

Assessment of Productive Performance, Morphological Characteristics, and Socioeconomic Impacts of Rabbit (*Oryctolagus cuniculus*) Farming in Carcar City, Philippines: Contributions to SDGs

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Abstract: This study characterized the phenotypic traits, morphometric parameters, and production profile of domestic rabbits (*Oryctolagus cuniculus*) across 13 barangays in Carcar City, Cebu, to establish baseline data supporting the development and sustainability of the local rabbit industry, aligned with Sustainable Development Goals (SDGs) 1, 2, and 15. Data were collected from February to April 2025 through structured interviews and direct measurements of 203 rabbit specimens and 40 raisers, and descriptive statistics and correlation analyses were performed following standard FAO protocols. Results revealed that New Zealand White is the dominant breed, followed by Californian and Chinchilla, while other breeds exist in small numbers for hobby or niche purposes. Phenotypically, the population is characterized by predominantly solid coat colors, long and narrow ears, straight facial and nasal profiles, compact or commercial body types, smooth coats, and red eyes. Most individuals exhibited a moderately docile temperament, with an average of 8.39 teats and narrow foot pads. Morphometric measurements showed low variability in most structural traits, indicating a stable, locally adapted population, though high variation in body length and heart girth reflected differences in management and nutrition. Statistical analysis showed no significant sexual dimorphism, suggesting uniform growth patterns between sexes. Management factors, such as the source of stock and rearing purpose, significantly influenced phenotypic expression. These findings highlight limited genetic diversity and gaps in record-keeping and technical practices. The study recommends implementing standardized management, improved breeding programs, and enhanced extension services to strengthen productivity, ensure genetic conservation, and support sustainable livelihoods in the region.

Keywords: Phenotypic Characterization, Morphometric Traits, Genetic Diversity, Descriptive-Correlational Study, Breeds Rabbit.

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I. INTRODUCTION

A growing need for sustainable food sources confronts the Philippines amid rapid population growth. With rapid population growth projected to reach 142 million by 2045 (Philippine Statistics Authority, 2015), the Philippines faces mounting pressure to expand livestock production and meet

rising demand for animal protein—an issue central to SDG 2: Zero Hunger (United Nations, 2015). Rabbit farming offers a viable, cost-effective solution to help close this dietary gap, while also supporting SDG 1: No Poverty and SDG 3: Good Health and Well-being by generating income and improving nutrition, particularly in areas such as Carcar City. Introduced decades ago by missionaries and the Peace Corps to address

post-war food shortages (Medenilla, 2021; Veneracion, 2017), rabbit production has grown in popularity, reflecting global trends and aligning with SDG 12: Responsible Consumption and Production through its efficient use of resources (United Nations, 2015). For rural households, it enhances food security and economic stability (Khatun et al., 2016). As of July 2024, the national inventory stood at 194,849 head, with Central Visayas contributing only 0.89 % and stocks concentrated in Cebu, Bohol, and Negros Oriental (OpenSTAT, 2024). The sector remains volatile, however: output fell 15 % in 2023 to 155,030 kg amid shifting demand (Philippine Statistics Authority, 2015), despite heightened interest during the pandemic and African Swine Fever outbreaks, when the Department of Agriculture promoted rabbit meat as a safe alternative protein source (The Philippine Star, 2024).

Biologically and practically, rabbits are uniquely suited to sustainable farming—fast-growing, highly reproductive, early-maturing, feed-efficient, and space-saving, without competing with humans for crops, thus supporting SDG 2 and SDG 15: Life on Land (FAO, 2007; United Nations, 2015). Nutritionally, their meat is high-quality, low in cholesterol, and rich in essential amino acids, minerals, and B-complex vitamins; the USDA recognizes it as heart-healthy and serves both dietary and public health goals (Dalle Zotte, 2014; Veneracion, 2017). Nonetheless, its full potential is underexploited: participation and production remain low, and research lags far behind that of poultry or swine (Ogbonna, 2015; McNitt et al., 2013). To advance SDG 8: Decent Work and Economic Growth, barriers such as weak supply chains, limited technical training, and poor extension support must be addressed, alongside improved access to inputs, education, and market infrastructure (Serem et al., 2013; Sylvester et al., 2014; Tembachako & Mrema, 2016).

This study, Phenotypic Characterization of Rabbit..., aims to fill critical knowledge gaps regarding local genetic resources, breeding, and management in Carcar City, where systematic documentation of breeds, traits, and practices is lacking. Generating baseline data will inform research, breeding strategies, and policy in line with SDG 2.4 on sustainable agricultural systems (United Nations, 2015). While rabbit meat is widely accepted globally, adoption in the Philippines is still emerging, and no comprehensive profile of farmers, production models, or marketing channels exists. By characterizing local populations, documenting practices, analysing value chains, and identifying constraints and opportunities, this work seeks to strengthen the scientific basis of the industry, guide investment, and unlock rabbit farming's role as a sustainable, inclusive, and nutritious food source that aligns with national development priorities and the United Nations 2030 Agenda.

II. MATERIALS AND METHODS

➤ Study Area

Data for this study were gathered from both primary and secondary sources to ensure a thorough evaluation of the rabbit industry in Carcar City. Primary information was obtained through structured interviews with 40 raisers across

13 barangays, covering breeding, feeding, and health management, as well as direct morphometric measurements from 203 *Oryctolagus cuniculus* specimens. Secondary materials included peer reviewed journals, prior research, and animal science textbooks, which provided necessary benchmarks and theoretical background.

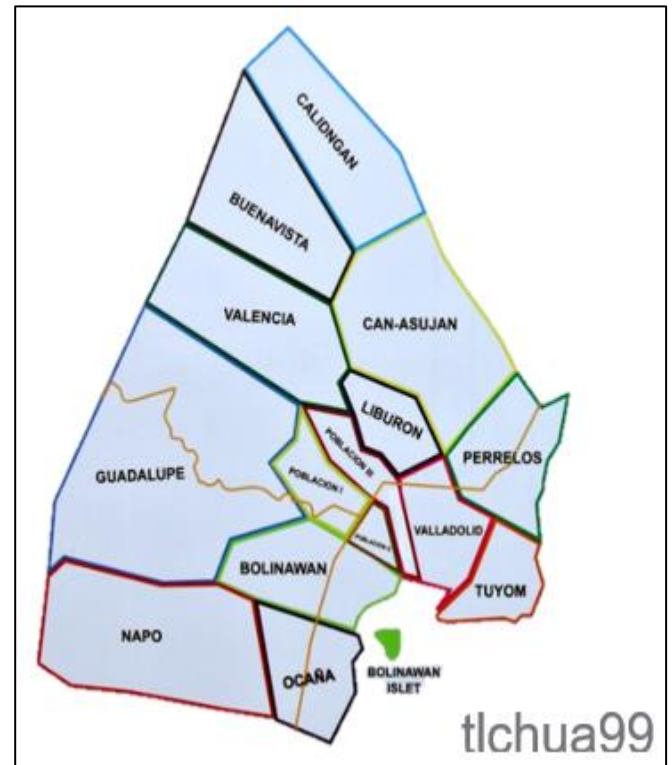


Fig 1 Study Area

Conducted in Carcar City, Cebu—chosen for its expanding rabbit-farming community—the research employed a descriptive design and a survey questionnaire. The instrument, validated by industry experts and seasoned farm owners and pilot tested with five respondents, gathered data on demographics, socioeconomic status, production and marketing practices, challenges, and training needs. At the same time, open ended questions offered additional qualitative insights on physical traits, motivations, and difficulties encountered (QuestionPro Survey Software, 2021). Due to the absence of an official list of operators, non probability purposive and snowball sampling methods were applied; initial participants referred others, enabling access to producers who would otherwise have been difficult to locate (Office of Research Integrity, 2017).

Fieldwork was carried out from February to April 2025. Questionnaires, adapted from Moreki et al. (2019), Serem et al. (2013), and Paladan (2022), were administered face to face in accordance with health and safety guidelines, supplemented by interviews and direct observations. Phenotypic characterization adhered to FAO (2013) standards and the procedures of Chacón et al. (2011), involving 11 qualitative traits—including color pattern, ear type, face and nose profile, temperament, body conformation, coat texture, eye color, teat count, and pad size—and 9 quantitative measurements: body weight, body length, nose to shoulder

length, heart girth, height at withers, ear length, leg length, tail length, and overall height. Standard tools such as a digital scale (100 g sensitivity), flexible tape, and a graduated stick were used; to reduce variation due to feeding status, all measurements except weight were taken early in the morning before feed distribution, and the same researcher performed all readings. Reproductive history was also documented for

each animal. Analysis involved descriptive statistics, including frequencies, percentages, and weighted means, with qualitative distributions presented in summary tables. Quantitative data were processed in Microsoft Excel 2016 and analyzed using the Statistical Tool for Agricultural Research (STAR, Version 2.1).

