Unravelling the Flock Dynamics and constraints to Poultry Production in a typical Indigenous Poultry-keeping community in Uganda

Caleb Waiswa[1], Junior Senyonga Kasima[1*], Harriet Mbabazi[2], and Marion Wilfred Okot[3]

[1]Department of Animal Production and Range Management, Faculty of Agriculture and Environment, Gulu University, Gulu-Uganda
[2]Department of Rural Development and Agribusiness, Faculty of Agriculture and Environment, Gulu University, Gulu-Uganda
[3]Professor Emeritus, Department of Animal Production and Range Management, Faculty of Agriculture and Environment, Gulu University, Gulu-Uganda

***Corresponding author:** kasi95js@gmail.com

ABSTRACT

The efforts to promote improved poultry production in Africa and Uganda in particular are a threat to the continent's indigenous poultry genetic resource, and the practices used by farmers to maintain these resources. In the efforts to conserve these resources, we conducted a survey among 80 farmers in a typical indigenous poultry-keeping community of Ibulanku, Busoga subregion where most of Uganda's indigenous poultry species are hosted. The study revealed a higher female (63.3%) and youth (over 40%) participation in indigenous poultry production. Only 2.5% of farmers kept exotic birds on top of the indigenous species. Indigenous chickens were the most common poultry species, being kept by all farmers most of whom had ≥10 chickens. Housing has been embraced by all farmers although only 27.5% had a designated poultry house, with the rest using either their kitchens or family dwellings. Primarily, birds were kept for home consumption (93.8%), income generation (92.5%) and welcome for visitors (86.3%). Diseases were the most constraining factor to indigenous poultry production which the farmers mainly managed by treatment (85.7%), with some using herbal and/or human medicines. The study has revealed an improvement in management of indigenous poultry, through housing, which improves on their welfare. However, further studies should be conducted to assess the traces of human medicine residues in indigenous poultry products, and appropriate policies on use of the same formulated to safe guard the consumers.

Keywords: Busoga subregion, Genetic resources, Herbal medicine, Indigenous knowledge, Indigenous poultry

1.0. INTRODUCTION

There has been a sustained global importance of poultry in the livelihoods of smallholder rural communities. This is because poultry offer a cheap surety to food and nutrition security in rural households, and a ready income source (Ochora *et al* 2023). In particularly, poultry are an immediate

source of proteins in form of eggs and meat, and incomes from the sale of these same products (Gulilat *et al* 2021).

Despite this unrivalled importance, Africa's poultry sector is still quite underdeveloped. Nonetheless, it is postulated that with the increasing demand for animal source foods, particularly chicken meat and eggs, a consequential growth will be realised in the nearby future (Shumye *et al* 2022). In Uganda, over 75% of livestock keeping households keep at least one species of poultry (UBOS, 2024). A further synthesis of the UBOS (2024) report indicates that the current population of poultry stands at 62.9 million birds with chicken constituting about 92%. About 70% of the total poultry population are indigenous, most of which are hosted in Busoga subregion of Eastern Uganda.

To the detriment of Uganda's indigenous poultry genetic resource, there have been attempts by Uganda's government to introduce and even promote the rearing of improved poultry species (Ekowu 2013). One notable initiative was an integrated effort between private sector and government in Acholi subregion of Northern Uganda where farmers were supplied with Kuroiler chickens to improve the performance of their flocks (Ochora *et al* 2023). It is quite unrealistic to applaud or negate these efforts, but even with the initiative, the poultry population in Acholi has remained low (UBOS, 2024). And, even in the districts where the above initiative was implemented, farmers still kept indigenous poultry (Ochora *et al* 2023). Thus, farmers still appreciate the importance of indigenous poultry. The superiority of indigenous poultry lies in their hardiness in the prevailing draught conditions (Manyelo *et al* 2020), and their tastier meat which is preferred by consumers (Magala *et al* 2012).

