Formation and phenotypic performance of the new breed POGASI Agrinak cattle

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Abstract. To increase domestic meat production is needed beef cattle which can be cultivated in marginal areas with feed conditions that are limited in quality and quantity. The new breed of POGASI (PO Grati Hasil Seleksi) Agrinak cattle is formed to have optimal productivity in provision of low-quality feed. Ongole Crossed (OC) cattle from selection at farmers in 2002–2003, are developed in experimental stall at Beef Cattle Research Station by gradually selected and regulation of mating into optimum excellence in providing low quality feed (low crude protein and energy but high crude fiber, made from agricultural by-products and by-products of processing agricultural products), continuously extorting for 14 years. In 2017, the new breed beef cattle, POGASI Agrinak, is formed which is the fourth generation. POGASI cattle has penotypic performance specific, likes body color is yellowish white, short and large horns, hump grows upward, screw is small but wide, body weight and size are greater and ability to utilize feed nutrients is better than compared to OC cattle. POGASI cattle are suitable to be cultivated in marginal areas where feed availability is limited in quality and quantity.

1. Introduction
Increased domestic beef production can be achieved if available beef cattle breed as research results, that have high adaptive potential to agroecosystem conditions, where they can grow, develop and reproduce optimally according to value input. Beef cattle farming in smallholder farmers still faces obstacles that have not been able to achieve optimum productivity, partly because efforts environment(feed, temperature, management) has not been able to sufficient need of cattle to be able to express their genetic potential.

Efforts to mating local beef cattle with Bos taurus and produce crossing cattle such as Simpo and Limpo, at the beginning of their growth show significant performance improvements due to heterosis [1, 2]. However, after weaning, performance of crossing cattle will depend on good condition of their feed consume, ambient temperature and management procedures [3]. Genetically, growing potential of crossing cattle is higher than local beef cattle, but genetically too they become less adaptive to domestic farmers conditions, because cattle also inherit genetic of Bos taurus as sub-tropical cattle that demand feed intake with better quality and higher quantity, also cooler temperature and more intensive maintenance management [4]. Conditions in smallholder farmers have shown that cultivation of crossing cattle that not fulfill with their requirement, actually show production and reproduction performance that is not better, even per case it is worse than local cattle. Based on this condition, needed to an efforts that be able to form a new breed or strain of beef cattle that do not need too high
production performance, but optimal their production and reproduction performance in smallholder farming conditions, so that it is useful not only as a savings and source of income that large in nominal value, but also as a business that does not too much cost and can increase to economic value of agricultural by-products which previously may not have economic value.

Since 2003, Loka Penelitian Sapi Potong (Lolitsapi) or Beef Cattle Research Station (BCReS) has begun research that conducts selection and arrangement mating continuously, closed and gradually to Ongole Crossing (OC) cattle to produce a new breed that has optimal adaptability in utilizing feed based on agriculture by-products and processing by-products of agricultural products, so feed contain low crude protein and energy but high crude fiber. In 2017–2018 and at Lolitsapi, a new breed of OC cattle has been formed with their excellence characteristics and released as POGASI (PO Grati Hasil Seleksi) Agrinak cattle. This study aims to determine the process during formation and improvement of penotipik performance of the new breed of POGASI Agrinak cattle.

2. Methodology
The research to form a new breed of POGASI Agrinak cattle, started in 2003 and earliest to get results in 2017, done in Lolitsapi experimental stall, using the initial material of OC cattle as selection resulted from smallholder farmers in Lamongan, Tuban and Nganjuk regencies, as many as 36 cows and 4 bulls with specification of hump height 122.5 ± 0.5 cm for cows and 126.5 ± 1.0 cm for bulls. In its development from generation to generation, the number of research material cows continues to increase (Table 1.) as follows:

Table 1. Basic population of POGASI candidate and POGASI cattle (heads) at the beginning of each generation.

| Year | Generation | Basic population of POGASI Candidate (heads) | POGASI Cattle (heads) |
|------|------------|-----------------------------------------------|----------------------|
|      |            | Male | Female | Male | Female |
| 2002 | ---        | 4    | 36     | 0    | 0      |
| 2003/04 | First  | 4    | 21     | 4    | 7      |
| 2007/08 | Second | 12   | 30     | 8    | 22     |
| 2012/13 | Thirth | 25   | 76     | 21   | 69     |
| 2016/17 | Fourth | 33   | 116    | 28   | 104    |
| 2018 | POGASI Breed | 56   | 142    | 51   | 128    |