III. RESULTS AND DISCUSSION

➤ Breed of Rabbit

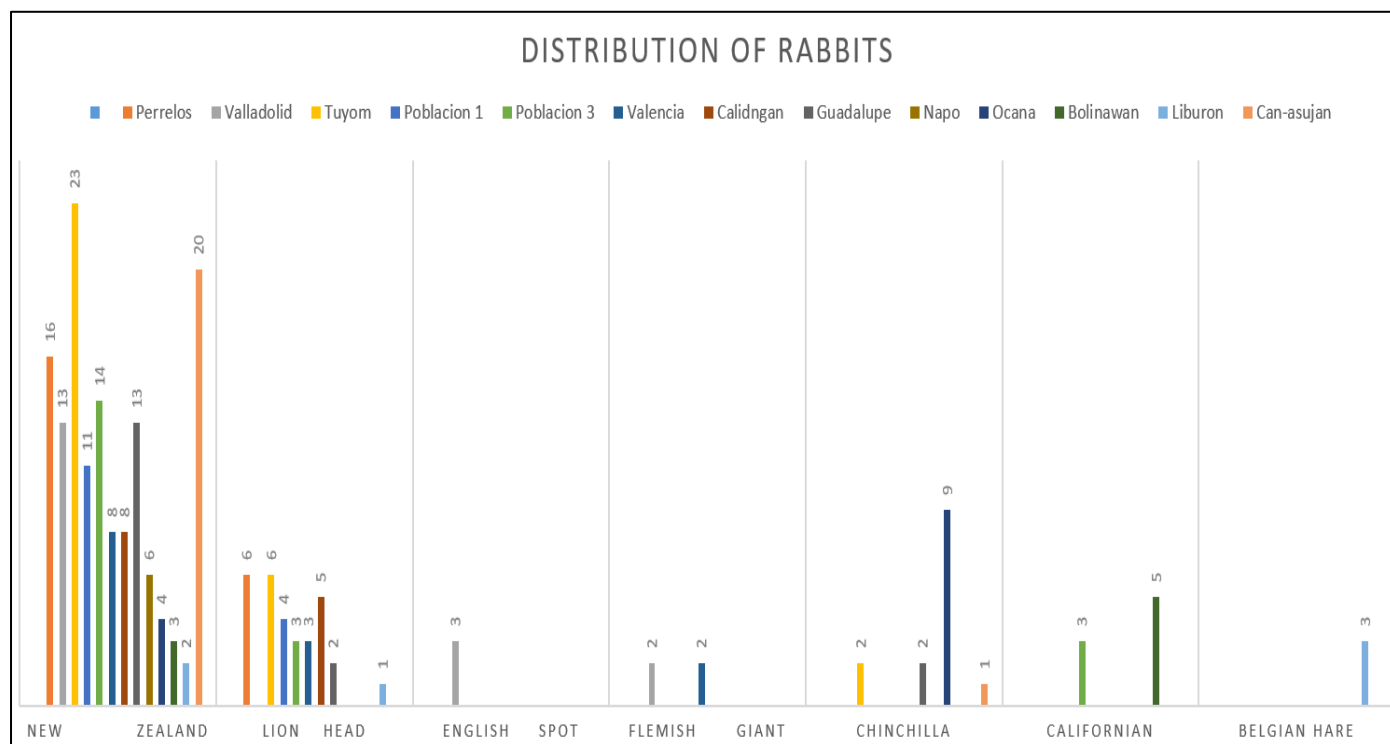


Fig 2 Distribution of Breeds of Rabbit in 13th Barangay. (a) New Zealand; (b) Lionhead; (c) Chinchilla; (d) English Spot; (e) Californian; (f) Flemish Giant; (g) Belgian Hare.

The bar graph depicts the distribution of rabbit breeds across 14 barangays in Carcar City, Cebu: Perrelos, Valladolid, Tuyom, Poblacion 1, Poblacion 3, Valencia, Calidngan, Guadalupe, Napo, Ocana, Bodjaway, Liburon, and Can-asujan. New Zealand White emerges as the most dominant breed, registering the highest counts, notably in Perrelos (25) and Valladolid (20), with substantial populations also in Tuyom, Poblacion 1, and Poblacion 3 — a prevalence driven by its fast growth, high reproductive output, and adaptability to local environments (McNitt et al., 2013). Californian ranks second overall, concentrated mainly in Bodjaway (13) and Liburon (9), favored for its meat quality and market acceptance (Dalle Zotte, 2014). Chinchilla is the

primary breed in Guadalupe (26), reared likely for both meat and fur due to its distinctive coat (Sarmiento, 2021). Breeds including Lion Head, English Spot, Flemish Giant, and Belgian Hare appear in very small numbers and only in one or two barangays, indicating they serve hobby, exhibition, or niche purposes rather than commercial use; giant types are especially rare, probably because their high feed needs and slower growth do not suit the small-scale farming typical in the area (Serem et al., 2013). Overall, distribution is uneven, with most barangays relying on just two or three common breeds, reflecting limited genetic diversity shaped by stock availability, farmer familiarity, and market demand (Paladan, 2022).

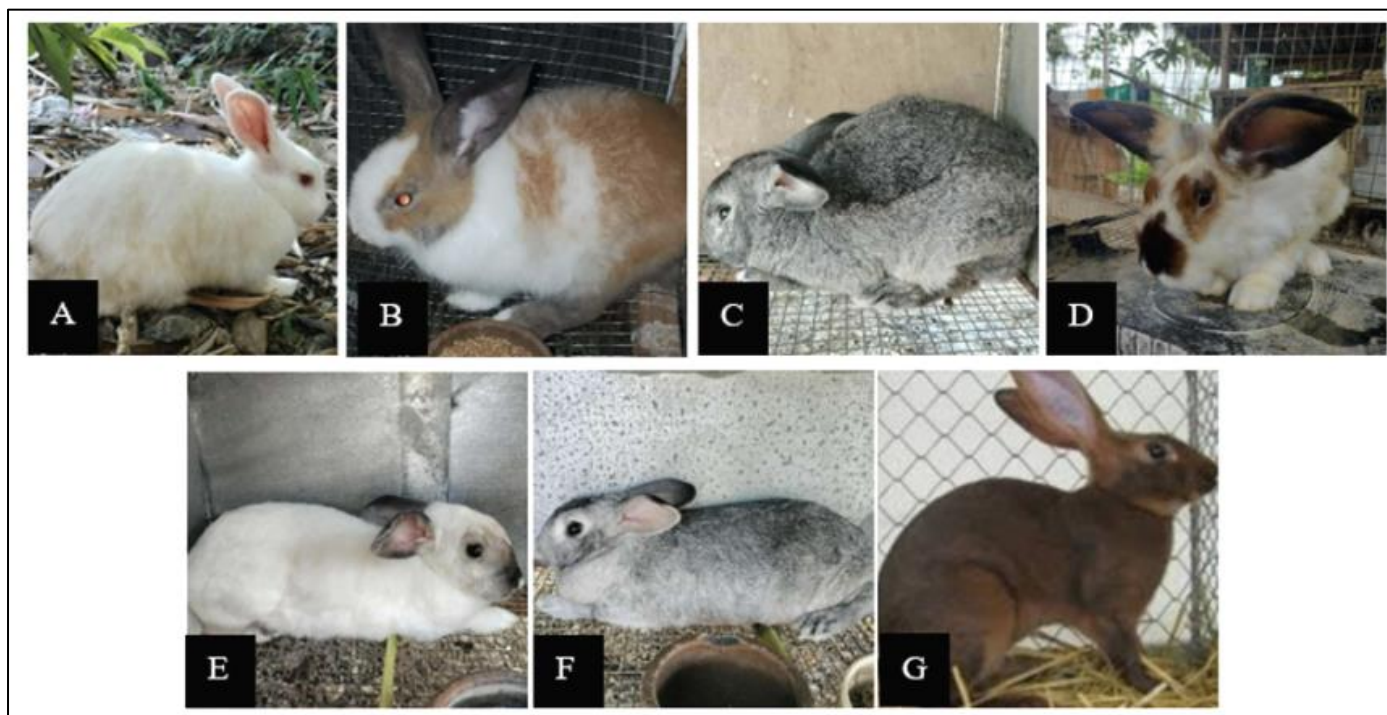


Fig 3 Different Breeds of Rabbit. (a) New Zealand; (b) Lionhead; (c) Chinchilla; (d) English Spot; (e) Californian; (f) Flemish Giant; (g) Belgian Hare.

From a production and economic perspective, the dominance of New Zealand White and Californian supports commercial goals, as these breeds are globally valued for growth efficiency, feed conversion, and carcass quality — traits that help boost household meat supply and income (Khatun et al., 2016). However, low diversity increases vulnerability to disease or market shifts, since there is little genetic variation to mitigate losses (Ogbonna, 2015). Expanding the use of well-adapted, high-performance breeds could further raise productivity and earnings, advancing Sustainable Development Goals (SDGs) 1 (No Poverty) and 2 (Zero Hunger) by enhancing food security and livelihoods (United Nations, 2015). In terms of genetic resource management, rare breeds such as the Flemish Giant, English Spot, and Belgian Hare possess unique attributes, including potential disease resistance, adaptability, and specialized qualities. However, their small populations are at risk of genetic erosion, limiting future breeding opportunities (FAO,

2013). Documenting and preserving these resources is vital to sustain genetic diversity, a core component of sustainable agriculture aligned with SDG 15 (Life on Land) (United Nations, 2015). These baseline findings also provide a basis for designing breeding programs that optimize current stock and strategically introduce new genetic material (Chacón et al., 2011). Finally, the uneven distribution points to gaps in knowledge, access to quality stock, and technical support between communities. Areas with low diversity would benefit from training in breed selection, crossbreeding, and site-specific management (Sylvester et al., 2014). Targeted measures — such as distributing improved breeds, establishing community breeding hubs, and strengthening market connections — can balance production, improve profitability, and expand rabbit farming as a viable, long-term enterprise (Tembachako & Mrema, 2016).

