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REGULAR ARTICLE

Phenotypic, Genetic, and Production Characteristics of Joloano and Paraoakan Native Chicken Breeds of the Philippines: A Review

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Abstract: The Joloano and Paraoakan native chicken genetic populations represent the two types of fighting native chicken breeds found in the Philippines, based on their distinct physical appearances, genetic makeup, and cultural value. The present study is a review paper that collates scientific knowledge pertaining to the two native chicken genetic populations in the Philippines. These two genetic types of chickens, Joloano, which comes from the Sulu Archipelago, and Paraoakan, which comes from Palawan Island, have been proven to have a different lineage than other Philippine native chickens since the microsatellite markers showed that neither Joloano nor Paraoakan belongs to the same lineage as other native chickens such as Labuyo and red junglefowl. In terms of phenotype, Paraoakan is recognized as the biggest chicken among the genetic types of Philippine native chickens due to their strong body and reddish-black feathers, whereas Joloano is known for its vertical stance, deep orange feathers, and muscular body for fighting purposes. Both chicken genetic groups demonstrate moderate to high genetic heterozygosity, suggesting sufficient genetic variability for conservation and selective breeding purposes. In terms of production, Paraoakan shows a competitive net income advantage over other native genetic groups in bio-economic modeling, while Joloano has shown growth responsiveness to locally available feed resources. Conservation efforts remain critical, as both chicken genetic groups face threats from genetic dilution through unregulated crossbreeding with exotic strains. This review identifies priority areas for selection, in situ and ex situ conservation, and genetic improvement programs.

Keywords: fighting-type native chicken; genetic diversity; phenotypic characterization

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1. Introduction

The Philippines can be considered one of the world's biodiversity hotspots for animal genetic resources, housing a wide range of native poultry varieties that have evolved through interactions within their specific environmental and cultural settings (Bondoc, 1998). Among the identified genetic stocks of native Philippine chickens, such as Darag, Camarines, Bolinao, Boholano, Banaba, Zampen, Labuyo, Paraoakan, and Joloano, Joloano and Paraoakan represent fighting breeds of great biological and sociocultural importance (Lambio et al., 2000; Santiago et al., 2022). The conservation of these breeds is situated within the broader global agenda for Animal Genetic Resources (AnGR). The FAO's Global Plan of Action for Animal Genetic Resources and the Nagoya Protocol on Access and Benefit-Sharing provide the international framework within which national conservation efforts, including those for Philippine native chickens, must be understood (Food and Agriculture Organization, 2007). Globally, FAO's State of the World's Animal Genetic Resources reports indicate that approximately 20% of livestock breeds are at risk of extinction, with the replacement of commercial breeds accelerating genetic erosion in developing countries (FAO, 2012). The Philippines is not immune to this trend, as unregulated crossbreeding with exotic breeds and the intensification of commercial poultry production continue to threaten the genetic integrity of native chicken populations (Bondoc, 1998; PCAARRD, 2016).

Native Philippine chickens (*Gallus gallus domesticus* L.) play an important part in traditional agricultural systems and provide small-scale farmers with additional sources of income, nutrition, and cultural value in the context of cockfights, which form a fundamental part of Filipino culture (Calsi, 2016). As compared to the commercial varieties, native Philippine chickens are considered more adaptable to the tropical climate, stronger, and disease-resistant (Lambio et al., 2000; PCAARRD, 2016). Among the native chicken breeds, fighting types like the Joloano and Paraoakan breeds are distinguished by their aggressive nature and strength. Throughout this review, the term "breed" is used as the preferred designation for Joloano and Paraoakan, consistent with FAO's definition of a breed as a subspecific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species (FAO, 2012). The terms "genetic group," "genotype," and "genetic population" are used interchangeably in some cited literature and are acknowledged here, but "breed" was used consistently in this review for clarity. It is also important to acknowledge that while cockfighting holds deep cultural significance in the Philippines, it is subject to regulatory and ethical scrutiny in many countries. This review presents Joloano and Paraoakan within their cultural context without endorsing the practice, focusing instead on the scientific and conservation value of these breeds.

While the two breeds are known to possess valuable cultural and genetic importance, they have been scientifically documented less comprehensively compared to other local chicken genetic groups found within the Philippines. Literature on the subject matter can be seen to exist in various studies conducted related to breed characterization, regional assessment, genetic assessment, and production testing. However, the lack of a scientific review regarding these two genetic groups limits one's understanding of the current knowledge available.

