Inbreeding Coefficient and Rate in Murrah Buffalo at BPTU-HPT Siborongborong

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Abstract: Balai Pembibitan Ternak Unggul – Hijauan Pakan Ternak (BPTU-HPT) Siborongborong is one of breeding station in Indonesia. One of animal which has been maintained is Murrah buffalo. The aims of the research are to calculated inbreeding coefficient and inbreeding rate of Murrah buffalo. Data and pedigree information were collected from 17 buffalo's (7 males; 10 females) in 2017 and 14 buffalo's (6 males ; 8 females) in 2018. The inbreeding coefficient was calculated using of pedigree analysis and inbreeding rate per generation based on the population structure. The result of inbreeding coefficient was 0,219 while the inbreeding rate was 2,29%. Significant inbreeding depression was found in BPTU-HPT Siborongborong because the breeding station wasn't regularly optimum rotated bull/generation.

1 INTRODUCTION

Balai Pembibitan Ternak Unggul-Hijauan Pakan Ternak Siborongborong has a main duty to maintenance, breeding, development, production and distribution of superior livestock and production and distribution of forage seeds. Some of its functions include 1) maintenance and production of superior livestock seeds, 2) implementation of performance test and superior livestock zuriat test, 3) implementation of superior livestock breeding, 4) implementation of germplasm conservation and 5) implementation of superior livestock breeding. In carrying out the main tasks and functions of the station, the implementation of activities is supported by several installations such as Siaro installation, Silangit, Bahal Batu and Rodaman Palas. Installation Siaro is a pig development site with an area of 17.5 Ha. Installation of Silangit is a place for the development of riverian buffalo (Murrah Buffalo) with an area of 23 Ha. Installation of Bahal Batu and Rodaman Palas where the development of swamp buffaloes with an area of 59.5 Ha and 94 Ha.

The Silangit Installation is one of the existing installations under the Siborongborong BPTU-HPT that carry out their main tasks and specific functions for the maintenance, production, breeding and development of Murrah buffalo. Murrah buffalo was brought to this location first time in 1994 about 25 heads from the Murrah buffalo breeder in Deli Serdang district. Since 1994 until now, Silangit installation has been maintaining, producing and breeding Murrah buffalo. The current population of Murrah buffaloes in Silangit installations is 81 heads consisting of 2 males, 18 females, 4 adult males, 16 adult females, 2 young males, 5 young females, 12 calves male and 22 calves females. Murrah buffalo is maintenanced with a system where in the morning grazed and in the afternoon put into the cage. Feed is given in the form of forage and concentrate. Patterns of mating with natural and artificial mating systems (artificial insemination). Natural mating is done by utilizing the stud in the installation. While the artificial mating is done by using the straw from UPTD BBID North Sumatra. Where the bull in UPTD BBID North Sumatra is coming from the murrah buffalo breeder in Deli Serdang District.

Since the Murrah buffalo was introduced to the BPTU-HPT Siborongborong, there has been no observation and calculation of inbreeding. Inbreeding may occur due to the origin of buffaloes in BPTU-HPT Siborongborong and UPTD BBID North Sumatera are originated from one population in Deli Serdang District. The origin of the same

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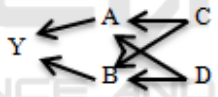
buffalo indicates that the buffalo has a close relative relationship. Signs of inbreeding have already begun to appear at BPTU-HPT Siborongborong, such as downward-looking horns, blue eyes and the death of buffalo several days after birth (Talib. 2011 and Talib., 2014). The purpose of this research is to know the value of coefficient and inbreeding rate of buffalo Murrah at BPTU-HPT Siborongborong.

2 MATERIAL AND METHOD

2.1 Value of Inbreeding Coefficient

This research was conducted at the center of Animal Breeding of Animal Feed (BPTU-HPT) Siborongborong located in North Tapanuli Regency, North Sumatra. Data were collected from April to May 2018. The data used were genealogy data from 17 buffalo Murrah born in 2017 (7 male and 10 female and 14 data from 2018 (6 male and 8 female). Then, the genealogical record data was sorted and validated from the recorded data owned by BPTU-HPT Siborongborong. The genealogical records obtained are then determined by common ancestors based on Warwick. (1990) as follows.



Inbreeding coefficient was calculated based on Allendorf dan Kuikart (2008).

$$F_x = \frac{1}{2}\sum\left[\left(\frac{1}{2}\right)^{n+1}(1+F_a)\right] \quad (1)$$

Annotation :
F_x: Inbreeding coefficient within buffalo X
F_a: Inbreeding coefficient of common ancestor
n: The number of arrows from X to the common ancestor and back to X

The calculation of the rate of inbreeding is calculated by referring to Wiener (1994).

$$\text{Rate of Inbreeding} = \frac{1}{8\,Nm} + \frac{1}{8\,Nf}$$

Annotation:
Nm : Number of male and male stud
Nf : The number of females that can be mated

3 RESULT AND DISCUSSION

Inbreeding is a mating between livestock with closer kinship relative to the average of kinship relations of the livestock group (Noor, 2008). Meanwhile, according to Warwick (1990), livestock is considered to be related when having common ancestry in the first four to six generations. The calculation of inbreeing coefficient by the method of genealogy analysis is to find the common ancestor of both parents. If after searching is not found a common ancestor, this is not the result of inbreeding so that the value of Fx = 0. Genealogical data that have been obtained from BPTU-HPT Siborongborong then analyzed to find common ancestors and then proceed to make the arrow diagram (Figure 1).

