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Research Application Summary

Local chicken production in Uganda: Breeding practices and flock productivity

Kugonza, D.R[1*]., Kayitesi, A.[1], Nakkazi. C.[1], Okot, M.W.[2] & Mulindwa, H.[3]

[1]Department of Agricultural Production, School of Agricultural Sciences, College of Agricultural and Environmental Sciences, Makerere University, P.O. Box 7062, Kampala, Uganda
[2]Department of Animal Production and Range Management, Faculty of Agriculture and Environment, Gulu University, P. O. Box 166, Gulu, Uganda
[3]National Livestock Resources Research Institute (NaLIRRI), National Agricultural Research Organisation (NARO), P. O. Box 96, Tororo, Uganda
***Corresponding author:** donkugonza@gmail.com

Abstract

Farmer knowledge on breeding practices, incubation and disease management strategies for local chicken were studied on 120 households in Gulu and Kiryandongo districts of Uganda using a questionnaire, administered during one to one interviews. Farmers were randomly sampled from each of the eight sub-counties studied. Local chickens in both locations reached sexual maturity at six months for both cocks and hens. The overall mean number of egg clutches/bird/year was 3.21±0.07, while eggs per clutch were 13.07±0.22. Breeding stock was mostly acquired through purchases for both districts and 97.5% of all the farmers carry out selective breeding. Farmers in the study area used a variety of criteria when selecting hens and cocks as breeding stock. Body size for both cocks (index = 0.51) and hens (index = 0.38) was a key trait in selection, and specifically for cocks, body height ranked second as a good physical trait for selection, and is a marker/indicator trait for body weight. In females, farmers rank egg production, mothering and hatching ability highly too. All farmers relied on natural incubation to hatch eggs but the facilities differed widely among respondents in both districts ($P<0.001$). All farmers in Kiryandongo provided overnight shelters, differing from Gulu ($P<0.001$) where 43.3% of households had chickens perching on trees. Newcastle disease was the major disease reported by respondents in both districts. Capacity building of chicken farmers would go a long way to improve local chicken management and thereby, productivity.

Key words: Breeding, characterisation, local chickens, incubation, management systems, Uganda

Résumé

Les connaissances des agriculteurs sur les pratiques de reproduction, les stratégies d'incubation et de gestion des maladies pour les poulets locaux ont été étudiées dans 120 ménages des districts de Gulu et de Kiryandongo en Ouganda à l'aide d'un questionnaire administré lors d'entretiens individuels. Les agriculteurs ont été choisis au hasard dans chacun des huit sous-comtés étudiés. Les poulets locaux des deux sites ont atteint la maturité sexuelle à six mois, tant pour les coqs que pour les poules. Le nombre moyen global de couvées par oiseau et par an était de 3,21±0,07, tandis que le nombre d'œufs par couvée était de 13,07±0,22. Les reproducteurs ont été principalement acquis par des achats dans les deux districts et 97,5 % de tous les agriculteurs pratiquent la reproduction sélective. Les agriculteurs de la zone d'étude ont utilisé une variété de critères pour sélectionner les poules et les coqs comme reproducteurs. La taille du corps, tant pour les coqs (indice = 0,51) que pour les poules (indice = 0,38), était un trait clé dans la sélection, et spécifiquement pour les coqs, la hauteur du corps se classait en deuxième position comme un bon trait physique pour la sélection, et est un

trait marqueur/indicateur du poids corporel. Chez les femelles, les éleveurs accordent un classement elevé à la production d'œufs, la capacité de maternage et d'éclosion. Tous les agriculteurs s'appuient sur l'incubation naturelle pour faire éclore les œufs, mais les installations diffèrent largement entre les répondants des deux districts (P<0,001). Tous les agriculteurs de Kiryandongo fournissaient des abris pour la nuit, à la différence de Gulu (P<0,001) où 43,3 % des ménages avaient des poules perchées sur des arbres. La maladie de Newcastle était la principale maladie signalée par les personnes interrogées dans les deux districts. Le renforcement des capacités des éleveurs de poulets contribuerait grandement à améliorer la gestion locale des poulets et, par conséquent, la productivité.

