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Morphometric and phenotypic characterization of the indigenous Jhargrami chicken population of West Bengal, India

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ABSTRACT

The Jhargrami Fowl is an indigenous non-descript chicken population traditionally maintained by the Santhal, Munda, Bhumij and Lodha tribal communities of the Junglemahal region in the Western Plateau and Forest Region of West Bengal, India. The present study was conducted during 2023–2026 under the ICAR–Network Project on Animal Genetic Resources to comprehensively characterize its phenotypic, productive, reproductive and adaptive attributes. A multistage stratified survey was carried out in 45 villages across Jhargram, Purulia and Paschim Medinipur districts, covering more than 200 households and 1,500 birds (1,000 adults and 500 young birds) following ICAR–NBAGR and FAO characterization guidelines. Jhargrami Fowl exhibited a distinct and recognizable phenotype characterized by a medium-to-large muscular body, mahogany to reddish-brown plumage, glossy black tail feathers, yellow featherless shanks and a single red comb. The population was maintained predominantly under low-input free-range scavenging systems with an average household flock size of 8–9 birds. Mean body weight increased from 35.00 ± 1.34 g at hatch to $2,180.00 \pm 5.21$ g in males and $1,750.00 \pm 4.42$ g in females at 52 weeks, demonstrating marked sexual dimorphism. Hens attained sexual maturity at 210.00 ± 2.01 days and produced 81.00 ± 0.98 eggs annually, with a clutch size of 10.00 ± 0.23 eggs. Mean egg weight was 41.20 ± 0.62 g, shell thickness 320 ± 5.60 μ m, and Haugh unit 76.50 ± 0.68 , indicating satisfactory egg quality. Fertility averaged $74.00 \pm 2.01\%$, while hatchability reached $90.00 \pm 0.55\%$ on a fertile-egg basis. Adult males recorded a hot dressing percentage of $62.50 \pm 1.34\%$ and a meat-to-bone ratio of 1.60, reflecting good carcass yield. The population also exhibited excellent scavenging ability, strong broodiness, maternal behaviour and environmental resilience, while its muscular conformation and aggressive temperament have made adult cocks culturally valued as traditional fighting birds in tribal festivals and village fairs. The study establishes Jhargrami Fowl as a distinct indigenous poultry genetic resource shaped through long-term farmer-mediated selection by tribal communities. Its unique phenotypic identity, moderate dual-purpose productivity, adaptive fitness and cultural significance justify priority for scientific recognition, molecular characterization, community-based in situ conservation and sustainable genetic improvement.

Keywords: Jhargrami Fowl, Indigenous chicken, Tribal communities, Fighting cock, Backyard poultry, Genetic resource conservation

1. Introduction

India possesses one of the world's richest reservoirs of indigenous poultry genetic resources, comprising several recognized native breeds and numerous localized non-descript chicken populations that have evolved through long-term natural and farmer-mediated selection. These populations are characterized by superior adaptation to diverse agro-climatic conditions, efficient scavenging ability, disease tolerance, broodiness, maternal behaviour and their capacity to survive under low-input backyard production systems. Consequently, indigenous chickens play a vital role in ensuring household nutrition, livelihood security and the conservation of animal genetic resources, particularly among tribal and smallholder farming communities.

The Western Plateau and Forest Region (Junglemahal) of West Bengal represent a distinctive agro-ecological landscape characterized by undulating lateritic terrain, tropical deciduous forests, rainfed agriculture and a sub-humid monsoonal climate. Within this region, the Santhal, Munda, Bhumij and Lodha tribal communities have traditionally maintained an indigenous non-descript chicken locally known as Desi Fowl. The population has been reared for generations under extensive free-range scavenging systems, where birds rely primarily on locally available feed resources and natural reproduction. Despite its widespread occurrence and socio-cultural importance, this indigenous population has received little scientific attention and remains undocumented as a distinct poultry genetic resource.

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Phenotypic characterization is the fundamental step in the identification, recognition and conservation of indigenous livestock and poultry populations. Comprehensive evaluation of morphological, productive, reproductive and adaptive traits provides essential baseline information for genetic improvement, sustainable utilization and the formulation of community-based conservation strategies. In India, similar characterization studies have contributed significantly to the recognition and conservation of several indigenous chicken breeds and non-descript populations.

