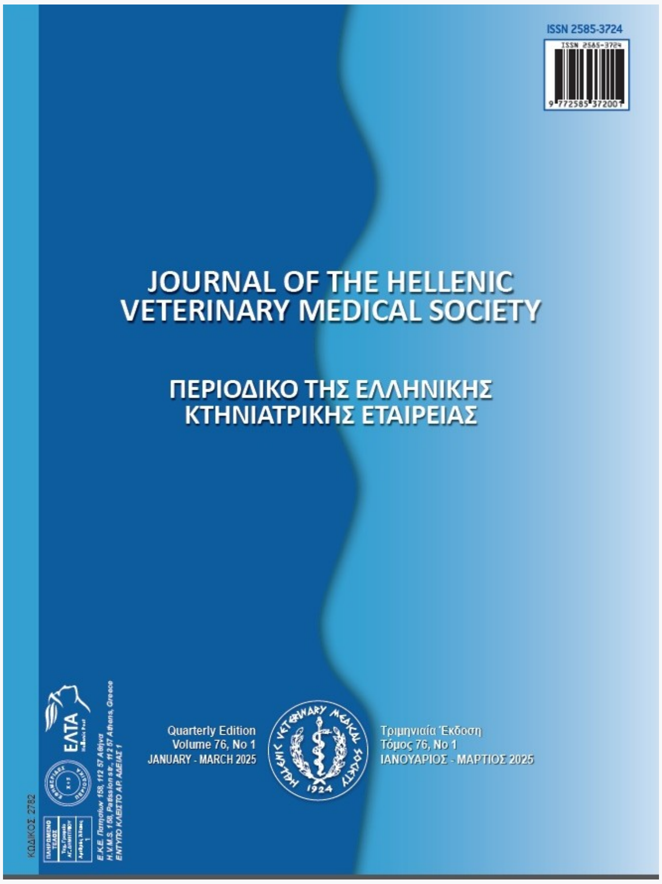
Journal of the Hellenic Veterinary Medical Society

Vol 76, No 1 (2025)



Maternal instincts of extensively managed indigenous village chickens

TT Desta, O Wakeyo

doi: [10.12681/jhvms.34427](https://doi.org/10.12681/jhvms.34427)

J HELLENIC VET MED SOC 2025, 76 (1): 8545-8554
ΠΕΚΕ 2025, 76 (1): 8545-8554

Research article
Ερευνητικό άρθρο

Maternal instincts of extensively managed indigenous village chickens

T. T. Desta[1]*, O. Wakeyo[2]

[1]*Department of Biology, College of Science and Mathematics Education, Kotebe University of Education, Addis Ababa, Ethiopia*

[2]*College of Agriculture and Environmental Science, Arsi University, Asela, Ethiopia*

ABSTRACT: Indigenous village chickens (IVCs) are self-reliant because they have accumulated several adaptive phenogenetic variants that guarantee their survival as a species. Reproductive characteristics and behavioural traits are mainly associated with maternal instincts. Inherently, local hens provide excellent maternal care and are serial brooders. This study reports the maternal instincts of IVCs, documented using face-to-face individual interviews with 119 small-scale farmers. Hens became broody on average 4 times a year, and in each cycle, on average, they keep on broody (interrupt laying) for 10 days. In the relatively cool highland region, hens have remained broody for extra days compared to the lowland region ($t = 2.53$, $df = 117$, $p = 0.01$, 95% CI: 0.45, 3.51). Squawking and deterrence of cocks were the most frequently reported signs that have been shown by broody hens. Prolonged broody is usually discouraged by small-scale farmers by relocating the broody hen to neighbourhoods located out of the reach of the broody hen, hanging it down, and disturbing the hen while trying to nest. On average, 14.6 eggs were incubated during the dry season, whereas about 10.6 eggs were incubated during the wet season (χ-squared = 0.63, df = 1, p-value = 0.43). The dry season was more appropriate for the incubation of eggs and the hatching of chicks. For example, although statistically insignificant, the reported average hatchability rate during the dry season was 84%, whereas it was 69% in the wet season (χ-squared = 1.47, df = 1, p-value = 0.23). To improve the rate of hatchability and survival of chicks, it is crucial to match the brooding of chicks with the appropriate season and select the ideal type of brooding hen and eggs. On average, hens brood chicks 2.3 times a year. Hens with excellent maternal instincts must be kept in the family flocks to enhance reproductive performance. Because this study was based on interviews, objective assessments involving on-site scoring are required to reduce the adverse impact of enhanced broodiness on unfavourably correlated traits, such as egg production. On-site scoring of maternal instincts helps to validate and triangulate the reliability of farmers' responses and their insights.