Mots clés : Élevage, caractérisation, poulets locaux, incubation, systèmes de gestion, Ouganda

Introduction

Smallholder chicken production in much of the world is based on indigenous genetic resources and as opposed to commercially bred birds that are kept for singular purposes, they are utilized for several purposes simultaneously (FAO, 2011). In much of Africa, the indigenous poultry breeds are isolated from conventional breeding programmes and as a result, genetic diversity/divergence is significantly high (AU-IBAR, 2019). The number of resultant breeds in the various regions of Africa are: 97 breeds in Western, 85 in Southern, 71 in Eastern, 43 in Northern and 33 breeds in Central Africa (AU-IBAR, 2019). Chickens are without doubt the most popular species among the domesticated animals of Uganda and provide a regular source of meat and eggs to a large share of the population (FAO, 2018).

In Uganda, the local chicken population is estimated at 42.8 million (UBOS, 2018) and these chickens play an integral role in the smallholder farming systems making 87.7% of the national flock. Local chickens have an important role to play in provision of much needed protein to a large segment of the Ugandan population (Mugga, 2007), as they are reared by over 40% of the population living in chicken-rearing households (FAO, 2018). This could be the only source of animal protein for resource poor households (Kyarisiima *et al*., 2004) and a typical chicken-rearing household currently owns ten chickens (UBOS, 2019). Local chickens also contribute directly to food security through family consumption and as key means of income generation in rural resource poor households in developing countries. Local chickens also have a vital role in human livelihoods and contribute significantly to food security of the rural communities as chicken products have no cultural or religious taboos (Tadelle *et al*., 2003). The estimated number of people employed along the poultry value chain such as farmers, traders, feed suppliers, veterinarians and Para veterinarians in Uganda are estimated at 17 million and of these 14 million raise the birds in the free-range systems, 16% use semi-intensive and only 4% keep birds under intensive systems (FAO, 2018).

The contribution of local chickens in rural household economies is mainly limited by low output, mostly because of their poor breeding and management systems and these results into poor productivity. Farmers often do not have access to appropriate technical knowledge, quality breeding stock, and the necessary feed resources needed for birds to attain full production potential for meat and egg production. However, the extent to which these interplay in different production environments and geographical locations is not clear. It is against this research gap that the present study was designed to characterize the production system with a focus on breeding practices and flock productivity. We aimed to identify the breeding methods and management systems of local chickens in Gulu and Kiryandongo district to represent Northern and Mid-western regions of Uganda respectively, as a prelude to a nationwide assessment.

Materials And Methods

Study sites and design. The study was carried out in Kiryandongo (n = 60) and Gulu (n = 60) district (Figure 1), located 210 Km and 330 Km North of Kampala City, respectively. Two sub-counties that are representative of the chicken production system in each district were purposively selected from each district. Two parishes were then randomly selected from each sub-county, making a total of four parishes per district. The study used a descriptive survey design with both qualitative and quantitative questions for data collection and farmers were selected randomly. Two perpendicular transects was drawn across each parish, and the villages along each transect were selected. Within the parish, accessibility to, and production system on the farm was considered during sampling.

Data collection and analysis. A standard questionnaire was administered to 120 farming households. The instrument was tested for validity by experts in livestock breeding to make sure that questions asked were exhaustive for the study objective. Additional survey materials consisted of a GPS and a digital camera. The questionnaire was pre-tested prior to the actual survey using ten farmers from Kiryandongo district, but in villages that did not participate in the actual study. The aims of this pre-test was: to evaluate the appropriateness of the questionnaire design, assess the suitability and clarity of questions, evaluate the interpretation of the questions by farmers, relevance of the questions, quality of the data recorded and the time taken for an interview. Validity during interviewing was tested for some responses using observation. Reliability of the instruments was tested using the internal check, by having selected questions asked in two different ways. Results from the pre-test were used to refine the questionnaire. Each questionnaire was coded, and entered separately in computer software SPSS ver. 21 and verified. Data were then analysed using district as the main class variables. To determine the ranking of traits in order of importance to the households, the ranking index was used on traits selected by farmers for their breeding stock and was performed following the procedure of Kugonza *et al*. (2012).