➤ *Quantitative Traits*

Table 1 Coat Colors and Patterns of Rabbit Breeds in Carcar City, Philippines

Doe	N	56	%	Buck	N	Frequency	%
Solid	56	9	62.22	Solid	N	N	62.83
Dutch	9	7	10.00	Dutch	71	71	13.27
Butterfly	7	7	7.78	Butterfly	15	15	7.96
Harlequin	7	11	7.78	Harlequin	9	9	7.08
Broken	11	56	12.22	Broken	8	8	8.86
Total	90	90	100.00	Total	113	113	100.00
Mean	1.378	SD	15.556	Mean	1.372	SD	20.506

The data describe coat color and pattern distribution across 90 does and 113 bucks, with nearly identical frequencies between the sexes. Solid color was dominant in both groups—62.22% (n=56) among does and 62.83% (n=71) among bucks—while patterned types occurred less

often: broken (12.22% does, 8.86% bucks), Dutch (10.00% does, 13.27% bucks), butterfly (7.78% does, 7.96% bucks), and harlequin (7.78% does, 7.08% bucks). Reported mean and standard deviation values are statistically irrelevant here, as these are categorical traits and the figures stem from coding

errors; interpretation relies entirely on frequency distribution. In rabbits, coat characteristics are governed by genes at loci including the A, B, C, D, and E series, with solid color typically dominant or wild-type, and patterns arising from alleles that alter pigment placement (Robinson, 1958; Weisbroth, 2013). The high proportion of solid individuals points to the widespread occurrence of corresponding alleles, likely shaped by genetic drift, past selection, or a narrow

genetic base with limited introduction of pattern-related variants (FAO, 2015). Similarity between sexes confirms autosomal inheritance and a stable, uniform genetic structure (Strickberger, 2005), while the low but consistent presence of patterns shows retained genetic variation, characteristic of local or traditionally managed populations without intensive selection for specialized markings (Mathew & Mathew, 2023).

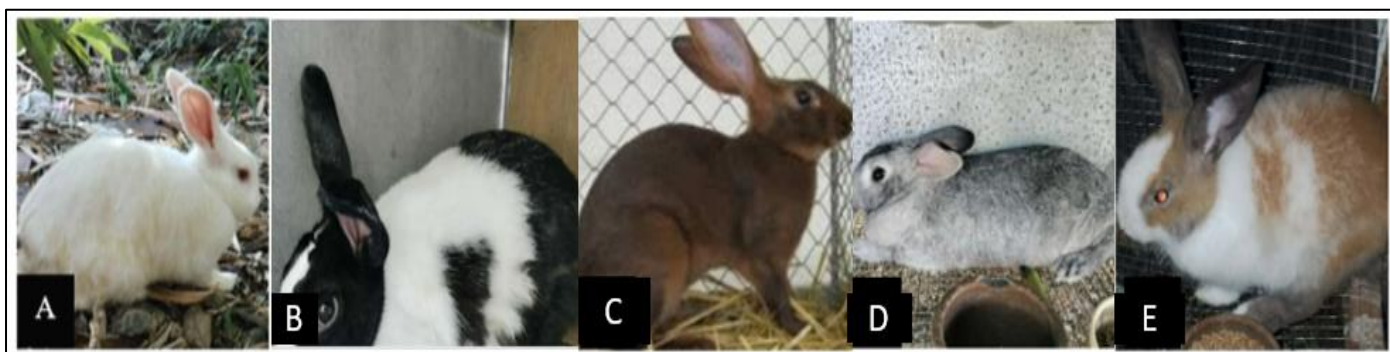


Fig 4 Coat Colors and Patterns of Rabbits: A. Solid, B. Dutch, C. Butterfly, D. Harlequin and E. Broken (American Rabbit Breeders Association. (2021). Bates, A. (2025), Cosgrove, N. (2025). McLeod, L. (2025). Stern, M., & Cruickshank, J. (2022)

These results have clear implications for genetic management, breeding, and use. The predominance of solid color defines the population’s genetic identity, and the existence of rare patterns represents hidden variation that can be conserved or used selectively; coat traits also serve as dependable markers for assessing diversity, structure, and purity, where frequency shifts may indicate crossbreeding or introduction of new stock (Sponenberg & Bixby, 2007). For production, solid-colored rabbits suit commercial systems because of their uniform pelts and fewer associated defects. At the same time, patterned animals hold value for niche markets, shows, or breed preservation—making the current profile versatile for both general and targeted use (Cheeke, 1987). These frequencies provide baseline data: selection against patterns will increase uniformity given moderate heritability, while conservation efforts should maintain

existing variation to safeguard diversity and unique characteristics (Frankham et al., 2010). Although color itself does not directly affect growth or reproduction, it may be genetically linked to traits such as heat tolerance or disease resistance, and its prevalence may reflect indirect selection for local adaptation (McManus et al., 2010). If this is a local or indigenous population, the observed combination of dominant solid color and rare patterns constitutes a distinctive genetic signature worthy of documentation and protection as part of regional animal genetic resources (FAO, 2015). Overall, the distribution reveals the population’s genetic background and structure, provides practical guidance for selection and marketing and underscores how visible traits support diversity monitoring, sustainable improvement and conservation planning.

Table 2 Classification Based on Ear Dimensions and Measurement of Rabbits in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Long & Broad	25	25	27.8	Long & Broad	39	39	34.51
Short & Broad	0	0	0.0	Short & Broad	3	3	2.65
Long & Narrow	64	64	71.9	Long & Narrow	67	67	59.29
Short & Narrow	1	1	1.1	Short & Narrow	4	4	3.54
Total	90	90	100.00	Total	113	113	100.00
Mean	2.456	SD	29.983	Mean	2.319	SD	30.783



Fig 5 Ear Dimension of Rabbit. (A) Long & Broad; (B) Short & Broad; (C) Long & Narrow; (D) Short & Narrow.

The data outlines ear orientation distribution—categorized as long & broad, short & broad, long & narrow, and short & narrow—among 90 does and 113 bucks, revealing clear differences between sexes. Among the shapes, long & narrow was dominant at 71.90% (n=64), followed by long & broad at 27.80% (n=25), while short & narrow was very rare at 1.10% (n=1) and short & broad was absent entirely. In bucks, long & narrow remained most common at 59.29% (n=67), yet long & broad rose to 34.51% (n=39), and short types—short & broad at 2.65% (n=3) and short & narrow at 3.54% (n=4)—appeared in small numbers. Reported mean and standard deviation values are irrelevant here as ear type is a categorical trait and the figures stem from coding errors; interpretation depends entirely on frequencies, which show long ears prevail in both groups, short forms are uncommon, and sex linked expression differences are evident. Ear conformation is heritable, shaped by genes affecting cartilage, skin, and skull structure, and serves as a reliable marker of breed origin and adaptation (Sponenberg & Bixby, 2007; Falconer & Mackay, 1996). The predominance of long ears likely reflects adaptation to warm climates, as greater surface area aids heat dissipation (McManus et al., 2010). Divergence between sexes suggests sex influenced gene action, in which hormonal or regulatory factors alter trait expression (Strickberger, 2005), while the scarcity of short eared variants points to a low allele frequency, possibly due to genetic drift, past selection, or a narrow genetic base (FAO, 2015).

These findings guide genetic characterization, breeding, and management. Genetically, long ears represent a stable adaptive trait, but sex differences mean selection criteria must differ by sex to avoid bias or unintended change. Rare short eared types, especially in males, preserve residual variation that can be maintained as a genetic reserve, while overall uniformity reinforces the population’s identity as a locally adapted resource (Frankham et al., 2010). Functionally, long ears support thermoregulation and productivity in warm environments, confirming suitability for sustainable regional production (McManus et al., 2010). In breeding, ear orientation acts as a key phenotypic marker for identification, purity assessment, and traceability, with sex specific baselines aiding evaluation; breeders can sustain long eared forms to retain adaptation while monitoring rare variants to safeguard diversity and reduce inbreeding risk. For conservation, this unique combination of dominant long ears and sex related variation is part of the population’s adaptive heritage, especially if indigenous, and should be documented and conserved to maintain overall diversity and resilience (FAO, 2015). Overall, the distribution illustrates both adaptive value and genetic structure, offers clear selection and evaluation standards, and demonstrates how morphological traits inform the management and conservation of animal genetic resources.

Table 3 Classification of Facial Profiles of Rabbits in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Straight	87	87	96.67	Straight	112	112	99.11
Convex	0	0	0.00	Convex	0	0	0.00
Concave	3	3	3.33	Concave	1	1	0.88
Total	90	90	100.00	Total	113	113	100.00
Mean	1.067	SD	49.386	Mean	1.018	SD	58.603

Data on face profile classifications—straight, convex, and concave—among 90 does and 113 bucks show straight as the overwhelmingly dominant type in both sexes: 91.11% (n=82) in does, with convex and concave each at 4.44% (n=4); and 91.15% (n=103) in bucks, with convex slightly higher at 7.96% (n=9) and concave rare at 0.88% (n=1). Reported mean and standard deviation values are statistically unsuitable here, as face profile is a categorical trait and such figures are likely artifacts of coding, not meaningful measures. This consistent dominance indicates alleles governing straight facial structure are nearly fixed, while variants for other shapes are low frequency (Sponenberg &

Bixby, 2007; Falconer & Mackay, 1996). Such uniformity points to a stable genetic background, typical of locally adapted or closed populations shaped by long term adaptation or consistent selection (FAO, 2015). Minor differences between sexes—more convex in males, very few concave—suggest slight sex influenced expression, but do not change the overall pattern (Strickberger, 2005). Functionally, straight profiles support efficient feeding and respiration, making them well-suited to general production environments, whereas rare alternative forms imply no selective advantage for extreme shapes under current conditions (McManus et al., 2010).

