



Indonesian Efforts to Conserve Gembrong Goats

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Abstract - Gembrong goat are mainly found in eastern part of Bali Island, especially in the village of Tumbu, Karangasem. Throughout Indonesia these goats are found no more than 50 heads. This condition puts Gembrong goat in a critical status that indicates the need of emergency and quick action. The present study was carried out to assess the characteristic of this breed and to preserve it through some proposed action plan. Information was obtained by personal observation and discussion with the leader of farmer group. Body weight (BW) and various body measurement were taken from 15 head of Gembrong goat. In general, the color of Gembrong goat body is white, or partly brown or solid brown. The average body weight is of 23.2 kg for females and 30.7 kg for males. The averages Body length of males is 60 cm, height 58.2 cm, and 14.4 cm ear length in males, and in females body length is 56.2 cm, height 55.1 cm and ear length 14.2 cm. To preserve Gembrong goat population from extinction collaborative activities is needed, namely: (1) multiplication of existing Gembrong goat population, (2) Rescuing animal genetic material and (3) up-grading female Kacang goat with Gembrong male goat as to achieve 99% Gembrong goat genetic composition.

Keywords—Phenotypic characteristic, Endangered breed, Gembrong goat

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I. INTRODUCTION

Many studies reported that Gembrong goats is a specific type of goat differ from the indigenous breed (Kacang goats) and their Ettawa-crossbreeds (Oka et al. 2011). The body size is bigger than Kacang goats but is smaller than Ettawa-crossbred (Setiadi, Mathius, and Utama 1998). This breed is found in Karangasem regency, eastern part of Bali Island. This type of goat is called Gembrong goats because of their long hair cover their body, neck and up to their face particularly in buck (male goat). The word gembrong come from Balinese word which means long hair (Oka et al., 2011). The results of the phylogenetic tree shows that the Indonesian local goat is based from Kacang goat that showed close genetic distance and is came from the same cluster. Except that Gembrong goats do not contain Kacang goat blood, which the most distant from other breeds and came from a separate cluster (Zein et al. 2012). Although earlier study indicated that Gembrong goat has close genetic relationship with local Kacang and PE goats (Oka et al., 2011), but low levels of genetic diversity was reported at Gembrong goat (Sulabda et al. 2012).

In World Watch List for domestic animal diversity the population of Gembrong goats in 1997 is reported about 100 heads but the population is likely to continue to decline (DGLS, 2003; Scherf, 2000). Based on FAO report, Gembrong goat is currently recorded in the global data bank for animal genetic resources as one of critical breed (FAO, 2012a, 2012b). This population decreased is due to the lost of suitable habitat (Sulabda et al., 2012) and else was mention by Guntoro, scientist from Bali Assessment Institute for Agricultural Technology (personal communication, 2013) that some causes of the decline of Gembrong goats population are a) most of farmers raise Gembrong goats mixed with Ettawa goat, or uncontrolled intermixing at grazing area that resulting crossbred animals, b) there is a perception that the fur will fall out when the males are used for mating so that males are could only used after shaving time, c) some farmers find it was difficult to detect estrus time because goats reared extensively, or because the back of the female fur is very dense, d) disease or parasite which causes death (bloat and worms) and, e) if there is an immediate need (for school, or for ritual ceremony) they sold the goat to slaughterhouses or to other farmer out of the area. Moreover, Batubara (2006) reported that Gembrong goats

have lower resistance to internal parasites compared to the Kacang goats. These events are leading to the endangered breed purity and potential animal genetic material lost (Sulabda et al., 2012).

Although there have been several studies on this Gembrong goat, however, efforts to preserve it are not available until this time. The present study was carried out to assess the characteristic of Gembrong goat of Karangasem, Bali, Indonesia, and effort to preserve it through proposed action plans.

II. MATERIALS AND METHODS

Study was done in Dusun Ujung Hyang, Tumbu Village at Karangasem District of Bali Province in Indonesia (Figure 1). The location is situated around 8°27'07.42" S and 115°37'33.53" E, with elevation of 229 ft. above sea level. The temperature ranges between 23°-27° C with humidity around 69%.



Figure 1. Location of Gembrong goats at Tumbu, Karangasem, Bali Indonesia

Data was recorded on October 20 – 23, 2011, consisted of management practices, housing, feeding, breeding and disease control. The information was taken by personal observation and discussion with the leader of farmer group. The goats are belonged to the WisnuSegara farmer group. The group was founded in 2009; they kept 18 heads of Gembrong goats from the total population of 33 head in Karangasem district.