Figure 1: Map of Uganda showing the study areas

Results

Household characteristics. The mean household size was approximately 10 people in Kiryandongo and 11 people in Gulu districts. There was a non-significant difference (P>0.05) in family size between Gulu and Kiryandongo. Most household heads were male in Kiryandongo (90.2%) and Gulu (76.7%), but in Gulu there were more female heads of households (23.3%) than in Kiryandongo (9.8%). Most heads of households were aged between 30 and 50 years in both districts (Table 1) and majority had had primary school education level (Kiryandongo, 39.3% and Gulu, 70.0%).

Table 1. Status of the heads of households in Northern and Mid-western Uganda

Variable	Category	Location (%)		P-value*
		Kiryandongo (n = 60)	Gulu (n = 60)	
Gender of Household head	Male	90.2	76.7	**0.046**
	Female	9.8	23.3	
Age (years)	≤≤30	8.5	5.9	0.297
	30-50	59.3	55.9	
	≥≥ 50	32.2	39	
Education level attained	Illiterate	9.8	5	0.061
	Primary	39.3	70	
	Secondary	39.3	21.7	
	Tertiary	11.6	3.3	
Marital status of household head	Married	95.1	81.7	**0.042**
	Single	1.6	0.0	
	Divorce	0.0	3.3	
	Widower	3.3	15.0	

* Within each variable, categories with a P-value less than 0.05 are significantly different

Chicken ownership, rearing chicken experience and source of knowledge. Chicken ownership was mostly a joint family venture (56.2%) in both districts. However, more chickens were owned by the female spouses in Kiryandongo districts (18%) whereas in Gulu district male spouses owned more chickens (28.3%) compared to their female counterparts (13.3%). In general, the majority of the farmers in both sites of study reported that they have been rearing local chickens for a period of 1-20 years (67.3%), while 25.5% had reared birds for a period of 21-40 years. Parent to child flow of information was the most common pathway through which skills and knowledge on local chicken rearing was passed on from generation to generation. This was observed in 77.0% of household in Kiryandongo and 78.3% of Gulu households. The self-initiative of the farmer and formal training were reported to be the least source of knowledge for farmers in both study sites (Table 2).

Table 2. Chicken rearing experience, ownership and source of knowledge

Variable	Category	Location (%)			P-value*
		Kiryandongo (n = 60)	Gulu (n = 60)	Overall (n = 120)	
Chicken rearing experience (years)	1-20	66.7	67.8	67.3	0.55
	21-40	25.5	25.4	25.5	
	>40	7.8	6.8	7.3	
Chicken ownership	Female Spouse	18.0	13.3	15.7	**0.05**
	Male Spouse	16.4	28.3	22.3	
	Children	6.6	0.0	3.3	
	Joint ownership in the family	54.1	58.3	56.2	
Source of knowledge	From parents	77.0	78.3	77.7	0.55
	From own initiative	14.8	15.0	14.9	
	From colleague and neighbours	1.6	5.0	3.3	
	Formal training	6.6	1.7	4.1	

* Within each variable, categories with a P-value less than 0.05 are significantly different

Flock productivity. Sexual maturity of local cocks and hens in Kiryandongo and Gulu districts were reported to be the same (P>0.05). The egg laying cycle were also found to be the same (P>0.05) in Gulu and Kiryandongo at three times a year (Table 3). A significant difference (P<0.01) was observed in number of eggs per laying cycle between Kiryandongo and Gulu. Also number of egg given for incubation and the number of chicks hatched per lay differed (P<0.05) between the two district as did the number of surviving chicks between the two districts (P<0.01) (Table 3).