Nonetheless, improvement initiatives could threaten the gene pool of indigenous poultry species. This could be at the expense of the quality of poultry products (eggs and meat) and the livelihoods of smallholder farmers. In the efforts to preserve the indigenous poultry genetics, it is important to have a thorough knowledge of the practices employed by communities that have persistently maintained indigenous poultry. To this effect, the current study sought to primarily establish the flock dynamics in a typical indigenous poultry-keeping community within Busoga subregion of Eastern Uganda where most indigenous poultry are hosted (UBOS, 2024). This initiative intends to unearth, and probably revitalise the practices of traditional poultry farmers in the efforts to preserve the indigenous Ugandan poultry. The study critically studied the practices of a smallholder indigenous poultry-keeping community of Ibulanku subcounty in Bugweri district, examining the flock structure, management practices, and most importantly, strategies employed to ensure the sustenance of indigenous poultry within a household. It is important to mention that the findings of this study will greatly contribute to efforts to conserve the livestock management practices which have contributed to maintaining the genetic resources of the native species of Africa. This will in the end contribute to reducing erosion of indigenous genes in Africa's livestock sector.

2.0. MATERIALS AND METHODS

The current study was conducted in Ibulanku sub-county of Bugweri district in Eastern Uganda. Generally, indigenous poultry birds are a source of livelihood and food security in the study area. Specifically, indigenous species dominate poultry production systems in the study area (UBOS, 2024), which makes it representative of a typical indigenous poultry-keeping community. Since we did not have prior knowledge on the dynamics of poultry production in the area, and had no list of poultry farmers we relied on information from the district, and we purposively obtained 80 poultry farmers within the sub-county.

Data was collected using a pre-tested semi-structured questionnaire and observations, especially on poultry feeding and housing practices in the households. The questionnaire consisted of several sections: (1) socio-demographic characteristics of the respondent; (2) poultry species and flock size; (3) constraints to poultry production. The data was coded, summarised in Statistical Package for Social Sciences (version 15) and subjected to descriptive statistics.

3.0. RESULTS

3.1. Socio-demographic characteristics of poultry farmers in Ibulanku, Bugweri district

The findings from the current study revealed higher (over 60%) female participation; and a higher (44%) youths (19-35 years) participation in poultry production (Table 1). Most (76.3%) of the poultry farmers were married, with an education background of primary (47.5%), and had kept poultry for more than 10 years (47.5%).

3.2. Flock characteristics

Exclusively, smallholder poultry production systems in the study area are characterised by indigenous poultry species (Figure 1). In addition to the indigenous poultry, only 2.5% of the farmers also kept improved poultry species (Figure 1A). About 84% of the farmers kept chicken alone while the rest kept either chicken and ducks (8.8%) or chicken and turkeys (7.5%) (Figure 1B). Predominantly, indigenous chickens were kept in all flocks, with most farmers having at least 10 chickens (Figure 1C).

Table 1: Socio-demographic characteristics of poultry farmers

Parameters	Number of respondents (n=80)	Percentage (%)
Gender		
Male	29	36.3
Female	51	63.6
Age structure		
0-18 years	2	2.5
19-35 years	35	43.8
36-55 years	33	41.3
56 and above years	10	12.5
Marital status		
Single	12	15.0
married	61	76.3
widow/widower	7	8.8
Education status		
Primary	38	47.5
Secondary	26	32.5
Tertiary	7	8.8
Others	9	11.3
Rearing experience		
1-5 years	28	35.0
6-10 years	14	17.5
10 and above years	38	47.5

3.3. Poultry management practices

All farmers allowed their birds to scavenge at some point (Table 2). However, on top of scavenging, most farmers (98.7%) supplemented with some readily available feedstuffs, especially kitchen leftovers. Although most farmers supplemented the scavenging, only 2.5% reported using a semi-intensive system, characterised by housing the birds during some part of the day. From our own knowledge, supplemental feeding is characteristic of a semi-intensive system, however, from the practices we observed, we could not qualify the level of supplementation to semi-intensive management, especially with regards to housing. At least all farmers provided some kind of housing to their birds, especially in the night. Most farmers (45%) kept their birds within the family dwellings and only 27.5% had designated poultry houses where birds were kept at night.