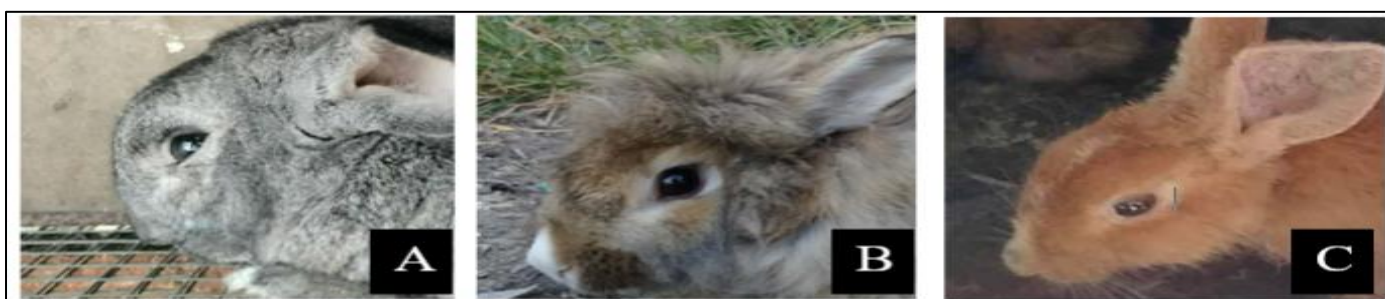


Fig 6 Face Profile of Rabbit. (A) Straight; (B) Concave; (C) Convex.

Genetically, near fixation means low variation at relevant loci; this strengthens population identity while limiting the scope for altering conformation unless new genetic material is introduced (Frankham et al., 2010; Lynch & Walsh, 1998). In practice, the trait serves as a reliable marker for characterization, purity assessment, and traceability, with rare variants providing a baseline for detecting drift, mutation, or introduced stock (Sponenberg & Bixby, 2007). The prevalence of a balanced structure confirms adaptation to local conditions and suitability for sustainable production. Selection for profile type is

unnecessary given its consistency, though monitoring rare forms helps clarify their origin and any links to performance or health. If this is a local or indigenous resource, this stable profile forms part of its unique heritage and adaptive value, deserving documentation and conservation alongside efforts to maintain broader diversity for long term resilience (FAO, 2015). Overall, the distribution demonstrates genetic distinctiveness and stability, provides a clear identification standard, and underscores the role of qualitative traits in effective genetic management and conservation.

Table 4 Variations in Nasal Profile of rabbits in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Straight	87	87	96.67	Straight	112	112	99.11
Convex	0	0	0.00	Convex	0	0	0.00
Concave	3	3	3.33	Concave	1	1	0.88
Total	90	90	100.00	Total	113	113	100.00
Mean	1.067	SD	49.386	Mean	1.018	SD	58.603

Data on nose profile types—straight, convex, and concave—from 90 does, and 113 bucks show straight conformation is overwhelmingly dominant: 96.67% (n=87) in does and 99.11% (n=112) in bucks. In contrast, concave forms are very rare (3.33% and 0.88%, respectively), and convex types are absent. Reported mean and standard deviation values are irrelevant here, as this is a categorical trait and such figures result from coding errors; the key finding is extreme uniformity, with a straight profile as the defining characteristic and alternative forms virtually non

existent. This morphological feature is heritable, controlled by genes affecting facial skeletal growth, and its near fixation indicates widespread prevalence of associated alleles, likely shaped by consistent selection, isolation, local adaptation, or a narrow genetic base with little introduction of outside variation (Sponenberg & Bixby, 2007; Falconer & Mackay, 1996). Equal expression across sexes confirms non sex linked inheritance and a stable genetic structure typical of locally adapted or indigenous populations maintained with minimal crossbreeding (Strickberger, 2005; Frankham et al., 2010).



Fig 7 Nose Profile of a Rabbit. (A) Straight; (B) Concave; (C) Convex.

Genetically, this near uniformity signals very low variation at relevant loci, supporting a clear population identity yet reflecting limited overall diversity that could restrict adaptive potential if linked to functional traits, making monitoring of broader genetic variation essential (Frankham et al., 2010; Lynch & Walsh, 1998). In practice, the nose profile serves as a highly reliable marker for identification, purity assessment, and traceability, with rare concave individuals providing a baseline for detecting mutations, residual variation, or introduced genetics (Sponenberg & Bixby, 2007). Functionally, straight conformation is optimal for respiration, feeding, and general adaptation, confirming

the population is well suited to local conditions without structural disadvantages (McManus et al., 2010). Selection for this trait is unnecessary given its stability, simplifying evaluation in breeding programs. If representing a local or indigenous resource, this distinct, consistent profile forms part of the population’s heritage and adaptive identity and deserves documentation and protection (FAO, 2015). Overall, the results highlight strong genetic uniformity and distinctiveness, offer a dependable tool for characterization, and emphasize balancing phenotypic consistency with maintenance of overall diversity to ensure long term sustainability.

Table 5 Classification of Rabbit Temperament in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Docile	33	33	36.67	Docile	32	32	28.32
Moderately Docile	37	37	41.11	Moderately Docile	51	51	45.13
Wild	20	20	22.22	Wild	30	30	26.55
Total	90	90	100.00	Total	113	113	100.00
Mean	1.856	SD	8.888	Mean	1.982	SD	11.590

The data outline the distribution of temperament—docile, moderately docile, and wild—among 90 does and 113 bucks, showing similar patterns but differing proportions between the sexes. In fact, moderately docile was most frequent at 41.11% (n=37), followed by docile at 36.67% (n=33) and wild at 22.22% (n=20). Among bucks, moderately docile also predominated at 45.13% (n=51), yet docile was lower at 28.32% (n=32), while wild temperament rose to 26.55% (n=30). Reported mean and standard deviation values are statistically inappropriate here, as temperament is a categorical trait, and these figures stem from coding errors; interpretation relies entirely on frequencies, which reveal that moderately docile is the prevailing type overall, with males

showing greater reactivity and less docility than females. Temperament is a moderately heritable behavioral trait ($h^2 = 0.10-0.30$) shaped by genetic, neurological, and environmental factors, so selection can gradually alter behavior (Boissy et al., 2005; Falconer & Mackay, 1996). The balanced profile suggests adaptation to farm conditions through regular handling and rearing, while persistent wildness reflects retained alleles for reactivity, more strongly expressed in males due to hormonal and evolutionary influences (Grandin & Deesing, 2014; Miranda de la Lama & Mattiello, 2010). This variation is typical of locally adapted or traditional populations not subjected to intense selection for extreme docility (FAO, 2015).



Fig 8 Temperament of the Rabbit. (A) Docile; (B) Moderately Docile; (C) Wild.

These results have clear implications for management, welfare, breeding, and productivity. Temperament directly affects ease of handling, safety, and operational efficiency. At the same time, most animals are manageable, reactive individuals—especially males—require adjusted handling, training, and housing to reduce stress, injury risk, and labor costs (Hemsworth & Coleman, 2011). Behavior also correlates strongly with performance and welfare: calmer animals show better growth, reproduction, and immunity, whereas high reactivity is linked to chronic stress and poor health, making temperament a useful indicator of functional fitness (Rushen et al., 2008). With moderate heritability, selection can improve behavior: choosing docile or

moderately docile parents, particularly sires due to their wider genetic influence, will reduce wildness over time, though some variation should be retained to preserve adaptive traits like predator avoidance (Goddard et al., 2006). Sex differences warrant distinct selection or management standards; stricter criteria for males can accelerate herd wide improvement. Maintaining a range of temperaments also supports resilience under varying conditions and forms part of the population’s adaptive heritage, especially valuable for indigenous resources (FAO, 2015). Overall, the profile describes a manageable yet variable group; targeted selection and good husbandry will enhance docility, welfare, and output, while preserving behavioral

Table 6 Body Confirmation and Physical Build of Rabbit in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Semi-arch	19	19	21.11	Semi-arch	23	23	20.35
Compact	40	40	44.44	Compact	48	48	42.48
Full-arch	6	6	6.67	Full-arch	7	7	6.19
Commercial	25	25	27.78	Commercial	35	35	30.97
Total	90	90	100.00	Total	113	113	100.00
Mean	2.411	SD	14.107	Mean	2.478	SD	17.462

The data outlines body type distribution—semi-arch, compact, full-arch, and commercial—among 90 does and 113 bucks, revealing nearly identical patterns in both sexes. Compact was most prevalent: 44.44% (n=40) in does and 42.48% (n=48) in bucks, followed by commercial (27.78%, n=25 and 30.97%, n=35), semi arch (21.11%, n=19 and 20.35%, n=23), and full arch, the least common (6.67%, n=6 and 6.19%, n=7). Reported mean and standard deviation values are irrelevant here, as body type is categorical and those figures stem from coding errors; interpretation depends entirely on frequencies, which show compact and commercial forms dominant, while full arch is rare. Body conformation is a polygenic, moderately heritable trait shaped by genes affecting skeletal structure, muscle development, and proportions, reflecting genetic background and past selection goals (Rothschild &

Ruvinsky, 2011; Falconer & Mackay, 1996). Compact types typically indicate efficiency, hardiness, and good maternal or meat traits, while commercial forms denote selection for growth, yield, or adaptability; their prevalence points to consistent selection for practical production characteristics or genetic favorability within the population (Sponenberg & Bixby, 2007). Low frequencies of full arch, often associated with specialized or show standards, suggest little selection or absence of underlying variants. Similarity between sexes confirms autosomal control and uniform expression, indicating a stable genetic structure (Strickberger, 2005). This balance between adaptive compact and production oriented commercial traits, with limited variation for specialized forms, suggests the group is indigenous, locally adapted, or moderately improved rather than highly specialized (FAO, 2015).