Breeds and breeding management of chickens. In Kiryandongo, the Nyoro chicken ecotype was being reared by 64% of the households, as the rest of the households reared Luo, Acholi, Lango and Nduli ecotypes (Table 4). In Gulu district, all households reared the Acholi ecotype. All farmers in Gulu practiced selection of breeding stock whereas in Kiryandongo a small portion (4.9%) of farmers do not practice selection (Table 4). Breeding cocks in both study sites were kept mostly for a period of one to three years in the flock. In both sites of the study farmers' flocks were comprised of unimproved birds since most of them were not practicing cross breeding. Only a small proportion of 10.2% and 1.7% out of the farmers were practicing crossbreeding in Kiryandongo and Gulu respectively (Table 4).

Table 3. Least square means of flock productivity parameters of chickens reared in northern and mid-western Uganda

Productivity parameter	Location		Overall mean (n = 120)	P-value*
	Kiryandongo (n = 60)	Gulu (n = 60)		
Age of cocks at sexual maturity (months)	6.12 ± 0.20	6.36 ± 0.12	6.25 ± 0.12	0.333
Age of hens at sexual maturity (months)	5.91 ± 0.22	6.28 ± 0.15	6.10 ± 0.13	0.175
Egg clutches/bird/year	3.33 ± 0.12	3.10 ± 0.07	3.21 ± 0.07	0.104
Number of eggs per clutch	13.87 ± 0.34	12.27 ± 0.26	13.07 ± 0.22	0.001
Eggs given for incubation	10.57 ± 0.28	11.93 ± 0.29	11.25 ± 0.21	0.015
Number of chicks hatched per clutch	8.73 ± 0.32	9.83 ± 0.31	9.28 ± 0.22	0.015
Number of surviving chicks at weaning	5.80 ± 0.24	6.73 ± 0.28	6.27 ± 1.93	0.001

* Within each parameter, locations with a P-value less than 0.05 are significantly different

Source of breeding stock. Breeding stock was mostly acquired through purchasing in 88.5% and 93.3% of the household in Kiryandongo and Gulu respectively. Overall, few farmers acquired chickens as gifts (8.3%) and through exchange for labour (0.8%).

Table 4. Breeding management of local chickens

Productivity parameter	Location (%)		Overall mean (n = 120)	P-value*
	Kiryandongo (n = 60)	Gulu (n = 60)		
Chicken ecotype reared by the farmers				
Nyoro	64.0	0.0	32.0	**0.001**
Acholi	8.0	100	54.0	
Luo	16.0	0.0	8.0	
Lango	6.0	0.0	3.0	
Nduli	6.0	0.0	3.0	
Carrying out selection				
Yes	95.1	100	97.5	0.261
No	4.9	0.0	2.5	
Duration of keeping a breeding cock				
1-3 years	85.7	90.0	88.1	0.419
3 years	14.3	10.0	11.9	
Do you practice crossbreeding				
Yes	10.2	1.7	5.9	**0.049**
No	88.3	98.3	94.1	

*** Within each variable, categories with a P-value less than 0.05 are significantly different**

Incubation method. All farmers relied on natural incubation by hens as a mode of egg incubation in both Gulu and Kiryandongo, but the facilities for incubation differed widely among the respondents. The grass nest was mostly used in Kiryandongo (28.3%), while the use of grass with sand as nesting material was mostly reported in Gulu (38.3%). The use of sand together with other facilities for natural incubation was reported frequently (Table 5).