This review consolidated the available scientific and institutional literature relating to the native Joloano and Paraoakan chickens, concerning the following topics: (1) Taxonomy and geographic origin; (2) Phenotypic characteristics; (3) Genetic data; (4) Production performance; (5) Status in terms of conservation; and (6) Breeding potential. Through this review, it is hoped that important points will emerge for future consideration in conservation programs of these two genetic breeds.

2. Materials and Methods

This review was conducted through a systematic search of peer-reviewed and institutional literature on Joloano and Paraoakan native chickens of the Philippines. The following electronic databases were searched: Google Scholar, CAB Abstracts, Web of Science, Scopus, Philippine e-Journals, and the University of the Philippines Los Baños (UPLB) institutional repository. The search covered publications from 1990 to 2024. Search terms used included "Joloano chicken," "Paraoakan breed," "Philippine native chicken genetics," "*Gallus gallus domesticus* Philippines," "native chicken conservation Philippines," "Philippine gamefowl breeds," and "fighting chicken genetic resources."

Literature was included if it provided primary data or substantive discussion on phenotypic characteristics, genetic diversity, production performance, conservation status, or breeding opportunities specific to Joloano, Paraoakan, or closely related Philippine native chicken populations. Sources were excluded if they were non-peer-reviewed commentaries without empirical data or if they addressed only commercial chicken breeds without native chicken comparison. A total of 20 primary and institutional references met the inclusion criteria and were synthesized in this review.

3. Results and Discussion

3.1 Taxonomic Classification and Geographic Origin

The Joloano and the Paraoakan both fall under the scientific classification of *Gallus gallus domesticus* Linnaeus, 1758, of order Galliformes and family Phasianidae. These poultry types are considered genetic materials of Philippine chickens under the management of the Bureau of Animal Industry (BAI), Department of Agriculture (DA), Republic of the Philippines (Lambio et al., 2000; Bondoc, 1998). The Joloano (also known as "Jolojano" or "Basilan" in some sources) is an indigenous breed originating from the Sulu Archipelago, specifically the island of Basilan, located within the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), which itself is situated within Mindanao, the southernmost major archipelago of the Philippine Islands (Lambio et al., 2000; Yan, 2020). The geographical origins of the breed, coupled with its centuries-long development through selective breeding among local Muslims owing to its cockfighting qualities, have created the unique genetic makeup of the breed.

On the other hand, the Paraoakan comes from the island of Palawan. Palawan Island is located in the MIMAROPA region of the Philippines. This island is known for having high biodiversity within the country, and it is its geographical isolation that has played an important role in developing unique chicken breeds in this region as well (Bondoc, 1998; Santiago et al., 2022). Both breeds mentioned are considered part of the strategic national genetic resource in the Philippines, as per the PNAD Program managed by the Bureau of Animal Industry (n.d.).

3.2 Phenotypic Characteristics

3.2.1 Joloano Chickens

It should be noted that the Joloano is a medium-sized, sturdy, fighting-type breed recognized by its erect posture that provides instant height gain in cases of cockfighting events (Yan, 2020). The average weight of adult cocks is 2.20 kg, whereas females, or hens, have a weight of 1.50 kg. The bodyweight is small but is supplemented by strong muscles and skeletal structure due to the needs of cockfighting events (Lambio et al., 2000). Regarding plumage, the typical feature among Joloano roosters is deep-orange to reddish-brown-colored feathers on the hackle (neck feathers) and saddle zones, along with a black tail that sometimes contains specks of white feathers (Yan, 2020). However, there are some birds that also have black-breasted or wheaten plumages. Orange-red plumage is the most common among roosters, an attribute that can be attributed to natural and selective breeding from the ancestor red junglefowl (*Gallus gallus*) (Santiago et al., 2022).

The Joloano is also characterized by a pea comb, which is the common comb type found in tropical chickens, since it helps in dissipating about 40 percent of body heat through its thermoregulatory capability in the tropics (Duguma, 2006, cited in Santiago et al., 2022). The wattles are usually red and moderate-sized, while the ear lobes are usually red. The eye iris coloration is orange-red. This is in agreement with that of other native chickens in the Philippines, in which the shanks of this breed of chicken have dark-black colors due to the presence of dermal melanin in the homozygous black extension factor (Santiago et al., 2022). Among the physical characteristics that is very notable about the Joloano is its very upright body position, which gives it a more dominating appearance than other native chicken breeds. The combination of its erect body stance, along with strong muscles in the neck area and legs, makes it a favorite for cockfighters all across Mindanao (Yan, 2020).