Keywords: broodiness; small-scale farmers; indigenous village chickens; maternal instinct; the scavenging production system

Corresponding Author:
Takele Taye Desta, Department of Biology, College of Science and Mathematics Education, Kotebe University of Education, Addis Ababa, Ethiopia
E-mail address: takele_taye@yahoo.com

Date of initial submission: 08-05-2023
Date of acceptance: 01-02-2025

INTRODUCTION

Anthropogenic effects have a limited impact on the nondescript indigenous village chickens (IVCs) developed under the decisive effect of natural selection (Desta, 2015; Desta, 2021a; Desta and Wakeyo, 2024). IVCs have maintained and acquired various behavioural traits to adapt to the extensive production system where unlimited interaction with the environment is inevitable (Desta and Wakeyo, 2023). Indeed, local hens are excellent mothers with a genetic predisposition for serial broodiness. Phenotypic attributes, such as broody behaviour, incubating and hatching eggs, and brooding chicks, represent some of the most important components of the maternal instinct of IVCs. However, broodiness traits are unfavourably correlated with egg production (FAO, 2010; FAO, 2014). In addition, natural incubation indisputably produces few chicks (FAO, 2010). Nevertheless, these maternal instincts are vital where artificial incubation, hatching eggs, and brooding chicks are impractical, as in the case of the scavenging chicken production system that is usually practiced in most of the less developed world (FAO, 2014).

Broodiness is an ambiguous term because it can be referred to as maternal care of chicks via the provision of heat and coaching or the interruption of egg-laying after a clutch of eggs was laid, that is, showing a propensity to incubate the eggs laid. The extended form of the latter instinct is usually perceived as an undesirable trait (Barbato, 1999). However, in the scavenging production system, naturally, broodiness is usually interrupted after a few days because broody hens must feed, refresh, exercise, and mate with cocks (Shahvali et al., 2000; Ahlers et al., 2009). To avoid confusion in the use of the term "broodiness," at least in this report, a hen that is brooding chicks is referred to as a "brooder or brooding hen," and a hen that has interrupted laying after a clutch is ended is referred to as a "broody hen." However, broody behaviour ultimately leads to the brooding of chicks. These traits, as have also been noted in junglefowl, represent sequential and cyclic behaviours in reproductively active hens (Hogan-Warburg et al., 1993). Broody and brooding behaviours are controlled, at least to some extent, by different physiological pathways; for example, they differ in the expression of the prolactin hormone and aggression. For instance, a broody hen is aggressive, whereas a brooding hen is comparatively calm. Broody behaviour may also help to maintain body energy reserves that have been lost during laying. For example, in commercial chickens, after experiencing a scarcity of nutrients, hens are getting broody (Clech, 2012). Scarcity of feed is a common problem in the scavenging chicken production system (Mujyambere et al., 2022).

Broodiness is an inherent trait essential for the continuation of the chicken as a species. However, the broody character that lasts for a prolonged period is undesirable because it reduces the performance of the family flock by reducing the hen-day production. Hens with excellent brooding ability can cross-foster eggs laid by poor brooders but have good layers (FAO, 2014). This strategy is important to make the best use of both good layers and good brooders. Keeping two lines of chickens good at laying or brooding may help the family flock improve its production and reproductive performance. In the free-ranging system, a hen broods chicks for at least 6 to 8 weeks (Peace Corps, 2015). During brooding, the hen is the source of natural heat, which mimics the use of a brooder guard and protects the chicks from wandering (Peace Corps, 2015). This study reports on the maternal instincts of local hens and assesses the impact of agroecology on the maternal instincts and hatchability rate of indigenous chickens. It also highlights seasonal variation in the hatchability of eggs.

MATERIALS AND METHODS

The study sites

The study site, the Wolaita zone, is located in southern Ethiopia between geographic coordinates of 6.4° and 7.1° N latitude and 37.4° and 38.2° E longitude. The elevation of Wolaita ranges from 1,200 to 2,950 meters above average sea level (masl). Based on elevation and the customary classification method of agroecological zones adopted in Ethiopia, Wolaita is classified as kolla, or lowland (35%, 1500 masl); woina dega, or mid-highland (56%, 1,500 to 2,400 masl); and dega, or highland (9%, >2,400 masl). The light rainy season usually lasts from March to May, and the heaviest from July to September. The mean annual rainfall is 1,014 mm, and the mean daily temperature is 19.9°C. The daily temperature usually ranges from 17.7°C in July to 22.1°C in February and March.

Sampling methods

A cross-sectional study was conducted in 2007 in two districts of the Wolaita zone: Damot Gale, representing the highlands, and Humbo, typical of the lowland agroecology. The study was conducted in six representative rural villages selected from the two agroecological zones (three from each agroecological zone) in consultation with the respective district's livestock extension advisory service. Respondents from each village were selected using a systematic sampling method from a master list of farmers found in the sampled villages. Accordingly, after dividing the total number of farmers in the list by 20 (the village sample size), the first farmer was randomly selected using a lottery method from the first-class interval. The remaining 19 farmers were selected at a fixed interval equal to the class interval. A semi-structured questionnaire pretested using 10 farmers was administered to 119 small-scale farmers using a trained enumerator after informed verbal consent was obtained. In each village, 20 farmers were face-to-face and individually interviewed, except Taba, where 19 farmers were interviewed.

The studied traits

Farmers were mainly interviewed about their demographic characteristics and the broodiness instincts of their flock. The agroecological zone, sex, and education status of the respondents were usually used as explanatory variables in the statistical analysis.