Selection is directed towards genetic improvement through increasing of average population phenotype from generation to next generation (it is called selection response [6]) ; final target at 24 months old are : OC bulls has minimum hump height 135 cm, good libido and semen quality; while in OC cows has minimum hump height 125 cm and reproductive conditions normal. Therefore, selection done at : production performance (body weight, body height and chest circumference) above from population average ; also qualitative traits of cattle (identity of OC cattle) at birth, weaning age (7 months), 12 and 24 months old in management condition of high crude fiber and low crude protein feeding. Some criterias culling are listed in Table 2., carried out after observation of parameters, at selection and or at certain times as needed. Culled cattles are not used as material to produce POGASI.

Intergenerational arrangement mating of OC cattle done continuously from 2003/2004 until 2018, following each selection result and intend to avoid inbreeding. Mating is done naturally, a selected bull whose identity and their parents are known, be gathered for 23 months with 10–20 cows who are breast feeding calves starting from 7 weeks [7], heifers that ready to be pregnant and or empty cows, who all are known of identity and pedigree of its parents. Pregnancy is known through rectal palpation at end of second/third month after mixed with bull.

Health control of cattle is prevention and treatment of physiological and health disorders. Prevention efforts are carried out every day by Veterinary team from Lolitsapi for all cattle whose
exterior shows symptoms/signs of impaired health, also periodically by Veterinary team from Balai Besar Penelitian Veteriner. Efforts to treat minor health problems were carried out by Veterinary team from Lolitsapi, while severe health problems were carried out by Veterinary team from Balai Besar Penelitian Veteriner. Preventive control is focused on IBR, Brucellosis, Leptospirosis, BVD.

Table 2. Culling criteria for cattle at each selection stage.

| Selection Stages                                      | Culling Criteria                                                                 |
|-------------------------------------------------------|----------------------------------------------------------------------------------|
| Weaning (205 days old)                                | • hump height is below the population average                                    |
|                                                       | • body diformity and or illness                                                   |
| Age 12 months                                         | • hump height is below the population average                                    |
|                                                       | • body diformity, illness and or deviations of OC cattle characteristics           |
| Age 18 and 24 months                                  | • hump height is below the population average                                    |
|                                                       | • body diformity, illness and or deviations of OC cattle characteristics           |
|                                                       | • male : not yet/little libido and or poor semen quality                          |
|                                                       | • female : do not want to ride a male                                            |
| Candidate bull, age 18 months                         | • hump height is below the candidate bull population average                     |
|                                                       | • body diformity, illness and or deviations of OC cattle characteristics           |
|                                                       | • weak/invisible libido (prolonged/unable to ride other cattle)                   |
|                                                       | • low quality semen                                                             |
| Candidate cow, age 18 months                          | • hump height is below the candidate cow population average                      |
|                                                       | • body diformity, illness and or deviations of OC cattle characteristics           |
|                                                       | • do not want to ride a cattle                                                    |
|                                                       | • have history of prolapse and or placental retention                            |
| Selected bull aged less than 24 months and productive | • hump height is below the young selected bull or productive bull age average    |
| bull aged over 24 months                              | • body diformity, illness and or deviations of OC cattle characteristics           |
|                                                       | • above the productive age                                                       |
|                                                       | • weak/invisible libido (prolonged/unable to ride other cattle)                   |
|                                                       | • low quality semen                                                             |
| productive cow, over 24 months old                    | • hump height is below the productive cow average                                |
|                                                       | • body diformity, illness and or deviations of OC cattle characteristics           |
|                                                       | • above the productive age                                                       |
|                                                       | • difficult to get pregnant, spacing more than 24 months / irregular             |
|                                                       | • have history of prolapse, placental retention and or low mothering ability     |

Provision of total dry matter feed per day, at least 3% cattle body weight, consist 40% concentrate that is composed from agricultural by-products, 30% elephant grass and 30% rice straw that available every day at feed bank, drinking water too available every day at cistern. The feed nutrient content is slightly different for each of cattle physiological status (Table 3), but it remains high in fibrous and low protein.