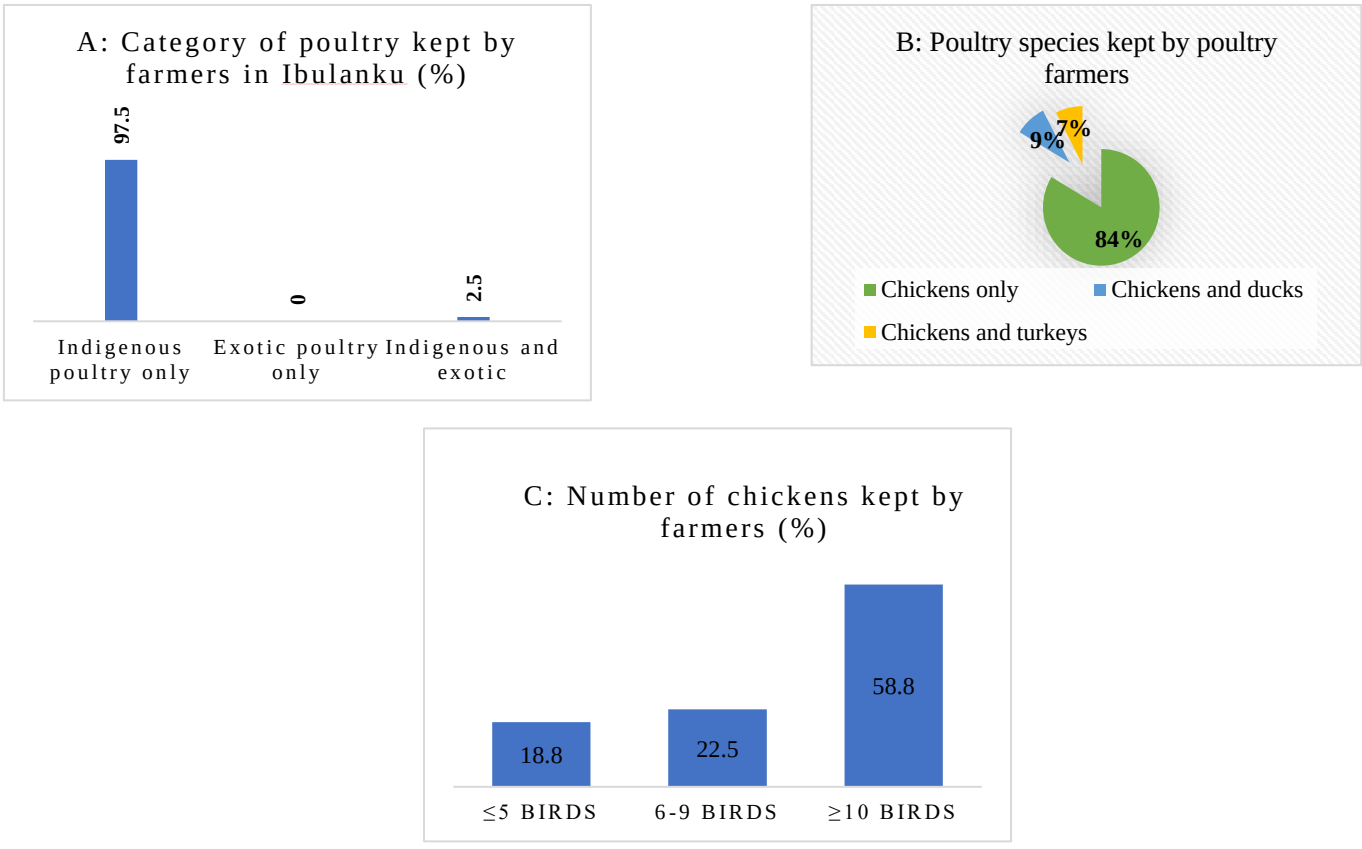

Figure 1: Flock composition of poultry in the study area

Table 2: Feeding and housing practices

	Frequency (n=80)	Percentage (%)
Feed sources in addition to scavenging		
Scavenging only	1	1.3
Scavenging with supplementation	79	98.7
Management system		
Free range	78	97.5
Semi-intensive	2	2.5
Type of housing		
Family dwelling	36	45
Designated poultry house	22	27.5
Kitchen	22	27.5

3.4. Reasons for keeping indigenous poultry birds

We further inquired about the reason for particularly keeping indigenous species as opposed to the improved breeds which the government is promoting. Preliminarily, the findings revealed that, the breeding system used by the farmers favoured continuity of the indigenous species unlike the improved. And this was key to sustaining the indigenous poultry genetic resource. The farmers reported that they obtained replacement stock mainly from hatching their own chicks or, at least from neighbours or local markets. Home consumption (93.8%), income generation (92.5%) and welcome for visitors (86.3%) featured as the primary reasons for keeping indigenous chickens and not the improved ones (Table 3). In addition, several (61.3%) farmers reported keeping indigenous birds for manure.