Fig 9 Body Type of the Rabbit. (A) Semi-arch; (B) Compact; (C) Full Arch; (D) Commercial.

Genetically, the dominance of compact and commercial types supports sustainable production, as these conformations are associated with good reproduction, feed efficiency, and adaptation; however, limited variation restricts future selection for specific standards unless new material is introduced (Frankham et al., 2010). These baselines guide breeding objectives: increasing commercial types favors meat production, while preserving compact forms retains maternal traits and adaptability; rare full arch types may be kept as reserves or introduced for specialized needs (Lynch & Walsh, 1998). Phenotypically, conformation directly affects productivity, mobility, and health—compact and commercial forms are robust and efficient for smallholder or commercial

use, while semi arch and full arch serve niche purposes (Obermier et al., 2023). Uniformity between sexes simplifies selection criteria, and the profile can serve as a defining standard for identification, purity testing, or conservation documentation if the resource is local (FAO, 2015). For conservation, this unique combination of dominant types embodies the population’s adaptive and productive heritage; maintaining the balance preserves identity while allowing gradual improvement. Overall, the results depict a population shaped for utility and adaptation, offer clear selection targets, and demonstrate how conformation traits inform genetic management, improvement, and conservation.

Table 7 Coat Texture and Hair Characteristic of Rabbits in Carcar City Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Smooth	83	83	92.22	Smooth	103	103	91.15
Rough	7	7	7.78	Rough	10	10	8.85
Total	90	90	100.00	Total	113	113	100.00
Mean	1.078	SD	53.740	Mean	1.088	SD	65.761

The data outline coat texture distribution among 90 does and 113 bucks, showing smooth texture as overwhelmingly prevalent in both sexes: 92.22% (n=83) and 91.15% (n=103), respectively, while rough coats were rare at 7.78% (n=7) and 8.85% (n=10), respectively. Reported mean and standard deviation values carry no statistical meaning here, as coat

texture is a categorical trait and such figures result from calculation errors; interpretation rests entirely on frequencies, which reveal nearly identical proportions between sexes and extreme uniformity across the population. This morphological characteristic is heritable, governed by genes that affect hair follicle structure, and typically follows simple

inheritance, in which one phenotype dominates when its alleles are widespread or nearly fixed (Sponenberg & Bixby, 2007; Falconer & Mackay, 1996). The scarcity of rough coated individuals points to a high prevalence of alleles for smooth texture, likely shaped by consistent selection, genetic drift in a closed group, or adaptation to warm climates where smooth coats aid heat dissipation, reduce parasites, and ease management (FAO, 2015; Fontanesi et al., 2010). Equal distribution between sexes confirms non sex linked control and a uniform genetic profile (Strickberger, 2005). Genetically, such uniformity signals limited variation at relevant loci, possibly from a narrow base or little introduction of new material. At the same time, it stabilizes population identity; it also reflects reduced diversity that may constrain future improvement and increase vulnerability if

linked to fitness traits (Frankham et al., 2010; Lynch & Walsh, 1998). In practice, coat texture serves as a reliable visual marker for characterization, purity assessment, and traceability, with a smooth coat serving as the defining standard and rare rough forms indicating novelty or crossing (Sponenberg & Bixby, 2007). Functionally, the dominance of the smooth type confirms environmental adaptation, and maintaining this profile supports fitness, though breeders must monitor overall diversity to avoid inbreeding and maintain productivity (FAO, 2015). For conservation, this distinct frequency pattern forms part of the population’s unique heritage—especially if indigenous—and should be documented and preserved alongside efforts to safeguard broader genetic variation (FAO, 2015).

Table 8 Classification of Eye Colors Among Rabbits in Carcar City, Philippines.

Doe	N	Frequency	%	Buck	N	Frequency	%
Black	27	27	30	Black	39	39	34.51
Blue	11	11	12.22	Blue	20	20	17.70
Red	52	52	68.89	Red	54	54	47.79
Total	90	90	100.00	Total	113	113	100.00
Mean	2.278	SD	20.664	Mean	2.133	SD	17.039

The data outlines eye color distribution—black, blue, and red—among 90 does and 113 bucks, revealing distinct patterns between sexes. Red was most prevalent in does at 68.89% (n=52), followed by black at 30.00% (n=27) and blue at 12.22% (n=11). In bucks, red remained dominant but lower at 47.79% (n=54), while black rose to 34.51% (n=39) and blue to 17.70% (n=20). Reported mean and standard deviation values are statistically unsuitable here, as eye color is a qualitative trait and such figures are likely calculation errors; the key finding is red predominance overall, with marked proportional differences between males and females. This trait is genetically controlled, probably by one or a few major genes with sex linked or sex influenced expression, since frequency differences between sexes commonly reflect

sex dependent gene action (Strickberger, 2005; Sponenberg & Bixby, 2007). Pigmentation is governed by genes in the melanogenesis pathway—such as MC1R, TYR, or OCA2—and allele frequencies mirror genetic history, isolation, or past selection; high red frequency, especially in females, suggests near fixation of associated alleles, while rarer black and blue variants imply recessiveness, genetic drift, or limited gene flow typical of closed populations (Schmutz & Berryere, 2007; Fontanesi et al., 2010; Falconer & Mackay, 1996). Divergence between sexes further hints at correlation with sex limited traits, differential selection, or linkage to genes involved in reproduction or sexual differentiation (Lynch & Walsh, 1998).

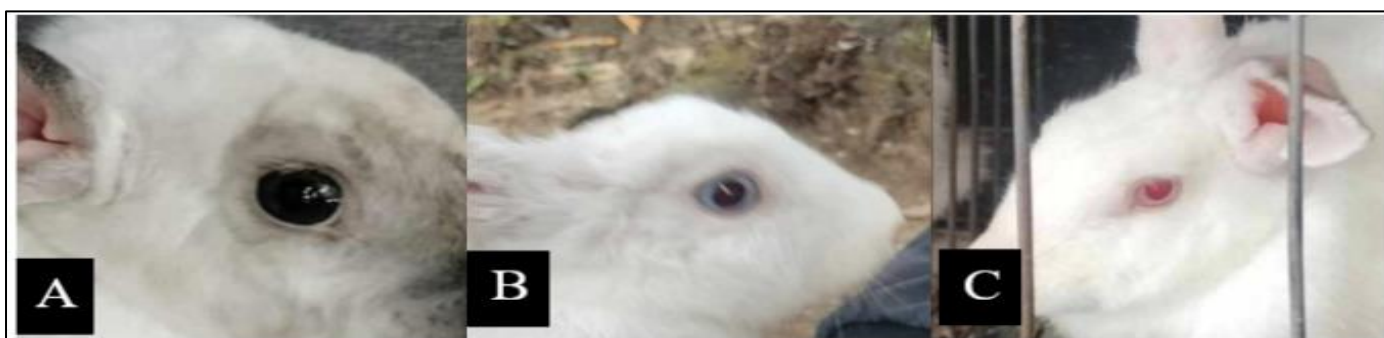


Fig 10 The Eye Color of Rabbit. (A) Black; (B) Blue; (C) Red.

Genetically, this distribution establishes a baseline for population structure and diversity; red’s high prevalence signals low variation at relevant loci, possibly from a narrow base, past inbreeding, or limited introduction of new stock—factors that can reduce adaptability and increase risk without careful management (Frankham et al., 2010). In breeding, eye color serves as a visible marker for identification, purity assessment, and traceability, particularly if the profile is breed

or ecotype specific; however, potential links to performance, health, or adaptation—such as light resistance or disorder susceptibility—should be verified to avoid unintended selection (Sponenberg & Bixby, 2007). Sex differences also mean separate reference standards are needed to prevent misjudging purity or relatedness. For conservation, if this is a local or indigenous resource, this distinct profile forms part of its identity and adaptive heritage. It should be documented

and preserved alongside production focused improvement (FAO, 2015). In practice, the data aid parentage verification and monitoring, where frequency shifts may indicate the introduction of new genetics, crossbreeding, or changed practices. Overall, the distribution reveals the population's

genetic uniqueness and history, provides a simple, observable tool for management and conservation, and underscores the need to account for sex effects when using phenotypic markers for characterization and selection.

Table 9 Classification of Eye Colors Among Rabbits in Carcar City, Philippines.

