens are vulnerable to theft and easily predated upon when not sheltered. Households in Tonj County were keen to provide night shelters to their chickens as evidenced by the different designs, styles and materials used to construct chickens' houses. Most households preferred to build chickens' houses above the ground due to fear of flood, predation, insect disturbance and termite attacks. Moreover, they are of the belief that above the ground buildings meet the physiological needs of a bird since birds by their very nature are happy to sit all night long on any resting place raised above the ground. The use of different designs is an indication that the owners are aware of the importance of housing for chickens.

In contrast, it was revealed that about 80% of households maintained such sheds, yet their chickens were poorly maintained to protect birds from predators. Bamboos and grass are commonly used for roofing the houses or preparation of cages, more than other locally available materials [26]. This is in line with the findings of [16, 26] that the type of chicken shelters provided by farmers depended on availability of resources and were designed in such a way that farmers could enter without complications. Moreover,

this study supports the findings of [19] that most chicken keepers resort to cheap and locally available materials such as mud, wooden poles and corrugated sheets. Furthermore, it was found that 79% of households made available rudimentary housing consisting of a variety of home-made shelters [21]. These houses were made up from local materials such as bamboos, wood, stones and plastic screens. Similar practices for provision of night shelter for indigenous chicken was observed in Botswana [27] and somewhere else in Africa [12, 21]

Provision of supplementary feeding is crucial for village chickens that depend mainly on scavenging for their nutritional needs which is consistent with the findings of [4, 12, 25, 28]. However, [13, 17, 29] indicated percentages of 62.75, 99.28, and 96.6, respectively of households offering supplementary feeds, which are higher than 38% as recorded in this study. The disparity could be demonstrated in that provision of supplementary feeds increases post-harvest outputs during dry season when most of the birds were kept indoors due to fear of predation.

In this study, chickens seemed to lay their first eggs at an average age of 6.5 months (range 5-8 months). However, it was observed that pullets in northern- western Ethiopia laid their first eggs around 20-24 weeks [17]. Average clutch number was 3 times (range 2-4) a year with 15 eggs (10-20) in each clutch and average eggs produced/ hen/ year were 45 (20-70 eggs). Nevertheless, such clutch count of 5 to 6 is lower and higher than clutches reported by [11, 30] respectively. Furthermore, a clutch of 3-4 per year in Botswana with a clutch size of 14-20 eggs was reported [31].

Similarly, in Ethiopia the mean clutch count in small scale family poultry production was 4.3 ± 0.7 with a clutch size of 15.1 ± 2.5 eggs [10]. The disparity could be attributed to the type of management practices and breed characteristics of the local birds. Fertility and hatchability levels were reported to be influenced by the effect of external parasites, predation, management and environmental conditions [16]. Fertility of candled eggs (89.9%) observed in this study is similar to indigenous Fulani (85.59%) and higher than that in Naked-neck (77.6%) ecotypes [32]. Hatchability in this study (90.6%) is higher than 68.0% which was reported by [16] as compared with the Frizzle feather birds [32-34]. The disparities could be ascribed to variations in chicken rearing conditions.

It was reported that 40-60% of chickens had died during the first 8 weeks of life mainly as a result of diseases and predation [11]. In contrast, indigenous chickens were supposed to be more adapted to local environmental conditions and became resistant to diseases [35]. Not surprisingly, every year disease outbreaks are known to decimate chickens' population in Tonj County and South Sudan at large. Lack of

veterinary capacity in this area rendered diagnosis and control of poultry diseases impossible which prompted some households to deplore rearing of chickens. Diseases recognition and season of outbreaks are therefore important for households so as to facilitate early intervention. Households agreed that in addition to predation, ill-health may decrease flock sizes. Recognition of signs of Newcastle disease as a major cause of high mortality especially during rainy season has concurred the findings of [10, 12, 36] in that Newcastle disease, White Bacillary Diarrhea, predation were contributors to chickens' losses.

In this study, more male chickens were sold that fetched more money than the female chickens and this might relate to consumers' preference and preservation of hens for eggs production. In the major towns of South Sudan, the demand on local poultry products has increased because of their nutritious and healthy image as natural products, as they are raised in a clean environment with no industrial residues. Furthermore, there is somehow a unanimous recognition of the high organoleptic properties of their meat and eggs, markedly superior to that of the so called industrial modern poultry which are considered as lacking flavor and taste. It has been observed that live chickens are mostly displayed to the market than eggs, as most eggs are reserved for brooding. Therefore, this business proved to be much lucrative and has attracted many youth in big towns of Bahr el-Ghazal region buying and selling live chickens. Money accrued from this business is again diverted to buying and accumulating cattle for marriage and attaining social position in their communities. Moreover, chicken producers in turn used the money for schooling their children, health insurance, buying seeds and agriculture implements or hiring oxen / tractor for ploughing or to help them stand for any eventualities that may occur in their day to day life.

Thus, this reciprocated economic benefits help alleviate poverty, household food and nutrition insecurity. This is in line with the observations made by [2-4] that have shown that chicken products provide rural households with scarce animal protein in the form of meat and eggs as well as being a reliable source of petty cash. Intake of quality protein provides good health and strengthens man power needed to alleviate poverty and ensure food and nutritional security for sustainable socio-economic rural households [37]. The demand for local chickens' meat was high in towns as a result of its taste and some organoleptic characters. This has become a token incentive to village households to enhance production and productivity of chickens for cash by provision of housing to safeguard against night predation.

V. CONCLUSION

Young age category, illiterate mostly women were involved in indigenous chicken rearing under extensive scavenging system with a few households

provide supplementary feeds. Average total flock size per household reflected that hens and chicks were kept more than cocks and cockerels. Shelter of different designs and materials were provided for fear of diseases and predation. The monetary returns from the sales of live chickens in Tonj County per household are lucrative. It is recommended that attitudes and routine practices of households in rearing local chickens should not go untapped to enhance performance, health status and survivability of the chickens. Moreover, further studies on village chicken marketing system are needed. The market analysis has shown a high demand and inconsistent supply of indigenous chickens in big towns of South Sudan. Furthermore, women groups should be targeted by policy makers and Nongovernmental Organizations (NGOs) through capacity building and skills training on the importance and application of management interventions at farmer and extension levels.

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