The parameters and data analysis:

a. penotipik performance : exterior characteristics, body weight and body size cattle (height and length body and chest circumference)

b. consumption of feed nutrients : dry matter (DM), crude protein (CP), crude fiber (CF) and total digestible nutrient (TDN)

The obtained data are presented descriptively
Table 3. Feed nutrient content (% dry matter basic) in each of physiological status of cattle.

| Agev/ Physiology of Cattle | Crude Protein | Total Digestible Nutrients | Crude Fiber |
|---------------------------|--------------|----------------------------|-------------|
| Empty Cow                 | 8 – 9        | 55 – 57                    | 20 – 22     |
| Mating, Pregnanting, Lactating | 9 – 10 | 57 – 60                    | 18 – 20     |
| Weaning – 24 months old   | 9 – 10       | 58 – 60                    | 20 – 22     |
| Candidate – Productive Bull | 10 – 12   | 58 – 60                    | 20 – 22     |

The nutrient content of feed is slightly different for each of the physiological status of cattle (Table 3), but it remains high in fibrous and low protein. The parameters and variables observed were:

a. Penotipik performance: exterior characteristics, body weight and body size of cattle (height and length body and chest circumference)

b. Consumption of feed nutrients: dry matter (BK), crude protein (PK), crude fiber (SK) and energy in the form of total digestible nutrient (TDN)

The obtained data are presented descriptively

3. Results and discussion

The new breed POGASI Agrinak cattle is formed through process selection and mating arrangement that intergenerational, tiered and continuously, in conditions of low quality feeding (low crude protein and energy content, but high crude fiber), because it is made from agricultural by-products and by-products of processing agriculture product.

![Figure 1. The stages and selection criteria for produce germ cattle as producer of new breed POGASI Agrinak cattle.](image-url)
Selection and mating arrangement are two of three (and feeds) main treatments in this study which occur alternately, sequentially and continuously from 2003 (with OC cattle screening result) until 2018 (new breed POGASI candidate). The stages and selection criteria for produce germ cattle as producer of new breed POGASI Agrinak cattle, are listed in figure 1, while selection and mating arrangement to produce candidate of new breed POGASI Agrinak cattle in figure 2.

The selection action in figure 1 is carried out to get body weight and body size calves that are higher and to avoid possibility non traits characteristics (penotypic) of OC cattle in cattle which will be produced in next generation. Specifically for bull candidate, selection is also carried out to better guarantee acquisition of bulls with libido also quality and quantity cement which is getting better. As a new breed of OC cattle, formation POGASI cattles is directed towards better body performance and productivity than OC cattles and has some specific penotipik characteristics, although it is still not much different from characteristics of OC cattle.

Each cow that passes selection will continue to be maintained, selected and arranged for mating at later stage, to be used as an elder (G1–G3) of producer "intermediate yield" of new breed POGASI cattle candidate (F2–F4). In order to produce new breed POGASI cattle (figure 2), a mating arrangement is carried out on G3 to produce F4 which if passed selection to be G4 is a new breed POGASI cattle; while for propagation of POGASI cattle, inter-G4 mating (inter-se) are arranged. After 15 years or 4 generations of continuous selection and mating arrangement, a new
breed POGASI cattle is obtained that has a unique characters/penotypic. At a glance, the new breed POGASI cattle is difficult to distinguish from OC cattle that exist in smallholder farmers, but if observed in detail POGASI have some distinctive exterior characteristics and are different from OC and Brahman cattle. The exterior appearance features between POGASI, OC and Brahman cattle, as a whole are in figure 3, while per body part in figure 4.

![Figure 3](image_url)

**Figure 3.** Overall exterior differences between BOGASI POGASI Agrinak (top) with PO cows (bottom left) and Brahman cows (bottom right).

In figure 3 it appears that body color of POGASI cattle tends to be yellowish white, while OC cattle is white to gray and Brahman cattle is gray with black in some parts of their body.

![Figure 4](image_url)

**Figure 4.** Exterior differences per body part between cow strain POGASI Agrinak (top) with PO cows (bottom left).
While from Figure 4 it appears that POGASI cattle have:
a. horns grow short but large, whereas OC cattle is elongated and smaller
b. snout color around nostrils is black, whereas in OC cattle is combination between black and white
c. hump grows moderately towards to top, whereas in OC cattle grow large towards to back
d. whip pleat are small but plentiful, whereas in OC cattle are wider and sparse
e. shape ass is not too pointy as in OC cattle

The body weight and body size of POGASI cattle at several ages, compared to non-POGASI cattle in Lolitsapi and OC cattle in farmers, the data are in table 4.