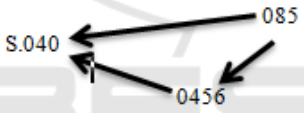


Figure 1. Example of Arrow Diagram of S.040

Making an arrow diagram like Figure 1 should be done with accuracy. The identity or name of an individual may not be repeated and is only allowed once. Furthermore, making a flowchart based on a pathway consisting of a common ancestor of a parent who has an inbreeding mating. The flow chart of the Murrah buffaloes is presented in Table 1.

Table 1. Flow Chart of Murrah Buffalo at BPTU- HPT Siborongborong

Path	N	Contribution
S.040 ← 085 – 0456 → S.040	2	$(1/2)^2 = 0{,}25$
	Fx	0,25

The results showed that there has been inbreeding in 2017, as many as 2 of 17 heads and in 2018 as many as 2 from 14 heads. According to Cervantes (2007), the value of inbreeding coefficient is F = 0 (non-inbreeding category), F value between 0 - 6.25% (low category), F value between 6.25 - 12.5% (medium category) and F value more from 12.5% (high category). The value of the inbreeding

coefficient obtained at the BPT-HPT Siborongborong is 0.219 or 21.9% (Table 2). When referring to Cervantes (2007), the value of inbreeding coefficients in the BPTU-HPT Siborongborong is high category. This can be seen from the flow chart that the males used in the BPTU-HPT Siborongborong is directly mated their biological offspring. According to Miglior. (1992) that the value of in-breeding coefficients is greater than 12.5% then inbreeding pressure will increase drastically from expected.

Table 2. Value of Inbreeding Coefficient in Murrah Buffalo at BPTU-HPT Siborongborong

Sex	Livestock Identity	Year of birth	Value of Inbreeding Coefficient
♂	S.011	2017	-
♂	S.012	2017	-
♀	S.013	2017	-
♂	S.014	2017	-
♀	S.015	2017	-
♂	S.016	2017	0,25
♂	S.017	2017	-
♀	S.018	2017	0,25
♀	S.019	2017	
♀	S.020	2017	-
♂	S.021	2017	-
♂	S.022	2017	-
♀	S.023	2017	-
♀	S.024	2017	-
♀	S.025	2017	-
♀	S.026	2017	-
♀	S.028	2017	-
♀	S.029	2018	-
♂	S.030	2018	-
♀	S.031	2018	-
♀	S.032	2018	-
♂	S.033	2018	-
♀	S.034	2018	-
♀	S.035	2018	-
♂	S.036	2018	-
♂	S.037	2018	-
♀	S.038	2018	0,125
♂	S.039	2018	-
♀	S.040	2018	0,25
♀	S.041	2018	-
♂	S.042	2018	-
Mean of Inbreeding Coefficient			0,219

Sayed. (2012) states that the value of inbreeding coefficients in Egyptian buffalo ranges from 0.029% to 0.202%. Dinarwati (2007) stated that the value of inbreeding coefficient in Caviar Company (Kikav) and Farming Company (Kinak) were 0.099 (9.9%) and 0.091 (9.1%) respectively. Filho (2015) states that the value of inbreeding coefficients in Gyr dairy cows is 2.82%. When compared with the results of the research, the obtained inbreeding coefficient is higher. However, when compared with the value of inbreeding coefficient in the bull population in Surabaya Zoo 0.42 (42%) (Sawitri and Mariana, 2012), the coefficient value obtained is lower.

3.1 Value of Inbreeding Rate

The number of males and females that serve as parent in a population can be used as a reference for estimating the rate of inbreeding. A population can survive if the rate of inbreeding per generation is smaller or equal to 1% (Salamena., 2007). The results of this study indicate that the rate of inbreeding in the buffalo population of Murrah at BPTU-HPT Siborongborong more than 1% (Table 3). Rusfidra (2012) stated that the rate of inbreeding rate at local ducks in Kecamatan Tilatang Kamang ranged from 0.1 to 0.13.

Table 3. Value of Inbreeding rate per Generation at BPTU-HPT Siborongborong

Sex / Inbreeding Rate	Location
	BPTU-HPT Siborongborong
Male and Male Stud Female	8 36
Inbreeding Rate (%)	1,91

The high inbreeding rate of population at BPTU-HPT Siborongborong can be decreased by increasing the number of males and increasing the effectiveness of the population (Sevinga., 2004). Increaseing 1% of inbreeding rates per generation, resulting in decreased production and performance in livestock (Praharani., 2009).

4 CONCLUSIONS

Value of Inbreeding coefficient and inbreeding rates at BPTU-HPT Siborongborong were 21.9% and 1.91%, respectively. The high value of coefficient and rates of inbreeding in BPTU-HPT Siborongborong can be reduced by introducing and increasing the number of Murrah buffalo bulls.

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