Data analysis

A statistical analysis of the association between dependent and independent variables was performed using IBM SPSS Statistics 23 (2015) and R (R Core Team, 2016). The Chi-square test, Independent-Samples Kruskal-Wallis test, F-test, and T-test were used to analyze the data. Summary statistics were performed using SPSS, and graphical summaries were produced using Excel. The findings of qualitative studies were narrated and thematized. The hatchability rate was calculated as the proportion of chicks hatched from the number of eggs incubated. The number of chicks that reached the grower stage was calculated as the number of chicks fledged from the number of chicks hatched.

RESULTS

A cross-sectional study was conducted in southern Ethiopia to assess the maternal instincts of extensively managed IVCs, and the findings are presented in the following sections.

Demographic characteristics of the respondents

The summary statistics for age and family size of the respondents are presented in Table 1. Among the respondents, 89.9% were males and 10.1% were females. Regarding the level of formal education, 33.5% were illiterate, 18.5% had elementary knowledge of reading and writing in the local language, 25.2% attended primary school (grades 1-6), and 22.7% attended secondary school (grades 7-12).

Frequency and length of broody period

Summary statistics of the reported annual frequency of showing broody behaviour are presented in Table 2. The annual frequency of showing broody behaviour exhibits wide variation among hens. Independent-Samples Kruskal-Wallis Test results show that the education level of the respondent has a statistically significant impact on the reported frequency of showing broody behaviour ($p = 0.02$). More frequent broody behaviour was reported by respondents with relatively advanced formal literacy levels. This finding indicates that formal education makes farmers critical observers of the reproductive cycle changes in their flock.

The respondents stated that after laying a clutch of eggs, hens intrinsically turn out to be broody to prepare themselves to incubate and hatch eggs and brood chicks. Descriptive statistics that show the length of

Table 1. Demographic characteristics of the respondents.

Attributes	Range	Mean	Std. Dev.	Median	Mode
Age, yr	19-75	41.9	10.4	41	45
Family size, n	3-19	7.0	2.7	6	6

Table 2. Summary statistics for the reported frequency and duration of exhibiting broody behaviour.

Traits	Range	Mean	Std. Deviation	Median	Mode
Frequency of showing broody behaviour, year	2-10	4.1	1.5	4	3
Length of a broody period, days	3-30	10.4	4.3	10	7
Frequency of brooding chicks, year	1-6	2.8	0.9	3	2
Length of brooding period, month	1-3	1.8	0.7	2	2

a broody period and its frequency are presented in Table 2. The reported length of showing broody behaviour significantly varied between agroecological zones (t = 2.56, df = 117, p = 0.01, 95% CI: 0.45, 3.51). Specifically, the mean and standard deviation for the number of days showing broody behaviour in the highlands were 11.39±5.03 (standard error of the mean = 0.65), whereas in the lowlands they were 9.42±3.23 (standard error of the mean = 0.42). Hens show a wide-ranging frequency and length of broody behaviour (Table 2), which creates room for selection against prolonged broody behaviour without significantly affecting the unfavourably correlated production traits.

Signs of broody behavior

As presented in Figure 1, the respondents reported that several signs were observed when hens get broody, and the frequency count of the reported signs shows statistically significant differences (χ-squared = 199.61, df = 6, p-value < 2.2e-16).

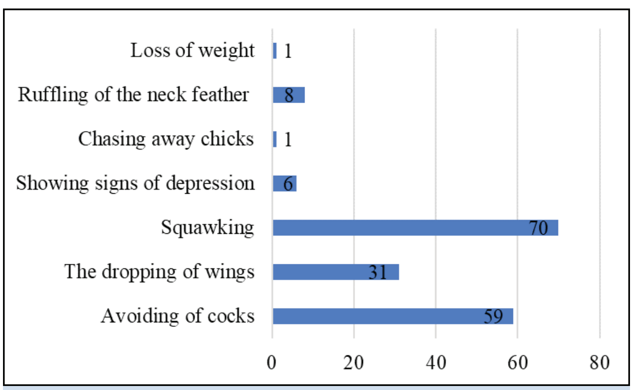


Figure 1. The signs that have been shown by broody hens.

Methods of interrupting prolonged broody behavior

Farmers have devised methods to interrupt protracted broody behaviour (Figure 2), and the proportions of the adopted methods show statistically significant differences (χ-squared = 61.63, df = 4, p-value = 1.31e-12). The interventions ranged from allowing a hen to express her broody instinct freely to anthropogenic interventions intended to disrupt broody behaviour.

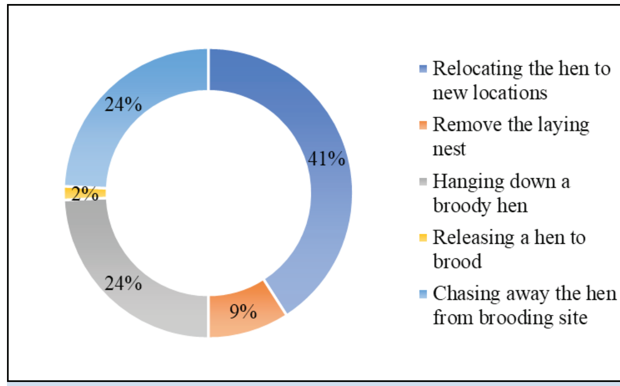


Figure 2. Methods that have been used by the respondents to interrupt prolonged broody behaviour.

