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Evaluating the Effect of Oestrus Synchronization on the Reproductive Efficiency of Indigenous Goats Reared in two districts of Gamo Zone, South Ethiopia

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***Abstract*— *The goal of the current study was to evaluate how oestrus synchronisation affected the reproductive effectiveness of native goats reared in two possible Gamo zone districts. Prostaglandin-based Lutalyse® (PGF2a) hormone was injected intramuscularly at a dose of 2.5 ml in a single shot to synchronise oestrus in sixty does. Does and chosen bucks were mate at random with a 1:10 buck to doe ratio right after the hormone treatment. The expression of standing heat when does were exposed to bucks was used to determine the oestrous response to hormone treatment. Within 96 hours, the does that displayed oestrus were allowed with bucks. Pregtone® was used to diagnose the pregnancy one month later, or it was done by visual observation. Approximately 85% of the does exhibited oestrus within 56 hours of hormone delivery, according to the results. The Pregtone® tool demonstrated high efficacy in detecting early pregnancy prior to hormone delivery. The observed rate of abortion was 6.12%, but the overall conception rate was 81.7%. In does, the gestation duration was 153±2.56 days on average. The synchronised does' kid had an average birth weight of 2.49±0.33 kg and a litter size of 1.31±0.46, respectively. While body weight and district had no effect on the oestrous response and conception rate, the does' age, parity, and body condition did (p<0.05). The oestrus response and conception rate of does with a parity of 1 to 4 were considerably higher than those of does with a parity of five. When it came to hormone treatment and conception rate, the does with body condition scores of 3 and 4 responded better than those with lower scores. Compared to younger does, older did displayed a reduced oestrus response and conception rate. It was discovered that taking age, parity, and body condition score into account during oestrus synchronisation in local goats was helpful for a higher conception rate.*

Keywords*— *conception rate; Gamo zone; indigenous goat; oestrus synchronization; reproduction efficiency.

I. INTRODUCTION

An estimated 50.5 million goats are thought to exist in Ethiopia; 71.08% of these are female and 28.92% are male (CSA, 2020). The majority of goats in the country are native to the region (99.9%), with hybrid and/or cross breeds making up the remaining 0.01%. For people living in areas unsuitable for crop cultivation and cattle production, small ruminant husbandry is the most significant and frequently their only source of income (Daskiran et al., 2006).

In Ethiopian agricultural systems, indigenous goats in particular make a substantial contribution to the diversification of production and means of subsistence for farmers who lack resources. Compared to sheep, goats are a smaller ruminant resource that is underutilized and poorly understood, while interest in goat production in the tropics has increased recently.

In temperate climates, goat reproduction is markedly seasonal, primarily because of the photoperiod effect. Animals' retinas detect variations in the length of the day's brightness, and the pineal gland is in charge of producing melatonin, a vital hormone, during short days and dark periods (Malpaux et al., 2001). Nevertheless, in tropical environments, they either don't reproduce seasonally or just show a slight periodicity. Nearly all year long, females undergo ovulation and display oestrus; nevertheless, there are short intervals of anestrous behaviour that can be observed based on several conditions such breed, latitude, heat stress, feed scarcity, physiological stage, and buck effect (Simões, 2015; Dereje, 2018). The main benefit of a non-seasonal breeding program for producers is a steady supply of milk, meat, and excess animals. Nevertheless, this approach results in low milk outputs and decreases the growth and survival of the offspring anytime late pregnancy and delivery coincide with periods of less than ideal fodder availability (Girma, 2009; Delgadillo, 2015).