Table 3: Reasons for rearing indigenous poultry

Purpose	Percentage (%)
Income generation	92.5
Home consumption	93.8
Manure production	61.3
Cheap to rear	18.8
For visitors	86.3
Bartering for goats and cattle	15.0

3.5. Constraints to smallholder poultry production systems and coping strategies

Farmers reported diseases, theft and predation as the key constraints to smallholder poultry production (Table 4). In addition, farmers also reported limited access to poultry veterinary services and counterfeit drugs. As coping strategies, many farmers reported treatment (85.7%) and vaccination (74%) to reduce the negative effect from disease incidences. Concerning treatment, some farmers reported using herbs (23.4%) while a small fraction (2.6%) used human medicine.

4.0. DISCUSSION

4.1. Socio-demographic characteristics of poultry farmers

The current study has revealed a higher female participation in smallholder poultry production, and this could be attributed to the ease with which poultry can be handled. Increasing female participation in handling small livestock species and birds has been much documented by earlier research (Saikia *et al* 2021; Alemayehu *et al* 2018; Natukunda *et al* 2011). Since females are increasingly seeking empowerment, we postulate that taking on such less-capital intensive enterprises like poultry could be a means of enhancing their incomes. In addition, their active involvement in agriculture is a means of increasing food security and household incomes since they have a role to play in decisions concerning food in a household (Saikia *et al* 2021). On the other hand, a more recent study in Western Uganda revealed a higher male participation in commercial broiler production (Nkuuhe *et al* 2024). The

Table 4: Constraints to smallholder production and coping strategies

Variable	Percentage (%)
Constraints	
Diseases	95.0
Predators	77.5
Inadequate poultry veterinary services	35.0
Theft	77.5
Counterfeit drugs	12.5
Coping strategies	
Vaccination	74.0
Treatment	85.7
Consumption	2.6
Use of local herbs	23.4
Human based drugs	2.6
Use strong locks, doors and fencing	5.2
Chasing predators	11.7

discrepancy could be because commercial poultry production systems are resource-demanding, yet females have minimal access to capital to invest in such ventures. Thus, we see that the strength of the indigenous poultry systems relies in higher involvement of females. This is noteworthy because females have always been pivotal in agricultural enhancement initiatives (Belay and Oljira 2019; Doss *et al* 2018; Ganta 2021), and could thus play a key role in preserving the indigenous poultry genetic resources.

The current study has also revealed a higher youth participation in indigenous poultry production and this could be a means of averting redundancy among youths due to unemployment. And, with the high level of unemployment in the country, youth participation in low-investment enterprises like poultry production could sustain the lives of youths. In an earlier study by Natukunda *et al* (2011), high participation of youths in poultry production was also noted. In Ethiopia, however, Fitsum *et al* (2017) reported high participation of individuals who are slightly above the youth age bracket.

Furthermore, our study realised that more married individuals participated in indigenous poultry production than the unmarried. This is probably because indigenous poultry are a "*living bank*" since their high demand due to tastier meat (Magala *et al* 2012) facilitates easy dissolution to obtain liquid cash for meeting household needs. In addition, the high prolificacy of poultry translates to higher returns on investment, making it possible to rely on the enterprise to sustain the needs of different individuals in a household. On the other hand, smallholder indigenous poultry systems were found to be dominated by individual with a low level of

education (primary). Primary education is the lowest level in Uganda's setting. However, having completed this level, one is able to read and write, and therefore ably manage records in their enterprises. Since indigenous poultry production systems have minimal requirements in terms of technical knowledge, they can be managed even by the less educated. Furthermore, by the fact that Uganda's formal employment system offers minimal chances for an individual with primary level of education (Kasima *et al* 2021), farmers could have opted for poultry production to meet their needs. And, since it is almost an inherent enterprise where one learns from their parents/relatives how to raise indigenous birds, it is easy for the less educated to obtain sufficient knowledge to manage these birds. On the other hand, Natukunda *et al* (2011) criticised a low level of education for deterring the uptake of improved management practices. This, however, may not deter furtherance of the indigenous practices used to maintain indigenous poultry since they are passed on across generations.