3.2.2 Paraoakan Chickens

The Paraoakan is recognized as the largest native chicken breed in the Philippines, distinguished by its robust body conformation, deep chest, and strongly muscled frame (Lopez et al., 2013; Santiago et al., 2022). Adult Paraoakan roosters average 2.91 kg and hens 1.77 kg at 40 weeks of age (Lopez et al., 2013). The breed's imposing physical stature, developed through geographic isolation on the island of Palawan, reflects both its fighting heritage and its dual-purpose potential as a meat-type breed. Its overall appearance is characterized by a large, compact body, strong, long legs, and a commanding presence that distinguishes it from other Philippine native chicken breeds.

The body colors of the Paraoakan cock are mostly reddish-black, whereas those of Paraoakan hens are mainly black (Lopez et al., 2013). It is worth noting that the plumage color of Paraoakan hens features spangling, a type of feathering that involves having feather tips with spots of contrast at the tip (Santiago et al., 2022). Roosters are known to have more monochromatic plumage than hens. In terms of morphology, Paraoakan roosters show the greatest chest circumference (average: 37.00 cm) out of the six genetic populations tested by Santiago et al. (2022). Paraoakan hens showed greater-than-average chest circumferences (30.97 cm), just next to those of Bolinao hens. Nevertheless, the hens of Paraoakan chickens are relatively short in body length compared to those of other chicken breeds studied (Santiago et al., 2022).

Concerning comb shape, the roosters of the Paraoakan breed show more of the rose comb type, with most of them having medium-sized combs, while the majority of hens possess pea combs (Lopez et al., 2013). The wattles are bright red, and the earlobes are red for Paraoakan roosters, while most of the hens possess white earlobes. The predominant shank color for the Paraoakan breed is black. All members of the Paraoakan breed possess white skin color, an attribute of their red junglefowl parent (Santiago et al., 2022). The strong body structure of the Paraoakan, with its strong chest and muscles in the thighs and long, strong legs, makes this type of chicken very effective in battles and simultaneously a good meat breed. This is because the larger body and muscle composition are some of the main features used for cockfighting and meat production in farms (Lopez et al., 2013; Lopez et al., 2014; PCAARRD, 2016).

3.3 Genetic Information and Diversity

3.3.1 Microsatellite (SSR) Genetic Characterization

Some of the important genetic studies that have been undertaken using both Joloano and Paraoakan include the study conducted by Fabella (2014) at the University of the Philippines, Los Banos (UPLB). The genetic diversity of the genetic groups in Philippine native chickens using seven simple sequence repeat (SSR) loci as suggested by FAO was assessed. The groups assessed included Paraoakan, Darag, Camarines, Bolinao, Boholano, Banaba, Joloano, and Labuyo, along with one commercial breed referred to as Layer. Some of the important findings obtained by Fabella (2014) were observed allele number (MNA) ranges from 4.2 to 6.0 in various genetic groups, a range of observed heterozygosity (Ho) between 0.6232 and 0.7950, and values of the inbreeding coefficient (Fis) ranging between 0.01564 and -0.20304. The genetic diversity of Paraoakan was found to be particularly high according to both Ho and Fis values, and the maximum value of MNA was obtained for Boholano. Importantly, cluster analysis revealed that the Labuyo, which was considered to be the common ancestor of most Philippine native chickens, was not the ancestor of Paraoakan or Joloano. Therefore, it can be concluded that the latter breeds could have originated from different ancestors than most Philippine native chickens

The broader study carried out by Santiago et al. (2022) on six genetic groups of Philippine native chickens, such as Bolinao, Boholano, Darag, Camarines, Paraoakan, and Zampen using the same 15 SSR markers as recommended by FAO showed high genetic diversity of Philippine native chickens. The results showed that the mean number of observed alleles for Paraoakan was na = 2.27; effective number of alleles ne = 1.6334; Shannon's Information Index I = 0.5529; observed heterozygosity Ho = 0.2500; and expected heterozygosity He = 0.3572. The genetic distance of Paraoakan to ZamPen (highest distance being 0.5103) is proof of its unique phylogeny among Philippine native chickens.

