Research Article

Simulation of Population Growth and Estimation of Breeding Parameters for Kejobong Goats in Purbalingga Regency, Indonesia

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Abstract | This study aimed to simulate population growth and estimate breeding parameters of Kejobong goats in Purbalingga Regency, Central Java, Indonesia. Population data were obtained from the Agriculture Office of Purbalingga Regency analyzed using a simulation model with technical coefficients derived from the literature. The parameters observed included birth rate, mortality, and selection ratios at different growth stages. The simulated population increased from 58,336 heads in 2024 to 131,254 heads in 2028, representing a cumulative increase of 125% over five years, with an average annual growth rate of approximately 18%. The average Natural Increase (NI) was 38.74%, categorized as high. The Net Replacement Rate (NRR) reached 319.2% for males and 211.80% for females. The total projected output over five years was 131,254 heads, with culling rates of 7.63% for males and 9.43% for females in 2028. These findings demonstrate the strong potential of Purbalingga Regency as a breeding source for Kejobong goats. However, optimization requires improved management of female populations, strategic selection, and sustainable breeding programs. Such measures are essential to ensure productivity, support local livestock development, and conserve this valuable genetic resource.

Keywords | Breeding estimation, Genetic conservation, Kejobong goat, Population dynamics, Simulation

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INTRODUCTION

The Kejobong goat is a local livestock breed originating from Purbalingga Regency, Central Java Province, Indonesia (Candrasari *et al*., 2023), and has been officially designated as one of Indonesia's local livestock genetic resources (germplasm) through the Decree of the Minister of Agriculture No. 301/Kpts/SR.120/5/2017. A distinguishing characteristic of this breed is its predominantly black coat color (Rizky *et al*., 2020). This breed is recognized for its advantageous traits, including high growth rate, superior carcass quality, and strong reproductive performance (Febriana *et al*., 2017). Recent studies confirm these advantages, reporting significant correlations between age and body weight in both males and females, and higher carcass yield when goats are fed diets with improved protein levels (Purnami *et al*., 2021; Purbowati and Rianto, 2024). Moreover, its high prolificacy, reflected by an average litter size ranging from 1.6 to 1.9 kids per kidding, indicates a strong tendency for twin and multiple births that significantly contribute to population growth (Lestari *et al*., 2020). Despite these favorable traits, population management remains suboptimal, as most Kejobong goats are reared under traditional systems with limited breeding control. The population development of Kejobong goats in Purbalingga Regency has been constrained by several issues, particularly the lack of accurate and continuous information on population size and structure over previous years. Recent efforts to improve data collection have provided updated records. The population of Kejobong goats reached 58,336 heads, reflecting the region's strong potential to further develop and expand its local livestock population. Therefore, strategic measures are necessary to preserve its genetic purity and ensure sustainable development under local agroecosystem condition. Regular evaluations of Kejobong goat development programs are essential to support long-term population stability and sustainability (Yendraliza *et al*., 2021).

A comprehensive assessment of the Kejobong goat population dynamics is crucial for formulating effective breeding and conservation strategies in Purbalingga Regency. Comparable initiatives have been implemented in other countries, for example: Ukraine has commenced initiatives to conserve its livestock genetic resources (Yevdekimova *et al*., 2019), whereas India utilizes population dynamics analysis to comprehend patterns in livestock sustainability and growth (Dinesh *et al*., 2023). In Indonesia, several studies have applied comparable approaches, such as Aceh cattle (Widyaningrum *et al*., 2021), Ongole crossbred cattle (Kusuma *et al*., 2017), and Etawah Crossbreed goats (Sumadi, 2001). However, no study has specifically analyzed the population dynamics and breeding potential of Kejobong goats in Purbalingga Regency, Central Java Province, Indonesia. This knowledge gap highlights the importance of investigating population changes and reproductive indicators to support sustainable breeding and genetic conservation efforts.

