Evaluations of Reproductive Performances of Fogera Cattle Breed in Selected Districts of Amhara Region, Ethiopia

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Abstract—The current study was initiated to identify the major production constraints and evaluate the on-farm reproductive performances of Fogera cattle breed. A total of 150 farmers, who have better knowledgeable and having at least one cattle of Fogera breed in their herd were purposively selected and interviewed. Structured questioner was used to collect the data and field observation was implemented to see the distribution and production constraints of the breed at its production area. GLM procedure of SAS (2002) was used to determine the effects of fixed factors on the selected economic traits (AFS, AFC, CI and NSC). District, parity and age of the dam were used as fixed effect. The overall mean cattle holding (both Fogera and non-Fogera breed) of the study districts were 9.73±0.92. Majority of the respondents indicates that the source of their Fogera cattle was from family (62.6%), purchased (30.6%) and own source (6.8%). The overall mean value of AFS, AFC, CI and NSC was reported to be 42.24±0.05 months, 51.4±0.05 months, 21.18±0.70 months and 1.42±0.05, respectively. In general, from this study it was noted that Fogera breed is well kept by its keepers and performance better by challenging the feed shortage, and diseases burden at its production environment. Therefore, improving the production environment of the breed is advised to increase the productivity of the breed.

Index Terms—amhara region, breeding practice, fogera cattle, reproductive performances

I. INTRODUCTION

Ethiopia has the largest cattle population (53.99 million heads) in Africa [1]; of which the vast majority (98.9%) of the national herd is of indigenous zebu cattle maintained in rural areas under extensive husbandry systems. Due to the low productivity of these local breeds and to increase the demand for milk products, however, the Ethiopian government's efforts to improve productivity in the livestock sector, through intensive husbandry with exotic and cross breeds [2][3]. The productivity of cattle depends largely on their reproductive performance, which are an indicator of reproductive efficiency and the rate of genetic progress in both selection and crossbreeding programs [4]. Among the reproductive traits, age at first service (AFS), age at first calving (AFC), calving interval (CI) and number of services per conception (NSC), are the bases for a profitable dairy farming [5][6].

Fogera cattle breed, which is populated in Amhara region, is well known for its milk production that gives 1500.0 litter of milk in one lactation season [7]. However, currently its productivity is declined because of different problems like genetic admixture with uncharacterized local breeds and inbreeding, shift of production system (shift of grazing lands to crop lands and crop diversification) leading shrinkage of grazing land, poor management practices (like, feed scarcity and disease prevalence), absence of well-defined breeding programs, poor selection strategy and genetic gain [8][9][10]. These problems have coupled with the changing climate leads the breed to lose its characteristics and lowering of its productivity performance.

The on-farm productive and reproductive performance evaluation of Fogera breed had done by [10] at Fogera district alone. But as Fogera breed is expected to be distributed over seven districts those surrounds Lake Tana, further studies was mandatory to understand its current performance and, therefore, this paper was initiated with the objectives; to evaluate the on-farm reproductive performances of Fogera cattle breed and to identify the major production constraints at selected districts of Amhara region.

II. MATERIALS AND METHODS

A. Description of the Study District

The study was conducted in three districts viz. Bahirdar Zuria, Dera and Fogera of Amhara region. The districts were selected purposively based on presence of Fogera cattle breed and their location that surrounds Lake Tana, the expected home track of the breed. Bahirdar Zuria, Dera and Fogera districts far from Addis Ababa, the capital of the country, 580; 610 and 635 km, respectively following and bounding Lake Tana in the

South direction. The three districts are characterized as a mid-altitude in the Ethiopian agro-ecological classification with a mixed crop-livestock farming system (Fig. 1).

Figure 1. Map of working districts.