Oestrus synchronisation is now required in the reproductive management of goats due to the diversity in the duration of the oestrus cycle and oestrus (Omontese et al., 2016). Oestrous synchronisation is a crucial assisted reproductive technique used to regulate breeding time in order to breed females out of season (artificially) (Rahman et al., 2008). Prostaglandins, progestagens, and, more recently, straightforward manipulation of the "buck effect" are used to synchronise oestrus in order to enhance the reproductive management of native goats in tropical regions during the breeding and non-breeding seasons. These methods range from complex hormonal alteration to natural (bio-stimulation) or mixed protocols (Ak et al., 1998; Leboeuf et al., 1998; Whitley, 2004; Omontese et al., 2016). Nonetheless, cost-effectiveness, application simplicity, and resulting fertility are factors that influence the selection of hormone and oestrus synchronisation procedures (Zeleke, 2015). Though there have been some initiations for the Menz sheep breed, there is little information available regarding the prostaglandin dose and application techniques in response to Ethiopian small ruminants (Zeleke, 2015).

Goat reproduction performance is low due to reproductive management issues such as oestrous detection, early pregnancy diagnosis, and unclear ovulation timing (Baldassarre and Karatzas, 2004). In smallholder breeding programs, recently reviewed assisted reproductive biotechnologies (such as oestrus synchronisation and early pregnancy diagnosis tools) are accelerators to improve the reproductive efficiency of indigenous goat populations. Therefore, the current study's design was to enhance reproductive efficiency and planned kid crop for community-based goat breeding programs by means of oestrus synchronisation.

II. MATERIALS AND METHODS

Description of the study areas

Two districts in the Gamo zone in southern Ethiopia—Arbaminch-Zuria and Mirab-Abaya—were the sites of the study. Geographically speaking, the Gamo zone lies between 50 and 60 N latitude and 360 and 370 E longitude. The typical minimum and maximum temperatures in the districts of Arba-Minch Zuria and Mirab-Abaya range from 10 to 25 degrees Celsius. In Mirab-Abaya district, the mean annual rainfall distribution runs from 854 to 1,278 mm, whereas in Arba-Minch Zuria district, it ranges from 854 to 1,527 mm. In the districts of Arba-Minch Zuria and Mirab-Abaya, the height varies from 746 to 3,478 m.a.s.l. and from 746 to 2,539 m.a.s.l. The two districts were classified as highland, midland, and lowland agro-ecologically, and they were distinguished by a mixed livestock-crop farming system.