Time series analysis is commonly applied to estimate livestock population dynamics (Widyaningrum *et al*., 2021), but this approach mainly projects total population growth without estimating key production indicators such as birth rates, mortality, or livestock output (Widianingrum and Khasanah, 2021). To overcome these limitations, population development simulation can be used as a more detailed approach that integrates technical parameters such as birth rate, culling, and mortality to simulate population growth accurately. Breeding parameters such as NI, NRR, and livestock output are also essential for evaluating reproductive performance and guiding population management. Therefore, this study aims to simulate population growth and estimate breeding parameters of Kejobong goats in Purbalingga Regency to support sustainable livestock development and conservation programs.

MATERIALS AND METHODS

The research was conducted in Purbalingga Regency, Central Java Province, Indonesia. The data used in this study consisted of secondary data from 2024 on the number and structure of the Kejobong goat population obtained from the Agriculture Office of Purbalingga Regency as this represents the most recent and complete dataset available and presented in Table 1. The parameters were as follows: birth rate 150% and sex ratio 1:1 (Rusdiana and Adiati, 2021; Adhianto *et al*. 2019). Pre-weaning mortality 5% and post-weaning mortality 2% (Chauhan *et al*., 2019). Selection rates of 50% for males and 90% for females, with a mating ratio of 1:20 (ILRI, 2013).

Table 1: Population structure of Kejobong goats in Purbalingga Regency in 2024.

Population structure	Number (heads)
Buck	12,367
Doe	15,051
Buckling	8,109
Doeling	9,911
kid male	5,606
kid female	7,292
Total	58,336

Source: Agriculture Office of Purbalingga Regency.

Data collection

The collected data included the population and structure of the Kejobong goat population from records of the Agriculture Office of Purbalingga Regency. Technical coefficients were based on literature sources (Figure 1). These coefficients were used due to the lack of comprehensive recording data in local farms.

Data analysis

The secondary data and technical coefficients obtained were used to predict the goat population from 2024 to 2028 using the number population simulation formula (Figure 2), and to calculate breeding parameters, including NI, NRR, and output (Figure 3). The data were subsequently simulated using formulas implemented in Microsoft Excel.

RESULTS AND DISCUSSION

Population growth simulation

Table 1 presents the population structure of Kejobong goats in Purbalingga Regency in 2024, totaling 58,336 heads, consisting of 21.2% buck, 25.8% doe, 13.9% buckling, 16.99% doeling, 9.61% kid male and 12.5% kid female.