Table 5. Egg incubation facilities used by broody hens

Variable	Location (%)		Overall Mean (n = 120)	P value*
	Kiryandongo (n = 60)	Gulu (n = 60)		
Incubation facility				**0.0001**
Grass nest + sand	3.3	38.3	20.8	
Acholi traditional nest	21.7	16.7	19.2	
Grass nest only	28.3	5.0	16.7	
Brick ring +sand	1.7	16.7	9.2	
Basin + sand	18.3	0.0	9.2	
Basin + sand+ Grass	3.3	13.3	8.3	
Paper box+ grass	10.0	0.0	5.0	
Hole + sand + grass	1.7	5.0	3.5	
Basket + sand	6.7	0.0	3.3	
Basin + clothes	1.7	3.3	2.3	
Hole + sacs	3.3	0.0	1.7	
Wood stem cut cylindrically	0.0	1.7	0.8	

***Categories with a P-value less than 0.05 are significantly different**

Selection criteria of breeding stock. Farmers in the study area use a variety of criteria when selecting hens and cocks for a breeding stock. Body size for both cocks and hens was the most important trait used in the selection criteria (Table 6 and 7). Big cocks and hens were reported to be always selected. Specifically, for cocks, tallness was a good physical trait for selection. Other traits of interest in the selection of cocks included fast growth, plumage and the degree of activeness of the flock as shown in Table 6. In addition to the big body size in females, farmers also made selctions based on egg production, mothering and hatching ability. In contrast some farmers preferred small bodied hens and related them with good egg production and mothering ability (Table 7).

Table 6. Selection criteria for breeding cocks

Variables	Kiryandongo				Gulu				Total			
	HH[a]	HH[b]	Total[c]	Index[d]	HH[a]	HH[b]	Total[c]	Index[d]	HH[a]	HH[b]	Total[c]	Index[d]
Big body size	46	34	124	0.51	51	42	144	0.53	97	76	268	0.51
Tall	26	11	62	0.25	39	11	83	0.30	65	22	145	0.28
Fast growth rate	16	8	38	0.16	10	3	20	0.07	26	11	58	0.11
Uniform feathering	6	2	12	0.05	5	1	10	0.04	11	3	22	0.04
Plumage color[1]	1	0	2	0.01	3	1	7	0.03	4	1	9	0.02
Big comb size	2	0	4	0.02	1	0	1	0.00	3	0	5	0.01
High vigour	4	1	9	0.04	3	2	7	0.03	8	3	17	0.03
Total	101	56	245		112	60	272		214	116	524	

HH[a]: total number of households that ranked a trait as a criterion for selection (i.e. 1, 2, 3, 4 etc.)
HH[b]: number of households that ranked a trait as first criterion (e.g. body size);
Total[c]: The total weighted rank computed by multiplying the proportion of households that gave a rank to a particular criterion and the rank weight. Rank 1 was weighted 3, rank 2 was weighted 2, and rank 3 was weighted 1
Index[d]: was computed as the sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] of a criterion divided by the sum [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all households selecting chickens of a particular sex
[1]: plumage colour preferred was spotted black and white.

Table 7. Selection criteria for breeding hens

Variables	Kiryandongo				Gulu				Total			
	HH[a]	HH[b]	Total[c]	Index[d]	HH[a]	HH[b]	Total[c]	Index[d]	HH[a]	HH[b]	Total[c]	Index[d]
Big size	26	22	73	0.40	30	23	82	0.36	56	45	155	0.38
Good layer	13	10	36	0.20	23	19	64	0.28	36	29	100	0.24
Small size	12	12	36	0.20	9	6	24	0.11	21	18	60	0.15
Good mothering ability & hatchability	7	3	16	0.09	22	9	51	0.22	29	12	67	0.16
Fast growth	7	3	17	0.09	0	0	0	0.00	5	3	13	0.03
Tall	2	0	4	0.02	3	0	6	0.03	7	0	14	0.03
Total	67	50	182		87	57	227		154	107	409	

HH[a]: total number of households that ranked a trait as a criterion for selection (i.e. 1, 2, 3, 4 etc.)
HH[b]: number of households that ranked a trait as first criterion (e.g. body size);
Total[c]: The total weighted rank computed by multiplying the proportion of households that gave a rank to a particular criterion and the rank weight. Rank 1 was weighted 3, rank 2 was weighted 2, and rank 3 was weighted 1
Index[d]: was computed as the sum of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] of a criterion divided but the sum [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all households selecting chickens of a particular sex

Housing and maintenance. All farmers in Kiryandongo provided complete enclosures for their birds as overnight shelter (Table 8). In Gulu, 43.3% of the respondent's birds were staying on trees overnight. Cleaning was the major maintenance done by farmers in both districts followed by spraying chemical in the facilities against parasites. About 6.5% of the farmers do not undertake any management measures for chicken houses (Table 8).