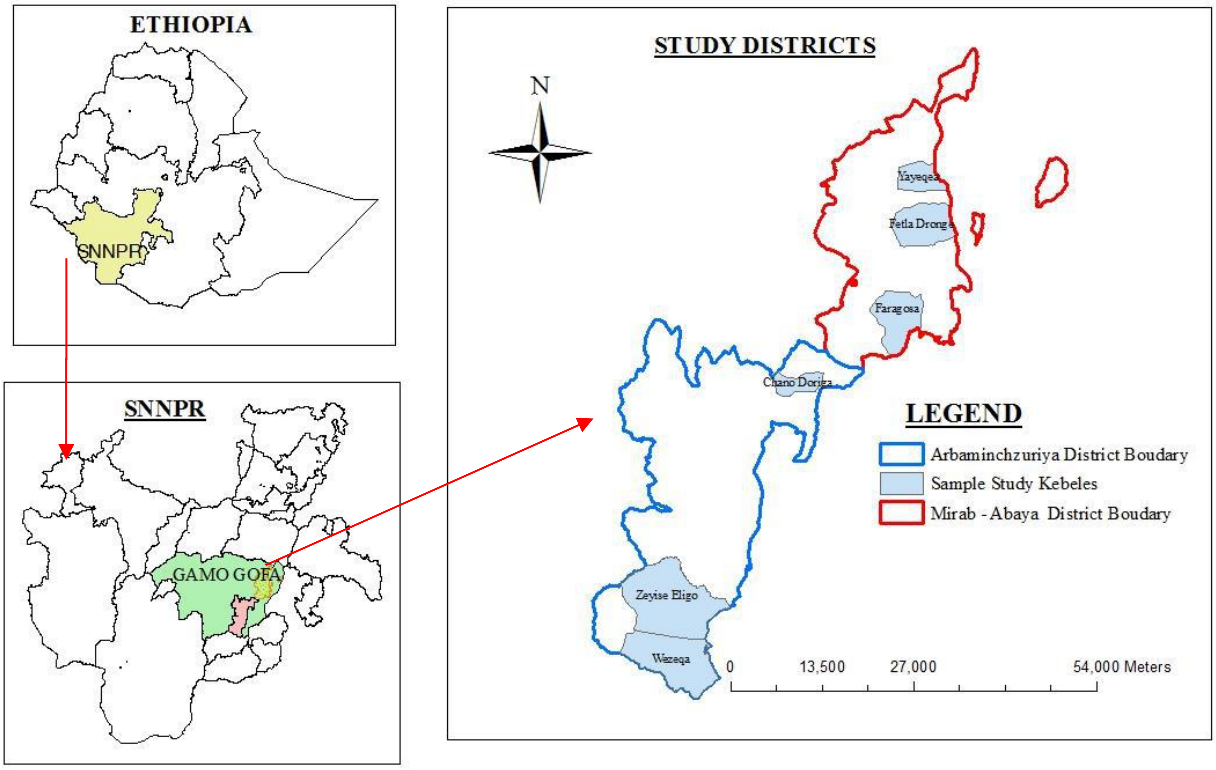

Fig.1: Location map of study areas

Sampling and data collection procedures

Body condition score (BCS) was subjectively evaluated using a five-point rating system (1 = extremely thin, 2 = thin, 3 = average, 4 = fat, and 5 = very fat/obese), according to FAO (2012). An animal's score was determined by using the tips of the thumb and fingers to feel the ribs and backbone.

Oestrus synchronization

21 doelings and 39 late-stage lactating and/or open does were randomly selected from Fetele (22), Faragosa (18), and Chano-Dorga (20) kebeles for the oestrus synchronisation investigation. Since prostaglandin hormone was only effective on active corpus litum, individuals who were either considered to be unhealthy, malnourished, showed heat sign within five days, non-cyclic, nursing, or pregnant were culled for synchronisation (Kefyalew, 2015). In order to reduce abortions caused by hormones, pregnancy diagnose using Pregtone (field ultrasonography) was also carried out prior to hormone administration. As previously advised, 2.5 millilitres of Prostaglandin-based lutalyse® (dinoprosttromethamine sterile solution, corresponding to 5 mg dinoprost per millilitre) hormone was injected intramuscularly in a single injection (Zeleke, 2015). Does were randomly assigned, based on a 1:10 buck to doe ratio, to mate with chosen bucks from the same kebeles immediately following hormone injection.

The breeding bucks were supplied with 300 gm concentrate per day to maintain their body weight two weeks prior to and during the breeding time.

Buck was permitted to serve doe oestrus within 96 hours (Hamed et al., 2012). The expression of standing heat when does were exposed to bucks was used to determine the oestrous response to hormone treatment. After a month, a pregnancy was diagnosed using the Pregtone® or by ocular inspection to confirm conception. Number of does presented, age by dentition, initial body weight, body condition score, parity, number of does treated with PGF2α, number of does that responded to PGF2α treatment and did conceive/get pregnant and give birth, gestation length, weight and sex of the child, litter size, and abortion rate are among the data collected for oestrus synchronisation.

III. DATA COLLECTION PROCEDURES

Data analysis

Descriptive statistics, multivariate test and binary logistic regression analyses were employed to determine the statistical significance of the effects of location, age, parity, body weight and body condition on oestrous response and conception rates by using SPSS Software ver. 20.

The effects of location, age, parity, body weight, and body condition on oestrous response and conception rates were examined statistically using binary logistic regression analysis, multivariate tests, and descriptive statistics using SPSS Software version 20.

IV. RESULTS

Oestrous response and conception rates

Following the delivery of 2.5ml of lutylase hormone per doe, almost 85% of the does expressed oestrus in 55.68±19.92 hours (Table 1 and 2). 81.67% of does conceived or became pregnant overall. Abortion rate was 6.12% in the research locations.