Selection criteria of a brooder hen

Farmers reported about the criteria they have used to select brooder hens (Table 3). A significant proportion of the respondents (40.3% (48/119); χ-squared = 4.44, df = 1, p-value = 0.04) did not select brooder hens. The absence of selection might be linked with the inherent excellent brooding behaviour of local hens. The respondents perceived that a good hatcher is a good brooder. The proportions of selection criteria for brooder hens adopted by the respondents differed significantly (χ-squared = 98.6, df = 5, p-value < 2.2e-16).

The annual frequency of brooding

The annual frequency of brooding ranged from 1 to 6, with a mean and standard deviation of 2.273±0.8728, a median of 3, and a mode of 2. The frequency of brooding is significantly affected by the education level of the respondents (F = 4.94, df = 3, p = 0.004). As the level of education advances from formally not educated to attending secondary school, the frequency of brooding significantly decreases (r = -0.20, p = 0.03). Farmers with better formal education levels might have noticed the physiological stress

Table 3. Selection criteria for brooder hens (multiple responses exist).

Criteria	Frequency	Percentage
No selection of brooder hen	48	32.4
Good hatching ability	19	12.8
Large wing size	43	29.1
Large body size	33	22.3
Being in good health condition	1	0.7
Good predators evading ability	3	2.0
Experienced brooder	1	0.7

associated with the brooding of chicks and the importance of assigning more time for egg production. Agroecology showed a statistically significant effect on the frequency of brooding ($t = 2.44$, $df = 117$, $p = 0.02$, 95% CI: 0.07, 0.69). Accordingly, a group statistic result shows that in the highland region, the mean annual frequency of brooding was 3.00±0.99 (standard error of the mean = 0.13), whereas it was 2.58±0.69 (standard error of the mean = 0.09) in the lowland region.

The number of eggs set for incubation and the rate of hatchability

Several eggs were incubated; their hatchability rate (the proportion of chicks hatched from the number of eggs incubated by a hen) is, however, within the acceptable range given the inherently poor storage conditions of eggs. However, the survival rate of chicks to the grower stage was low due to the adverse impact of suboptimal management, diseases, and predators. Additionally, because many chicks are hatched in batches by a hen, this is unmanageable for a brooder hen. There was a substantial seasonal variation in the number of eggs set for incubation and the corresponding hatchability rate (Table 4). The reported cases confirm that hatchability was low during the wet season. Irrespective of the season of the hatch, on average, 67.3% of the hatched chicks reached the grower stage.

Agroecology disaggregated descriptive statistics of eggs set for incubation and hatchability rate during dry and wet seasons are presented in Table 5.

The impact of agroecology on the number of eggs incubated and hatched during dry and wet seasons and the survival of chicks in the growers' stage is presented in Table 6. Although not statistically significant, hatchability tended to be reduced in the wet season when unselected eggs were incubated ($r = -0.21$; $p = 0.06$). The number of eggs incubated during dry and wet seasons shows a statistically significant positive correlation ($r = 0.35$; $p = 0.002$). The hatchability rate shows a statistically significant positive correlation ($r = 0.28$; $p = 0.01$) in the dry and wet seasons.

Table 4. The number of eggs incubated and hatched varies seasonally, as does chick survival to the grower's stage.

Variables	Range	Mean	Std Dev	Median	Mode
The number of eggs incubated during the dry season. n	8-20	14.6	3.2	15	12
The number of eggs hatched during the dry season, n	5-20	12.3	3.5	12	10
Dry season hatchability, %	50-100	83.7	12.5	83.3	100
The number of eggs incubated during the wet season, n	6-20	10.6	2.7	10	10
The number of eggs hatched during the wet season, n	2-16	7.3	2.8	6	6
Wet season hatchability, %	20-100	68.5	16.7	66.7	62.5
The average number of chicks reached the grower stage, n	3-10	6.6	1.8	7	5, 6, and 7 (multiple modes exist)

Table 5. The agroecologically disaggregated statistics for the number of eggs laid, hatchability rate, and chick survival to the grower stage.

Variables	Agroecology	Mean	Std. Deviation	Std. Error Mean
The number of eggs set during the dry season	Highland	15.7	3.0	0.4
	Lowland	13.5	3.1	0.4
The number of hatched eggs in the dry season	Highland	13.4	3.6	0.5
	Lowland	11.1	3.0	0.4
The number of eggs set during the wet season	Highland	10.9	2.8	0.4
	Lowland	10.1	2.5	0.5
The number of hatched eggs in the wet season	Highland	7.5	2.9	0.4
	Lowland	7.1	2.6	0.5
The average survival of chicks to the grower stage	Highland	6.2	1.9	0.3
	Lowland	7.0	1.7	0.2

Table 6. Agroecology's impact on the number of eggs incubated and hatched, as well as chick survival to the grower stage.