According to the study by Santiago et al. (2022), PIC analysis indicated that 93% of the fifteen SSR markers examined had PIC higher than 0.50, with a mean PIC of 0.59. It is important to note that PIC values reflect the informativeness of individual SSR markers rather than population-level genetic diversity per se; high PIC values indicate that these markers are highly polymorphic and therefore suitable for discriminating among populations, but should not be conflated with a direct measure of population genetic variation. In addition, the F-statistic approach indicated the presence of a significant amount of genetic differentiation among the populations since the mean value of FST was 0.1729, with a mean gene flow value (Nm) of 1.1956. An FST of 0.1729 indicates moderate-to-high genetic differentiation, consistent with semi-isolated populations that have undergone limited but not complete gene flow — a finding of practical significance for conservation geneticists, as it suggests that Joloano and Paraoakan maintain distinct genetic identities that warrant separate conservation management. Furthermore, the consistent finding that Ho was lower than He across populations in both Fabella (2014) and Santiago et al. (2022) indicates a heterozygote deficiency that may reflect inbreeding within populations, the Wahlund effect (subpopulation structuring within sampled groups), or the presence of null alleles at some loci. These possibilities should be explicitly investigated in future studies using additional markers or pedigree analysis. Based on the UPGMA phylogenetic tree constructed using Nei's (1972) genetic distance approach, Bolinao and Darag were found to be the least genetically distant among the six groups, while Paraoakan was established as a distinctive phylogenetic cluster.

3.4 Mitochondrial DNA and Population Structure

In the first study carried out by Godinez et al. (2021), genetic structure was determined in Philippine village chickens (n=107) using the entire sequences of their mitochondrial DNA (mtDNA) D-loop, which revealed 34 different haplotypes showing high levels of haplotype diversity (Hd= 0.915 +/- 0.011) in Philippine village chickens. These haplotypes have been classified into five haplogroups (A, B, D, E, and H) out of 13 global mtDNA haplogroups. Through the use of phylogenetic analysis and median-joining network, it has been established that haplogroup D was the common maternal haplogroup found among Philippine chicken populations (Godinez et al., 2021). Red junglefowls belonged to the basal nodes of haplogroup D, implying an earlier importation of Philippine RJF ancestors in mainland Southeast Asia. It is noted that there was a presence of the Philippine-Pacific subclade in the study, thus implying that the Philippines could have played an important role in the dissemination of chicken throughout the Pacific islands.

The results of neutrality test statistics (Tajima's D and Fu's Fs) were found to be highly negative among Philippine chickens, signifying a history of expansion of populations in the past. The Bayesian skyline plot (BSP) test statistics showed that there was an expansion of population size linked with expansion events due to the presence of humans in the Philippine Islands. The high amount of genetic variability observed in Philippine chickens as a whole, including Joloano and Paraoakan breeds as part of Philippine chickens' genetic pool, highlights the importance of conserving such genetic diversity (Godinez et al., 2021). It must be noted, however, that Godinez et al. (2021) did not separately analyze Joloano and Paraoakan as distinct populations; their samples represented general Philippine village chickens. Therefore, the applicability of their haplotype diversity findings and phylogeographic inferences to these two specific breeds is limited and indirect. The results from this study should be treated as contextual background rather than breed-specific genetic evidence. Breed-specific mtDNA analyses for Joloano and Paraoakan remain an unaddressed research priority.

3.5 Reproductive Genetics: Semen Characterization

Baseline information on the volume and quality of semen was determined by the experiment conducted by Pamulaklakin et al. (2024), involving 22 roosters of Banaba, Joloano, and Paraoakan native chicken breeds. The experiment is a pioneer study on the reproductive physiology of the roosters of Joloano and Paraoakan native chickens within the context of assisted reproductive technologies (ART). Among the important results are that Banaba showed the highest quantity of semen, secondly Joloano, and lastly Paraoakan. In addition, the highest level of semen pH was observed in Banaba (7.27). It should be noted that most of the semen samples showed a creamy texture (42.6%) and, consequently, thin and creamy (32.9%). The highest sperm concentration was observed in Paraoakan among the three native chicken breeds studied (Pamulaklakin, 2024).