B. Description of Fogera Breed

Fogera breed is an intermediate Zebu-Sanga type [7] characterized and well known by its pied coat of black-and-white or black-and-grey; short, stumpy, pointed horns; hump ranges from thoracic to cervico-thoracic; dewlap is folded and moderate to large in size; docile temperament; used for draught, milk and meat [11][12]. Additionally, the breed is known for its tolerance to high altitudes, parasite and disease infestation, fly burden, wet soils or swampy areas, low quality of feed and other unfavorable environmental conditions [7]. Fogera cattle are generally large, being tall with long legs, a massive body with solid strong bones is one of the breed's main features [12]. Farmers describe and choose Fogera breed due to its lower age at first calving and ability to plough the marshy area and better dowry (exchange value) and other social purposes. Fig. 2 below shows the physical appearance of the breed kept at Andassa Livestock Research Center.

Figure 2. Pure Fogera cows at Andassa Livestock Research Center.

C. Data Collection

From Bahir Dar and Dera districts two Peasant Associations (PA) and one PA from Fogera district (where Fogera cattle breed conservation and improvement is practiced) were purposively selected based on the distributions of the breed. A total of 150 farmers (30 farmers from each PA), which are knowledgeable and having at least one cattle of Fogera phenotype in their herd were purposively selected and interviewed. Additionally, farmer's focus group discussion was conducted to capture the historical background of the breed at the selected areas and to understand their population and distribution.

D. Data Management and Statistical Analysis

The questioner data were screened and cross checked for reliability and consistency; questions which were not clearly addressed were removed. General linear model (GLM) procedures of the Statistical Analysis System [13] were used to determine the effects of fixed factors on the selected economic traits. The presence of any significant differences was checked by using TUKEY Kramer multiple comparison tests. The fixed effects used in this study comprised of working district (1=Fogera, 2=Bahir Dar zuria and 3=Dera), parity of the dam (1, 2, 3, 4, 5 and ≥6) and age of the dam (1 = 3 to 6 year, 2 = 7 to 10 year and 3 = ≥11 years). The following GLM model was used to evaluate the reproductive performance of Fogera cattle breed (AFS, AFC, CI and NSC).

$$Y_{ijkl} = \mu + D_i + P_j + A_k + e_{ijkl}$$

where, Y_{ijkl} =l[th] record of ith district, j[th] parity, k[th] age of the dam, and μ = overall mean; D_i = effect of ith working district; P_j = effect of jth parity of dam; A_k = effect of kth age of the dam; e_{ijkl} = random error associated with each observations.

III. RESULT AND DISCUSSION

A. Household Characteristics

The survey result revealed that majority of the interviewed farmers are categorized in the working age group (20-50 year) (Table I), which is categorized as the working and productive age group in the agriculture system of the country. Similarly, Ethiopian scholars indicated many of the farmers participating in the agriculture sector have grouped in the same range [14]-[16]. In addition, 75%, 83% and 65% of Bahir Dar Zuria, Fogera and Dera districts, respectively, are capable to read and write through formal and non-formal educations. The younger age group of the respondents might be the main reason for better educational level found in this study. The capability of read and write is best indicator for the improvement of the agriculture production through adoption of better technologies as well as to follow applicable recommendations in the livestock sector.

B. Fogera Cattle Production System

1) Fogera cattle keeping experiences

Fogera cattle keeping experience of the farmers shows significant difference across districts; Fogera district farmers had better experience in keeping of the breed which might be due to the home tract of the breed is expected to be Fogera plain (Table II) and relative to other districts Fogera plain is known to be swampy which the breed prefers and can also obtain better feed.

TABLE I.   HOUSEHOLD INFORMATION

Parameters	Working districts		
	Bahir Dar Zuria Respondent (%)	Fogera Respondent (%)	Dera Respondent (%)
Age (year)			
20-35	37	20	27
36-50	45	60	58
51-65	17	10	12
>65	2	10	3
Educational background			
Illiterate	25	17	35
Read and write	28	53	42
1-4complete	8	17	8
5-8 complete	23	13	8
9-12 complete	13	0	7
College	3	0	0

TABLE II.   FOGERA CATTLE SOURCE AND EXPERIENCE IN KEEPING THE BREED

Traits	Working districts		
	Bahir Dar Zuria Respondent (%)	Fogera Respondent (%)	Dera Respondent (%)
Source of cattle			
Own	2	10	8
Purchased	40	27	25
From Family	58	63	67
Cattle keeping experience			
1-20 year	65	17	55
21-40 year	33	33	30
41-60 year	2	20	3
>60 year	0	30	12