Variable	t	df	p-value	95% CI
The number of eggs incubated during the dry season	3.79	114	0.00	1.03, 3.28
The number of eggs hatched during the dry season	3.72	114	0.00	1.07, 3.50
The number of eggs incubated during the wet season	1.35	79	0.18	-0.40, 2.05
The number of eggs hatched during the wet season	0.65	79	0.52	-0.85, 1.68
The number of chicks reached growers 'stage	2.37	117	0.02	-1.45, -0.13

Seasonal variation in hatchability

Most of the respondents (95.8%) reported that the dry season is more suitable for hatching, while a few reported the wet season, that is, summer, June to August (3.4%), and the minor rainy season, that is, spring, March to May (0.8%). Regardless of their small proportion, most respondents reported the summer (wet) and spring (light rainy season) as appropriate seasons for hatching that were from the highland region. The proportions of the three response categories are significantly different (χ-squared = 175.7, df = 2, p-value < 2.2e-16). The reported reasons for the increased hatchability rate are summarized in Figure 3.

Most of the respondents reported that in the wet season (summer), the hatchability of eggs was low (91.6%), which is followed by the minor rainy season, that is, the spring (5.9%), while the lowest response rate was obtained for the dry season, winter (2.5%). The reported three categories of responses are significantly different (χ-squared = 152.95, df = 2, p-value < 2.2e-16). Regardless of their small proportion, all the respondents reported the winter (dry) and spring (light rainy season) as inappropriate seasons for hatching from the highland region. The reported reasons are presented in Figure 4; however, their proportions did not show a statistically significant difference (χ-squared = 5.13, df = 2, p-value = 0.08), hence they are reasonably equally important in determining the inappropriateness of the wet season for hatching chicks. Those respondents that have mentioned the wet season as good for hatching reported that chicks may die due to heat waves in the dry season (a single response), while the remaining two respondents stated that the hen frequently leaves the nest to refresh itself due to the hot weather, which may lead to the rotting of incubated eggs.

DISCUSSIONS

IVCs are low-tech birds; however, natural selection has invested a lot to make them excellent fits for the low-input, low-output production system of subsistence farmers (McAinsh et al., 2004; Alders and Pym, 2009). Consequently, they have acquired several adaptive traits that guarantee survival in a hostile environment. Maternal instinct *per se* is an important trait for maintaining the scavenging chicken production system (Desta, 2021b; Desta, 2021c). Maternal

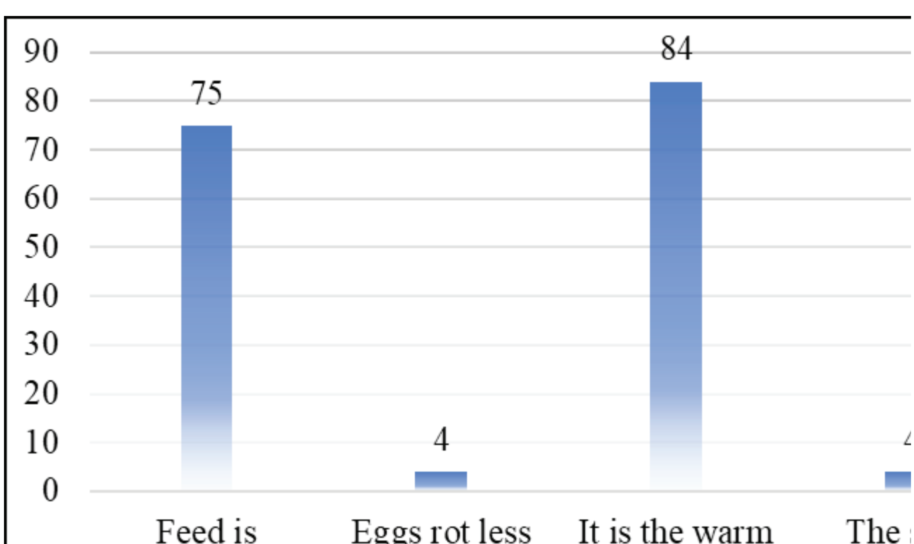


Figure 3. The reported reasons for the appropriateness of the dry season for the hatching of chicks.

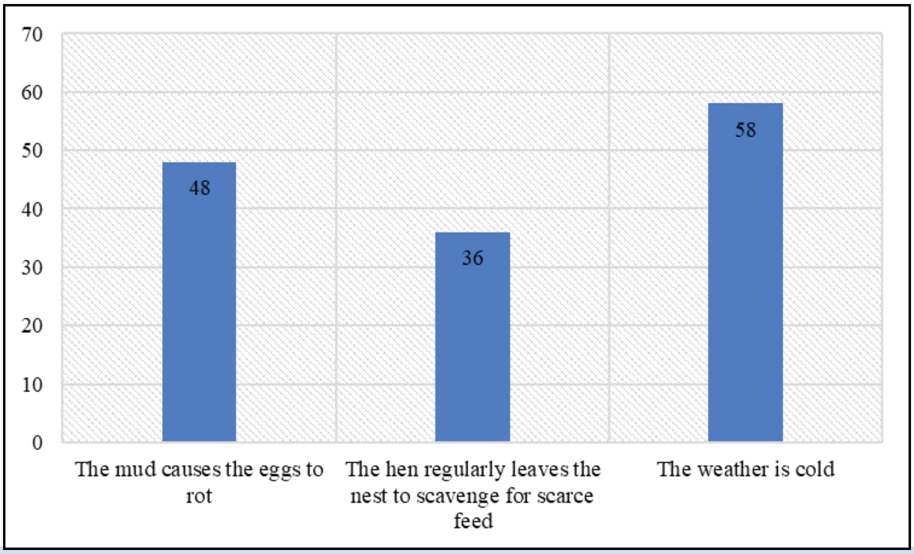


Figure 4. The reported reasons for the inappropriateness of the wet season for hatching of chicks.