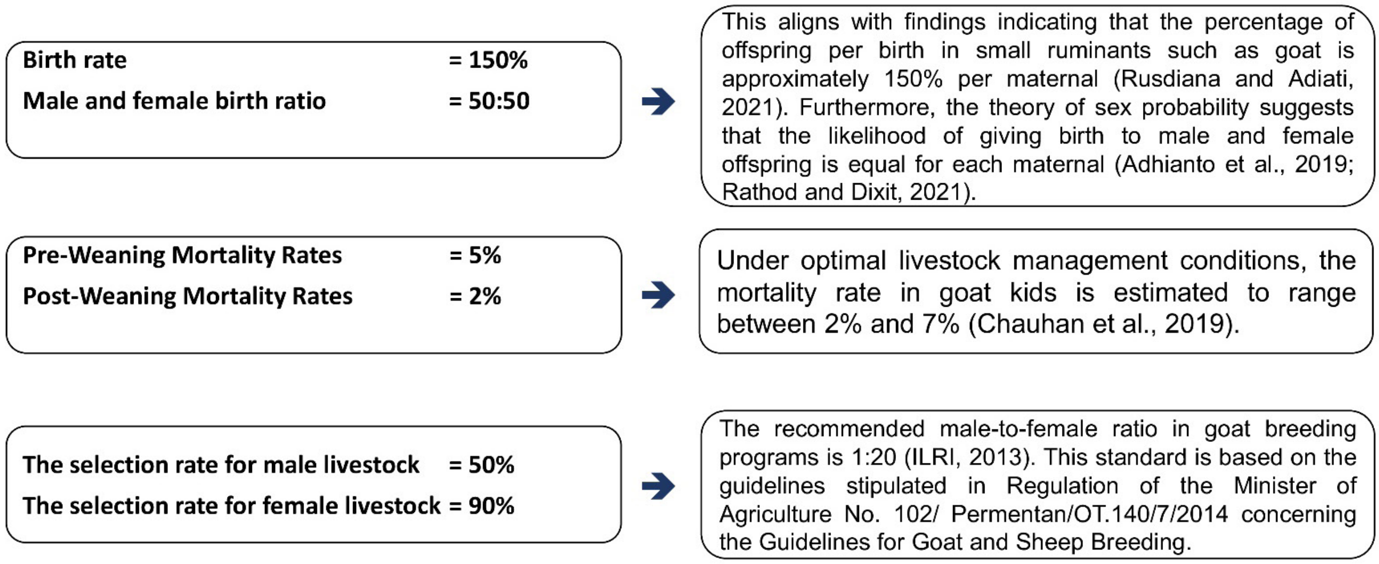

Figure 1: Technical coefficients of population growth simulation.

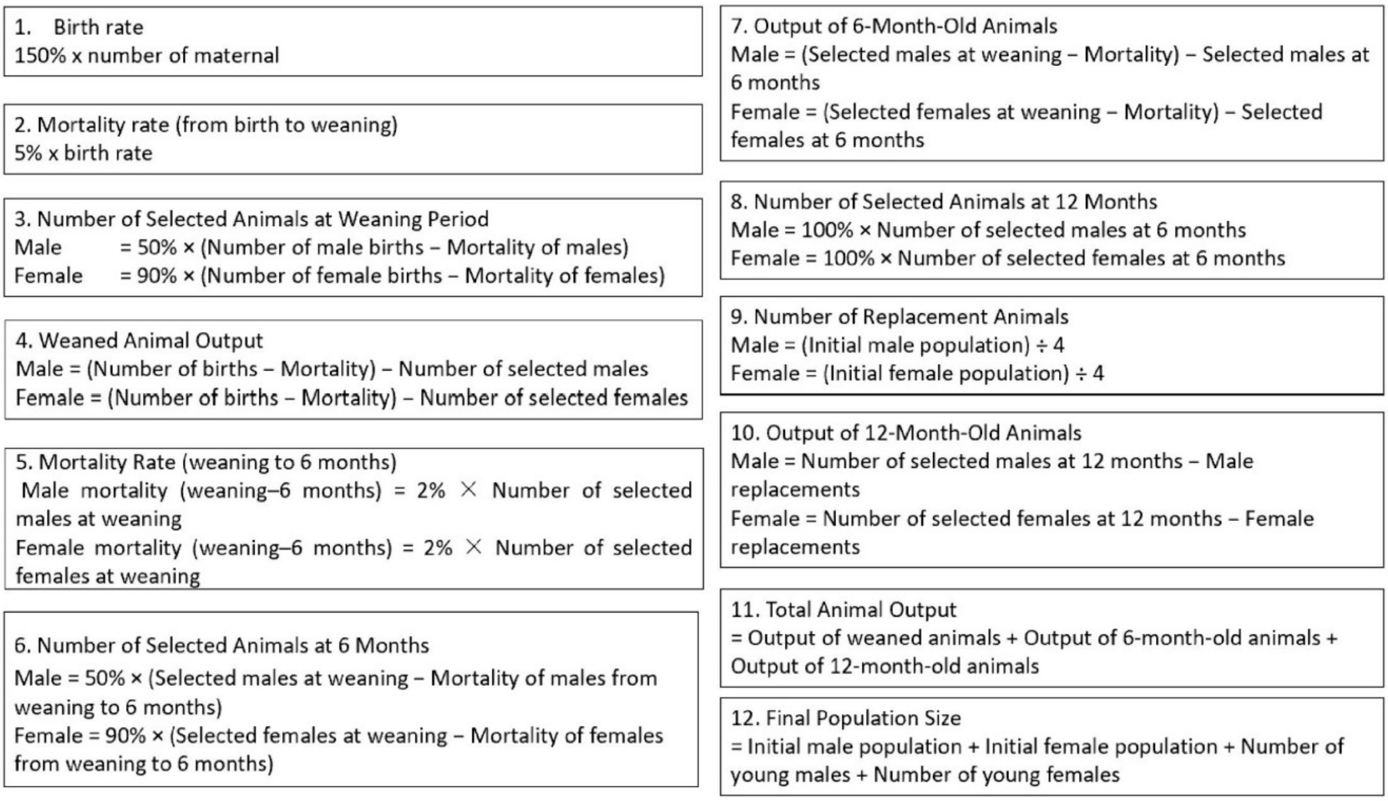

Figure 2: Population development simulation calculation formula.