4.2. Flock characteristics

Indigenous poultry species were reported in all households which supports our choice of the study area. Predominantly, indigenous chickens were kept in all flocks, with most farmers having at least 10 chickens, which approximates the national average of 11 chickens per household (UBOS 2024). According to the National Livestock Census of 2021, over 70% of Uganda's households kept chickens. Furthermore, 98% of the chicken-keeping households keep indigenous chickens (UBOS 2024) with the rest keeping either crosses or exotic birds. Despite these high numbers of indigenous chickens, it is important to note that UBOS (2024) reported a reduction in the total indigenous chicken flock size, which threatens the indigenous poultry genetic resource. With the high number of indigenous poultry being hosted in Busoga subregion, it could imply that the region could have a critical role in efforts to conserve Uganda's indigenous poultry. However, conserving these genetic resources in the region might necessitate gazetting the region as a centre for indigenous poultry genetic resource conservation. Although government efforts are to promote improved birds, the necessity to have indigenous genetics conserved cannot be overlooked.

4.3. Poultry management practices

All farmers allowed their birds to scavenge at some point but with supplementation. Although the characterisation of the traditional free-range indicates non-supplementation, this is a rare practice since farmers always throw leftover food to the birds. Supplementation was also reported as a common practice by most poultry farmers in Ethiopia (Fitsum *et al* 2017). The advantage with supplementation is that it contributes to approximating the daily feed requirements of birds, especially in times of scarcity. Contrary to the current findings, Natukunda *et al* (2011) reported that farmers in Kamuli district only supplemented in seasons of scarcity. The fact that all farmers housed their birds, especially at night, indicates that farmers are realising the importance of

housing in ensuring the welfare of birds. This translates to improved productivity of indigenous poultry flocks. Shuma and Gurmessa (2021) also reported chicken housing to be practiced among indigenous chicken farmers in Ethiopia. However, the current study has revealed that only a fraction of the farmers offer a definite poultry house, with most using other available houses like kitchen or family dwelling. This is a common practice among smallholder poultry farmers (Yadessa *et al* 2017; Weyuma *et al* 2015; Zewdu *et al* 2013).

4.4. Reasons for keeping indigenous poultry

The flock replacement strategy of farmers hatching their own chicks is common among smallholder poultry systems to conserve birds of superior traits. On the other hand, buying from neighbours or markets is aimed avoiding the negative effects of inbreeding. The fact that most farmers keep indigenous birds for home consumption supports earlier reports that indigenous birds yield tastier meat than improved ones (Magala *et al* 2012). Because of this attribute, indigenous birds actually fetch higher prices in Ugandan markets. In earlier studies, (Yadessa *et al* 2017; Zewdu *et al* 2013; Ssewanyana *et al* 2008), similar findings have been reported where farmers primarily kept indigenous birds for consumption and sale. In African households generally, there is much hospitality and visitors are a sign of a receptive home. They are thus offered the best environment in any traditional household, and a good meal with indigenous poultry is considered fit for visitors. Although this is real, rarely have studies reported this as a reason for keeping indigenous households, and its thus a key finding in this study. Since most smallholder production systems integrate both crops and livestock, it is not surprising to find that farmers are increasingly keeping birds as also a source of manure. This could inevitably enhance the performance of such systems.

4.5. Constraints to smallholder poultry production systems and coping strategies

In smallholder poultry production systems, diseases are the primary cause of death (Nakkazi *et al* 2014) probably because birds left to scavenge and come in contact with other birds. New castle disease has been particularly reported as a common cause of mortality in free-ranging indigenous chickens (Hirwa *et al* 2019). In addition, poultry being small animals are easily taken by thieves. This makes theft rampant in village poultry production systems. On the other hand, predators, especially wild birds have also been reported to constrain village poultry production systems in Rwanda (Hirwa *et al* 2019) and Ethiopia (Fitsum *et al* 2017). With the inefficiency in Uganda's extension system, smallholder farmers scarcely have access to extension services. However, the extension system always provides for improved poultry management practices (Moges *et al* 2010; Natukunda *et al* 2011), many of which are not part of indigenous poultry systems. We postulate that enriching the system with knowledge on indigenous poultry production could contribute to

conserving the indigenous genetic resource. In addition, reinforcing the extension policy in its totality could probably increase coverage and increase access to extension services even by the marginalised members of the community.