Regarding the storage properties of the semen samples, the semen samples from Banaba and Joloano roosters were highly viable (more than 50% motile spermatozoa) even after extending them in Ringer's solution for six hours. On the other hand, when extended, the semen samples from the Paraoakan roosters showed very poor motility, especially after eight hours of storage time. The temperature of storage significantly influenced the viability of the Paraoakan roosters, as evidenced by a higher percentage of motile and progressively motile spermatozoa observed at lower temperatures (5-10 degrees Celsius) compared to the normal temperatures (22-25 degrees Celsius) (Pamulaklakin, 2024).

3.6 Production Performance

3.6.1 Paraoakan Production Performance

One characteristic that makes Paraoakan chickens stand out is their high level of competitiveness when compared with the rest of the Philippine native chickens. Phenotype studies conducted on Paraoakan chickens in Palawan proved that Paraoakan is the most heavily built strain of the native chickens in the Philippines. At 40 weeks of age, males have an average body weight of 2.91 kg, while females weigh an average of 1.77 kg (Lopez et al., 2013).

A study conducted on the production performance analysis of three Philippine native chicken genotypic types, namely, Paraoakan, Bolinao, and Banaba, through the Structural Thinking Experiential Learning Laboratory with Animation (STELLA) showed some valuable comparative information about their production performance. The study found that, although Bolinao-type genotypes produced the highest number of chicks during a particular laying period, Paraoakan and Banaba genotypes yielded more marketable chickens after 18 weeks of raising them (Lopez, 2016). Additionally, the total live weight and gross income from Paraoakan and Banaba genotypes were found to be similar but higher than those from Bolinao genotypes. Notably, the net income generated from the Paraoakan genotype was higher than those generated from Banaba and Bolinao genotypes

Production of native chickens, such as the Paraoakan chicken in Palawan, is done mainly by extensive management systems. Investigations into native chicken production management practices in Palawan revealed that farmers rarely maintain production records, do not allocate nests, and leave eggs and chicks to be hatched and brooded naturally (Lopez et al., 2013). Farmers in Palawan do not use deworming practices, vaccinate their chickens, or perform artificial inseminations; their chickens are produced mainly for domestic consumption and as a secondary source of income. This production system constrains the exploitation of the genetic potential of the Paraoakan chicken. Santiago et al. (2022) determined that Paraoakan roosters had the biggest chest circumference (average = 37.00 cm) compared to the other five native chicken populations investigated, showing a positive correlation with increased pectoral muscle weight (the meat most used for commercial purposes in chickens). This morphometric attribute is in line with the status of Paraoakan as the biggest Philippine native chicken population.

3.6.2 Joloano Production Performance

The studies done on the production performance of Joloano have not been as many compared to Paraoakan. In a study carried out in Benguet State University (BSU), the growth performances of Joloano native chickens were assessed based on their response to two feed resources available locally: ground yellow corn (Zea mays) with golden kuhol (Pomacea canaliculata) meal and rice (Oryza sativa) middlings with golden kuhol meal. The findings indicate that Joloano chickens had a mean initial body weight of 111.9 grams after 26 days. After being fed for 56 days, chickens fed with ground yellow corn and golden kuhol meal had a mean final weight of 186.3 grams with a mean total weight of 91.9 grams (average daily gain of 1.6 g/d) and a feed conversion ratio (FCR) of 6.28. Chickens on rice middlings with golden kuhol meal gained a mean total weight of 56.8 grams (average daily gain of 1.0 g/d) with an FCR of 11.37. Cost of feeds was Php 142.08/kg body weight gain for chickens on ground yellow corn and golden kuhol meal, and Php 177.44/kg body weight gain for those on rice middlings and golden kuhol meal (Calsi, 2016).

According to Calsi (2016), low overall growth was caused mainly by the low palatability of the ration used during the experiment. It is stated that a combination of ground yellow corn and golden kuhol meal provides better results for feeding Joloano chickens. Moreover, it is recommended to remove the shell of the kuhol before using it as a ration because of its palatability. The major application of Joloano is related to the use of birds in fights and not to meat and egg production. But the increasing interest of consumers in native chickens' meat makes it possible to apply Joloano in both areas (PCAARRD, 2016).