The body weight (BW) and various body measurement for this study were taken from 9 head of males, and 6 head of females: body length (BL), rump height (RH), rump width (RW), rump length (RL), shoulder height (SH), chest width (CW), chest depth (CD) chest girth (CG), horn length (HL), ear length (EL), head length (HL), head width (HW), head height (HH), canon circumference (CC), tail length (TL), tail thick (TT), tail width (TW), and scrotum circumference (SC). Measurement was done using body weight scale (with 50 gr precision), caliper (in mm) and measuring tape (in cm). For this data collection guideline for phenotypic characterization of animal genetic resources was used (FAO, 2012c). Concerning limited data collected, the results are presented descriptively.

III. RESULTS AND DISCUSSIONS

Goat Population

Indonesian Farmers Harmony Association (HKTI) in 2009, in attempt to conserve the existence of this breed initiated to collect - as much as they could get - all Gembrong goats that scattered within Karangasem district in one place in Dusun Ujung Hyang, Tumbu Village of Karangasem District. As the result HKTI could collect 18 heads of Gembrong goats and it was given to Farmer group at this Dusun. In October 2011 the population increased to the number of 24 heads. It is also important to notice that only two bucks were aggressive for mating in this farmer group, which meant inbreeding depression will be expected to happen soon. This tendency was proven by Sulabda et al. (2012) that reported of low level of genetic diversity in this animal group.

Indonesian Goat Research Station in Sei Putih, North Sumatra reported that they keep 6 adult female, 3 adult male, and kids: 3 female and 3 male, with the total of 15 heads of Gembrong goats. All of Gembrong goats at this station were initially came from Karangasem too. While one hobbyist farmer in Pacet, Bogor, West Java reported that they keep one Gembrong buck, 3 does, 3 young females, 2 females kids (personal communication, 2013). However all the young and kids were resulted from that one buck. This situation is highly risky with inbreeding depression. So, from these three places known, the total population is only 48 animals.

Table 1. Gembronggoats population at Tumbu, Karangasem, Bali Indonesia, (Ocktober, 2011)

	Mature (Head)	Young (Head)	Kid (Head)	Total (Head)
Male	7	7	2	16
Female	5	2	1	8
Total	12	9	3	24

Source: ICARD (2011).

Utility

Gembrong goat hair is used for fishing bait; this fine silky hair of Gembrong goat is very attractive to fish. On the other hand the modern textile technology resulted in cheaper silky thread that could be used for fish bait too. It is one of several reasons that farmer do not care whether their animal producing long hair or just short hair. As a results farmer who interested in raising pure Gembrong goat is declining too, since benefit from keeping the pure goat was economically low. The goat meat is very thin given the body size is small too (Mahmalia et al. 2004). On the contrary, as reported by farmer there are hobbyist farmer that are fond of keeping Gembrong goat since this animal is very beautiful and very attractive. The exact number of hobbyist is not known, but at least one hobbyist from West Java bought one buck and two does from Bali. The latest number of population in this hobbyist become one adult of Gembrong Goats, 3 adult females, 3 young females, 2 females kids (personal communication, 2013). They bought it from farmer with higher price and keep them as a pet. This is a golden opportunity for farmer to raise Gembrong goat, to get higher selling price.

Management practice

Group of farmer of 10 households collaborated in maintaining this endangered population. Closed pen

housing is provided for individual animal, except for does with its kids they were kept all together in one pen. The animals were removed from the cage to get exercise around the cage only once a week. Mating system was a natural system, there was only one male used for breeding for most of the time, as other males are less aggressive. This less aggressive of male in this small population is caused by inbreeding depression. Frankham (2005) reported that inbreeding has deleterious consequences on all aspects of reproduction and survival, including sperm production, mating ability, female fecundity, juvenile survival, mothering ability, age at sexual maturity and adult survival in animals.

Feeding and health care

Mixture of forage/grass/legume were fed to these goats as well as feed supplement which consists of rice bran, waste tofu cake, banana trunk, teak leaf, and sweet potatoes leaf. Diseases that often attack are bloat, scabies and hernia. This problem has been traditionally handled by farmer, no assistance from veterinarian because there is no money to pay neither for medicine nor for vaccine.



Figure 2. Feed preparation (banana trunk).

Physical characteristic

In general, the body color of Gembrong goats is white, or partly brown, and solid brown. The average body weight is 23.2 kg for females and 30.7 kg in males, with body length of 60 cm, height 58.2 cm, and 14.4 cm ear length in males, and in females body length is 56.2 cm, height 55.1 cm and 14.2cm ear length, and other body measurements is presented in Table 2. Mahmalia et al. (2004) reported that the body shape of Gembrong goat was smaller than Ettawa grade, but bigger than Kacang goats.