Table 4. Average performance of POGASI and non POGASI in Lolitsapi, and OC cattle at farmers.

| Penotypic                          | POGASI Cattle¹ | Non POGASI¹ | OC Cattle at Farmers² |
|-----------------------------------|----------------|-------------|-----------------------|
| Body weight (kg) at age:          | Male | Female | Male | Female | Male | Female |
| • born                            | 25.9 | 24.6   | 23.6 | 22.4   | 22.7 | 19.8   |
| • weaning 7 months                | 108.7| 108.2  | 100.1| 97.6   | 74.6 | 74.3   |
| • 12 months                       | 194.3| 141.8  | 134.8| 133.8  | 114.9| 95.9   |
| • 18 months                       | 298.6| 266.5  | 207.3| 196.5  | 147.0| 125.1  |
| • 24 months                       | 321.0| 324.9  | 291.7| 316.8  | 220.3| 216.3  |
| Hump height (cm) at age:          | 76.8 | 76.3   | 75.9 | 75.6   | 68.5 | 67.2   |
| • born                            | 104.4| 101.0  | 95.7 | 95.4   | 96.4 | 95.2   |
| • weaning 7 months                | 118.8| 116.7  | 105.8| 104.7  | 105.1| 104.2  |
| • 12 months                       | 125.1| 123.7  | 124.0| 121.4  | 120.2| 113.7  |
| • 18 months                       | 134.3| 129.2  | 128.7| 123.7  | 127.4| 123.2  |
| • 24 months                       |      |        |      |        |      |        |
| Body length (cm) at age:          | 60.1 | 56.7   | 57.8 | 54.3   | 57.4 | 56.5   |
| • born                            | 93.1 | 92.6   | 92.1 | 90.1   | 90.8 | 92.1   |
| • weaning 7 months                | 115.9| 114.9  | 97.2 | 97.0   | 97.2 | 97.2   |
| • 12 months                       | 124.3| 121.9  | 122.2| 109.8  | 114.8| 124.3  |
| • 18 months                       | 128.4| 128.1  | 125.3| 125.5  | 119.8| 125.0  |
| • 24 months                       |      |        |      |        |      |        |
| Chest circumference (cm) at age:  | 68.1 | 66.2   | 65.6 | 64.6   | 63.3 | 62.2   |
| • born                            | 114.8| 114.7  | 110.4| 113.2  | 100.3| 103.7  |
| • weaning 7 months                | 143.6| 132.6  | 140.9| 130.1  | 138.1| 123.3  |
| • 12 months                       | 154.7| 147.3  | 147.6| 140.5  | 142.6| 133.1  |
| • 18 months                       | 160.0| 156.7  | 158.1| 154.9  | 151.0| 149.2  |
| • 24 months                       |      |        |      |        |      |        |

Source: ¹ Aryogi et al [8] ² Hartati et al [9]

It appears that, body weight and body size of POGASI cattle, from birth to 24 months old, are greater/higher than non-POGASI and OC cattle in farmers. This superiority as a result of selection and mating arrangements that has been continuously carried out since the first generation (G1). As a result of selection, superiority of this POGASI cattle will be passed on to their offspring so that it is expected to improve performance of OC cattle at smallholder farmers.

The data as results observations for nutrient daily consumption of POGASI cattle in table 5. It appears that ability of young POGASI cattle is enough to consume feed with high CF but low CP and TDN; this is expected because POGASI Agrinak cattle has expected potential, which is able to maintain ideal conditions of its rumen characteristics, so there is a balance between C₂, C₃ and C₄ and its pH and NH₃ content (table 6).
Table 5. The average consumption of nutrients ration in POGASI Agrinak cattle (kg/h/d).