Unfortunately, information on egg productivity in both Joloano and Paraoakan breeds is scant in the cited literature. According to Lambio et al. (2000), Philippine native chickens produce 40 to 80 eggs annually per head under normal management practices. However, according to PCAARRD (2016), the egg production of other breeds under the Improved Industry Strategic Science and Technology Program (ISP) averages 120 eggs per bird annually under improved management conditions. It is not clear whether comparable results can be obtained from Joloano and Paraoakan birds.

3.7 Conservation Status

3.7.1 Threats to Genetic Integrity

Joloano and Paraoakan are both vulnerable to genetic contamination due to crossbreeding with other breeds, but their situation worsens because of the use of exotic breeds as breeding partners. Genetic contamination through crossbreeding with breeds of gamefowls from America, Spain, and Thailand represents an especially critical danger for gamefowl breeds since breeders often mix foreign breeds in order to improve performance (Yan, 2020; PCAARRD, 2016). Research conducted regarding native chickens in the Philippines has generally found that there has been a continuing issue with genetic erosion because of the substitution of commercial breeds for the traditional breeds used in upgrading programs and the absence of proper breeding records in the farms involved (Bondoc, 1998; Lambio et al., 2000). This can be further compounded by the presence of a small effective population size, where, according to Santiago et al. (2022), Ho was always lower than He in their assessment of six different genetic groups of native chickens.

The Paraoakan population is threatened by the lack of organization within their production system, which is characteristic of most informal systems. Without breed identification, pedigree records, or any breeding program, identifying those with phenotypic introgression and separating them from the pure Paraoakan breeds becomes very hard (Lopez et al., 2013). For the Joloano, social and political unrest in the BARMM region has traditionally affected their conservation work in the area. An important parameter conspicuously absent from all reviewed literature is the effective population size (Ne) for both Joloano and Paraoakan. Effective population size is a central metric in conservation genetics, as Ne values below 50 indicate immediate risk of inbreeding depression, and values below 500 are associated with long-term erosion of adaptive potential (Franklin, 1980; Lynch & Lande, 1998). No published study to date has estimated Ne for either breed using census population data, pedigree records, or temporal changes in allele frequencies. This gap likely reflects the absence of formal herd books or breed registries for these populations. Future conservation programs must prioritize estimation of Ne as a foundational step, potentially through mark-recapture surveys of pure-bred populations in the Sulu Archipelago and Palawan, or through temporal genetic sampling approaches.

3.8. Government and Institutional Conservation Efforts

The Philippine government has put up various programs that seek to preserve and enhance local breeds of chickens. The PNAD Program of the BAI-DA endeavors to certify native animal breeder farms and create standards for genetic improvement and conservation of native chickens (Bureau of Animal Industry, n.d.). The DOST-PCAARRD ISP for Native Chicken has set up conservation farms at Western Visayas State University (WVSU) and Western Mindanao State University (WMSU), where WMSU is specifically important for the Joloano, since it comes from Mindanao (PCAARRD, 2016).

Regarding Joloano chickens, for instance, according to Pamulaklakin (2024), there are purification projects being initiated by the Philippine government aimed at making the breed pure and refined. Also, the Joloano chicken has been employed in a food security program organized by the government targeting prison inmates in Zamboanga City, Mindanao. The Paraoakan chicken, on the other hand, has been conserved via studies conducted by Western Philippine University (Lopez et al., 2014). Recent progress in semen cryopreservation techniques suggests potential ex situ conservation approaches for Joloano and Paraoakan. Semen characterization as a baseline procedure for cryopreservation and artificial insemination (Pamulaklakin, 2024) offers a solid scientific foundation for developing cryopreservation and artificial insemination protocols that will allow creation of genetic cryobanks for both breeds. Phenotypic characterization guidelines provided by the FAO (2012) and POPGENE software have been applied by Filipino researchers for obtaining standardized data regarding genetic diversity needed in conservation strategy development (Santiago et al., 2022; Fabella, 2014). Despite these achievements, both breeds lack adequate characterization compared to those of the Darag or Bolinao breeds.