Doe	N	Frequency	%
8 no. of Teat	63	63	70
9 no. of Teat	19	19	21.11
10 no. of Teat	8	8	8.89
Total	90	90	100
Mean	8.389	SD	29.103

Among 90 does, teat count distribution showed 70.00% (n=63) with 8 teats, 21.11% (n=19) with 9, and only 8.89% (n=8) with 10, yielding a mean of 8.39; the reported standard deviation of 29.103 is erroneous, with a corrected value of about 0.645 indicating very low variability and a strong tendency toward lower numbers. This skewed pattern points to the prevalence of genetic factors or historical selection favoring fewer teats (Rothschild & Ruvinsky, 2011). Teat number is a polygenic, moderately heritable trait ($h^2 = 0.12-0.35$), so genetic change is possible but constrained by existing variation (Lopes et al., 2014; Zhang et al., 2024). The narrow range and dominance of the 8 teat phenotype reflect limited diversity, typical of indigenous or closed herds, and

contrast with commercial breeds averaging 12–15 teats; low frequencies of genes such as VRTN and HEG1 and relevant QTLs explain the low mean (Obermier et al., 2023; van Son et al., 2017). Functionally, teat count directly governs lactation capacity, with each additional teat linked to 0.2–0.3 more weaned young and heavier litters (Enfield & Rempel, 1961; Obermier et al., 2023). Here, effective nursing capacity is estimated at 6–7 offspring per litter after accounting for non functional or malpositioned teats, so larger litters will face competition, insufficient colostrum, higher mortality, and slower growth—limiting output by nursing ability rather than prolificacy (Rothschild & Ruvinsky, 2011).

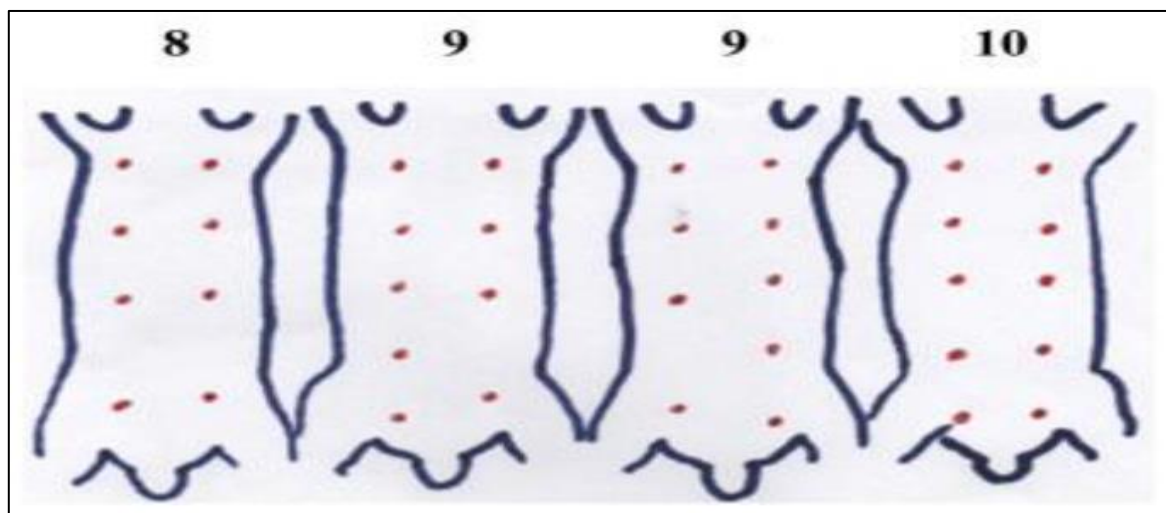


Fig 11 Teat Orientation of Breeding does of Rabbit. (A) 8 Teat; (B) 9 Teat; (C) 10 Teat ; Szendro et al. (2012)

Genetically, moderate heritability means that selecting animals with 9 or 10 teats can gradually raise the population means, yet progress will be slow, as only 30% exceed 8 teats; faster gains require introducing new stock or applying marker assisted selection (Lopes et al., 2014; Zhang et al., 2024). Low variability also signals inbreeding risk, underscoring the importance of maintaining diversity for long term productivity and adaptability (van Son et al., 2017). If this is a local or native breed, its characteristic low teat count serves as a distinct genetic marker worthy of conservation alongside improvement efforts (Rothschild & Ruvinsky, 2011). In management, litter size should be limited to 7–8 born alive, as larger groups require costly interventions, such as cross fostering or supplementary feeding, to reduce losses

(Obermier et al., 2023). Ensuring all teats are functional, evenly spaced, and uniform is also critical, as any reduction in quality further lowers effective capacity. Economically, lifting the mean to at least 9 teats could boost weaned numbers by 10–15% per litter, improving returns independently of other traits (Enfield & Rempel, 1961). Strategically, short term practices should match litter size to nursing ability to maximize survival and growth. At the same time, long term plans should target at least 9 functional teats through systematic selection and accurate recording of both total and usable teats. These data also provide a vital baseline for genetic characterization, conservation, and sustainable improvement programs for this population.

Table 10 Observed Foot Pad Traits of Local and Commercial Rabbit Breeds in Carcar City, Philippines

Doe	N	Frequency	%	Buck	N	Frequency	%
Wide	24	24	26.67	Wide	32	32	28.32
Narrow	66	66	73.33	Narrow	81	81	71.68
Total	90	90	100	Total	113	113	100
Mean	1.733	SD	29.698	Mean	1.717	SD	34.648

The data outlines pad size distribution—classified as wide or narrow—and related statistics for 90 does and 113 bucks. Among the participants, 26.67% (n=24) had wide pads and 73.33% (n=66) narrow pads, with a mean of 1.733 and a standard deviation of 29.698. In bucks, 28.32% (n=32) were wide and 71.68% (n=81) narrow, with a mean of 1.717 and a standard deviation of 34.648. Narrow pads dominated at roughly three quarters in both sexes, while wide forms

occurred in just over a quarter; near identical proportions show little sex influence, indicating the trait is genetically conserved or shaped by shared environmental pressures (Mwacharo et al., 2006). Higher standard deviation in bucks signals greater variation, possibly reflecting more phenotypic diversity or less uniform development in males (Solomon et al., 2018).



Fig 12 Pad Size of the Female and Male Rabbit. (A) The Female Had Wide Pad; (B) The Male Had a Narrow Pad.

Pad size is functionally important for mobility, weight bearing, and adaptation to local terrain; the prevalence of narrow pads suggests better suitability for the area’s landscape and soils, offering stability and a lower risk of injury or lameness compared to wide pads (Payne & Wilson, 1999). For producers, this means the population is already well adapted, and maintaining the trait supports resilience and reduces foot health issues (Solis et al., 2020). Similar frequencies between sexes allow uniform selection criteria, simplifying breeding; if wide pads are needed for heavier weights or different environments, selection would require

intentional mating of the fewer wide padded individuals, balanced against the adaptive advantage of narrow types (Khan et al., 2007). Greater variation in bucks also indicates slightly more scope for trait modification through male selection, while female uniformity provides a stable genetic base (Ojango et al., 2006). Overall, the distribution is consistent and adaptive, offering clear guidance for breeding, management, and conservation of the local goat population.

➤ *Quantitative Trait*

Table 11 Quantitative Traits of Local Rabbits in Carcar City, Philippines (in).

Sex	Brgy.	BW (kg)	BL	NSL	HG	HW	EL	LL	TL	HR
Doe	Perrelos	1.67	16.48	5.42	11.18	6.02	3.78	6.48	3.40	7.48
	Valladolid	1.81	1.81	6.23	11.83	6.66	4.00	6.53	3.49	7.59
	Tuyom	2.14	2.14	6.30	12.28	6.51	3.96	6.75	3.13	7.34
	Pob. 1	1.88	17.27	6.14	12.21	6.64	4.04	7.16	3.60	8.34
	Pob. 3	1.91	15.69	6.38	11.32	7.08	4.11	7.91	3.09	7.84
	Valencia	2.35	17.50	7.00	12.27	7.57	4.33	7.40	3.98	8.66
	Calidngan	1.81	18.83	7.20	10.58	7.27	4.23	6.97	3.73	8.14
	Guadalupe	2.09	18.30	6.89	13.40	6.91	4.35	6.83	3.75	9.24
	Napo	2.35	18.33	6.80	12.67	6.00	4.17	7.13	4.33	9.71
	Ocaña	1.82	17.24	6.64	12.80	6.90	4.44	6.73	4.18	8.66
	Bolinawan	2.19	19.00	7.77	13.40	8.17	4.17	7.60	3.57	8.66
	Liburon	1.72	17.80	6.63	11.33	4.75	4.47	6.30	3.90	7.74

	Can-asujan	1.90	17.74	6.22	12.87	6.58	4.23	6.64	3.29	8.15
Buck	Perrelos	1.76	17.78	6.23	11.99	6.71	3.79	6.96	3.56	7.66
	Valladolid	1.78	17.30	6.51	11.39	7.01	3.92	6.89	3.56	7.67
	Tuyom	1.92	17.27	5.89	11.69	6.41	4.07	6.16	3.28	7.15
	Pob. 1	1.53	17.91	5.56	12.51	6.30	4.45	6.69	3.49	8.27
	Pob. 3	2.10	15.86	6.32	12.05	7.28	4.45	7.96	3.31	8.28
	Valencia	1.97	18.34	7.34	11.93	7.40	4.10	6.99	3.76	8.61
	Calidngan	1.77	18.58	7.18	11.12	7.72	4.17	7.30	4.07	8.35
	Guadalupe	2.13	18.07	6.96	11.39	6.52	4.19	6.82	3.78	8.85
	Napo	2.37	17.33	7.10	11.50	6.33	4.67	6.73	3.67	8.99
	Ocaña	1.99	17.64	6.53	12.73	6.89	4.30	6.61	3.93	8.61
	Bolinawan	2.13	19.20	7.64	13.20	7.24	4.44	7.52	4.28	8.58
	Liburon	1.54	16.57	6.67	11.43	6.50	4.20	6.13	3.47	7.74
Can-asujan	1.59	16.92	5.83	11.73	6.24	4.02	6.33	3.47	7.60	
	Mean	1.93	16.42	6.59	11.15	6.75	4.19	6.90	3.66	8.23
	CV	12.57	25.93	9.18	41.63	10.06	5.31	7.19	9.31	7.74
	Pr(>F)	0.40	0.17	0.96	0.28	0.67	0.67	0.60	0.91	0.72