Therefore, the present investigation was undertaken under the ICAR–Network Project on Animal Genetic Resources to comprehensively characterize the indigenous chicken population of the Junglemahal region, herein designated as the Jhargrami Fowl. The study aimed to document its native breeding tract, phenotypic distinctiveness, morphometric characteristics, growth, production and reproductive performance, egg and carcass quality, adaptive attributes, traditional management practices and socio-economic significance, thereby generating baseline information for its scientific recognition and long-term conservation.

2. Materials and methods

2.1 Study area

The study was conducted during 2023–2026 under the ICAR–Network Project on Animal Genetic Resources, funded by ICAR–National Bureau of Animal Genetic Resources (NBAGR), Karnal, and implemented by the West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata. The investigation covered the principal native breeding tract of the Jhargrami Fowl in the Western Plateau and Forest Region (Junglemahal) of West Bengal.

The surveyed area included Jhargram, *Purulia* and Paschim Medinipur districts, located between 21.60°–23.70° N latitude and 85.75°–87.30° E longitude. Representative blocks comprised Jhargram, Gopiballavpur and Nayagram (Jhargram); Balarampur, Baghmundi and Borabazar (*Purulia*); and Midnapore Sadar, Salboni and Garbeta (Paschim Medinipur). The region is characterized by undulating lateritic topography, red gravelly soils, tropical deciduous vegetation, annual rainfall of approximately 1,100–1,500 mm, and temperatures ranging from 4 °C to 46 °C. Backyard poultry production is the predominant production system, particularly among tribal, marginal and smallholder households, providing the natural ecological environment in which the Jhargrami Fowl has evolved and persisted.

2.2 Sampling design and field survey

A multistage stratified sampling design was adopted following the characterization guidelines of ICAR–NBAGR and the FAO for animal genetic resources. Three representative blocks were selected from each district, followed by five villages from each block based on the prevalence of indigenous backyard poultry, resulting in 45 villages covering the native breeding tract.

More than 200 households maintaining indigenous chickens for at least five years were surveyed. A total of 1,500 birds, comprising 1,000 adults (greater than 5 months of age) and 500 young birds (less than 5 months), were included for phenotypic and performance characterization. Information on flock composition, breeding practices, feeding, housing, health care, production, reproduction and socio-economic importance was collected using pre-tested questionnaires, farmer interviews and direct field observations.

2.3 Phenotypic and performance characterization

Phenotypic characterization was conducted following the ICAR–NBAGR poultry breed descriptor using standardized field protocols. Qualitative and quantitative traits were recorded separately for adult males and females to assess population characteristics, phenotypic variation and sexual dimorphism.

Qualitative traits included plumage colour and pattern, body conformation, comb type, eye and beak colour, skin pigmentation, wattle and earlobe colour, shank colour and feathering, tail characteristics,

and body posture. Trait frequencies were documented to identify the predominant phenotype, while consistent and notable variations among sexes, households and sampling locations were also recorded. Quantitative characterization included body weight, body length, chest girth, keel length, wingspan, neck length, head dimensions, bill length and width, shank length and circumference, and comb dimensions. Body weight was measured using a calibrated electronic balance, and linear measurements were obtained using a digital vernier caliper and measuring tape at standardized anatomical landmarks. These measurements were used to assess body conformation, sexual dimorphism and phenotypic variability within the population.

2.4 Growth, production and reproductive performance

Growth performance was assessed by recording body weight at hatch, 8, 12, 24 and 52 weeks of age in both sexes. Birds were weighed using a calibrated digital balance (± 1 g accuracy), preferably at a consistent time of day to minimize variation due to feeding and gut fill. Measurements were obtained from healthy birds maintained under typical village scavenging conditions and used to characterize age-related growth, sexual dimorphism and mature body size.

Production traits were evaluated using farmer records, structured interviews and repeated field observations. Parameters included age at first egg, annual egg production, clutch size and duration, clutch interval, laying cycle, and age at culling or disposal. Annual egg production was expressed as the mean number of eggs per hen per year. Wherever possible, farmer-reported information was cross-validated through field observations and flock records.

Reproductive performance was assessed under the prevailing backyard system, where natural mating and incubation predominated. Traits recorded included age at sexual maturity, fertility, hatchability, broodiness, incubation period, maternal behaviour and chick survival. Fertility was calculated as the proportion of fertile eggs among eggs set, while hatchability was expressed on both total-egg-set and fertile-egg bases. Data on production and reproductive traits were obtained from more than 500 representative birds across sampled households, with sex- and age-specific observations recorded where applicable. Standardized field protocols were followed to ensure comparability among households and sampling locations.