instinct practically includes broodiness-associated traits such as incubating and hatching of eggs, broody behaviour, and brooding and coaching of chicks that guarantee the survival of IVCs in the mere absence of artificial incubation and hatching units and technical skills. Therefore, natural incubation is a common practice in the scavenging production systems of subsistence farmers (FAO, 2009; FAO, 2014). However, quite rarely, classical incubation and hatching methods, such as brooding baskets (Yusuf and Popoola, 2022) and hay-box brooders (Demeke, 2007), can be used. However, natural brooding for a protracted period adversely affects egg production by interrupting laying during incubating eggs and brooding chicks (Mahoro et al., 2017).

In this study, highland hens have shown prolonged broody behaviour. The highland region is chillier, which makes the hens show broodiness for extra days to keep their bodies warm. However, in the hotter lowland region, if hens stay broody for more days, they create a favourable condition for the proliferation of ectoparasites; therefore, they are forced to interrupt the broody behaviour earlier. Broody character is a naturally programmed trait. The physiological system of the hen is virtually set to incubate after a clutch of eggs is laid. Broody behaviour is, therefore, a transitory, cyclic reproductive trait between laying and incubating eggs and hatching chicks. Broody behaviour has evolved during the breeding and management histories of IVCs. An extended broody period is interrupted using nonconventional methods that disrupt the normal physiological rhythm of a hen (Ahlers et al., 2009; Dessie et al., 2013). Broody behaviour is usually interrupted by small-scale farmers when the laid eggs are intended for consumption or sale and not for hatching. However, the scavenging habit of local hens forces them to interrupt their broody behaviour after a few days. Broodiness is decisively regulated by the prolactin hormone. Plasma concentration increases when the hen shows broodiness (Du et al., 2020), whereas prolactin concentrations reduce after hatching (Zadworny et al., 1988).

Broody behaviour in hens is associated with aggression and frequent clucking (Ahlers et al., 2009). Accordingly, it causes physiological stress, including the loss of body weight and agility (Star Milling Co., 2024). Culling, either through sale or slaughter, is one of the strategies to cast off hens showing extended broody behaviour. In commercial chickens, broody behaviour is a trait that has been bred out (Peace Corps, 2015) or counter-selected. Broody behaviour is characterized by reduced feed intake and restlessness; therefore, it is often accompanied by a significant loss in body condition (Ahlers et al., 2009). When the hen shows broody behavior, it is the appropriate time to incubate eggs.

In this study, there was a wide variation in the reported annual frequency of showing broody behaviour, that is, 2-10; however, the mean value is around 4, consistent with the findings of Hailemichael et al. (2017), who recorded the frequency of exhibiting broody behaviour 4-5 times a year. Whenever they are not engaged in the incubation of eggs and brooding of chicks, reproductively active hens normally get broody after laying a clutch of eggs. However, the frequency of showing broody behaviour could vary depending on the breeding goals of farmers. For example, those farmers who are highly interested in egg production may encounter hens that show frequent broody behaviour, which practically occurs at the end of each clutch; in contrast, if the interest is in hatching chicks, broody behaviour is reduced. Therefore, the frequency of showing broody behaviour directly relates to the number of clutches.

The minimum value for an acceptable rate of hatchability from fertile eggs is 80% (FAO, 2013). To maximize hatchability, the rule of thumb is to incubate those eggs that are laid fresh as part of a recent clutch. However, dirty and rotten eggs must be discarded. Ahlers et al. (2009) have recommended incubating a maximum of 8 to 10 eggs, depending on the talent, experience, and body size of the broody hen. As the number of incubated eggs exceeds 10, hatchability is reduced depending on the size and brooding instinct of the hen (FAO, 2004). Hatchability could be affected by the season. For example, the dry season was frequently reported as more appropriate for hatching. The broody hen spends less time scavenging during the dry season, which represents the crop harvesting period, leaving behind leftovers that IVCs can scavenge. The warm, dry season also provides an ideal temperature for the incubated eggs while the hen leaves them to scavenge. Junglefowl are seasonal breeders, but their siblings, the IVCs, although they are also inhabited in tropical regions, are bred throughout the year. However, the laying rate may slightly vary among seasons, that is, long-day vs. short-day, especially in temperate regions (Geng et al., 2014). Incubating many eggs adversely affects the hatchability rate and proportion of chicks that reach the grower stage. Eggs can be stored for a longer period in cool weather or cool regions. However, it is not recommended to store eggs for a longer period (more than a clutch period, that is, around two weeks) in the absence of cold chains in the tropics. In this study, the highlands have better access to markets and a high offtake rate for chicken products due to the high human population density. Farmers are therefore highly interested in incubating and hatching eggs more frequently in the highlands to produce a replacement flock, satisfy the prevailing demand, and earn extra income.