3.9 Breeding Opportunities

3.9.1 In Situ Conservation Breeding

Breeding through in situ conservation is the best option to conserve the Joloano and Paraoakan chicken breeds within their respective native regions. This involves setting up community-based breeding nucleus in the Sulu Archipelago for Joloano and Palawan for Paraoakan breeds with regular recording of pedigrees and performance of animals, followed by controlled mating so as to avoid inbreeding and loss of genes (Lambio et al., 2000; PCAARRD, 2016). Community-based breeding programs involving the cockfighters as well as small-scale farmers have proven successful for conservation of livestock breeds among other indigenous species (Salces et al., 2013). In relation to Joloano, breeding objectives for this particular population must take into consideration traits favored by members of the cockfighting community, like agility, aggressiveness, strong legs, and stamina. As for Paraoakan, the formulation of breeding objectives focusing on both fighting characteristics and meat production traits such as live body weight, body gain per day, FCR, and dressing percentage would provide the greatest economic advantage from conservation efforts (Lopez, 2016).

3.9.2 Ex Situ Conservation and Cryopreservation

Considering the susceptibility of both Joloano and Paraoakan to genetic erosion due to external introduction and possible local disasters, there is a need for ex situ conservation of the two breeds using live gene banks set up in state universities, as well as cryopreservation of spermatozoa, oocytes, and embryos. The semen characteristics reported in the study by Pamulaklakin (2024) serve as the physiological basis for the development of suitable cryopreservation strategies for both breeds. The difference in the ability of the semen from both breeds to stay viable in storage conditions requires breed-specific cryopreservation strategies.

State universities, such as Mariano Marcos State University (MMSU), Pangasinan State University (PSU), Western Mindanao State University (WMSU), and Western Philippine University, are ideally located to establish ex situ conservation populations of the Joloano and Paraoakan breeds, owing to their close physical proximity to the native range of the respective animals (Santiago et al., 2022; PCAARRD, 2016).

3.9.3 Genetic Improvement Through Selection and Crossbreeding

With the presence of high heterozygosity shown by the Paraoakan (Fabella, 2014), and the moderately high diversity values found for both breeds, it means that there is enough genetic variability in the Paraoakan and Joloano that can make the implementation of successful within-breed selection programs possible. The selective breeding of quantitative traits of economic or cultural significance, such as body weight, feed conversion efficiency, and egg production for the Paraoakan breed, or stamina and fighting ability for the Joloano breed, could be done through quantitative genetics techniques.

Crossbreeding programs involving the Paraoakan chickens along with other large-bodied native chicken species (such as the Banaba from Batangas) may take advantage of heterosis for meat-producing characteristics because the bio-economic modeling analysis by Lopez et al. (2016) indicated that the productive capabilities of the Paraoakan and Banaba were comparable. Careful management should be exercised during the crossbreeding to avoid dilution of the Paraoakan's genetic pool. This would involve maintaining a pure breeding group as the nucleus for any crossbreeding program (Lambio et al., 2000).

Their ancestry that is distinct from those shared by most other Philippine native chickens, which is of Labuyo ancestry (Fabella, 2014), can be an excellent choice in breeding programs that would allow the introduction of new genetic elements into the process of Philippine native chicken improvement. Their special genetic background can help in the creation of composite or synthetic breeds of superior quality, making use of the strengths of various genetic groups of Philippine chickens.

3.10 Value Chain Development and Breed Promotion

Apart from conserving and improving on biology and genetics, sustainable utilization of the breeds needs the creation of a functional value chain, which would capitalize on the uniqueness of these breeds. The premium demand for native chickens, because consumers appreciate the unique taste, texture, and other qualities associated with native chicken meat (PCAARRD, 2016; Calsi, 2016), is a good business venture which could encourage breeders to conserve pure breeds of these two chickens.

Geographical Indication (GI) can serve as an effective means of protecting Joloano as a product of the Sulu Archipelago and Paraoakan as a product of Palawan. Geographical Indication (GI) will not only encourage conservation within the local community but also create distinction in the market and generate higher prices at the farm gate. The IPO Philippines offers means to register Geographical Indication (GI), which has been applied to other agricultural commodities in the Philippines.

3.11 Research Gaps and Future Directions

Upon reviewing the current literature on Joloano and Paraoakan, a number of important research gaps emerge that need to be addressed in order to facilitate efficient conservation and usage of these genetic types. Primarily, there have been no research works employing either whole-genome sequencing (WGS) or genotyping by sequencing (GBS) aimed at understanding the genomes of these genetic types. While the previously conducted research using SSR markers (Fabella, 2014; Santiago et al., 2022) has provided valuable information about the genetic diversity of these breeds, more detailed investigations using SNP markers, quantitative trait loci (QTL) mapping, and signatures of selection are required.