Figure 3. Farmer preparing feed for their goats (banana trunk, waste tofu cake, tick leaf, sweet potato leaf).

Body weight and all body measurement of Gembrong goat is bigger than kacang goat as presented in Table 2. Setiadi et al. (1998) reported that male Gembrong goat has fur length of 19.61 ± 6.12 cm even they have hair on the head that cover their face and ears especially in males, while female goats have shorter fur, it is around 2-3 cm.

Action plan for conservation and utilization

Originally Gembrong goat was developed by fishermen and farmers. This was associated with the habit of assembling fishing lures in the coastal areas. Gembrong goat hair will be shiny in the water and attracts fish when it is used as bait. The flock size of Gembrong goat per farmer was very small since the population was also very limited. The economic value of Gembrong goat actually is from the fur. However the availability of modern textile that could be used to substitute the fishing lures with low price, this make farmer interest in developing Gembrong goat relatively low and economically it is not beneficial for them.

The goat meat is very thin given the body size is small too, compared to adult PE goat ($83,5 \pm 3,53$ for male, and $40,20 \pm 6,33$ kg for female) but it is bigger than Kacang goat ($23,83 \pm 4,53$ kg for female, $26,88 \pm 3,93$ kg for male) as reported by Rumich (1967) and Setiadi et al., (1998).

The value could be higher if it is kept as a pet. This animal is very beautiful and very attractive; people from out site of Bali island are willing to pay it with a high cost for this animal and keep it as a pet. However the law of Bali government prohibits the sale of these goats out of Bali Island. This situation is a dilemma for farmers, while they have to pay a lot of money to keep these animals, but they could not sell their animals out of Bali islands, when they need cash.

Table 2. Body weight (kg) and morphometric measurement of Gembrong goats compare to Kacang goats.

No	Traits	Male (2-4 years)*		Female (2-4 years)**		Kacang Goat***	
		Mean	SD	Mean	SD	Male	Female
1.	body weight (kg)	30.71	3.15	23.17	5.34	25	20
2.	body length (cm)	60.00	2.65	56.17	4.63	55	47
3.	rump height (cm)	60.43	2.15	57.42	1.80	58.4	54.7
4.	rump width (cm)	13.86	1.86	14.08	1.86	-	-
5.	rump length (cm)	15.00	1.63	15.83	1.33	-	-
6.	shoulder height (cm)	58.14	2.27	55.08	1.69	55.7	55.3
7.	chest width (cm)	16.43	2.42	15.42	1.56	-	-
8.	chest depth (cm)	28.43	2.07	25.17	0.75	-	-
9.	chest girth (cm)	76.00	3.46	70.00	5.06	67.6	62.1
10.	horn length (cm)	12.10	4.56	5.50	3.16	7.8	7.0
11.	ear length (EL),	14.36	1.11	14.17	1.33	4.5	4.0
12.	head length (cm)	20.50	1.89	16.83	2.14	-	-
13.	head width (cm)	13.14	1.86	11.50	1.05	-	-
14.	head thick (cm)	14.71	0.70	13.33	1.21	-	-
15.	Canoncircumference (cm)	8.86	0.69	7.50	1.05	-	-
16.	tail length (cm)	13.71	1.80	11.33	1.75	12.0	12.0
17.	tail thick (mm)	9.14	1.21	7.83	1.72		
18.	tail width (mm)	16.14	2.34	11.03	4.87	2.5 cm	2.0 cm
19.	scrotum circumference (cm)	21.29	1.70				

*n=9 heads; **n=6 heads ***(Setiadi et al. 1998)



Figure 4. Male Gembrong goats

The number of Gembrong goat kept by farmer group is 24 heads, but information from Livestock Services that there are currently 2 females of Gembrong goats kept by farmer in neighboring village. In order to give a chance for these animal to reproduce, one male from Tumbu village, just recently send to this location (Guntoro, 2013, personal communication). Even so, the total population is currently still below 50 heads. Since the number of Gembrong goat is not more than 50 heads, this critical population need to be saved by Central Government as it is written in Indonesian Government Regulation, (Indonesian Government Regulation 2011)

In November, 2012 the Mininister decree stated that Gembrong goat is one of Indonesian breed. By that decree, conservation and utilization of Gembrong goat have a strong legal basis. What we need to do is to make action plan to be funded by the Central Government or any other Non-Governmental entity that put high attention to the conservation and preservation.