Due to seasonal variation in the hatchability rate (Abioja et al., 2020), farmers have attempted to synchronize hatching with the warmer dry season. Although local hens are not preferred for spending too long on off-laying activity while incubating eggs and hatching chicks, both attributes are economically important traits and essential for the survival of chickens as a species. Nevertheless, prolonged broodiness reduces the number of clutches and the size of the family flock that can be otherwise used for income generation and to meet the nutritional demand and socio-cultural requirements of the community (McAinsh et al., 2004). Although chicks are precocial, they are coached and trained by the brooder hen on how to make the best use of available resources and avoid potential dangers (Desta, 2021b). Seasonal and spatial variation in the number of eggs set for incubation and hatchability rate may be attributed to variations in the scavenging feed resource and the burden of diseases. For example, fowl cholera was more common in the lowland region of Wolaita, which adversely affected the broodiness behaviour of hens (Desta and Wakeyo, 2013). The impact of fowl cholera worsens in older birds (Petersen et al., 2001; Glisson et al., 2008; Singh et al., 2014).

While selecting brooding hens, farmers emphasize body and wing size and sex-limited traits (FAO, 2009). Besides, they observe plumage colour, assess hatching and brooding histories, and assess predators evading and scavenging abilities (Tunsisa and Reda, 2022). However, because selection by smallholder farmers is mild, it does not significantly affect the unfavourably correlated production traits. Training farmers and engaging in the all-encompassing discourse regarding the scavenging production system and the driving factors behind adopting non-conventional practices may significantly improve the IVC's production system (Yusuf and Popoola, 2022).

CONCLUSION

Broody and brooding behaviours are vital traits for the reproductive success of the IVC production system. There is considerable phenotypic plasticity in these traits, which creates room for selective breeding. These attributes of maternal instinct are as important as mainstream traits, that is, egg and meat production, because the continuation of the chicken as a species in the extensive production system entirely relies upon these maternal instincts. However, maternal instincts are unfavourably correlated with mainstream production traits, such as eggs and meat production; therefore, trade-offs need to be considered while selecting local chickens for enhanced maternal instincts. Because this study was based on interviews, longitudinal studies are required to score the desirable attributes of brooding hens and to study the adverse impact of enhanced broodiness on unfavourably correlated egg production under field conditions. On-site scoring of maternal instinct traits helps to validate and triangulate the reliability of farmers' responses.

CONFLICT OF INTEREST

None declared

ACKNOWLEDGMENTS

The respondents are highly acknowledged for sharing their thoughtful insights.

REFERENCES

Abioja, M. O., Williams, T. J., Abiona, J. A., & Iyasere, O. S. (2020). Seasonal variations in egg fertility and hatchability in layer-breeder hens under two climatic conditions. African Journal of Agriculture, Technology and Environment, 9(1), 73-85.

Ahlers, C., Alders, R., Bagnol, B., Cambaza, A. B., Harun, M., Mgomezulu, R., Msami, H., Pym, B., Wegener, P., Wethli, E., Young, M. (2009). Improving village chicken production: a manual for field workers and trainers. ACIAR Monograph No. 139. Australian Centre for International Agricultural Research: Canberra, 194 pp. https://www.aciar.gov.au/publication/books-and-manuals/improving-village-chicken-production-a-manual-field-workers-and-trainers

Alders, R. G., & Pym, R. A. E. (2009). Village poultry: still important to millions, eight thousand years after domestication. World's Poultry Science Journal, 65(2), 181-190.

Barbato, G. F. (1999). Genetic relationships between selection for growth and reproductive effectiveness. Poultry Science, 78(3), 444-452.

Clech, L. (2007). Broodiness. Technical Bulletin. April 2012. https://www.hubbardbreeders.com/media/broodiness_en.pdf. Accessed on 18 October 2024.

Demeke, S. (2007). Suitability of hay-box brooding technology to rural household poultry production system. Livestock research for rural development, 19(1), 3.

Dessie, T., Esatu, W., Waaij, L.V., Zegeye, F., Gizaw, S., Mwai, O., van Arendonk, J. (2013). Village chicken production in the central and western highlands of Ethiopia: Characteristics and strategies for improvement. Nairobi, Kenya: International Livestock Research Institute. https://core.ac.uk/download/pdf/132647171.pdf.

Desta, T. T., & Wakeyo, O. (2024). Breeding practice of indigenous village chickens, and traits and breed preferences of smallholder farmers. Veterinary Medicine and Science, 10(4), e1517.

Desta, T. T., & Wakeyo, O. (2023). Predation and theft: the standing threats of the scavenging chicken production system. Journal of Biological Research-Bollettino della Società Italiana di Biologia Sperimentale, 96(2).

Desta, T. T., & Wakeyo, O. (2013). Village chickens management in Wolaita zone of southern Ethiopia. Tropical Animal Health and Production, 45(2), 387-396.

Desta, T. T. (2021). Indigenous village chicken production: a tool for poverty alleviation, the empowerment of women, and rural development. Tropical Animal Health and Production, 53(1), 1.

Desta, T.T. (2015). Phenomic and genomic landscape of Ethiopian village chickens (Doctoral dissertation, University of Nottingham). http://eprints.nottingham.ac.uk/53569/.

Desta, T. T. (2021). Sustainable intensification of indigenous village chicken production system: matching the genotype with the environment. Tropical Animal Health and Production, 53(3), 337.