2.5 Egg quality and carcass evaluation

Egg quality was assessed using 310 freshly laid eggs collected from representative households and analyzed within 24 h of collection. Egg weight was measured using a calibrated digital balance (0.01 g accuracy). External quality traits included shell colour, shell weight, shell thickness and specific gravity, while internal traits comprised albumen weight, yolk weight, albumen index, yolk index and Haugh unit. Shell colour was classified visually as cream or brown, and blood and meat spots were recorded as abnormalities. All measurements were performed under standardized conditions following established poultry egg-quality procedures (Sreenivasaiah *et al.*, 2018) [1].

Carcass characteristics were evaluated in more than 100 healthy adult birds of both sexes under representative field conditions. Age at slaughter, pre-slaughter body weight, hot and cold carcass weight, dressing percentage and meat-to-bone ratio were recorded using standard poultry carcass evaluation procedures. Hot carcass weight was measured immediately after slaughter, followed by standardized chilling before determination of cold carcass weight. Dressing percentage was calculated as carcass weight relative to pre-slaughter body weight, whereas the meat-to-bone ratio was estimated from the respective edible meat and bone components. These parameters were used to assess the carcass and meat-producing potential of the population under traditional backyard management.

2.6 Mortality and adaptive traits

Mortality and survivability were assessed under the prevailing backyard production system using farmer records, structured interviews and periodic field verification. Mortality was recorded for three age intervals: 0–1, 1–8 and 8–20 weeks. Age-specific mortality (%) was calculated as the number of deaths during each interval relative to the

number of birds present at the beginning of that interval. Probable causes, including disease, predation, adverse weather, nutritional deficiencies and management-related factors, were documented wherever identifiable.

Adaptive traits were evaluated through repeated field observations and farmer interviews, focusing on scavenging ability, agility, broodiness, maternal behaviour, chick-rearing ability and environmental resilience. These observations were used to assess the survivability, hardiness and field adaptability of Jhargrami Fowl under its native low-input production environment.

2.7 Statistical analysis

Data were compiled, coded, verified and analysed using IBM SPSS Statistics Version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including mean, standard deviation (SD), standard error (SE), range, frequency and percentage, were computed as appropriate. Quantitative variables are presented as mean $\pm$ SE, while qualitative traits are expressed as frequencies and percentages. The findings were summarized in tables and graphical form, with figures prepared using Microsoft Excel where applicable. The analysis was primarily descriptive and aimed to characterize phenotypic variation, growth, production, reproductive performance, egg quality and adaptive attributes of Jhargrami Fowl under traditional backyard conditions.

3. Results

3.1 Origin and development

Field investigations established that the Jhargrami Fowl is an indigenous non-descript chicken population traditionally maintained in the Junglemahal region of the Western Plateau and Forest Region of West Bengal. The population was predominantly associated with tribal and rural communities, particularly the Santhal, Munda, Bhumij and Lodha communities, who have traditionally served as its principal custodians. Flocks were maintained through natural mating and farmer-mediated selection rather than through organized breeding programmes.

Farmers preferentially retained birds possessing desirable attributes such as survivability, scavenging ability, broodiness, maternal behaviour, and satisfactory meat and egg production for subsequent flock replacement. Continued selection under comparable ecological and management conditions was associated with the development of a recognizable phenotypic type throughout the native breeding tract. Although variation in plumage pattern and colour intensity was observed, the population generally exhibited medium-to-large body size and a muscular, game-type conformation.

The population did not correspond closely to any recognized commercial, improved or exotic chicken breed based on field-level phenotypic assessment. No direct evidence of deliberate introduction of exotic germplasm was identified during the survey. The combination of a recognizable phenotype, geographical concentration and long-term farmer-mediated selection supports the characterization of Jhargrami Fowl as a distinct indigenous non-descript chicken population maintained within a traditional community-based production system.

3.2 Distribution and management practices

The Jhargrami Fowl was predominantly distributed across Jhargram, Purulia and Paschim Medinipur districts of West Bengal, with greater concentration in forest-fringe, tribal-dominated and rural areas. The principal geographical range extended approximately between 21.60°–23.70° N latitude and 85.75°–87.30° E longitude. Major areas of occurrence included Jhargram, Gopiballavpur, Jambani and Nayagram blocks of Jhargram district; Borabazar, Balarampur and Bagmundi blocks of Purulia district; and Midnapur Sadar, Salbani and Garbeta blocks of Paschim Medinipur district.