To preserve Gembrong goat population from extinction, there are three collaborative activities needed, namely: (1) multiplication of existing Gembrong goat population, (2) Rescuing animal genetic material and (3) up-grading female Kacang goat with Gembrong male goat as to achieve 99% Gembrong blood composition. This can be achieved on F₇ or after about 10.5 years to come (Table 3).



Figure 5. Female Gembrong goats with twin kids
Multiplication of existing Gembronggoats population

For this activity (activity 1) all the female of Gembrong goat should be collected at government goat multiplication center or at Karangasem farmers group. However, incentive for keeping these goats should be given. The current population of female Gembrong goat in the whole Bali province is not more than 15 individual. These female goats will be estrus synchronized using CIDR. Mating should be conducted under supervision using selected buck. Record of mating between female and male should be performed strictly in order to avoid inbreeding.

Fortunately recent study proof that these small population is belong to seven different clades (Sulandari et al. 2013). So, to avoid inbreeding, mating program is a little bit easier since uncorrelated grouped of animal are already known. To increase genetic variation, it would be much better if we could collect semen from all bucks that have been reported previously (from Bali, from hobbyist as well as from North Sumatera).

Postpartum mating should be conducted immediately after does weaning their kids (3 months old), and resynchronization should be done as needed. This synchronization practice is selected just to make breeding management efficient and make it easier to supervise, beside to accelerate the reproduction rate.

Young female kids should be mated at one year old and inbreeding should be avoids. Similarly, further activities are done repeatedly to increase population number until it could reach optimum population effective size. Culling in both males and females should be taken very lightly. Animals with physical handicap that prevent them to reproduce then should be culled out to minimized inputs.

Rescuing animal genetic material

Since the number of animal is very limited, preservation of Gembrong goat semen and ovum are very urgent (activity 2). For this purpose the Central Artificial Insemination Institute at Singosari, East Java, Indonesia could play an important role. Semen from all of adult males should be collected and then preserved in the form of frozen semen. It can save the genetic material in case something unexpected happen to the bucks since the number is very small indeed. The semen from this activity then could be used in breeding program. It was reported that at Sei Putih the semen preservation is already done. They can collect up to 500 straws until now (personal communication, 2014).

Gembrong goat ovum should be taken from unproductive, sick, or recently dead female goat. The ovum could be preserved first before it is used in embryo transfer program. Then there will be no genetic material wasted.

Up-grading Kacang goat with Gembrongbucks

Up-grading to get 99% of Gembrong goats composition (Activity 3) can be done by involving farmers who received free adult female Kacang goats (> 1 year). The number of female Kacang goats used for this activity at least 100 heads. The number could be increase depend on the number of farmer participant and the availability of budget. These Kacang goats are then crossed with Gembrongbucks (Table 3). Genetic distance of Gembrong goats to Kacang goats is 0.1655 (Zein et al. 2012). Furthermore, Oka et al. (2011) reported that Gembrong goats are closely related to Kacang goats from Bali. So the use of Kacang goat is scientifically and biologically supported.

Breeder cooperators are breeders who raise goats and have barn facilities, easy to get feed for their animal and have time to raise animals. The selected does of Kacang goat should be mated only with Gembrong bucks. Females will be synchronized with CIDR and then mated using artificial insemination. Semen used is frozen semen that

has been collected from the activity (2). The success of artificial insemination is reported 59% by intra-uterine insemination ((Djemali et al. 2009). At the time when sufficient number of male from activity (1) is reached then natural mating could be practiced.

This activity should be carried out until the blood composition of Gembrong goats reached 99% (F₇), this will be achieved at least in about 10.5 years. Given the length of time required for these activities then a good program and budget needed should be proposed as soon as possible. These activities would require real role of the various stakeholders involved. This commitment should be adhered to budget planning by every responsible stakeholder. Budgeting is planned in accordance to the development activities, while the detail of the activities in each year should be specified in the multi-stakeholder meeting. Yapi-Gnoaré (2000) suggested that for animal breeding activities involving farmers in rural areas, the work should be conducted together with animal husbandry extension workers. Breeding programs should be in line with counseling programs to train and improve the skills of the technical aspects of production and increase the experience in raising small ruminant. In that period the farmers are trained to recognize how important it is to keep records and livestock pedigree, productivity and profitability and anything else to be gained from recording activities (Moioli, Astruc, and Sanna 2002).