Although National Drug Authority and the Ministry of Agriculture, Animal Industry and Fisheries are responsible for regulating veterinary drugs that are marketed, counterfeit drugs have persistently recurred within the system (Larive International 2020). This is not only with livestock but also with crop inputs which predisposes the animal source food-consuming populace to potential cases of consuming. It is surprising that feeding was lightly considered as a constraint in the current study. This could, however, be because all farmers at least let their birds to scavenge for their own food.

Although vaccination is reported in the current study, our experience reveals that this exercise in smallholder poultry systems always occurs actually when an outbreak has occurred. Therefore, the effectiveness of vaccination exercise is low. Nonetheless, a study by Bessell *et al* (2020) in Lango and Teso subregions of Uganda realised vaccination exercises as having the potential to sustain flock productivity. Concerning treatment, some farmers reported using herbs and human medicine. Among the herbs, farmers cited wood ash, *Aloe vera*, red pepper, neem tree leaves, pawpaw seeds and leaves, administered with drinking water as the common ones. The use of herbal medicine in Africa's livestock systems is a common practice (Chitura *et al* 2018). *Aloe vera*, in particular is appraised for its antibiotic properties (Gado *et al* 2019). In addition, studies have shown improved growth rate among birds treated with herbal medicines (Akib *et al* 2019). With the increasing interest in organic livestock production systems (Shahrajabian *et al* 2022; Seidavi *et al* 2021), the use of herbal medicines in livestock is gaining more importance. Despite this, the use of herbs is still considered a primitive practice and, with regards to this study, it reveals that sustenance of indigenous poultry is centered around the use of indigenous technical knowledge.

The use of human medicine in treating livestock diseases and/or improving their performance is becoming a common practice in Uganda. However, this is a public health concern since traces of drugs (whether human or veterinary) in poultry meat could have pathological effects to consumers (Mund *et al* 2017).

5.0. CONCLUSION AND RECOMMENDATIONS

The current study sought to unearth the practices employed by a community which has sustained indigenous poultry in their flocks. The study aimed to contribute to efforts to conserve the genetic resources of indigenous Ugandan poultry. The study has revealed that indigenous practices like the use of herbal medicines are integral to indigenous poultry-keeping communities. In addition, farmers have

shifted from the traditional extensive system where birds would spend their night in tree branches to at least providing housing. However, the use of human medicine which is being used by some members in treating poultry diseases could be a human health hazard. Thus, we recommend studies to assess the existence of human drug residues not only in this community but along the indigenous poultry value chain all over the country. We also recommend the integration of indigenous poultry management practices in the extension systems as a strategy to revitalise the traditional practices used in sustaining indigenous poultry species.

Acknowledgement

We are indebted to the farmers who willingly gave us their time during the study and for their selfless sharing which has resulted into constructive insights presented in here.

Conflict of interest

The authors declare no conflict of interest.

Authors' Contributions

Waiswa C and Okot MW conceptualised the study, Waiswa C collected and analysed the data; Kasima JS wrote the first draft of the manuscript; Waiswa C and Mbabazi H reviewed the first draft of the manuscript; Okot MW over saw the entire process as the supervisor. All authors approved the final manuscript.

REFERENCES

Akib, M. A., Ambar, A., Rusman, A. D. P., & Abdullah, A. (2019, March). Herbal for increasing immunity and weight of poultry. In *IOP Conference Series: Earth and Environmental Science* (Vol. 247, No. 1, p. 012056). IOP Publishing.