2) Cattle holding of the study districts

The overall mean cattle holding of the study districts were 9.73 ± 0.92; from which 7.16 ± 0.53 of them has Fogera cattle phenotype that include the expected, mixed Fogera with other zebu breeds and the remaining 2.57 ± 0.39 is highland breed dominated in the study districts. This indicates that the respondents hold 73.58% of Fogera breeds blood on their herd composition which directs, the selected working districts are home for the Fogera breed. The higher Fogera blood cattle holding of the study districts is mainly due to the peasant associations used for the survey were selected purposively on which the breed is expected to be populated and the farmers were also selected to have Fogera breed in their herd to understand the productivity history of the breed. The result supports the assumption that Fogera breed is living at districts surrounding Lake Tana.

The total cattle holding of this study is greater than the cattle holding report of 6.7 in North Gondar zone [17]; 9.66 ± 0.60 at Selale [18]; 4.16 ± 3.6 [19] in Burea district; 7.43 [20] in North western Ethiopia; 1.60 ± 1.49 [21]; 4.39 ± 0.23 [22] and 6.89 TLU [23] in Debre Markos district and is lower than the report of 11.2 ± 0.48 in Oromiya region [15], 13.99 ± 1.08 in Metekel zone [16] and 21.8 cattle in East Gojjam zone [24]. The variation across different working districts might be due to the production system difference, forage availability, difference in total livestock population and composition and dependency in livestock and other related reasons.

Working districts had shown significant difference ($p<0.01$) in Fogera cattle holding and farmers of Fogera district hold more number of Fogera breed followed by Bahir Dar zuria and Dera district (Table III). Significant difference of district in cattle holding was reported by [17][24][22].

TABLE III.   CATTLE HOLDING OF THE STUDY DISTRICTS

Cattle type	Fogera cattle phenotype (Mean ±SE)				Non-Fogera cattle (Mean ±SE)			
	B/Dar zuria district	Fogera district	Dera district	Overall	B/Dar zuria district	Fogera district	Dera district	Overall
Milking cow	2.55±0.27	2.9±0.12	1.4±0.11	2.16±0.13	0.82±0.17	0.33±0.08	0.53±0.09	0.61±0.08
Traction oxen	1.48±0.15	1.9±0.1	0.93±0.13	1.35±0.09	0.4±0.09	0.1±0.05	0.85±0.13	0.52±0.07
Heifer	1.58±0.21	1.7±0.22	0.45±0.1	1.15±0.11	0.37±0.09	0.07±0.04	0.67±0.15	0.43±0.07
Breeding bull	0.75±0.12	1.3±0.19	0.37±0.08	0.71±0.07	0.13±0.05	0.13±0.06	0.53±0.12	0.29±0.05
Male calf	1.13±0.16	1.23±0.21	0.65±0.12	0.96±0.09	0.25±0.07	0	0.58±0.12	0.33±0.06
Female calf	1.13±0.14	0.93±0.15	0.48±0.08	0.83±0.07	0.25±0.07	0.1±0.05	0.67±0.12	0.39±0.06
Overall	8.62±1.05[a]	9.96±0.99[a]	4.28±0.62[b]	7.16±0.56	2.22±0.54[ab]	0.73±0.28[b]	3.83±0.73[a]	2.57±0.39

Means with the same letter are not significantly different

3) Breeding practices

According to the survey result, 43% of respondents use selected bull for breeding purpose. While 15% and 41% of them responds as they use unselected bull and both selected and unselected bull for breeding purpose, respectively.

The respondents of all the selected districts use their own, neighboring, and any one bull at the field with respective percentage of 34.4, 37.8, and 27.8% to mate their breeding cows and heifers. As the overall result indicates, there is no control mating in the breeding system followed by the districts; which might be lack of understanding in genetic admixture (inbreeding) and its effect on the performance of their cattle. Similar result on use of uncontrolled matting via local bull sourced mainly of neighbors and own was reported by [14], [23]. This uncontrolled mating is now being the main bottleneck problem for the deterioration of Fogera breed population and performance. Due to this uncontrolled matting the physical appearance of the breed had changed, as shown in Fig. 3.