Table 1: Overall goat performance of oestrus synchronization in study areas

Parameters	N	%
Total females presented for oestrus synchronization	60	100.00
Does gave response to hormone injection	51	85.00
Does conceived	49	81.67
Does aborted	3	6.12

N= Number of observations, %= percent

Performance of synchronized does and kids

Table 6 displayed the reproductive and production performances of the does over the course of three kebeles. The original mean body weight of the female population was 25.32±3.13 kg. The synchronised children's mean birth weight was 2.49±0.33 kg overall. Does had a gestation period of 152.6±2.56 days and a litter size of 1.31±0.46 days. The pregtone® technology has a 100% success rate in detecting early pregnancy before hormone therapy was administered. The locations of hormone delivery and other activities are shown in Figure 3.

Table 2: The overall mean values for synchronized kids' and does performance in study areas

Parameters	N	Mean	SD
Doe body weight (kg)	60	25.32	3.13
Birth weight (kg)	58	2.49	0.33
Male	33	2.60	0.33
Female	25	2.34	0.27
Gestation length (day)	50	152.62	2.56
Oestrus response after hormone injection (hours)	51	55.68	19.92
Liter size	59	1.31	0.46

N=Number of observations, STD=Standard deviation

Fig.1: Hormonal synchronization of goat

Factors affecting oestrous response and conception rate

The oestrous response to hormone treatment was found to be significantly influenced by doe body weight (P<0.05) (Table 7). According to the regression analysis, for every kilogramme increase in body weight, there would be a 33.9% increased risk of an oestrous reaction. The body weight of did not influence the rate of conception. Hormonal response and conception rate do not differ statistically significantly between research sites (P>0.05). The age of the does, parity, and body condition score all had a substantial impact on the rates of conception and hormonal response. Compared to those of parity 5, those of parity 0–4 have demonstrated a noticeably greater differential in hormone response and conception rate. The oestrous response to hormone treatment and the rate of conception have been demonstrated to be highly influenced by body condition score. Doe responses to hormonal treatment and conception rate were higher in those with body condition scores of three and four than in those with lower scores. The rate of pregnancy and hormonal response are significantly impacted by age as well. Compared to younger does, older did displayed a reduced oestrus response and conception rate.

Table 3: Effect of body weight on oestrous response and conception rate of does

Reference category	β	Sig.	Exp (β)
Response	0.339	0.036	1.403
Conception	0.261	0.052	1.298

Table 4: Variation in oestrus rate to PGF2a and pregnancy rate in the study areas

Items	Number of observations	Rate of response of does to PGF2α (%)	Pregnancy/conception rate (%)
Overall	60	51(85.0)	49 (81.7)
Sites		NS	NS
Chano-Dorga	20	17 (85.0)	17(85.0)
Fetele-Doronje	22	19 (86.4)	18(85.7)
Faragosa	18	15 (83.3)	14(77.8)
Parity		*	*
0	21	20(95.2)[a]	19(90.5)[a]
1	4	4 (100)[a]	4(100)[a]
2	5	5 (100)[a]	5(100)[a]
3	17	15 (88.2)[a]	15(88.2)[a]
4	7	7 (100)[a]	6 (85.7)[a]
5	6	6(0.00)[b]	6(0.00)[b]
Body condition score		*	*
2	12	6(50.0)[b]	5(41.7)[b]
3	32	30(93.8)[a]	29(90.6)[a]
4	16	15(93.8)[a]	15(93.8)[a]
Age		*	*
0PPI	8	8(100)[a]	8(100.00)[a]
1PPI	14	13(92.9)[a]	12 (85.71)[a]
2PPI	6	6(100)[a]	6(100)[a]
3PPI	17	17(100)[a]	17(100)[a]
4PPI	15	7(46.7)[b]	6 (40.0)[b]

Columns with different superscripts were statistically significant (P<0.05)
* Statistically significant (P<0.05), NS statistically not significant (P>0.05)