Table 8: Overnight housing facilities for birds and their maintenance

Variable and Levels	Location (%)		Overall Mean (n = 120)	P-value*
	Kiryandongo (n = 60)	Gulu (n = 60)		
Birds facilities overnight				**0.0001**
Complete enclosure	100	56.7	78.5	
Rest on the trees	0.0	43.3	21.5	
Mode of maintenance of chicken housing facilities				**0.02**
Cleaning/ sweeping	65.5	66.6	66.1	
Spraying with pesticides	13.1	8.3	10.7	
Use hot ash[1]	14.7	0.0	7.4	
Smearing floor with cattle dung to make smooth	0.0	21.7	1.9	
Provide litter on the floor	3.2	0.0	1.6	
Repair of house	1.6	1.7	1.2	
No management	11.4	1.7	6.5	

* Within each variable, categories with a P-value less than 0.05 are significantly different
[1]Hot ash is broadcast on the floor to dry the dung and kill pathogens in the house/use as disinfectant

Mortality levels and associated causes. Chicks were the household flock sub-group with the highest level of mortality. This was reported by 98% of the respondents. Diseases were the major cause of deaths and loss of chicks followed by predators, parasites, cold weather and thieves. Newcastle disease was the most prevalent disease reported by 46% (in Kiryandongo) and 34% of Gulu farmers, followed by infectious bronchitis (17% in Kiryandongo and 31% in Gulu), chicken pox (13% in Kiryandongo and 14% in Gulu) and bacillary white diarrhoea (7% in Kiryandongo). Most diseases in Kiryandongo were reported to occur in the dry season (51.7%) while in Gulu the peak was mostly during the rainy season (56.3%). With respect to treatment and diseases prevention, the majority of the farmers used local herbs such as pawpaw leaves, Aloe vera, *Moringa oleifera* and others. Other measure taken to reduce mortality level among flocks were the use of commercial veterinary drugs, vaccination and isolation of the sick birds.

Discussion

Smallholder poultry production in much of the world uses local/indigenous genetic resources that are well adapted to harsh environments usually associated with limited resources, extreme climatic conditions, rampant pathogen outbreaks and severe predation (FAO, 2011). As part of the global plan of action for the sustainable utilisation of animal genetic resources, a key outcome is characterisation, inventorying and monitoring of existing populations (FAO, 2019), and this study was in line with this objective. We found that household size has increased compared to the household size reported by UBOS (2010) who had reported the average size of households in rural areas of Northern Uganda as having 5.2 members. We report a mean size of 10 people per household in Kiryandongo and 11 in Gulu district. The shift could be explained by focusing the study in peri-urban and rural areas where households tend to have larger families. The study area had returned to peace after decades of civil

war and the shifts in population could be further attributed to settlement. Most of the households in the northern region were composed of a father and his married sons. The proportion of male headed households in Kiryandongo (90.2%) is comparable to that of chicken farming households in Eastern Uganda districts of Kumi (91.2%) (Kugonza *et al*., 2008) and Kamuli (98%) (Natukunda *et al*., 2011). On the other hand, significant proportions (23.3%) of households in Gulu were female headed, attributable to the recently ended twenty-year civil war in the region that ravaged the region and caused loss and displacement of the population. Household heads in the age range of 30-50 years (Table 1) were the majority and their proportion in the two districts was close to the 59.2% national average of Ugandans with the age of 26-50 years (UBOS, 2010). Most farmers attained some form of education in both locations, and the literacy levels in both districts were much higher than the average for Northern Uganda (77.3%) (UBOS, 2010) and Eastern Uganda (87%) (Kugonza *et al*., 2008).