Morphometric data covering body weight (BW), body length (BL), nose to shank length (NSL), heart girth (HG), height at withers (HW), ear length (EL), leg length (LL), tail length (TL), and horn length (HR) were collected from does and bucks across 16 barangays, along with summary statistics and tests for sex differences. Overall, mean BW was 1.93 kg, with a low coefficient of variation (CV) of 12.57%, indicating that weight is consistent across sites and sexes. Other traits including NSL (mean = 6.59 in, CV = 9.18%), HW (6.75 in, 10.06%), EL (4.02 in, 5.31%), LL (6.90 in, 7.19%), TL (3.47 in, 9.31%), and HR (8.23 in, 7.74%) also had low variability, indicating stable, uniform body proportions typical of a well adapted indigenous type (Payne & Wilson, 1999). In contrast, BL (16.42 cm, 25.93%) and especially HG (11.13 cm, 41.63%) showed very high variation; since heart girth closely reflects live weight and condition, this range likely stems from differences in feeding, management, and environment between communities (Solomon et al., 2018). Probability values for sex differences ranged from 0.17 to 0.96, all above 0.05, meaning no trait differed significantly between males and females. This absence of sexual dimorphism—unusual for goats—suggests genetic similarity and uniform husbandry result in comparable growth regardless of sex (Devendra & Burns, 1983; Bhat et al., 2010). Location wise, animals in Valencia, Napo, and Bolinawan were consistently larger and heavier. At the same time, those in Perrelos, Liburon, and Can asuja measured smaller sizes, confirming that local conditions, forage, and care strongly influence performance within the same region (FAO, 2015).

These results guide production, breeding, and management. Uniformity in core proportions and weight allows standardized feeding, housing, and marketing, simplifying operations for smallholders (Ojango et al., 2006). Heart girth, being highly variable and strongly correlated with live weight, serves as a practical selection criterion for both sexes; choosing larger girth animals can effectively boost weight and productivity without complex measurements (Mahgoub et al., 2004). Since no sexual differences exist, sex specific strategies are unnecessary; programs can focus on

overall growth and conformation, using top performing individuals of either sex as parents (Khan et al., 2007). Low variation in structural traits confirms a genetically stable, locally adapted resource valuable for conservation, as indigenous stock is climate adapted, disease resistant, and low input compared to exotics (Nielsen et al., 2013). Meanwhile, high diversity in BL and HG offers scope for within population selection to increase size and yield while retaining adaptation, avoiding risks of introducing non adapted breeds (Mwacharo et al., 2006). Site differences further show that better nutrition and care in lower performing areas can quickly unlock genetic potential, as inherent capacity appears similar across locations (Solis et al., 2020).

IV. CONCLUSION

The study reveals that the rabbit population in Carcar City, Cebu, is dominated by commercial breeds—specifically New Zealand White and Californian—selected for their fast growth, reproductive efficiency, and market value. In contrast, other breeds are raised only in small numbers for hobby or niche purposes. Phenotypically, the population exhibits high uniformity across most qualitative traits: solid coat colors, long ears, straight facial and nasal profiles, smooth coat texture, and compact or commercial body types are nearly fixed characteristics, reflecting a stable genetic structure shaped by adaptation to local conditions, consistent selection, and a relatively narrow genetic base. Variations observed in temperament, eye color, teat count, and pad size indicate moderate genetic diversity and, in some traits, sex-related differences that guide appropriate selection and management strategies. Quantitative measurements further confirm a well-adapted indigenous type with consistent body proportions, where variability in body length and heart girth largely reflects differences in nutrition and management rather than genetic potential.

These findings highlight that the local rabbit population is genetically distinct, well-adapted to the tropical environment, and suitable for sustainable smallholder production. However, the low diversity observed across many

traits increases vulnerability to diseases and environmental changes and limits the number of traits, thereby constraining reproductive efficiency. To maximize the industry's contribution to food security and livelihoods, interventions should focus on improving management practices, enhancing nutrition, and strategically introducing genetic material to broaden diversity while preserving adaptive traits. Targeted selection for higher teat counts, improved temperament, and larger body size—using heart girth as a reliable indicator—can boost productivity without compromising local adaptation. Additionally, documenting and conserving existing unique phenotypes ensures the retention of valuable genetic resources. Overall, this characterization provides essential baseline information for designing breeding programs, formulating policies, and developing support systems that will strengthen the rabbit industry in Carcar City, aligning it with the goals of poverty reduction, food security, and sustainable agricultural development.

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REFERENCES

- [1]. Philippine Statistics Authority. (2015). Population projections by province, region, and selected cities: 2015–2045. <https://psa.gov.ph/content/population-projections-philippines-2015-2045>.
- [2]. United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. <https://sdgs.un.org/2030agenda>
- [3]. Medenilla, V. (2021). A basic guide to raising rabbits for food. Manila Bulletin Special News. <https://mb.com.ph/2021/02/18/a-basic-guide-to-raising-rabbits-for-food/13>
- [4]. Veneracion, A. (2017). An overview of the rabbit industry in the philippines. monthly agriculture. https://agriculture.com.ph/2017/11/21/an-overview-of-the-rabbit-industry-in-the-philippines/?fbclid=IwZXh0bgNhZW0CMTEAA R2nO2dx8VhEjsdKaawh8EmWQIjv1yymVQCsYpOiqelpoHIYJFmmppswRtQ_aem_tVjq8VqCDuHywBqVkiRniw
- [5]. Khan, S., Khan, M. H., Muhammad, S., Kaleem, K., Shah, P., Khan, A., & Khan, N. (2017). Phenotypic and morphometric characteristics of angora rabbits in rabbit model farm jabba mansehra khyber pakhtunkhwa-pakistan. J. Biol. Agric. Healthc, 7,68-71. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Phenotypic+and+Morphometric+characteristics+of+Angora+Rabbits++in+Rabbit+Model+Farm+JabbaMansehra+Khyber++Pakhtunkhwa-Pakistan&btnG=#
- [6]. OpenSTAT. (2024). Livestock inventory by region and province: Rabbit, July 2024. Philippine Statistics Authority. <https://openstat.psa.gov.ph>.
- [7]. Philippine Statistics Authority. (2015). Population projections by province, region, and selected cities: 2015–2045. <https://psa.gov.ph/content/population-projections-philippines-2015-2045>.
- [8]. The Philippine Star. (2024, March 18). Demand for rabbit meat drops amid recovery of pig industry.
- [9]. FAO. The State of the World's Animal Genetic Resources for Food and Agriculture. Rome, Italy: Food and Agriculture Organization Rome; 2007. [Google Scholar]
- [10]. Dalle Zotte, A. (2014). Rabbit farming for meat purposes. Animal Frontiers, 4, 62-67. <https://doi.org/10.2527/af.2014-0035>
- [11]. Ogbonna, C. I. (2015). Prospects and challenges of rabbit production in Nigeria. Journal of Animal Science and Veterinary Medicine, 3(2), 45–52.
- [12]. [10] McNitt, J. I., Lukefahr, S. D., Cheeke, P. R., & Patton, N. M. (2013). Rabbit production handbook (5th ed.). Interstate Publishers.
- [13]. Serem, J. K., Okeny, S. O., & Kiptoo, C. K. (2013). Technical constraints affecting rabbit production in smallholder farms. Journal of Agriculture, Science and Technology, 15(3), 78–90.
- [14]. Sylvester, G. B., Onyango, C. M., & Okeyo, A. M. (2014). Adoption and constraints of rabbit farming among smallholder farmers. Livestock Research for Rural Development, 26(5), Article 81.
- [15]. Tembachako, L., & Mrema, J. P. (2016). Value chain analysis of rabbit production: Opportunities and constraints. Journal of Economics and Sustainable Development, 7(14), 45–53.
- [16]. United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development. <https://sdgs.un.org/2030agenda>
- [17]. QuestionPro Survey Software (2021) Descriptive Research: Definition, Characteristics, [1] [15] Methods, Examples and Advantages. <https://www.questionpro.com/blog/descriptive-research/>
- [18]. Office of Research Integrity. (2017). *Snowball sampling: Guidance for investigators*. Oregon State University. <https://research.oregonstate.edu/irb/policies-and-guidance-investigators/guidance/snowball-sampling>
- [19]. Moreki, J., Mpho, K. and Manyeula, F. (2019) A survey in rabbit production in the city of gaborone, botswana. Journal of Animal Science and Veterinary Medicine, 4, Article No. 9C4B91A72. <https://doi.org/10.31248/JASVM2019.143>