Alemayehu T., Bruno, J., Getachew, F. and Dessie, T. (2018). *Socio-economic, marketing and gender aspects of village chicken production in the tropics: A review of literature*. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Belay, F. and Oljira, A. (2019). Review on gendered perspective of household's participation in agricultural activities in Ethiopia. *Journal of Agricultural Extension and Rural Development 11*(1): 1-10. https://doi.org/10.5897/JAERD2018.0985

Bessell, P. R., Woolley, R., Stevenson, S., Al-Riyami, L., Opondo, P., Lai, L. and Gammon, N. (2020). An analysis of the impact of Newcastle disease vaccination and husbandry practice on smallholder chicken productivity in Uganda. *Preventive Veterinary Medicine, 177*(2020), 1-8. https://doi.org/10.1016/j.prevetmed.2020.104975

Chitura, T., Muvhali, P. T., Shai, K., Mushonga, B., and Kandiwa, E. (2018) Use of medicinal

plants by livestock farmers in a local municipaity in Vhembe district, South Africa. Applied Ecology and Environmental Research 16(5):6589-6605.

Doss, D., Meinzen-Dick, R., Quisumbing, A. and Theis, S. (2018). Women in agriculture: Four myths. *Global Food Security, 16* (2018) 69–74. http://dx.doi.org/10.1016/j.gfs.2017.10.001.

Ekou, J. (2013). Eradicating extreme poverty among the rural poor in Uganda through poultry and cattle improvement programmes - A Review. *Journal of Development and Agricultural Economics, 5*(11), 444-449. https://doi.org/10.5897/JDAE2013.0494

Fitsum, M., Belay, B. and Tesfay, Y. (2017). Survey on poultry production and marketing systems on central zone, Tigray region. *Academic Research Journal of Agricultural Science and Research, 5*(3), 151-166. https://doi.org/10.14662/ARJASR2017.039

Gado, A. R., Ellakany, H. F., Elbestawy, A. R., Abd El-Hack, M. E., Khafaga, A. F., Taha, A. E., ... & Mahgoub, S. A. (2019). Herbal medicine additives as powerful agents to control and prevent avian influenza virus in poultry–a review. *Annals of Animal Science*, *19*(4), 905-935. https://doi.org/10.2478/aoas-2019-0043

Ganta, S. (2021). Economic status of women in agriculture sector – a study of Karimnagar district in Telangana. *International Journal of Multidisciplinary Educational Research, 10*(6): 19-24. DOI: http://ijmer.in.doi./2021/10.10.123.

Gulilat, L., Tegegne, F., & Demeke, S. (2021). Hatchery and broody technologies and least cost ration practice for poultry production improvement in Ethiopia: Review. *Cogent Food & Agriculture*, *7*(1), 1913793. https://doi.org/10.1080/23311932.2021.1913793

Hirwa, C. D., Kugonza, D. R., Kayitesi, A., Murekezi, T., Semahoro, F., Uwimana, G. and Habimana, R. (2019). Phenotypes, production systems and reproductive performance of indigenous chickens in contemporary Rwanda. *International Journal of Livestock Production, 10*(10), 213-231. https://doi.org/10.5897/IJLP2019.0618

Kasima, J. S., Mugonola, B. and Ndyomugyenyi, E. K. (2021). Pig Production in Gulu and Omoro Districts of Northern Uganda. *Stechnolock Veterinary Science*, *1*(1), 1-9.

Larive International (2020). "Piggery and poultry market roadmap for sustainable value chain development" *Identifying opportunities in the Ugandan poultry and piggery sectors*. For the embassy of the kingdom of Netherlands in Uganda. 201911124 / PSS19UG02

Magala, H., Kugonza, D. R., Kwizera, H., & Kyarisiima, C. C. (2012). Influence of management system on growth and carcass characteristics of Ugandan local chickens. *Journal of Animal Science Advances*, *2*(6), 558–567.

Manyelo, T. G., Selaledi, L., Hassan, Z. M. and Mabelebele, M. (2020). Local Chicken Breeds of Africa: Their Description,Uses and Conservation Methods. *Animals, 10*(2020). https://doi.org/10.3390/ani10122257

Moges, F., Mellesse, A. and Dessie, T. (2010). Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North west Ethiopia. *African Journal of Agricultural Research, 5*(13), 1739-1748.