Figure 3. Fogera cattle breed: breeding cow ai fogera districts (left) and calf at Bahir Dar zuria district (right).

C. *Reproductive Performances of Fogera Cattle Breed*

The result of the survey data indicated that district difference, age group of the dams and parity had shown significant differences on reproductive performance traits. Additionally, the result also reveals, reproductive performance of Fogera breed had shown a declined trend (Table IV) compared to the previous results reported by [8], [10]. This might be due to quality deterioration of available feed staffs, degradation/ shrinkage of grazing land and decline of Fogera population in its home tract from time to time.

TABLE IV. TYPE OF BREEDING BULL USED AT THE STUDY DISTRICTS

District	Type of breeding bull		
	Selected bull (Respondent %)	Unselected bull (Respondent %)	Both selected and unselected (Respondent %)
Overall	43	15	42
Bahir Dar Zuria	72	3	25
Fogera	7	0	93
Dera	33	35	32

Age at first service of the current study is lower than 45.7±8.16 for Kereyu Sanga cattle of Oromia region [25] and 50.72±0.6 months for Horro cattle [26]. Whereas, the average AFC recorded in this study is higher than 49.32 months and the CI is lower than 20.04 months reported by [10] for the same breed. Similarly, higher result for AFC was reported 54.1±8.81 [25], 55.65 months [23] and 60.96±0.7 months [26]. Lower AFC was reported 46.06±13.99 [16] and 47.46 months [27]. Lower results for CI compared with the current study were reported 18.0±3.28 months [25], 20.16 months [23], 20.2 months [27] and 15.12 months [28]. Whereas, longer calving interval was reported 21.84±0.4 month for Horro cattle [26] and 23.38±13.95 months [16]. Higher result for NSC (1.7±0.2) was reported by [28]. The findings of the current study shows better performance of the breed compared to AFC and NSC for other Ethiopian indigenous cattle breeds which is summarized and reported by [29].

District had shown a significant (p<0.01) effect on AFS, AFC and CI; cattle's from Dera district results higher AFS and AFC and longer CI followed by Bahir Dar Zuria and Fogera district. This difference might be attributed to the better grazing land availability and additional feed source available from rice crop residue at Fogera district. Whereas, change of production system at Bahir Dar zuria might be a reason for lower result compared to Dera district. While district difference had no significant difference on NSC which might be due to all districts follow uncontrolled natural mating at the grazing land. Similarly, [16] reported significant difference of district on AFC and CI.

TABLE V. REPRODUCTIVE PERFORMANCE OF FOGERA CATTLE BREED

Category	Reproductive performance traits							
	AFS		AFC		CI		NSC	
Overall	42.24±0.05		51.4±0.05		21.18±0.70		1.42±0.05	
CV %	18.23		14.39		34.81		51.26	
R^2	0.28		0.28		0.138		0.079	
District	N	Mean ±SE	N	Mean ±SE	N	Mean ±SE	N	Mean ±SE
		**		*		**		NS
Fogera	91	39.48±0.11[b]	91	50.16±0.12[b]	91	20.64±1.34[ab]	91	1.46±0.13
B/Dar	127	40.68±0.06[ab]	127	51.48±0.06[a]	99	18.55±0.91[b]	134	1.47±0.07
Dera	97	46.08±0.11[a]	97	55.96±0.12[a]	85	24.27±1.38[a]	99	1.32±0.08
Parity		***		**		NS		NS
1	56	46.44±0.12[a]	56	56.6±0.13[a]	17	21.86±1.87	63	1.58±0.14
2	104	38.88±0.06[bc]	104	49.16±0.04[bc]	104	20.37±0.68	104	1.30±0.06
3	89	41.28±0.06[bc]	89	52.08±0.06[bc]	90	21.09±0.71	90	1.32±0.07
4	43	44.52±0.09[a]	43	55.44±0.09[a]	42	18.94±1.06	43	1.63±0.10
5	10	44.28±0.25[ab]	10	55.08±0.25[ab]	10	24.09±2.90	10	1.43±0.26
≥6	13	36.12±0.16[c]	13	46.12±0.17[c]	12	20.50±2.08	14	1.19±0.19
Age		*		*		*		**
3-6 year	89	38.64±0.08[b]	89	47.68±0.08[b]	51	19.79±1.00[ab]	89	1.23±0.09[b]
7-10 year	189	40.92±0.04[ab]	189	50.96±0.04[ab]	187	19.77±0.51[b]	198	1.24±0.05[b]
>11 year	37	42.6±0.11[a]	37	51.76±0.1[a]	37	22.53±1.31[a]	37	1.71±0.12[a]

