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Breeding practice and objective of indigenous chicken in North Wollo, Amhara regional State, Ethiopia

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Characterization of breeding practices of indigenous chicken of North Wollo was conducted from January 2011 to May 2012 with the aim to identifying farmers' trait preferences of chicken, breeding objectives and priority areas of intervention. Focus group discussions were held, followed by a survey using semi-structured questionnaires. The survey revealed that both uncontrolled and controlled mating was practiced. Egg production, meat yield and disease resistance were the most preferred traits by farmers for further improvement. Based on flock size, production system, infrastructure availability, preferred traits and economic return, population settlement; roll mating and grading mate would be recommend to low altitude areas where as clan mating and breed out-out was the recommended breeding program to the mid altitude and high altitude study area.

Key words: Breeding objective, indigenous chicken, North Wollo, Ethiopia.

INTRODUCTION

Ethiopia has one of the largest and most diverse livestock populations in Africa (CSA, 2011). The livestock sector contributes 20% to the total GDP, supports the livelihoods of 70% of the population and generates about 11% of annual export earnings. The livestock sector has further potential to increase and contributing to the economic development of the country (CSA, 2011).

Most chicken in Ethiopia are Indigenous (49.3 million), distributed across different agro-ecological zones (CSA, 2011) and mostly under a traditional family-based scavenging management system (Alemu and Tadelle, 1997). This indicates that they are highly important farm animals kept as a good source of animal protein and income to most of the rural populations. Furthermore, their widespread distribution indicates their adaptive potential to the local environmental conditions, diseases and other stresses (Halima, 2007). Although, the chicken has a significant contribution to the national economy, production per chicken is extremely low. The total chicken egg and meat production in Ethiopia is estimated to be about 78,000 and 72,300 metric tons, respectively (Fisseha et al., 2010); of that More than 90% of the national chicken meat and egg output is derived from indigenous chickens (Nigussie, 2011).

Breed improvement and subsequent proper utilization of these indigenous chicken genotypes require comprehensive characterization, including breeding practice. Therefore, this study was initiated with the aim of identifying trait preferences, breeding objectives and priority areas of intervention of indigenous chicken ecotypes in North Wollo, Amhara regional state, Ethiopia.

MATERIALS AND METHODS

Description of study area

The study was conducted in North Wollo zone, which is located in eastern part of Amhara regional state within8°95' to 12º8'N

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Table 1. Characteristics of study site.

Sample site	Altitude	Indigenous chicken	RIR	WLH	human population	Land size/he
High altitude						
Kon	3000	40644	1678	3171	132296	81875
Filaket	2900	137165	7189	15889	234933	191959
Mid altitude						
Lalibela	2400	9437	624	1399	77766	115534
Sanka	1900	61248	5597	5603	144337	93021
Low altitude						
Mersa	1600	156015	1675	3075	199804	167147
Kobo	1500	10839	882	1831	230546	173364

RIR = Rhode Island Red; WLH = White Leghorn; he = hectare; Source: BoARD, 2010.

longitude and 38º5' to 40°20'E The altitude ranges from 700 to 4100 masl (Abuna Yosef Mountain) in Gidan district (in the western parts of the study area). The annual rainfall varies from 650 mm (low altitude) to 1200 mm (high altitude) with the maximum temperature of 25°C in the low altitude and minimum temperature of 16°C in the high altitude. The area can be broadly classified into two seasons: The wet season from June to September and the dry season from October to May (Belay, 2010).

The zone is divided into three main agro-ecological zones: High altitude (>2500 masl) 31.951%, mid altitude (1500–2500 masl) 57.493% and low altitude (<1500 masl) 10.556% (BoARD, 2010). The study area has a population of 1,731,849 in an area of 16,400.98 km^2 (CSA, 2005). North Wollo zone has 3,652,308 livestock of which 1,132,383 are chickens (~30%) (CSA, 2011). The characteristics of the zone are summarized in Table 1.

Most of this zone is mountainous and characterized by steep slopes (Figure 1). The land is unsuitable for agriculture. A survey conducted in this zone showed that 24% of the land is arable or cultivable, 4.6% pasture, 0.37% forest, 17.4% shrub land and 47.3% of the land is degraded or unusable. Only 6.3% of the land is used for all other purposes (BoARD, 2010). On average each rural household had 0.7 ha of land (compared to the national average of 1.01 ha and a regional average of 0.75 for the Amhara region and the equivalent of 0.7 heads of livestock (BoARD, 2010). About 13% of the population participated in non-farm related jobs, compared to the national average of 25% and a regional average of 21%. The zone is drought prone for many years (BoARD, 2010).