V. DISCUSSION

Goat oestrus synchronization

The current study's average oestrous response and conception rate were between the response and conception ranges reported in the literature. Zelelek et al. (2016) observed 55–65% oestrous response rate in Ethiopian sheep breeds. In Nigerian goat breeds, oestrous responses varied from 20 to 100%, while conception rates varied from 65.0 to 100% (Omontese et al., 2016). The present study corroborates the findings of Santoralia et al. (2011), who reported that a high body condition score was linked to an increase in ovulation, with scores of less than two and greater than three corresponding to the lowest and highest pregnancy rates in sheep, respectively, regarding the effect of body weight and body condition score on oestrous response to hormone treatment and conception rate. Additionally, it was discovered that pregnancy loss increased by 2.4 times for every unit decrease in bodily condition score (López-Gatius et al. 2002). In the current investigation, the responsiveness and conception rate dropped as dopant parity increased. Ungerfeld and Sanchez-Davila (2012) discovered that multiparous ewes had a considerably higher oestrous response to hormone treatment (91.5%) compared to primiparous ewes (75.0%). However, the rates of conception were statistically equivalent for both groups of ewes (59.6% and 50.0%). The current study's decreased responsiveness and conception rate as a result of the older goats' ages were consistent with Trigg's (2003) findings on Black Bengal goat synchronisation, which found that it caused super ovulation in younger goats. Nonetheless, research on the oestrous synchronisation of dairy cattle revealed that cows had a higher oestrous expression (90.9%) than heifers (63%), but there was no statistically significant difference in the frequencies of conception between the two groups (Bayemi et al., 2015).

The average birth weight of the children (2.49 kg) was lower than the results of Weldu et al. (2004) for Arsi-Bale goat under traditional management system, but higher than the findings of Deribe and Taye (2013) for Abergelle goat. The gestation length matched the findings of Girma (2009). The litre size of 1.31 was in contrast to Shenkute's (2009) findings for Kaffa goats kept under traditional management. The gestation length matched the findings of Girma (2009). The litre size of 1.31 was in contrast to Shenkute's (2009) findings for Kaffa goats kept under traditional management. The percentage of mechanical abortions that occurred throughout the trial demonstrated the effectiveness of the pregtone technique in identifying early pregnancy (between 30 and 40 days), as advised by Renco Corporation (2000) prior to hormone administration.

VI. CONCLUSION

After receiving hormone therapy, the does' overall oestrus response was 85%, but the pregnancy rate was 81.67%, which was thought to be better for the production of goats by small-holder farmers. While location has little bearing on the oestrous response to hormone treatment and the rate of conception, doe body weight, body condition score, parity, and age do. Oestrus response and conception rate often rise with increasing body weight and body condition score, while the opposite is true for parity and age. Therefore, in low input production systems, it is crucial to take into account the proposed does' live body weight, body condition score, parity, and age categories backed with early pregnancy diagnosis methods in order to minimise the abortion rate.

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REFERENCES

[1] Ak K., Ozturkler Y., Kasikci G., Horoz H., Kilicarslan R., Ileri I.K. (1998): Ankara keçilerde farkli östrus senkronizasyonu yöntemleri ve serum progesteron, LH seviyeleriuzerindearastirmalar. Journal of the Faculty of Veterinary Medicine, University of Istanbul, 24, 367–377.

[2] Alemu Yami, Kassahun Awgichew, Gibson, T.A. Merkel, R.C.,(2009). Goat Breeds o Ethiopia: A guide for identification and utilization. Technical Bulletin No. (27) (Solomon Gizaw, eds). http://www.esgpip.org

[3] Baldassarre H, Karatzas CN. Advanced assisted reproduction technologies (ART) in goats. AnimReprodSci 2004; 82–83: 255- 266.

[4] Belete Shenkute. 2009. Production and Marketing Systems of Small Ruminants in Goma District of Jimma Zone, Western Ethiopia. MSc. thesis Submitted to School of Graduate Studies. Hawassa University, Awassa, Ethiopia. 144p.