The goats is primarily raised for breeding, resulting in a higher proportion of doe compared to buck. Table 2 showed that the simulated population increased from 58,336 heads in 2024 to 131,254 heads in 2028, representing a total rise of 125% with an average annual growth rate of approximately 18%.

The simulation results indicate that population dynamics are influenced by parameter such as birth rate (150%), mortality (5% at pre weaning) and 2% at (post weaning). The number of goats available for replacement or culling is determined by maintaining a balance between births, mortality, and selection. Population reduction through culling and mortality, together with population growth through births and livestock inflow, determine the overall population trend. Similar to the findings of Kulyk *et al.* (2023), the simulation results indicate that improving reproductive performance and reducing mortality can substantially contribute to population expansion. However, unlike the controlled production systems described by Kulyk *et al.* (2023) the Kejobong goat population is maintained under smallholder conditions, where traditional management

Natural increase

Birth rate=$\frac{\text{Number of birth each year}}{\text{Average population a year}} x100\%$

Mortality rate=$\frac{\text{Number of mortality a year}}{\text{Average population a year}} x100\%$

Natural increase = Birth rate - Mortality rate

Net replacement rate

The length of time to use the elders (year)= maximum of old to breeding (year) – first mating old (year)

Replacement stock needs (%)=$\left[\frac{\left(\frac{\text{number of adult}}{\text{population}}\right) x \text{ mortality rate}}{\text{the length of time to use the elder (year)}}\right] x100\%$

Net replacement rate (%)=$\left[\frac{\text{NI}}{\text{replacement stock needs}}\right] x100\%$

Output

Remaining replacement stock of male goat(%)
= male NI (%) – male replacement need (%)
Remaining replacement stock of female goat(%)
= female NI (%) – female replacement needs (%)
Culled male goat(%)
= male replacement need (%)
Culled female goat(%)
= female replacement needs (%)
Total output (%)
= The number of remaining replacement stock of male(%) + The number of remaining replacement stock of female(%) + culled male(%) + culled female(%)

Figure 3: Breeding estimation calculation formula.

Table 2: Population development simulation of Kejobong Goat (2024 – 2028) in Purbalingga Regency.

Year	Sex	Start of year population	Births (150%)	Deaths (5%)	Weaning		Death (2%)	Age 6 months		Age 12 months			End of year population (g)
					selected (a)	Culled (b)		Selected(c)	Culled (d)	Selected (100%)	Replacement (e)	Culled (f)	
2024	M	26082	24190	1210	11490	11490	229	5631	5631	5631	6520	-889	32602
	F	32254	24191	1209	20684	2298	414	18243	2027	2080	8064	10179	40318
	Total												72920
2025	M	32602	30238	1512	14363	14363	287	6895	7182	6895	6520	375	39122
	F	40318	30238	1512	25854	2873	517	22751	2585	22751	8064	14688	48381
	Total												87503
2026	M	39122	36286	1815	17235	17235	345	8273	8618	8273	6520	1753	45642
	F	48381	36286	1814	31025	3447	620	27301	3103	27301	8064	19237	56445
	Total												102087
2027	M	45642	42334	2116	20109	20109	402	9652	10054	9652	6520	3132	52162
	F	56445	42334	2117	36195	4022	724	31852	3620	31852	8064	23788	64509
	Total												116671
2028	M	52162	48381	2420	22981	22981	460	11031	11490	11031	6520	4511	58682
		64509	48382	2419	41366	4597	827	36402	4136	36402	8064	28339	72572
	Total												131254