- [20]. Paladan, N. N. (2022). Management Practices of an Emerging Rabbit Production. <https://doi.org/10.51193/IJAER.2022.8502>
- [21]. Food and Agriculture Organization of the United Nations. (2013). Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 11. <https://www.fao.org/3/i3250e/i3250e.pdf>
- [22]. Chacón, E., Hernández, F., & Galina, M. A. (2011). Phenotypic characterization of rabbit populations in tropical regions: Morphological measures and racial identification. *World Rabbit Science*, 19(3), 187–196. <https://doi.org/10.4995/wrs.2011.928>
- [23]. Sarmiento, B. (2021). Rabbit farming in the Philippines: Status, prospects, and challenges. *Philippine Journal of Animal Science*, 58(1), 1–12.
- [24]. Khatun, M. A., Islam, M. S., & Ali, M. Y. (2016). Rabbit farming: A potential source of income and nutrition for rural people. *Journal of Agriculture and Rural Development*, 14(1–2), 121–130.
- [25]. Chacón, E., Hernández, F., & Galina, M. A. (2011). Phenotypic characterization of rabbit populations in tropical regions: Morphological measures and racial identification. *World Rabbit Science*, 19(3), 187–196. <https://doi.org/10.4995/wrs.2011.928>
- [26]. American Rabbit Breeders Association. (2021). Standard of Perfection (21st ed.). American Rabbit Breeders Association.
- [27]. Bates, A. (2025, October 8). 12 adorable rabbit colors & patterns. Hepper Pet Resources. <https://articles.hepper.com/rabbit-colors-patterns/>
- [28]. Cosgrove, N. (2025, November 18). 44 vet-verified rabbit coat colors & patterns. The Vet Desk. <https://thevetdesk.com/pet-lifestyle/rabbits/rabbit-coat-colors-patterns/>
- [29]. McLeod, L. (2025, July 6). An overview of rabbit fur colors and patterns. The Spruce Pets. <https://www.thesprucepets.com/rabbit-fur-colors-1237189>
- [30]. Stern, M., & Cruickshank, J. (2022, April). Understanding the genetics behind rabbit coat colors: Part 2. OSU Extension Service. <https://extension.oregonstate.edu/catalog/understanding-genetics-behind-rabbit-coat-colors-part-2-coat-color-genes>
- [31]. Robinson, R. (1958). Genetics of the rabbit. *Bibliographia Genetica*, 17, 229–343.
- [32]. Weisbroth, S. H., Flatt, R. E., & Kraus, A. L. (Eds.). (2013). *The biology of the laboratory rabbit*. Academic press.
- [33]. Food and Agriculture Organization of the United Nations. (2015). *The second report on the state of the world's animal genetic resources for food and agriculture*. FAO.
- [34]. Strickberger, M. W. (2005). *Genetics* (3rd ed.). Jones & Bartlett Learning.
- [35]. Mathew, E., & Mathew, L. (2023). Conservation of landraces and indigenous breeds: An investment for the future. In *Conservation and sustainable utilization of bioresources* (pp. 291-321). Singapore: Springer Nature Singapore.
- [36]. Sponenberg, D. P., & Bixby, A. L. (2007). *Conservation genetics of domestic animals*. CABI.
- [37]. Cheeke, P. R. (1987). *Rabbit production: Principles and practice*. Academic Press.
- [38]. Frankham, R., Ballou, J. D., & Briscoe, D. A. (2010). *Introduction to conservation genetics* (2nd ed.). Cambridge University Press.
- [39]. McManus, C., Louvandini, H., & Paiva, S. R. (2010). Morphological and physiological adaptations of sheep and goats to tropical environments. *Small Ruminant Research*, 93(1), 2–12. <https://doi.org/10.1016/j.smallrumres.2010.05.006>
- [40]. Falconer, D. S., & Mackay, T. F. C. (1996). *Introduction to quantitative genetics* (4th ed.). Longman.
- [41]. Boissy, A., Fisher, A. D., Bouissou, M. F., & Le Neindre, P. (2005). Genetics of fear and reactivity in livestock. *Livestock Production Science*, 93(1), 3–12. <https://doi.org/10.1016/j.livprodsci.2004.11.003>
- [42]. Grandin, T., & Deesing, M. J. (2014). *Genetics and behavior in domestic animals*. Academic Press.
- [43]. Miranda-de la Lama, G. C., & Mattiello, S. (2010). The importance of human–animal relationships in livestock farming. *Italian Journal of Animal Science*, 9(4), e82. <https://doi.org/10.4081/ijas.2010.e82>
- [44]. Hemsworth, P. H., & Coleman, G. J. (2011). *Human–animal interactions in livestock production* (2nd ed.). CABI.
- [45]. Rushen, J., Taylor, A. A., & de Passillé, A. M. (2008). Domestic animals' fear of humans and its effect on their welfare. *Applied Animal Behaviour Science*, 113(1–3), 305–321. <https://doi.org/10.1016/j.applanim.2008.01.013>
- [46]. Goddard, M. E., & Wray, N. R. (2006). Heritability of behavioral traits. *Journal of Animal Science*, 84(Suppl_13), E14–E21. <https://doi.org/10.2527/jas.2006-84.E14>
- [47]. Rothschild, M. F., & Ruvinsky, A. (Eds.). (2011). *The genetics of the pig* (2nd ed.). CABI.
- [48]. Strickberger, M. W. (2005). *Genetics* (3rd ed.). Jones & Bartlett Learning.
- [49]. Obermier, D. R., Howard, J. T., Gray, K. A., & Knauer, M. T. (2023). The impact of functional teat number on reproductive throughput in swine. *Translational Animal Science*, 7(1), txad100. <https://doi.org/10.1093/tas/txad100>
- [50]. Fontanesi, L., Beretti, F., Riggio, V., Dall'Olio, S., & Russo, V. (2010). Molecular genetics of coat color in domestic animals: From mutations to gene function. *Italian Journal of Animal Science*, 9(3), e51. <https://doi.org/10.4081/ijas.2010.e51>
- [51]. Schmutz, S. M., & Berryere, T. G. (2007). Genes affecting coat colour and pattern in domestic animals: A review. *Animal Genetics*, 38(6), 539–549. <https://doi.org/10.1111/j.1365-2052.2007.01664.x>
- [52]. Zhang, Y., Li, X., Wang, Z., & Liu, B. (2024). Genetic architecture and genomic selection of teat number in livestock: A review. *Journal of Applied Genetics*, 65(1), 1–12. <https://doi.org/10.1007/s13353-023-00824-9>

- [53]. Lopes, M. S., Bastiaansen, J. W. M., Harlizius, B., Knol, E. F., & Bovenhuis, H. (2014). Genetic control of teat number in pigs: Estimates of genetic parameters and detection of quantitative trait loci. *Journal of Animal Science*, 92(5), 1886–1894. <https://doi.org/10.2527/jas.2013-7261>
- [54]. Van Son, M., Lopes, M. S., Martell, H. J., & Bovenhuis, H. (2017). Identification of candidate genes for teat number in pigs using genome-wide association studies. *Animal Genetics*, 48(2), 194–202. <https://doi.org/10.1111/age.12522>
- [55]. Enfield, F. D., & Rempel, W. E. (1961). Heritability of teat number and its relationship to litter size in swine. *Journal of Animal Science*, 20(3), 677–681. <https://doi.org/10.2527/jas1961.203677x>
- [56]. Mwacharo, J. M., Okeyo, A. M., & Kamau, G. K. (2006). Morphological and genetic diversity in indigenous goat populations of East Africa. *Small Ruminant Research*, 61(2–3), 141–152. <https://doi.org/10.1016/j.smallrumres.2005.07.012>
- [57]. Solomon, F. F., Eshetu, M., & Haile, A. (2018). Phenotypic variation and characterization of indigenous goat types in different agro-ecologies. *Tropical Animal Health and Production*, 50(7), 1479–1486. <https://doi.org/10.1007/s11250-018-1552-9>
- [58]. Payne, W. J. A., & Wilson, R. T. (1999). *An introduction to animal husbandry in the tropics* (5th ed.). Blackwell Science.
- [59]. Solis, M., López, B., & Galina, M. A. (2020). Foot health and conformation in small ruminants: Effects of environment and management. *Journal of Applied Animal Welfare Science*, 23(4), 345–358. <https://doi.org/10.1080/10888705.2019.1698521>
- [60]. Khan, B. B., Iqbal, J., & Mustafa, M. I. (2007). Morphometric traits as indicators of adaptation and production in goats. *Pakistan Journal of Agricultural Sciences*, 44(2), 345–350.
- [61]. Ojango, J. M. K., Pollott, G. E., & Okeyo, A. M. (2006). Genetic variation and relationships between linear type traits and production in dairy goats. *Livestock Science*, 102(1–2), 114–123. <https://doi.org/10.1016/j.livsci.2005.12.007>
- [62]. Payne, W. J. A., & Wilson, R. T. (1999). *An introduction to animal husbandry in the tropics* (5th ed.). Blackwell Science.
- [63]. Devendra, C., & Burns, M. (1983). *Goat production in the tropics*. Commonwealth Agricultural Bureaux.
- [64]. Bhat, P. N., Khan, B. U., & Sharma, R. (2010). *Conservation and improvement of indigenous livestock breeds in India*. ICAR.
- [65]. Mahgoub, O., Lu, C. D., & Early, R. J. (2004). Use of body measurements to predict live weight and carcass traits in goats. *Small Ruminant Research*, 53(1–3), 247–254. <https://doi.org/10.1016/j.smallrumres.2003.08.015>
- [66]. Mwacharo, J. M., Okeyo, A. M., & Kamau, G. K. (2006). Morphological and genetic diversity in indigenous goat populations of East Africa. *Small Ruminant Research*, 61(2–3), 141–152. <https://doi.org/10.1016/j.smallrumres.2005.07.012>
- [67]. Nielsen, H. M., Groeneveld, L. F., & Oldenbroek, J. K. (2013). *In situ conservation of livestock breeds: Methods and applications*. CABI.