[5] Central Statistical Agency (CSA). 2020. Agricultural Sample Survey. Report on Livestock and Livestock Characteristics, Volume II, Addis Ababa, Ethiopia.

[6] Chacón E., Fernando M., Francisco V., Samuel R. P., Eliecer P. & Concepta M. 2011. Morphological measurements and body indices for Cuban Creole goats and their crossbreds. Revista Brasileira de Zootecnia. v.40, n.8, p.1671-1679.

[7] Daskiran I, Askin K, Mehmet B (2006). Slaughter and carcass characteristics of Norduz male kids raised in either intensive or pasture conditions. Pakistan J. of Nutrition 5(3): 274-277.

[8] Dereje Dea and Ermias Eramo. 2018. Performance of the Woyto-Guji Goats under Traditional Management Systems in Konso District, Ethiopia. Journal of Biology, Agriculture and Healthcare, Vol.8, No.1 (www.iiste.org).

[9] Dekhane, S.S. et al. 2023. Assessment of Growth and Yield Performance of Twelve Different Rice Varieties Under North Konkan Coastal Zone of Maharashtra. International Journal of Horticulture, Agriculture and Food science.

[10] Delgadillo JA, Flores JA, Hernández H, Poindron P, Keller M, Fitz- Rodríguez G, et al. Sexually active males prevent the display of seasonal anestrus in female goats. *HormBehav*2015; 69: 8-15.

[11] Deribe Gemiyu. 2009. On-farm performance evaluation of indigenous sheep and goats in Alaba, Souuthern Ethiopia. MSc. Thesis, Hawassa University, Hawassa, Ethiopia.

[12] FARM-Africa. 1996. Goat Types of Ethiopia and Eritrea: Physical Descriptions and Management Systems. FARM-Africa / International Livestock Research Institute, Addis Ababa.

[13] Food and Agriculture Organization of the United Nations (FAO).1999. AGRI. Paper No. 25, Rome, Italy.

[14] **FAO.** 2012. Phenotypic characterization of animal genetic resources.FAO Animal Production and Health Guidelines No. 11. Rome.

[15] FAO. 2015. The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture, edited by B.D. Scherf & D. Pilling. FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome (available at http://www.fao.org/3/a-i4787e/index.html).

[16] Frandson RD, Elmer HW (1981). Anatomy of the male Reproductive system In: Frandson RD (ed). Anatomy and Physiology of farm Animals 3rd edition pp 430-442 Lea and Febiger, Philadephia.

[17] Gebremeskel, T. 2000. The experience of Farm-Africa in Goat Development Project in Ethiopia. In: Merkel, R .C., Abebe, G. & Goetsch, A. L. (eds) The Opportunities and Challenges of Enhancing Goat Production in East Africa. Proceedings of a conference held at Debub University, Awassa, Ethiopia, November 10 - 12, 2000. E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK.

[18] Gerald, W (1994). The Tropical Agriculturalist. Macmillan Press Ltd. London, pp. 54-57.

[19] Girma Abebe. 2009. Sheep and Goat Production Handbook for Ethiopia: Reproduction in Sheep and Goats. Addis Ababa, Ethiopia, pp 73-74

[20] Solomon G., Getachew, T., Edea, Z., Mirkena, T., Duguma, G., Tibbo, M., Rischkowsky, B., Mwai, O., Dessie, T., Wurzinger, M., Solkner, J. and Haile, A. 2013. Characterization of indigenous breeding strategies of the sheep farming communities of Ethiopia: A basis for designing community-based breeding programs. ICARDA working paper, Aleppo, Syria. 47pp.

[21] Haile, A., Wurzinger, M., Mueller, J., Mirkena, T., Duguma, D., Mwai, M., Sölkner, J. and Rischkowsky, R. 2011. Guidelines for Setting up Community-based Sheep Breeding Programs in Ethiopia. ICARDA - tools and guidelines No.1. Aleppo, Syria, ICARDA.