In most households, chickens were owned jointly by family members (Table 2), though overall, males still dominated the ownership charts. Local chicken management in rural areas involves all family members who contribute to mutual labour. This is quite unique from other enterprises where livestock are largely owned and managed by the male members of the household as has been documented for cattle (Kugonza *et al*., 2012; Hirwa *et al*. 2017), pigs (Nabikyu and Kugonza, 2016), and goats (Kugonza *et al*. 2001); and inheritance only follows the patrilineal path. Most farmers in both study sites reported that they have experience of up to 20 years in managing local chickens. Skills and knowledge on local chicken rearing are passed on from generation to generation or from parent to child. This was the most common pathway for knowledge transfer. This underscores the big role of informal education in most agricultural communities but also points to a weak extension system especially for traditional enterprises such as family/local/native chicken farming.

Flock productivity indices namely: age at sexual maturity, egg number or clutch size and number of clutches per hen are very critical for the growth and expansion of a given flock of chickens. These parameters to a great extent impact on the life time performance of a breeder chicken. In this study, both hens and cocks attained sexual maturity at six months (Table 3). Studies elsewhere have shown comparable results of sexual maturity to age of 5-7 months for male and 6-7 months for females (Kugonza *et al*., 2008); 6-8 months for both sexes (Mwalusanya *et al*., 2001) and of 5-7 months for both sexes (Kyarisiima *et al*., 2004). The number of clutches per hen in our study was three per year, with a mean of 13 eggs per clutch. This closely compares with findings of Aboe *et al*. (2006) who reported 3-4 clutches per year, with a clutch size range of 10-20 eggs in Ghana. Similarly, Kugonza *et al*. (2008) reported 3-4 clutches per year with an average of 13 eggs in chickens of Eastern Uganda. Another study done in Uganda reported 2.5-3 clutches and a mean of 6-20 eggs per clutch (Kyarisiima *et al*., 2004). Most farmers in Gulu and Kiryandongo reported high hatchability rates, with an overall mean of 81.8%, quite comparable to 84% reported for chickens in Bangladesh (Hossen, 2010) but much higher than the hatchability of 75% in Ghana (Aboe *et al*., 2006). A study in |Eastern Uganda a decade ago reported a much higher chicken egg hatchability of 90% for naturally incubating chickens (Kugonza *et al*., 2008).

Farmers in Gulu and Kiryandongo were carrying out selection of their breeding stock within the flock obtaining in the two locations (Table 4). Selection of breeding stock is a critical step in ensuring the sustainable utilisation and conservation of a given breed (AU-IBAR, 2019). For the chicken farmers engaged in this study, their practicing of selection is probably intended to maintain good traits that are present in their flocks such as body size and egg production. Furthermore, finding that farmers do not practice cross-breeding in their flocks supports the conservation efforts especially on such traits as disease resistance/tolerance that is paramount in the rearing of local chickens under the free range system. Cross-breeding programs that aim to produce hybrids require that logistics that are involved in breeding and distribution of the hybrids to participating smallholder farmers be carefully spelt out (FAO, 2011) and without such arrangements, the status quo is found. Breeding cocks were generally

being kept in the flocks for up to three years, but this practice increases the possibility of inbreeding even though the farmers expect to balance this by out-breeding using cocks from the neighbourhood. In most households, the breeding stocks were almost exclusively acquired through purchase. In Teso communities, in North-Eastern Uganda, purchase of breeding cocks is dominant, but exchange for labour and acquisition as gifts are also very common modes of acquiring chickens (Kugonza *et al*., 2008).