Mixed crop-livestock farming was preferred to denote farming system of the study area. Scavenging was predominant in case of chicken production. The chicken feed was predominantly derived from scavenging of crop, clay, grass (saspania), *injera*, household leftovers, earth warm, and non-conventional foodstuffs and to some extent also agro-industrial by-products (oil seed cake) (Taddel, 2003). During the wet season, grass and cereal crop were the main source of feed. In dry season, it mainly depends on supplementation feeds of crop and *injera*. The most of economically important disease was Newcastle. The two most common breeding practices in the study area were natural pure breeding (95.3%) and crossbreeding (4.7%) (BoARD, 2010).

Sampling framework and data collection procedures

The study comprised a mixed mode of data collection: rapid field surveys, focus-group discussions and a household survey. First of all, a rapid field survey was conducted on 90 individuals to asses breeding practice of farmers in study area. Based on the results, the study site was classified in to three agro-ecological zones depending on altitude and farmers breeding practice. One focus group discussion (10 to 15 peoples) per altitude was held prior to the household survey. Multi-stage sampling procedure (purposive: two sample sites per altitude were selected based on chicken population and infrastructure availability) and simple random sampling was applied to choose 306 chicken owning respondents. The selected chicken owners were interviewed using semi-structured questionnaires to collect information on flock size, breeding objective, trait preference, egg selection, egg incubation, brooding procedures, broody hen selection, culling practice, mating system, and preferred trait to be improved..

Data management and statistical technique

Data from focus group discussion were checked for their completeness before the end of each session. Information compiled from focus group discussions were summarized and synthesized and used to better understand the household survey results.

Some incomplete or vague records were corrected back immediately in the respondents' houses or if still incomplete were dismissed from the data entry and cleaning process. All data that had been collected from the survey were entered, cleaned and managed using Microsoft Excel and regularly up-dated and checked for errors.

Breeding objective, breeding practice and trait preference data were imported to SPSS VER.19 for descriptive statistics of crosstabs. Since the percentage comparison across agro-ecology was non- significant, the results were presented as percentage.

RESULTS AND DISCUSSION

Respondent's and owner`s profile

The majority age group of respondent in the study area was found between 20 and 30 year (42.52%). With regards to sex of respondent, 83.66% were female while 16.35% were male (Table 2). This result is not in line with the report of Mekonnen (2007) majority interviewed respondents age group were found within 30 and 40 and

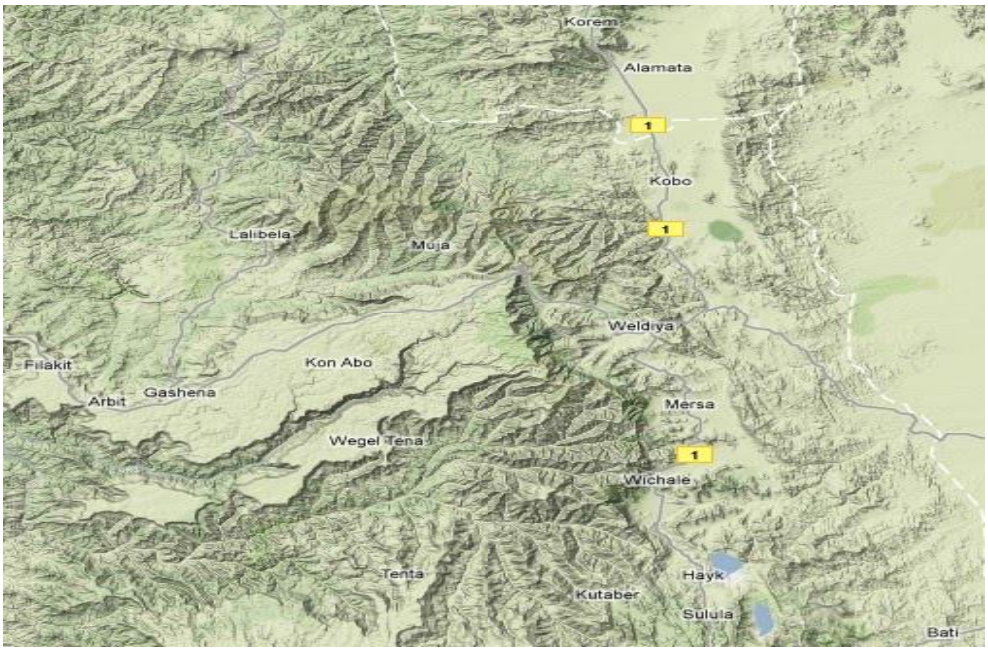

Figure 1. Characteristics of study area.