The native tract was characterized by undulating lateritic terrain, red and lateritic soils, tropical deciduous vegetation, seasonal monsoon rainfall and predominantly rainfed agriculture. The birds were locally referred to as *Desi Fowl*. Based on the principal geographical concen-

tration of the population in Jhargram district, the name Jhargrami Fowl is proposed for this indigenous chicken population.

The average household flock consisted of approximately 8–9 birds, comprising about 20% cocks, 52% hens and 28% chicks. Most households maintained one or two breeding cocks with several hens, while surplus males were utilized for household consumption, meat production and live-bird sales. In some communities, adult males were also associated with traditional cockfighting. The proportion of chicks within household flocks indicated regular natural replacement of birds.

Management was predominantly low-input and backyard-based. Birds were generally allowed to range freely around homesteads, crop fields and forest margins, where they scavenged for insects, termites, earthworms, grains, weed seeds, crop residues and household waste. Supplementary feed, when provided, consisted mainly of locally available paddy, broken rice, maize and wheat bran. Simple night shelters constructed from locally available materials were used for protection from predators and adverse weather. Natural brooding was the principal method of chick production. Health-care interventions were generally limited to occasional vaccination, deworming and traditional ethnoveterinary practices.

3.3 Phenotypic characterization

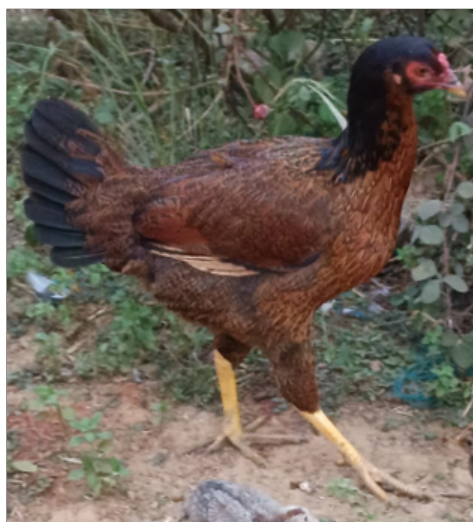
The Jhargrami Fowl exhibited a recognizable phenotypic type characterized by medium-to-large body size, muscular game-type conformation, erect carriage and a strong skeletal framework. The predominant field-identification features included mahogany to reddish-brown plumage, glossy black tail feathers with greenish iridescence, yellow featherless shanks, a prominent single red comb and a compact, muscular body. Some variation in plumage pattern and colour intensity was observed among individual birds.



Adult Cock: Adult males were medium to large in size and possessed an elongated, muscular body with a broad chest, strong neck, prominent shoulders and well-developed thighs. Plumage was predominantly deep mahogany to reddish-brown, with glossy black coloration on the wings, breast, abdomen and lower body. Neck hackles were generally golden-red to coppery red. The tail was high-set and composed of long, curved, sickle-shaped black feathers with metallic green iridescence.

The head was broad, with dark brown to black eyes, a strong yellow beak, a prominent single red comb and well-developed red wattles and earlobes. The shanks and feet were long, strong and yellow, with no feathering.

Adult Hen: Females were smaller and more compact than males, with a sturdy body and well-developed abdominal region. Plumage was predominantly brown to reddish-brown, with fine black mottling over the neck, back, wings and body. The head and neck were comparatively darker, while the tail was dark brown to black, moderately broad and slightly upright.



The comb was small to medium-sized and red, accompanied by small red wattles and earlobes. The beak and featherless shanks were yellow. Broodiness and pronounced maternal behaviour were frequently observed among hens. Hand Fan like black tail.

3.4 Growth performance

Body weight increased progressively from hatch to 52 weeks of age in both sexes. Males consistently exhibited higher body weights than females, with the magnitude of sexual dimorphism increasing with age. Mean hatch weight was 35.00 ± 1.34 g, with a range of 29–48 g. At 8 weeks of age, mean body weight was 275.00 ± 1.98 g in males (265–280 g) and 255.00 ± 1.34 g in females (218–272 g). At 12 weeks, the corresponding values increased to 490.00 ± 3.05 g (390–520 g) in males and 465.00 ± 2.76 g (380–495 g) in females. By 24 weeks, males attained a mean body weight of 870.00 ± 4.98 g (720–910 g), compared with 795.00 ± 2.01 g (690–850 g) in females. At 52 weeks, mean body weight reached $2,180.00 \pm 5.21$ g (1,780–2,890 g) in males and $1,750.00 \pm 4.42$ g (1,400–2,200 g) in females. Thus, males maintained a higher body weight throughout the recorded growth period.