Desta, T. T. (2021). The proclivity of free-ranging indigenous village chickens for night-time roosting in trees. CABI Agriculture and Bioscience, 2(1), 19.

Du, Y., Liu, L., He, Y., Dou, T., Jia, J., & Ge, C. J. B. P. S. (2020). Endocrine and genetic factors affecting egg laying performance in chickens: A review. British Poultry Science, 61(5), 538-549.

FAO. (2009). Characterization of indigenous chicken production systems in Cambodia. Prepared by M.T. Dinesh, E. Geerlings, J. Sölkner, S. Thea, O. Thieme and M. Wurzinger. AHBL - Promoting strategies for prevention and control of HPAI. Rome. https://www.fao.org/3/al677e/al677e.pdf.

FAO. (2010). Chicken genetic resources used in smallholder production systems and opportunities for their development, by P. Sørensen. FAO Smallholder Poultry Production Paper No. 5. Rome. https://www.fao.org/publications/card/en/c/43fd958d-1698-59af-8d1b/

FAO. (2014). Decision tools for family poultry development. FAO Animal Production and Health Guidelines No. 16. Rome, Italy. https://www.fao.org/publications/card/en/c/577e4e7b-3741-572c-a37e-de393280445/.

FAO. (2013). Poultry Development Review. https://www.fao.org/3/i3531e/i3531e.pdf

FAO. (2004). Small-Scale Poultry Production technical guide. FAO Animal Production and Health 1. https://www.fao.org/4/y5169e/y5169e00.htm#Contents. Accessed on 27 October 2024.

Geng, A. L., Xu, S. F., Zhang, Y., Zhang, J., Chu, Q., & Liu, H. G. (2014). Effects of photoperiod on broodiness, egg-laying and endocrine responses in native laying hens. British Poultry Science, 55(2), 264-269.

Glisson, J. R., Hofacre, C. L., & Christensen J. P. (2008). Fowl cholera. In Swayne DE (ed), Diseases of Poultry, 12th ed. Blackwell Publishing, Ames, IA. 739-758.

Hailemichael, A., Gebremedhin, B., & Tegegne, A. (2017). Status and drivers of village poultry production and its efficiency in Ethiopia. NJAS-Wageningen Journal of Life Sciences, 83, 30-38.

Hogan-Warburg, A. J., Panning, L., & Hogan, J. A. (1993). Analysis of the brooding cycle of broody jungle fowl hens with chicks. Behaviour, 125(1-2), 21-37.

IBM Corp. (2015). IBM SPSS Statistics for Windows, Version 23.0. (Released 2015). Armonk, NY: IBM Corp.

Mahoro, J., Muasya, T. K., Mbuza, F., Habimana, R., & Kahi, A. K. (2017). Characterization of indigenous chicken production systems in Rwanda. Poultry Science, 96(12), 4245-4252.

McAinsh, C. V., Kusina, J., Madsen, J., & Nyoni, O. (2004). Traditional chicken production in Zimbabwe. World's Poultry Science Journal, 60(2), 233-246.

Mujyambere, V., Adomako, K., Olympio, S. O., Ntawubizi, M., Nyinawamwiza, L., Mahoro, J., & Conroy, A. (2022). Local chickens in East African region: Their production and potential. Poultry Science, 101(1), 101547.

Peace Corps. (2015). The Peace Corps Welcomes You to Kyrgyz Republic. https://files.peacecorps.gov/documents/M0011-Practical-Poultry-Raising.pdf. Accessed on 08 November 2024.

Petersen, K. D., Christensen, J. P., Permin, A., & Bisgaard, M. (2001). Virulence of Pasteurella multocida subsp. multocida isolated from outbreaks of fowl cholera in wild birds for domestic poultry and game birds. Avian pathology, 30(1), 27-31.

R Core Team. (2016). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. URL https://www.R-project.org/.

Shahvali, M., Moinizadeh, H., & Ardekani, M. A. (2000). Local poultry management practices in southwest Iran. Indigenous Knowledge and Development Monitor (Netherlands), 8(3).

Singh, R., Remington, B., Blackall, P., & Turni, C. (2014). Epidemiology of fowl cholera in free range broilers. Avian Diseases, 58(1), 124-128.

Star Milling Co. (2024). What To Do with A Broody Hen. 24067 Water Street, Perris, CA 92570. https://starmilling.com/what-to-do-with-a-broody-hen/. Accessed on 27 October 2024.

Tunsisa, L., & Reda, K. B. (2022). Assessment on indigenous chicken incubation, brooding hen and chicks' husbandry practice of farmers at different agroecological zones of Sidama Region, Ethiopia. Agricultural and Veterinary Sciences, 10(1).

Yusuf, S. F. G., & Popoola, O. O. (2022). An Evaluation of the effectiveness of the training offered to smallholder scavenging chicken farmers in Raymond Mhlaba local municipality, Eastern Cape Province, South Africa. Sustainability, 14(23), 15735.

Zadworny, D., Shimada, K., Ishida, H., Sumi, C., & Sato, K. (1988). Changes in plasma levels of prolactin and estradiol, nutrient intake, and time spent nesting during the incubation phase of broodiness in the Chabo hen (Japanese bantam). General and Comparative Endocrinology, 71(3), 406-412.