Table 2. Respondents and owners profile in the North Wollo.

Respondents profile	Agro-ecological zone			
	High altitude n(%)	Mid altitude n(%)	Low altitude n(%)	Total n(%)
Age of respondent				
<20	22 (22.00)	23 (23.00)	11 (20.75)	56 (18.30)
20-30	29 (29.00)	44 (44.00)	45 (42.46)	114(37.25)
30-40	31 (31.00)	19 (19.00)	22 (20.75)	74(24.18)
40-50	13 (13.00)	10 (10.00)	22(11.32)	47 (15.36)
>50	4 (4.00)	4 (4.00)	5 (4.72)	15 (3.92)
Gender				
Female	73(73.00)	89 (89.00)	94 (88.68)	256(83.66)
Male	27 (27.00)	11(11.00)	12 (11.32)	50 (16.34)
Major occupation of respondents				
Broker	1 (1.00)	-	2 (1.89)	3 (0.98)
Farmer	11 (11.00)	9 (9.00)	10 (9.43)	30 (9.80)
Monk	-	2 (2.00)	1 (0.94)	3 (0.98)
Student	16 (16.00)	14 (14.00)	17 (16.04)	47 (15.36)
Merchant	2 (2.00)	1 (1.00)	1 (0.94)	4 (1.31)
Homemaker	70 (70.00)	69 (69.00)	74 (69.81)	213(69.61)
No job	-	5 (5.00)	1 (0.94)	6 (1.96)
Religion				
Muslim	39 (39.00)	49 (49.00)	35(32.02)	123(40.20)
Christian	54 (54.00)	51 (51.00)	66 (62.26)	171(55.88)
Others	7 (7.00)	-	5 (4.72)	12 (3.92)

Table 3. Breeding practice, breeding method and selection criteria of chicken in the study area.

Breeding practice	Agro-ecological zone			
	High altitude n(%)	Mid altitude n(%)	Low altitude n(%)	Total n(%)
Breeding practice				
No	94 (94.00)	75 (75.00)	84 (79.24)	253 (82.7)
Yes	6 (6.00)	25 (25.00)	22 (20.75)	53 (17.3)
Methods of breeding				
Importing exotic	7(77.78)	0	4(33.33)	13(24.53)
Improving Indigenous	2 (22.22)	30 (100)	8 (66.67)	40 (75.47)
Ways of improving indigenous				
Cross breeding	1 (11.12)	0 (0)	7 (36.84)	8 (20.0)
Line breeding	8 (88.89)	12 (100.0)	12 (63.16)	32 (80.0)
Selection criteria chicken for improvements of indigenous				
Male				
PC and CT	7 (29.17^{a})	2 (20.0^{b})	6(31.58^{a})	15 (28.30)
comb type	1 (4.17^{a})	5(50.0^{b})	1 (5.26^{a})	7 (13.21)
Female				
Plumage colour	6 (25.00^{a})	1 (10.0^{b})	7(36.84^{a})	14(26.41)
EPP & BP	10 (41.67^{a})	2 (20.0^{b})	5 (26.32^{b})	17 (32.07)

PC = plumage colour; CT= comb type; EPP = egg production performance; BP = broodiness performance.

the percent of male respondent were dominant (86.2 %). Another study conducted in Northwest Ethiopia discovers that female (74.16 %) were the major age group (Halima, 2007). In other countries like Gambia, Tanzania and Zimbabwe, it was reported that women dominated on most activities of village chicken husbandry system (Dinesh and Jean, 2011).

Adults especially females used chicken as a means of addressing short period financial problems. This result shows an agreement with the findings of Tadelle et al. (2003) and Meseret (2010) in which they report that women own and manage chickens and control the cash generated from the sale of chickens in central highland part of Ethiopia and Gomma district, respectively.