Selected male goats at weaning are calculated as 50% of (number of male births number of deaths from birth to weaning). Selected female goats at weaning are calculated as 90% of (number of female births number of deaths from birth to weaning). Goats culling (output) during the weaning period are calculated as (number of births number of deaths from birth to weaning number of goats selected at weaning). Selected male goats at 6 months of age are calculated as 50% of (number of male goats selected at weaning number of deaths from weaning to 6 months). Selected female goats at weaning are calculated as 90% of (number of female births number of deaths from birth to weaning). Goats culling (output) during the 6-month period are calculated as (number of births number of deaths from birth to weaning number of goats selected at weaning). The number of replacement male goats is calculated as the number of male goats at the start of the year divided by 4. The number of replacement female goats is calculated as the number of female goats at the start of the year divided by 4. Goats culling (output) at 12 months are calculated as (number of goats selected at 12 months number of replacement goats). End-of-year male goat population is calculated as the number of male goats at the beginning of the year + number of replacement male goats. End-of-year female goat population is calculated as the number of female goats at the end of the year + number of replacement female goats.

limits the rate of improvement. This highlights the importance of targeted breeding and management interventions to achieve similar productivity gains at the local level. The population trend of Kejobong goats in Purbalingga Regency corresponds with the Ministry of Agriculture Regulation Number 101/Permentan/OT.140/7/2014 concerning Good Breeding Practices, emphasizing effective management and maintenance of local breed. Furthermore, sufficient infrastructure, including land availability, housing systems, and supporting facilities, also plays a vital role in supporting population development. Several farmer groups in Purbalingga Regency maintain permanent housing systems with good management practices. Farmers have access to forage areas or purchase feed from crop farmers and apply animal health management based on Good Breeding Practices (GBP) in collaboration with village facilitators. Some groups still show limited feeding management, particularly for pregnant and lactating does, resulting in high pre-weaning kid mortality approximately 10% especially among twins due to insufficient milk supply. Similar patterns have been reported in other local goat populations, where limited feed availability and unbalanced management reduced reproductive efficiency (Yusriani and Allaily, 2022). In contrast, improvements in feeding and health management were shown to enhance kidding rates and reduce pre-weaning mortality (Alem and Aklilu, 2025). These findings support the need to strengthen nutritional management for breeding does in Purbalingga to maximize the high reproductive potential observed in Kejobong goats. Moreover, Harmoko *et al.* (2022) emphasized the importance of applying systematic selection and recording programs to ensure that local genetic resources are utilized efficiently. This aligns with the present simulation results, which suggest that proper selection intensity and replacement strategies can sustain population growth while maintaining genetic quality. The rising population indicates that the farmers' breeding methods were successfully implemented. Socioeconomic conditions, feed limitations, and reproductive inefficiencies still influence population stability. The simulations demonstrate the importance of controlling breeding management to optimize the number of births, deaths, and replacement rates, ensuring population dynamics. This situation aligns with the viewpoint of Harmoko *et al.* (2022), who emphasized the significance of population component balance as a key factor in livestock system sustainability.

As mortality rate impacts the population size, the early life stage of goat kids is the most vulnerable time. This is evidenced by the high mortality rate of kids before weaning compared to after weaning (Harmoko *et al.*, 2022). Disease outbreaks and a shortage of maternal milk are the leading causes of death for Kejobong goat offspring during this stage. Furthermore, the livestock output calculation in 2024 displayed a negative value of -889, which was attributed to the inadequate livestock requirements for replacement stock in the first year. The negative output (889 heads) in 2024 reflects a short-term adjustment phase when mortality and culling exceeded births as the population structure stabilized. This early imbalance is also influenced by smallholder management behavior, where breeding males are often sold when farmers need cash, resulting in a shorter utilization period and a temporary reduction in reproductive output. Such behavior is common in smallholder goat systems, where livestock function both as productive assets and financial reserves (Suhartina *et al.*, 2017; Rivai *et al.*, 2025). The output value is expected to become positive once breeding males are retained longer and reproductive turnover stabilizes. Extending the utilization period of breeding males can therefore enhance reproductive continuity and improve long-term population sustainability under smallholder conditions (Figueredo *et al.*, 2023). According to the simulation, selection was carried out at 6 months of age, with a proportion of 50% for kid male and 90% for kid female (Table 2). While kid male are typically sold as soon as they are weaned, traditional farmers prefer to retain kid female as possible breedstock. Kusuma *et al.* (2017) found that farmers typically retain a larger percentage of female livestock for breeding purposes, whereas only a small percentage of male livestock is kept for breeding.