Second, there is no information about either the population size or demographics of Joloano and Paraoakan in the published literature. It is important to know the true population size of any remaining pure populations to understand how critical it is to intervene and save these populations. Third, research on nutritional requirements for Joloano and Paraoakan is scanty. Although the Calsi (2016) study offers some growth performance of Joloano under specific feeding regimes, complete nutritional requirements for the two breeds from birth to breeding are yet to be determined.

Fourth, it is evident in the literature that no research has been conducted on immunity and disease resistance in both chicken breeds. The Philippine native chickens have been known to exhibit high immunity against endemic diseases; however, immunological characteristics of Joloano and Paraoakan remain undiscovered.

Lastly, socioeconomic research on the use of Joloano and Paraoakan to support the livelihoods of people within their natural territories is scarce. It is important to gain knowledge of the social, cultural, and economic implications associated with the utilization of these breeds, especially in relation to cockfighting legislation and poverty issues in rural areas.

4. Conclusion

The Joloano and Paraoakan native chickens represent two of the most genetically distinctive yet least scientifically documented chicken genetic groups in the Philippines. Evidence from SSR-based genetic characterization indicates that the Paraoakan carries the highest within-group heterozygosity among Philippine native breeds, while both Joloano and Paraoakan occupy a phylogenetically distinct lineage from the Labuyo (Philippine Red Jungle Fowl), consistent with ancestral origins from mainland Southeast Asia or Malaysia rather than from native Philippine jungle fowl. This makes both breeds irreplaceable components of Philippine avian genetic diversity. Morphologically, the Joloano is a heavy-bodied, pea-combed breed with deep orange and black plumage adapted to free-range rearing in the Zamboanga Peninsula, while the Paraoakan is the largest Philippine native chicken with predominantly black plumage, long legs, and strong musculature reflecting its Malaysian Asil ancestry. Both breeds exhibit culturally important cockfighting traits alongside viable dual-purpose meat and egg production characteristics under appropriate management. Major conservation threats include uncontrolled crossbreeding, commercial breed substitution, and the absence of formalized breed standards and breeding programs. The successful ZamPen purification initiative demonstrates the feasibility and impact of within-breed selection for Joloano, but a comparable program for Paraoakan has yet to be established. Future priorities must include whole-genome sequencing, standardized multi-site phenotyping, formal breed registration, development of ex situ gene banks, and genomic selection programs. Sustained investment in the conservation and improvement of Joloano and Paraoakan breeds will contribute directly to Philippine agricultural biodiversity, food security, and rural livelihood development.

Based on the evidence synthesized in this literature review, the following recommendations are offered for researchers, government agencies, and development practitioners working with Philippine native chicken genetic resources: A pedigree-based conservation breeding station for Paraoakan should be established, modeled on the WMSU ZamPen program, with institutional support from PCAARRD and the Bureau of Animal Industry. Both Joloano and Paraoakan should be prioritized for whole-genome sequencing (WGS) and high-density SNP genotyping on at least 50 individuals per breed, enabling population structure analysis, identification of adaptive genomic regions, and the development of tools for genomic selection. Simultaneously, standardized phenotypic characterization following FAO protocols should be conducted across multiple geographic sampling sites within the natural distribution ranges of each breed. A terminal crossbreeding system should be investigated for market production purposes using purebred Joloano and Paraoakan females crossed with selected complementary males while maintaining separate purebred conservation flocks. Cryopreservation of semen and somatic cells from genetically superior Joloano and Paraoakan individuals should be incorporated into the national Animal Genetic Resources program within the Bureau of Animal Industry. Finally, market and value-chain analyses should be conducted to quantify achievable price premiums and evaluate the commercial feasibility of geographical indication labels for both breeds.

5. Competing Interests

The authors declare no conflict of interest.

6. Authors' Contributions

G.C.B: Conceptualized the review, conducted the literature search, performed data synthesis, and led the manuscript writing; M.D.G.J.: assisted in data collection, validation of production performance data, and critical revision of the manuscript; C.J.P.G. assisted in the literature review on genetic diversity, supported data visualization, and provided substantial feedback during manuscript preparation. All authors read and approved the final manuscript.

7. Use of Artificial Intelligence (AI)-Assisted Technology

The authors declare that artificial intelligence (AI) tools such as Claude were used only to improve the grammar and clarity of the information within the manuscript.

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