Homemaker (69.61%), studying (15.36%) and farming (9.8%) were the major occupation of respondents in the survey while 1.96% of respondents did not have any kind of job. Higher percent of homemaker respondents reported in high altitude (70.00%). Broker and monk (0.98%) were the least respondents in the study area (Table 2). In contradiction of this result about 95.6% of the respondents are fully involved in farming activities in Gomma district (Meseret, 2010).

More than half of the respondents were Christian (55.88%) (Table 2). This result is contradicted with the report of Meseret (2010) who states that 86.1% of the respondents were Muslim whereas the remaining 12.8 and 1.1% are Orthodox Christian and Protestants respectively.

Breeding objectives and practice

Farmers breeding practice

Only 17.3% of respondents had breeding experience in improving their chicken productivity either by cross breeding (20.0%) or by line breeding (80.0%) (Table 3). This result is not in line with report of Meseret (2010) in which traditional chicken production system is characterized by lack of systematic breeding practice in Gomma district. Similarly, another study in different part of Ethiopia revealed that village chicken breeding is completely uncontrolled and replacement stock produced through natural incubation using broody hens (Nigussie, 2011). In another study, Fisseha (2009) reports that, 92.2% of chicken owner farmers in Bure district have the tradition of selecting cocks for breeding stock. Similarly, Okeno et al. (2011) in Kenya reportsthat farmers who are confining their flocks do selection of chicken for breeding.

Combination of comb type and plumage colour (28.3%) and egg production and broodiness performance (32.1%) were the major selection criteria of farmers in genetic improvement for male and female chickens, respectively. About half of the respondents in mid agro-ecological zones considered comb type as selection criteria of male

chicken while 29.2% respondents in high altitude and 31.6% respondents in low altitude considered plumage colour and comb type as a selection criterion (Table 3). This result is in line with the report of Fisseha (2009) in which plumage color (45.4%), physical stand and shank length (37.1%), comb type (8.6%) and pedigree history (1.1%) are some of selection criteria for breeding stock in Bure district. Another study conducted in mid Rift valley of Oromia revealed that 68.0% of the farmers selected productive hens by body size, 12.0% by finger accommodation between the pelvic bones and 20% by pedigree performance for replacement (Samson and Endalew, 2010).

Incubation practice

Mating system and culling practice

About 11% of respondents in the study areas had a means of control mating system of their flock for at least two or three egg per clutch while 88.9% of respondent had uncontrolled natural mating system (Table 3). The eggs had to be collected and stored separately till incubation period. This result is not in line with the report of Nigussie (2011) in which there is no systematic mating in any regions of Ethiopia. Similarly, another study disclosed that the free-range feeding practice in the three districts of SNNPRS attributed to indiscriminate mating of cocks and hens. Therefore, aggressive and dominant cock in the neighbor tends to be sire (Mekonen, 2007).

Retaining the best indigenous or high yielding exotic cock (41.2%) with hens during conception period was the major way of mate controlling system in the study area. Furthermore, preventing mate of unwanted cock (24.4%) and culling unwanted coloured cockerels or pullets at early age (19.3%) was the second and third means of mate controlling system in the study area.

Slaughtering (53.3%), sell (41.2%) and devour or sell eggs of unwanted hens (5.6%) were the major means of culling less productive chicken from the flock in the study area (Table 3). This result disagrees with the finding of Bogale (2008) who reports that the reason of culling chicken from their flock is poor productivity (46.5%), old age and poor productivity (25.0%) and sickness (5.7%). Another study in Northwest Ethiopia by Halima (2007) also revealed that farmers cull chickens from the flock because of poor productivity and old age. Similarly, a study conducted in Bure district revealed that selling and home consumption (62.6%) were the most common methods of culling unproductive chicken from the flock (Fisseha, 2009).

About 56% of respondents had a concept of inbreeding effect on productivity as well as diversity whereas the rest 44.1% of respondent did not have inbreeding information. Higher percent farmers those do not have a concept of inbreeding was reported in low altitude (50.0%) than high altitude (45.0%) and mid altitude (37.0%) (Table 3).