Natural increase

This study utilized population growth simulation data to analyze the Natural Increase (NI) of the Kejobong goat population in Purbalingga Regency (Table 3). The NI was calculated using livestock population data, birth rates, and death rates over a one-year period, where NI represents the difference between the birth and death rates (Guntoro *et al.*, 2023). These indicators are widely used to assess livestock production performance (Kgosikoma and Batisani, 2014).

The average NI over five years was 38.74%, indicating strong reproductive potential. Although this figure is lower than that of the PE goat (55.04%) (Sumadi, 2001), it surpasses the Lakor goat (22.13%) (Harmoko *et al.*, 2022), highlighting inter-breed differences influenced by reproductive and mortality dynamics. These findings are consistent with Teni *et al.* (2021), who emphasized that NI is shaped by both birth and death rates. The consistently higher birth rate compared to the death rate in Kejobong goats supports optimal population growth (Sumadi *et al.*, 2004). The NI value in the first year also provides a baseline for evaluating breeding management in subsequent years (Budiarto *et al.*, 2013).

Table 3: Estimated Natural Increase (NI) of Kejobong Goats (2024–2028) in Purbalingga Regency.

Variable	Year					Annual average	Category
	2024	2025	2026	2027	2028		
Birth relative to population (heads)	48381	60476	72572	84668	96763	72572	
Birth relative to population (%)	39.89	40.87	41.55	42.05	42.44	41.36	
Death relative to population (heads)	3062	3828	4594	5359	6126	4596	
Death relative to population (%)	2.52	2.59	2.63	2.66	2.69	2.62	
NI	37.37	38.28	38.92	39.39	39.75	38.74	High
12 months NI for males (%)	18.69	19.14	19.46	19.70	19.88	19.372	High
12 months NI for females (%)	18.69	19.14	19.46	19.70	19.88	19.372	High

Notes: NI category thresholds were derived by dividing the range between the minimum and maximum NI values into three equal intervals. Low NI = 0 – 8.86, Medium NI = 8.87 – 17.73, High NI = 17.74 – 26.59.

Table 4: Simulation Results of Net Replacement Rate (NRR) for Kejobong Goats (2024–2028) in Purbalingga Regency.

No	Variable	Year					Average
		2024	2025	2026	2027	2028	
1	Replacement male requirement (%)	7.17	7.34	7.47	7.56	7.63	7.34
2	Availability of males (%)	18.69	19.14	19.46	19.70	19.88	19.37
3	Male NRR (%)	260.67	260.76	260.63	260.70	260.66	260.68
4	Replacement female requirement (%)	8.86	9.08	9.23	9.34	9.43	9.18
5	Availability of females (%)	18.69	19.14	19.46	19.70	19.88	19.37
6	Female NRR (%)	210.95	210.79	210.76	210.85	210.82	210.83

A high NI reflects favorable demographic conditions, characterized by low mortality, high birth rate, and sufficient numbers of breeding females (Oktafiana *et al*., 2021). Kejobong goats are known for their twinning ability, which enhances population growth. According to Widyaningrum et al. (2021), reproductive success and early offspring survival are key contributors to NI. In this study, NI categories were defined based on the proportion of breeding females: low (0–8.86%), medium (8.87–17.73%), and high (17.74–26.59%). With an NI of 38.74%, the Kejobong goat population clearly exceeds the high category threshold. Contributing factors include a high birth rate, favorable genetics, and low mortality due to improved management practices, particularly in feeding, housing hygiene, and health care. Reduced mortality, especially among pre-weaning kids, enhances survival rates and supports population regeneration. Furthermore, maintaining a sufficient number of productive females through selection strategies such as retaining female kids and marketing males ensures the continuity of breeding. Sociocultural practices also contribute to sustainability, as traditional farmers in Purbalingga possess valuable experience and local knowledge in managing Kejobong goats.