[22] Halima Hassen, Michael Baum, Barbara Rischkowsky and Markos Tibbo. 2012. Phenotypic characterization of Ethiopian indigenous goat populations. African Journal of Biotechnology Vol. 11(73), pp. 13838-13846.Available online at http://www.academicjournals.org/AJB.

[23] Hamed Naderipour1, JafarYadi, Ali GhaziKhani Shad and Mohammad Ali Sirjani. 2012. The effects of three methods of synchronization on estrus induction and hormonal profile in Kalkuhi ewes: A comparison study. African Journal of Biotechnology Vol. 11(5), pp. 530-533, Available online at http://www.academicjournals.org/AJB

[24] Hulunim Gatew. 2014. On-Farm Phenotypic Characterization and Performance Evaluation of Bati, Borena and Short-Eared Somali Goat Populations of Ethiopia. MSc Thesis, Haramaya University, Dire Dawa, Ethiopia.

[25] Kosgey, I.S. & Okeyo, AM. 2007. Genetic improvement of small ruminants in low-input, smallholder production systems: Technical and infrastructural issues. Small Ruminant Research, 70: 76-88.

[26] Leboeuf B., Manfredi E., Boue P., Piacére A., Brice G., Baril G., Broqua C., Humblot P., Terqui M. (1998): Artificial insemination of dairy goats in France. Livestock Production Science, 55, 193–203.

[27] López-Gatius, F., Santolaria, P., Yániz, J., Rutllant, J. and López-Béjar, M. 2002. Factors affecting pregnancy loss from gestation day 38 to 90 in lactating dairy cows from a single herd. *Anim. Reprod. Sci*. 57:1251–1261.

[28] Mahilet Dawit. 2012. Characterization of Hararghe Highland Goat and Their Production System in Eastern Hararghe. MSc. Thesis, Haramaya University, Dire Dawa, Ethiopia.

[29] Malpaux B, Migaud M, Tricoire H, Chemineau P. Biology of mammalian photoperiodism and the critical role of the pineal gland and melatonin. *J Biol Rhythms* 2001; **16**(4): 336-47.

[30] Markos Tibbo. 2006. Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopia highlands. PhD dissertation. Department of Animal Breeding and Genetics, Faculty of Veterinary Medicine and Animal Sciences, Swedish University of Agricultural Science(SLU), Uppsala, Sweden. pp 74.

[31] Omontese BO, P.I. Rekwot, I.U. Ate, J.O. Ayo, M.U. Kawu, J.S. Rwuaan, A.I. Nwannenna, R.A. Mustapha, A.A. Bello. 2016. An update on estrus synchronisation

of goats in Nigeria. Asian Pacific Journal of Reproduction. http://dx.doi.org/10.1016/j.apjr.2016.01.002

[32] Payne, W.J.A., Wilson, R.T., 1999. An introduction to Animal Husbandry in the tropics. Blackwell Science Ltd, pp. 447-484.

[33] Piccoli, A.P. 2024. Reproductive phenology and environmental temperatures in the Smooth Newt Lissotriton vulgaris meridionalis (Boulenger, 1882), (Amphibia, Urodela) in a Mediterranean habitat. International Journal of Environment, Agriculture and Biotechnology.

[34] Rahman, A.N.M.A., R.B. Abdullah, and W.E. Wan-Khadijah. 2008. Estrus synchronization and superovulation in goats: a review. J. Biol. Sci. 8: 1129-1137.

[35] Santolaria, P., Palacin, I. and Yániz, J. 2011. *Management Factors Affecting Fertility in Sheep. In: Artificial Insemination in farm animals*. http://www.intechopen.com/books/artificial-insemination-in-farm-animals/management-factors-affectingfertility- in-sheep.

[36] Sebsibe A (2006). Meat quality of selected Ethiopian goat genotypes under varying nutritional Conditions (upetd.up.ac.za/thesis/ available/etd-07092008-081206/). Ph.D.Thesis, University of Pretoria, South Africa.