N= number of observation; ***P<0.001; **P< 0.01; *P<0.05; NS= Not Significant. Means with the same letter are not significantly different

Parity had shown a significant (*p*<0.001) effect on AFS and AFC, while non-significant (*p*>0.05) difference is observed in CI and NSC. Irregular value of AFS and AFC across parity might be due to the informative nature of respondents which related with their educational level. In a general way, there is a decreasing value of AFS and

AFC as parity had increased; this might be due to variation in management practice of cattle keepers that in turn favors early maturity in physiological activity of dams. On the contrary, significant effect of parity on CI and NSC is reported by Ref. [28].

Age of the dam had shown significant (p<0.05) differences in all reproductive traits used for the study; and as the age of the dam increases all values of the reproductive performance also increases. The increased value for CI and NSC across the increased value of age might be due to the retardation of physiological activities (unable to show observable heat, inefficient functioning of the uterus and other reproductive organs), and low feed conversion efficiency in advancement of age. Additionally, the higher value of AFS and AFC across the advancement of age might be due to long living cows start to give their first calve in late age in that their physiological activities will mature enough to give birth and living longer, while early calving dams might be retarded across age due to early birth before maturing of their reproductive physiology.

D. Longevity

The survey result indicated that the overall mean age of the breeding cow in production is reported to be 12.95±0.33 year and gives overall average of 4.49±0.43 calves within this life time. There is a significant difference (*p*<0.01) in production life of cows across the three districts; and the maximum productive life is reported from Dera district (13.98±0.59 years) followed by Fogera and Bahir Dar zuria districts with respective age of 13.47±0.32 and 11.67±0.59 years. The variation might be due to the agro ecological differences which related with feed availability, and disease occurrence. In selected kebeles of Dera district there is better feed availability around Lake Tana on which no crop diversification had been done on the edges of the Tana. Whereas in Fogera district there is crop diversification on the surrounding of the lake and in Bahir Dar zuria district there is coverage of homesteads by chat (*Catha edulis*) and plowing of the private grazing lands for irrigation.

IV. CONCLUSION AND RECOMMENDATION

The reproductive performance considered in this study viz. AFS, AFC, CI and NSC shows improvements compared to other indigenous cattle breeds of Ethiopia, which indicates the potential of the breed for milk production is high. As the breed is expected to live at the selected districts, the performance difference across districts might be due to feed availability, management difference and access to livestock technologies. Being better performer over other breeds makes Fogera breed to be selected by farmers to be dominant in their herd and need to expand for the future. The farmers those kept have better attitude to keep Fogera breed, and this benefits for implementing conservation and improvement strategy for future.

Basing on the result of this study, the following recommendations are made for better future use of the breed potential.

- ✓ Optional feed development strategies like backyard and farming plot surroundings and treating of bulk crop residue produced at the area should be designed and adopted as a strategy;
- ✓ As the dominant breeding system in the study districts is uncontrolled mating with unselected bulls, attention should be given on implementation of selected Fogera bulls for breeding purpose that will in-turn improves the blood level of the breed;
- ✓ Works on population estimation of Fogera breed should be addressed to develop appropriate conservation as well as improvement strategies.

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Additionally, He has published a book article targeting on indigenous cattle breed conservation and genetic parameter estimates.