| Age/Physiological Status | Sex     | DM     | CP     | CF     | TDN   |
|--------------------------|---------|--------|--------|--------|-------|
| Weaning - < 12 months    | Male    | 2.86(2.2) | 0.28   | 0.64   | 1.55  |
|                          | Female  | 2.63(2.1) | 0.26   | 0.59   | 1.42  |
|                          | Average | 2.74(2.15)| 0.27   | 0.61   | 1.48  |
| 12 - < 18 months         | Male    | 4.93(2.9) | 0.48   | 1.21   | 2.64  |
|                          | Female  | 4.05(2.7) | 0.39   | 1.00   | 2.17  |
|                          | Average | 4.49(2.80)| 0.43   | 1.10   | 2.40  |
| 18 - < 24 months         | Male    | 7.17(3.1) | 0.82   | 2.65   | 4.06  |
|                          | Female  | 7.14(3.0) | 0.83   | 2.50   | 3.90  |
|                          | Average | 7.15(3.05)| 0.82   | 2.57   | 3.98  |
| ≥ 24 months              | Male    | 9.48(3.3) | 1.06   | 3.25   | 5.22  |
|                          | Female  | 8.80(3.1) | 0.96   | 2.70   | 4.78  |
|                          | Average | 9.14(3.20)| 1.01   | 2.97   | 5.00  |

DM = dry matter; CP = crude protein; CF = crude fiber; TDN = energy: number in parentheses is % DM intake of ration over body weight.

Table 6. Rumen characteristics of POGASI Agrinak cattle.

| Age        | pH    | NH3 (mg/l) | C2 (%) | C3 (%) | C4 (%) | C2C3 (%) |
|------------|-------|------------|--------|--------|--------|----------|
| Weaning    | 6.91  | 81.60      | 60.26  | 23.58  | 16.10  | 2.85     |
| Young male | 6.42  | 158.50     | 72.07  | 15.72  | 12.19  | 4.73     |
| Young female | 6.45 | -          | 69.18  | 16.17  | 16.64  | 4.72     |

Source: Maryono et al [10]

4. Conclusion
Based on the research results, it can be concluded that selection treatment, mating management, and feeding based on agricultural byproducts that contain high crude fiber, low crude protein and energy, have formed new breed cattle which more efficient at feed nutrients using, so it has potential to be developed in marginal areas where availability of feed is usually limited in quality and quantity.

References
[1] Frahm R R 1998 Systems of Crossbreeding OSU Extension Facts no 3151
[2] Hammack S P 1998 Sire types for commercial beef herds Agrc. Communications The Texas A and M University System
[3] Aryogi 2005 Kemungkinan terjadinya interaksi antara genetik dengan lingkungan terhadap performans sapi Peranakan Ongole silangan Tesis (Yogyakarta: Sekolah Pascasarjana, Fak. Peternakan Universitas Gadjah Mada)
[4] Aryogi, E Baliarti, Sumadi and Kustono 2013 Pengaruh genotip Bos taurus terhadap performans fisiologi dan reproduksi sapi silangan Simpo dan Limpo induk di dataran rendah Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner 2013
[5] Aryogi, D Pamungkas, L Affandhy, Mariyono, YN Anggraeny, M Luthfi, DM Dikman and Y Adinata 2018 Proposal usulan pelepasan rumpun baru sapi POGASI Agrinak (Jakarta: Lolitsapi, Puslitbangnak, Kementan)
[6] Hardjosubroto W 1994 Aplikasi pemulaiakan ternak di lapangan (Jakarta: PT Grasindo)
[7] Rasyid A, J Efendy and Mariyono 2012 Sistem pembibitan sapi potong dengan kandang kelompok “Model Litbangtan” (Jakarta: IAARD Press Badan Penelitian dan Pengembangan Pertanian)

[8] Aryogi, Y Adinata, D Pamungkas, J Effendy, Y Widyaningrum and Hartati 2017 Pemantapan galur baru sapi potong lokal Lap. Akhir Penelitian Lap. Akhir Penelitian (Pasuruan: Loka Penelitian Sapi Potong)

[9] Hartati, Sumadi, Subandriyo and T Hartatik 2010 Keragaman morfologi dan diferensiasi genetik sapi Peranakan Ongole di peternakan rakyat Jurnal Ilmu Ternak dan Veteriner (Bogor: Puslitbangnak, Kementan) 15 (1) 72 – 80

[10] Mariyono, A Rasyid, Y N Anggraeni, N H Krishna and T A Sulistyam 2015 Pakan sapi potong berbasis limbah pertanian dan perkebunan ramah lingkungan : Kadar serat optimal pada pakan protein rendah, mendukung pertambahan botot badan harian lebih besar 0.70 kg dan kualitas semen normal untuk sapi jantan muda Lap. Akhir Penelitian (Pasuruan: Loka Penelitian Sapi Potong)