Mund, M. D., Khan, U. H., Tahir, U., Mustafa, B. E. And Fayyaz, A. (2017). Antimicrobial drug residues in poultry products and implications on public health: A review. *International Journal of Food Properties, 20*(7), 1433-1446. https://doi.org/10.1080/10942912.2016.1212874

Nakkazi, C., Kayitesi, A., Mulindwa, H. E., Kugonza, D. R. and Okot, M. W. (2014). The status of local chicken (*Gallus domesticus*) production in Northern Uganda. *Livestock Research for Rural Development, 26*(11), 1-9.

Natukunda, K., Kugonza, D. R. and Kyarisiima, C. C. (2011). Indigenous chickens of the Kamuli Plains in Uganda: I. Production system and flock dynamics. *Livestock Research for Rural Development, 23*(10), 1-15.

Nkuuhe, D., Gor, C. and Kalibwani, R. (2024). Evaluating Farmers' Awareness and Adoption of Housefly Maggots as Alternative Protein for Broiler Chicken Production in Mbarara District, Western Uganda. *Egyptian Academic Journal of Biological Sciences A. Entomology, 17*(3), 101-115. https://doi.org/10.21608/EAJBSA.2024.376803

Ochora, S., Kasima, J. S., Okot, M. W. and Ndyomugyenyi, E. K. (2023). Performance of local and local x improved chicken crosses under semi-intensive management system in Northern Uganda. *Cogent Food and Agriculture, 9*(1), 1-10. https://doi.org/10.1080/23311932.2023.2213925

Saikia, A. K., Gogoi, G. and Neog, M. (2021). Economic analysis of Kamrupa compared to local chicken production in Assam under backyard system of rearing. *Asian Journal of Agricultural Extension, Economics and Sociology, 39*(11), 408-413. Article no. AJAEES.77220

Seidavi, A., Tavakoli, M., Slozhenkina, M., Gorlov, I., Hashem, N. M., Asroosh, F., ... & Swelum, A. A. (2021). The use of some plant-derived products as effective alternatives to antibiotic growth promoters in organic poultry production: A review. *Environmental Science and Pollution Research, 28*, 47856-47868. https://doi.org/10.1007/s11356-021-15460-7

Shahrajabian, M. H., Cheng, Q., & Sun, W. (2022). Application of herbal plants in organic poultry nutrition and production. *Current Nutrition &*

Food Science, *18*(7), 629-641.

Shuma, S. and Gurmessa, K. (2021). A study on management systems and performances of local chicken kept under smallholder farmers: The case of Jimmahorro district of Kelem Wollega Zone Western Oromia, Ethiopia. *International Journal of Agricultural Science and Food Technology*, *7*(1), 092-098. https://dx.doi.org/10.17352/2455-815X.000094

Shumye, M., Molla, M., Awoke, T., & Dagnew, Y. (2022). Effect of banana peels as a substitute for white maize grain on laying performances and egg quality of Bovans Brown chickens. *Cogent Food & Agriculture*, *8*(1), 2116803. https://doi.org/10.1080/23311932.2022.2116803

Ssewannyana, E., Ssali, A., Kasadha, T., Dhikusooka, M., Kasoma, P., Kalema, J., Kwatotyo, B. A. and Aziku, L. (2008). On-farm characterization of indigenous chickens in Uganda. *Journal of Animal & Plant Sciences*, *1*(2), 33 – 37.

Uganda Bureau of Statistics [UBOS] 2024. National Livestock Census 2021 Report, Kampala, Uganda: pp718.

Weyuma, H., Singh, H. and Megersa, M. (2015). Studies on Management Practices and Constraints of Back Yard Chicken Production in Selected Rural Areas of Bishoftu, *British Journal of Poultry Sciences 4* (1), 01-11. https://doi.org/10.5829/idosi.bjps.2015.4.1.86181

Yadessa, E., Tulu, D., Bogale, A., Mengistu, G., Aleme, M., Shiferawu, S., Esatu, W. and Amare, A. (2017). Characterization of smallholder poultry production systems in Mezhenger, Sheka and Benchi -Maji zones of south western Ethiopia. *Academic Research Journal of Agricultural Science and Research*, *5*(1), 10-19. https://doi.org/10.14662/ARJASR2016.041

Zewdu, S., Kassa, B., Agza, B. and Alemu, F. (2013). Village chicken production systems in Metekel zone, Northwest Ethiopia. *Wudpecker Journal of Agricultural Research*, *2*(9), 256 – 262.