In summary, the high NI observed is the result of synergistic factors, including genetic potential, enhanced husbandry practices, and farmer awareness. The high NI value obtained in this study indicates that the Kejobong goat population in Purbalingga Regency has a strong potential for sustainable reproduction and population growth. This finding can serve as a foundation for developing practical breeding and conservation strategies at the local level. Selective retention of productive and fertile females is recommended to maintain population stability and ensure a continuous supply of breeding stock. Proper culling management targeting unproductive animals will help improve breed quality and reproductive efficiency. Local government support in promoting recording systems and controlled mating through community-based breeding programs would enhance genetic improvement and prevent inbreeding. The integration of these strategies into existing local breeding programs could strengthen the long-term sustainability of the Kejobong goat population. Similar approaches have been effectively applied in indigenous goat breeding schemes in Ethiopia (Kaumbata *et al*., 2021) and could be adapted to the conditions in Purbalingga Regency.

Net replacement rate (NRR)

The Net Replacement Rate (NRR) is a key indicator used to determine the number of replacement animals required in a population to maintain stability. The NRR is calculated by dividing the number of available breeding animals by the number of animals needed for replacement, and then multiplying the result by 100% (Sumadi, 2001). Estimates of male and female NRR values for the Kejobong goat population in Purbalingga Regency during the period 2024–2028 were obtained from the population development simulation study (Table 2; Table 4). The results indicate that the average male NRR is 260.68%, while the average female NRR is 210.83%. These values, both of which exceed 100%, suggest that the Kejobong goat population is more than adequately equipped to meet the annual replacement requirements for culled or deceased breeding stock.

In particular, the high male NRR indicates a surplus of male offspring, even though most are sold after weaning, which exceeds the number required to sustain the male segment of the breeding population. Similarly, the elevated female NRR demonstrates that the population of productive females is sufficient not only to ensure population stability but also to support potential population growth. If the estimated NRR values remain consistent over the five-year projection period, the reproductive system is expected to remain stable, thereby ensuring the sustainability of the Kejobong goat population in Purbalingga Regency.

Natural Increase and the demand for replacement livestock in a given area significantly influence the Net Replacement Rate (NRR). One key factor affecting the need for replacement stock is the duration of productive use of the livestock. As stated by Sumadi *et al.* (2004), a shorter utilization period leads to a higher demand for replacement animals, whereas a longer utilization period results in a lower demand. The estimated male and female NRR values for Kejobong goats in Purbalingga Regency, both exceeding 100%, indicate that this region has strong reproductive potential and the capacity to adequately supply replacement breeding stock. This suggests that the population is capable of sustaining and even expanding under appropriate management practices. However, this potential requires careful regulation, as the area is being developed as a breeding center. The applied selection rate of 50% for males and 90% for females is designed to maintain genetic quality while preventing overpopulation. Implementing strategic selection and controlled distribution of breeding stock will ensure sustainable population growth and effective utilization of local genetic resources (Figueredo *et al.*, 2023). According to Samberi *et al.* (2010), the NRR can serve as an indicator of whether the birth rate in a given population is sufficient to meet replacement needs and thus maintain population stability. An NRR value below 100% suggests that replacement needs are not being met, while a value above 100% indicates that replacement requirements are fulfilled and the population is self-sustaining.

Estimating output

Output refers to the capacity of a region to produce replacement stock and cull animals without disrupting the stability of the local livestock population. It is typically measured by the number of animals that can be removed annually while maintaining population equilibrium. According to Anggraini *et al.* (2016), estimating livestock output is a critical initial step in preventing the extinction of livestock populations within a given area. Output is calculated as the sum of animals available for harvesting each year and the remaining replacement stock. Table 5 presents the projected total annual output of Kejobong goats in Purbalingga Regency for the period 2024–2028.

Based on the data in Table 5 , a total of 131,254 Kejobong goats are projected to be produced over five years. Based on the data in Table 5 , a total of 131,254 Kejobong goats are projected to be produced over five years. The average replacement rate for males is 11.94%, remaining safely below the maximum threshold of 50%, while that for females is 10.18%, approaching the critical threshold of 10%. The threshold values of 50% for males and 10% for females

Table 5: Estimated output results.