[37] Salako A.E. 2006. Application of morphological indices in the assessment of type and function in sheep. Intern. J. of Morphology, v.24, p.13-18.

[38] Khargharia G., Kadirvel G., Kumar S., Doley S., Bharti P.K. and Mukut Das. 2015. principal component analysis of morphological traits of assam hill goat in eastern himalayan india. The Journal of Animal & Plant Sciences, 25(5): 1251-1258.

[39] Arredondo-Ruiz V., Macedo-Barragán R., Molina-Cárdenas J., Magaña-Álvarez J., Prado-Rebolledo O., García-Márquez L. J., Herrera-Corredor A., Lee-Rangel H. 2012. Morphological characterization of Pelibuey sheep in Colima, México. Trop Anim Health Prod. DOI 10.1007/s11250-012-0303-1.

[40] Shumuye Belay, Gebreslassie Gebru, Guesh Godifey, Minister Brhane, Mulalem Zenebe, Hailay Hagos and Tsegay Teame. 2014. Reproductive performance of Abergelle goats and growth rate of their crosses with Boer goats. LRRD Newsletter . Livestock Research for Rural Development 26 (1) 2014

[41] Simões J. 2015. Recent advances on synchronization of ovulation in goats, out of season, for a more sustainable production. Department of veterinary Science. University of Trás-os-Montes e Alto Douro. 5000-811Vila Real, Portugal.

[42] Singh PN and Mishra AK (2004). production of body weight using conformation traits in Barbari goats Indian Journal of ruminants 10(2) 173. Small Rumin. Res. 34:197-202 Small Ruminant Research 35, 181-193.

[43] Solomon Abegaz Guangul. 2014. Design of community based breeding programs for two indigenous goat breeds of Ethiopia. Doctoral Thesis. Vienna, Austria.

[44] Tesfaye Alemu. 2004. Genetic characterization of indigenous Goat populations of Ethiopia using microsatellite DNA markers. PhD thesis, NDRI, India.

[45] Trigg Hall. 2003. An update on estrus synchronization in goats: A minor species. Department of Agriculture, University of Maryland Eastern Shore, Princess Anne 21853

[46] Tsegahun, A., Lemma, S., Ameha, S., Abebe, M. and Zinash, S. 2000. National goat research strategy in Ethiopia. In: Merkel, R .C., Abebe, G. &Goetsch, A. L. (eds). The Opportunities and Challenges of Enhancing Goat Production in East Africa. Proceedings of a conference held at Debub University, Awassa, Ethiopia, November 10 - 12, 2000. E (Kika) de la Garza Institute for Goat Research, Langston University, Langston, OK 1-5.

[47] Tsigabu Gebreselassie. 2015. Phenotypic characterization of goat type and their husbandry practices in nuer zone of Gambella people regional state, south western Ethiopia. M.Sc Thesis, Haramaya University, Haramaya, Ethiopia.

[48] Ungerfeld, R. and Sanchez-Davila, F. 2012. Oestrus synchronization in postpartum autumn-lambing ewes: Effect of postpartum time, parity, and early weaning. *Spanish Journal of Agricultural Research* 10(1):62–68.

[49] Whitley N. C. and D. J. Jackson. 2004. An update on estrus synchronization in goats: A minor species. Department of Agriculture, University of Maryland Eastern Shore, Princess Anne 21853.

[50] Wurzinger, M., Sölkner, J. and Iniguez, L. 2011. Important aspects and limitations in considering community-based breeding programs for low-input smallholder livestock systems. Small Ruminant Research, 98:170–175.

[51] Yoseph Mekasha. 2007. Reproductive traits in Ethiopian male goats: With specialreference to breed and nutrition. Doctoral thesis, Swedish University of Agricultural Sciences, Uppsala, Sweden.pp61.

[52] Zeleke Mekuriawu, Habtemariam Assefa, Azage Tegene and Dagne Muluneh. 2015. Estrus response and fertility of Menz and crossbred ewes to single prostaglandin injection protocol. Trop Anim Health Prod.