Trait preference of farmers

Number of eggs (37.91%) and plumage colour (37.6%) were the two most preferred traits. Farmers in high altitude were more likely to prefer number of eggs (36.0%) as primary trait than farmers in mid altitude (33.0%) and low altitude (33.9%) areas. Plumage colour (32.0%) is highly selected as primary trait in mid altitude (32.00%) (Table 3). This result is in line with the report of Abdelqader et al. (2007) and Okeno et al. (2011) in which the most important traits of farmers were growth rate, disease tolerance, egg yield, body size and fertility in Jordan and Kenya. The majority of the farmers in Kenya considered egg yield as the most important trait followed by mothering ability and body size (Okeno et al., 2011). Identification of traits of economic importance is vital in the development of breeding objectives (e.g. Vidogbèna et al., 2010). Therefore breeding programs for improving the productivity of indigenous chicken should target these traits and consider the current and future production circumstances.

According to the survey, about 88.2% of respondents use any available eggs for incubation whereas the rest 11.8% of respondents had a practice of egg selection based on size (larger sized) to be incubated for replacement. On the other hand, 88.2% of respondents had broody hen selection for incubation based on body size (26.8%) and broodiness ability history (73.2%) (Table 5). This result shows an agreement with report of Meseret (2010) in which farmers in Gomma district have good practice of selecting hens for incubation based on size; large size hens (66.7%) were selected. Similarly, a report from Bure district revealed that 86.3% of village chicken owners have a practice of selecting broody hens used for egg incubation purposes based on looking hen's past egg incubation performance (73.9%), body size (7.9%), thick feather (2.1%), size of eggs laid (2.5%) (Fisseha, 2009).

Respondents in the study areas also have experience of impending broodiness behavior (96.7%) when they lost full egg of a particular hen in different way. Hanging down the hen (65.2%) and sending the hen to neighbors (27.4%) were the major way of breaking broodiness (Table 5). This result shows an agreement with the findings of Nigussie (2011) who reports that hanging upside-down (33), moving to neighbor houses (33), submerge into water up to the breast (1), change brooding place (9) are some form of obstacle broodiness in different part of Ethiopia.

Description of components of breeding program

Development of any genetic improvement strategy requires description of production environment, identifying the availability of infrastructure, setting appropriate breeding objective, selecting traits to be improved based on their influence on returns and costs to the producer and

Table 4. Mating system, mating control, culling practice of less productive chickens and trait preference of farmers in the study area.

Breeding practice	Agro-ecological zone			
	High altitude n(%)	Mid altitude n(%)	Low altitude n(%)	Total n(%)
Mating system				
No	100 (100.0)	90 (90.00)	82 (77.36)	272 (88.89)
Yes	0 (0)	10 (10.00)	24 (22.64)	34 (11.11)
Ways of mate controlling				
Culling underproductive chicken	0 (0)	2 (20.0)	6 (25.0)	9 (26.47)
Cull at young stage unwanted color	0 (0)	3 (30.0)	5 (20.83)	8 (23.53)
Retaining the best cock and hen	0 (0)	5 (50.0)	9 (37.5)	14 (41.18)
Preventing mate of unwanted cock	0 (0)	0 (0)	4 (16.67)	3 (8.82)
Culling practice of less productive chicken				
Slaughter	56 (56.00)	51 (51.00)	56 (52.83)	163 (53.27)
Sell	30 (30.00)	33 (33.00)	32 (39.62)	126 (31.18)
Sell or consume eggs	3 (3.00)	5 (5.00)	8 (7.55)	17 (5.56)
Inbreeding concept				
No	63 (63.00)	55 (55.00)	53 (50.00)	171 (55.88)
Yes	37 (37.00^{a})	35 (35.00^{a})	53 (50.00^{b})	135 (33.12)
Trait preference				
Egg	36(36.00^{a})	33(33.00^{a})	37(33.91^{a})	116 (37.91)
Meat	13(13.00^{a})	19(19.00^{a})	22(20.75^{a})	55 (17.97)
Plumage color	37(37.00^{a})	32(32.00^{a})	36(33.96^{a})	115 (37.58)
Mothering ability	3(3.00^{a})	3(3.00^{a})	7(6.60^{a})	13 (3.58)
Diseases resistance	-	2(2.00)	3(3.77)	6 (1.96)

consideration of stockholders (Zewdu, 2004). Thus, designing a breeding program needs decision on a series of such interacting components (Dansh and jean, 2011). Some of the most important components of this breeding program are discussed as follows.