Variable	Year				
	2024	**2025**	**2026**	**2027**	**2028**
Culled livestock					
Male (heads)	8693.24	10861.73	13041.21	15214.52	17390.17
Male (%)	7.17	7.34	7.47	7.56	7.63
Female (heads)	10751.31	13436.58	16126.85	18811.77	21502.10
Female (%)	8.86	9.08	9.23	9.34	9.43
Remaining replacement stock					
Male (heads)	13977.92	17461.64	20947.44	24449.27	27939.81
Male (%)	11.52	11.80	11.99	12.14	12.25
Female (heads)	11919.84	14886.79	17861.79	20852.01	23827.88
Female (%)	9.83	10.06	10.23	10.36	10.45
Total Output (heads)	45342	56647	67977	79328	90660
Total Output (%)	37.38	38.28	38.92	39.40	39.76

were derived from the technical coefficients applied in the simulation model, reflecting the selection rates used in the breeding program 50% of males and 90% of females are retained for breeding, while the rest are marketed or culled. This approach represents a practical smallholder strategy aimed at maintaining population stability and optimizing breeding potential (Figueredo *et al*., 2023). Although the female NRR values (>210%) indicate strong reproductive potential, this does not contradict the low replacement rate observed. The NRR represents the capacity to produce replacement stock, whereas the replacement rate (output) denotes the proportion of breeding females actually removed from the population. Under the applied 90% female retention policy, a high NRR can coexist with a low replacement rate, ensuring sustainable population growth and efficient utilization of genetic resources. Monitoring female turnover and adjusting retention or culling intensity, such as through the targeted removal of unproductive females, will further align replacement surplus with long-term breeding objectives (Figueredo *et al*., 2023). To avoid future shortages of productive breeding females, the Purbalingga Regency government should implement careful population management strategies. Sustaining the Kejobong goat population as a valuable genetic resource requires close monitoring of female turnover and reinforcement of breeding and conservation programs.

The Natural Increase (NI), which represents the net population growth rate over a one-year period, significantly affects output potential. Higher NI values enhance output, defined as the region's capacity to provide animals for harvest after meeting replacement and culling needs. This finding aligns with Sumadi (2001), who reported a proportional relationship between NI and output. Additionally, several factors influence regional livestock output, including mating patterns, breeding systems, age at first mating, duration of reproductive use (based on maximum age limits), mortality rates, the proportion of adult animals in the population, as well as the NI and Net Replacement Rate (NRR) values.

Simulation and estimation of breeding parameters indicate that the Kejobong goat population in Purbalingga Regency has strong reproductive potential (NI= 38.74%; NRR= 319.2% for males and 211.8% for females), confirming its suitability as a sustainable breeding resource. The results can guide local breeding policies through selective retention of productive females, controlled culling, and structured breeding programs. The study utilized secondary data from the 2024 dataset with fixed assumptions for birth, mortality, and selection rates due to limited field validation, which may slightly affect precision but not the overall interpretation of the results.

CONCLUSION

The simulation results from 2024 to 2028 demonstrate strong population growth of Kejobong goats in Purbalingga, supported by a high natural increase and a high replacement production capacity. These findings confirm the region's potential as a breeding center for this valuable local genetic resource. To optimize this potential, strengthening the female breeding population and implementing strategic management are essential. The simulation indicates a surplus replacement capacity (NRR >100%), however, because 90% of female offspring are retained for breeding, only small proportion are removed from population. This retention policy results in female output levels approaching the operational threshold. Sustainable development will require improved reproductive management, better husbandry systems, and supportive regional policies to ensure both productivity and genetic conservation. Future studies should integrate molecular genetics and socio-economic analyses to provide a more comprehensive foundation for long-term breeding strategies.

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NOVELTY STATEMENT

The novelty of this study lies in providing the first simulation of population growth and estimation of key breeding parameters (NI, NRR, and output) for Kejobong goats in Purbalingga Regency, offering essential insights for evaluating population sustainability and guiding local breeding program development.

AUTHOR'S CONTRIBUTION

DPC developed the research design, collected and analyzed data, and produced the manuscript. DM examined the data, gave the concept, and authored the manuscript. Panjono reviewed the manuscript. All authors were responsible for reviewing and approving the final manuscript.

Ethical approval

The Faculty of Veterinary Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia approved this experimental work (Approval Number: 148/EC-FKH/int/2024).

Generative AI and AI-assisted technology statement

Generative AI and AI-assisted tools were used to improve the clarity, grammar, and readability of the English language in the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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