Table 3. Mating plan to produce Gembrong goat with up-grading

Year	Buck	Does	Progeny	F
2013-2014	G	K	50%G 50%K	F1
2014-2016	G	50%G 50%K	75%G 25%K	F2
2016-2018	G	75%G 25%K	87,5%G 12,5%K	F3
2018-2020	G	87,5%G 12,5%K	93,5%G 6,5%K	F4
2020-2022	G	93,5%G 6,5%K	96,75%G 3,25%K	F5
2022-2024	G	96,5%G 3,2%K	98,375%G 1,625%K	F6
2024-2026	G	98,3%G 1,6%K	99,2%G 0,8%K	F7

G=Gembrong buck; K=Kacang does; F=Filial

Farmers who are involved in these activities are possible to earn money from the sales of males resulted from cross breeding activity. All males animals resulted from cross breeding activity must be sold since only pure Gembrong buck will be used for breeding. F7 offspring buck can be compared to the pure Gembrong goat buck, so if it is good then it can be used as a stud at the next mating season.

To support the conservation and utilization of Gembrong goat the Research and Development institutions such as Indonesian Center for Animal Research and Development (ICARD), Research Center for Biotechnology LIPI, BPTP Bali, and Higher Education (Univ. of Udayana, IPB, Unpad, UGM), in accordance with their respective responsibility should propose conservation plan for Gembrong goat. To avoid overlap or lagging in several activities as mandated by Indonesian Government Regulation No 48/2011, this activity needs to be done in a coordinated manner. ICARD as a national research center is suggested to coordinate this action.

Attention on the technical aspects should be accompanied also with attention to social, economic and

cultural aspect that attached to the AnGR management activities. This will be closely linked to traditional knowledge in conservation and utilization of Gembrong goat for economic activities which actively involved in "community-based conservation". In this case the Indonesian Agency for Agricultural Research and Development (IAARD) will play an active role to provide real support to increase productivity, population size, and provide real benefits for the farmer as a manager of the AnGR.

Community based conservation

At present the existing Gembrong goat has become an icon of Karangasem district in an effort to gain attention/support to preserve this AnGR. In response, HKTI has provided financial assistance amounting to USD 4,500 for the farmer group at Ujung Hyang kampong, Tumbu village, Karangasem, Bali in 2009.

To raise the animal, feeding concentrate were provided, beside local feed from around the breeding site. However, this turned out that maintenance costs for feed, medicines, repair of cages and other costs is very high, while this operation does not generate income. Therefore these efforts have not been able to resist the perceived extinction of Gembrong goats, so that more progressive efforts should be done.

In the Karangasem Regent, Gembrong goat is set up as animal genetic resources that should be maintained in terms of goat farming by granting subsidies. The animal feed is supplemented with concentrates, beside natural feed like gliricidia, king grass, coconut leaves, and other agricultural waste product. However, the subsidy received by farmer is not enough to support the farming. On the other hand, goat farming can also support the development of organic farming, by using goat manure for fertilizer, in turn this practice can improve the balance of nature conservation as a form of sustainable farming.

Socialization about the importance of goat conservation should involve the utilization of biogas made of goat manure that has been project piloted in several locations in other district of Bali, even the waste product of the biogas can be used as natural fertilizer. This natural fertilizer is reported could be used in integrated farming system between coffee plantation and Ettawa goats in Bali and this practice is reported could increase coffee bean production as well (Rubiyo, Guntoro, and Suprpto 2003).

It is suggested by Seleka (2001) that a breeding program should have market-oriented goals. In the event that market is more dominated by a broker who is dominant in determining the price, farmer does not get any incentive of his hard work in producing good quality goat. Thus breeding technology innovation becomes useless. For farmers, it is advisable to form a group of farmers. The group will play a role in the provision of the production facility and also in determining the selling price. This group of farmers should receive guidance/escort from the instructor/researcher.

Good cooperation between the group and the instructor/researcher, in addition the smooth flow of technology information can also increase their knowledge and their confidence. Thus they will become the strong party when they sell their goats. With the improved

knowledge, farmers will have the courage to sell their livestock at different prices for breeding or for fattening program.

IV. CONCLUSIONS

Gembrong goat is characterized primarily by the long-haired fur and in male goat the face and ear are covered by the hair, while female goat has a shorter fur. In general, the body color of Gembrong goat is white, partly brown, and totally brown. To preserve Gembrong goat population from extinction collaborative activities is needed, namely: (1) multiplication of existing Gembrong goat population, (2) Rescuing animal genetic material and (3) up-grading female Kacang goat with Gembrong male goat as to achieve 99% Gembrong goat genetic composition.

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