Production system, stakeholders, and infrastructures of the study area

The production system of the study area as explained earlier is characterized by low input and high environmental stress and no essential infrastructure. It is a subsistence based production system, and not market-oriented. As reported by the farmers, diseases, predators and feed shortage are the most important limiting factors. Lack of marketing facilities was also mentioned as one of the constraints. The typical flock sizes were small; there was no farmers' association specifically equipped for chicken genetic improvement. The involvement of other stakeholders (non-governmental organizations and government bodies) in genetic improvement of indigenous chicken genotype was none.

Selected traits for genetic improvement in the study area

The goal traits, which are used in designing of the forthcoming breeding program, should logically be based on preferred traits identified by farmers. Traits that represent breeding goal, easy to measure, heritable are considered/selected. Traits which are not easy to be measured must have a high genetic correlation with indicator trait, and desirable economic value, either as a marketable commodity or as a means of reducing production costs (Zewdu, 2004).

Egg production/hen, age at first slaughter (meat yield) and diseases resistance were the farmer's preferred traits to be improved in the study area; accordingly egg production/hen (Vivian, 2011), and meat yield (Bihan, 2004).

By considering the production system, the availability of infrastructure, flock size of respondents and trait preference of farmers and their heritable value; the

Table 5. Incubation practice in the study area.

Incubation practice	Agro-ecological zone			
	High altitude n(%)	Mid altitude n(%)	Low altitude n(%)	Total n(%)
Egg selection				
No	88 (88.00)	87 (87.00)	95 (89.62)	270 (88.23)
Yes	12 (12.00)	13 (13.00)	11 (10.38)	36 (11.76)
Size of selected egg				
Large	12 (100.00)	13 (100.00)	11(100.00)	36 (100.00)
Broody hen selection				
No	13 (13.00)	12 (12.00)	10 (9.33)	36 (11.76)
Yes	86 (86.00)	88 (88.00)	96 (90.57)	270 (88.23)
Bases of broody hen selection				
Body size	28 (32.18)	20 (22.73)	25 (25.77)	73 (26.83)
Broodiness ability history	59 (67.82)	68 (77.27)	72 (73.23)	199 (73.16)
Impending broodiness				
No	3 (3.00)	3 (3.00)	3 (3.77)	10 (3.27)
Yes	97 (97.00)	97 (97.00)	102 (96.23)	296 (96.73)
Ways of impending broodiness				
Hanging down the hen	62 (63.92)	69 (69.07)	63 (62.75)	193 (65.20)
Sending to neighbors	29 (29.90)	22 (22.68)	30 (29.31)	81 (27.36)
Preventing feed	6 (6.19)	3 (3.12)	3 (3.92)	13 (3.73)
Showing broken egg	-	3 (3.12)	3 (3.92)	8 (2.7)

following breeding program would be proposed for sustainable breed improvement.

Proposed breeding program

Traditional breeding methods with full participation of farmer's are the best approach at farm level for small flock size. Rolling mating, grading mating, clan mating and breeding out-and-out mating are methods of traditional breeding program (http://www.backyardpoultrymag.com).

More or less the characteristics of all study area were the same. The only difference in on settlement of farmers (that is, High altitude and mid altitude farmers were found in scattered village; concomitantly, most of farmers in low altitude found settled by condensed in one area. Rather, all farmers' had small flock size, poor infrastructure and similar trait interest. Base on this and heritable value of traits traditional breeding methods were recommended.

Conclusion

Mating of chickens was usually natural, either controlled or uncontrolled. Uncontrolled mating was practiced mainly due to free scavenging production system. In controlled mating, both crossbreeding and line breeding was performed to improve egg production and plumage colour to fetch higher prices at markets. About 11.8 and 88.2% of respondents practiced egg and hen selection, respectively based on size: All respondents preferred large eggs and 26.8% of respondents selected for a large body in hens). Home consumption (30.4%) was the major reason for rearing chicken, followed by replacement (23.8%) and market reasons (18.0%).

Egg production, meat yield and disease resistance were farmers' preferred traits to be improved. Gaining a better understanding of farmers' preferred chicken production systems, their breeding strategies and preferred chicken traits might be used government or NGOs to increase rewards of farmers from indigenous chicken by planting appropriate breeding program.

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