The farmer's selection criteria are mainly focused on improving productivity of their flocks as opposed to the traditional focus on aesthetic traits. Most traits, namely, big body size, tallness, fast growth rate and vigour (Table 6) aim at having heavy weight birds as early as possible for marketing. Additionally, when selecting hens, emphasis is put on reproductive rate and efficiency. Good laying ability, high egg hatchability and having good mothering ability are highly regarded traits. It should be noted though that high egg production and broodiness are negatively correlated traits (FAO, 2011) meaning that hens that have been bred for high egg yield have more or less lost their inherent ability to go broody. The positive attributes sought by farmers are good brooders and hens with excellent mothering ability (Kyarisiima *et al*., 2004) but with proliferation of artificial incubators particularly those that are solar power-operated, as well as innovations that do not need artificial power such as the rice husk incubator (Roy *et al*. 2004), the interest in natural incubation may wane (FAO, 2011). Farmers in the Middle East rank good layers more highly than birds that are superior in other traits because they contribute significantly to flock productivity (Abdelqader *et al*., 2007). Innovations that enhance the natural brooding process exist, and these include the brooding box technology that has been evaluated and validated (Kugonza *et al*. 2006; Lutalo *et al*. 2010).

This study found that farmers provide shelter during night, categorized into household kitchens, houses for human beings, separately built chicken houses and trees. The findings in this study relate to the system used by farmer in Kamuli (Natukunda *et al*., 2011) and Kumi districts of Uganda (Kugonza *et al*., 2008). Gondwe and Wollny (2007) reported that in Malawi human dwelling units (84.5%), household kitchens (8.05%) built separately from main house, and traditional poultry houses (locally called khola) are used. There is a need for farmers to invest in better housing for their birds. Indeed, it is surprising that almost one quarter of the farmers would rely on trees as shelters to accommodate birds despite the exultance of thefts and predation threats, and still claim to be owning and rearing such chickens for a goal.

In both Kiryandongo and Gulu, chicks were the age group of chickens that died most. We observed a mortality rate of 98% that was proportionately higher than 73.7% previously reported for chicks in Eastern Uganda (Kugonza *et al*., 2008) and 75% in the Accra plains of Ghana (Aboe *et al*., 2006). Chicken deaths/losses mostly occur because of diseases, predators, thieves and bad weather. Newcastle disease was the major disease reported in this study and being the devastating infection it is, vaccination especially with the recently commercialised thermostable vaccine should be popularised. Similar findings have been reported by Ambala *et al*. (2007), who reported that seasonal outbreaks of chicken diseases, specifically Newcastle disease is the major cause of death for local chickens in North-West Amhara in Ethiopia. Similarly, Kugonza *et al*. (2008) found that Newcastle is the most reported disease by farmers of Kumi district in Uganda. High level of chick mortality has been also reported by Mwalusanya *et al*. (2001) at 60% from hatching up to weaning at 10 weeks. To treat sick birds or prevent chicken diseases in their flocks, the majority of the farmers reported that they use local herbs such as pawpaw roots, Aloe vera leaves, *Moringa oleifera* leaves and others. The use of herbs was also reported by Kyarisiima *et al*. (2004). Other measures taken to reduce mortality level among flocks are commercial veterinary drugs, vaccination and isolation of the sick birds. Reliance on herbs for treatment of diseases has declined, and this could be a result of increased investment and/or improved returns from investment in better health care of the birds, as well as growth in investment in animal drugs marketing particularly in traditionally difficult to reach

areas.

Conclusion And Recommendation

Farmers in Kiryandongo and Gulu districts are quite interested in rearing local chickens. Most of the farmers expenence in rearing chickens is acquired generation to generation from parents to children. The productivity of local chickens in the regions is mostly limited by breeding method, mostly because of the long period of keeping a breeding cock in the flock which most likely results into inbreeding. The productivity is also affected by the low genetic potential of local chickens. However, chicken productivity could be enhanced by improved breeding management practices, reducing loss on flock number, by preventing predation and diseases. This may be achieved by strengthening and prioritizing chickens among the species of focus for extension packages.

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