Table 1. Growth Performance

Age	Sex	Body Weight (g)		Observation
		Mean $\pm$ SE	Range	
Hatch		35 ± 1.34	29–48	360
8 weeks	Male	275 ± 1.98	265–280	37
	Female	255 ± 1.34	218–272	420
12 weeks	Male	490 ± 3.05	390–520	99
	Female	465 ± 2.76	380–495	540
24 weeks	Male	870 ± 4.98	720–910	65
	Female	795 ± 2.01	690–850	620
52 Weeks	Male	2180 ± 5.21	1780–2890	430
	Female	1750 ± 4.42	1400–2200	780

3.5 Egg production performance

Jhargrami hens exhibited moderate egg production under traditional backyard management. The mean age at first egg was 210.00 ± 2.01 days, ranging from 185 to 225 days. Annual egg production averaged

81.00 ± 0.98 eggs per hen, with a range of 65–98 eggs. Mean clutch size was 10.00 ± 0.23 eggs (8–16), while the mean clutch interval was 25.00 ± 0.22 days (18–27 days). The mean laying cycle was 12.00 ± 0.52 months, ranging from 9 to 17 months. The mean age at culling was 25.00 ± 1.01 months, with a range of 22–32 months.

Table 2. Egg Production Performance

Trait	Mean $\pm$ SE	Range	No. of observations
Age at first egg (days)	210.00 ± 2.01	185–225	580
Annual egg production (no.)	81.00 ± 0.98	65–98	670
Clutch size (eggs)	10.00 ± 0.23	8–16	670
Clutch interval (days)	25.00 ± 0.22	18–27	670
Laying cycle (months)	12.00 ± 0.52	9–17	670
Age at culling (months)	25.00 ± 1.01	22–32	470

3.6 Egg quality characteristics

A total of 310 fresh eggs collected from the native breeding tract were evaluated for external and internal quality characteristics. Mean egg weight was 41.20 ± 0.62 g, ranging from 38 to 45 g. Mean shell, albumen and yolk weights were 3.80 ± 0.08 g (3.2–4.4 g), 24.00 ± 0.43 g (21–27 g) and 12.50 ± 0.25 g (11–14 g), respectively.

Mean shell thickness was 320 ± 5.60 μ m, ranging from 280 to 360 μ m, while mean specific gravity was 1.073 ± 0.001 (1.065–1.080). The albumen index averaged $7.80 \pm 0.14\%$ (6.8–8.6%), and the yolk index was $42.50 \pm 0.46\%$ (39–46%). The mean Haugh unit was 76.50 ± 0.68 , with values ranging from 70 to 82. Shell colour varied from

light brown to brown. The albumen was generally clear, firm and moderately viscous. Inclusion bodies were absent in the majority of eggs examined.

Table 3. Egg Quality Characteristics

Trait	Mean $\pm$ SE	Range
Egg weight (g)	41.20 ± 0.62	38–45
Shell weight (g)	3.80 ± 0.08	3.2–4.4
Albumen weight (g)	24.00 ± 0.43	21–27
Yolk weight (g)	12.50 ± 0.25	11–14

(continued on next page)

Trait	Mean $\pm$ SE	Range
Shell thickness (μm)	320 $\pm$ 5.60	280–360
Specific gravity	1.073 $\pm$ 0.001	1.065–1.080
Albumen index (%)	7.80 $\pm$ 0.14	6.8–8.6
Yolk index (%)	42.50 $\pm$ 0.46	39–46
Haugh unit	76.50 $\pm$ 0.68	70–82
Shell colour	Light brown to brown	—
Albumen quality	Clear, firm and moderately viscous	—
Inclusion bodies	Absent	Absent in majority

3.7 Carcass characteristics

Marked sexual differences were recorded in carcass characteristics. Adult males were slaughtered at a mean age of 52.00 $\pm$ 1.34 weeks (49–63 weeks), whereas females were slaughtered at 58.00 $\pm$ 1.09 weeks (51–67 weeks). Mean hot carcass weight was 1,240.00 $\pm$ 1.11 g in males, ranging from 980 to 1,320 g, compared with 915.00 $\pm$ 1.56 g in females (765–975 g). Corresponding cold carcass weights were 1,120.00 $\pm$ 1.78 g (960–1,225 g) in males and 830.00 $\pm$ 0.76 g (655–875 g) in females. Hot dressing percentage averaged 62.50 $\pm$ 1.34% in males and 60.58 $\pm$ 2.01% in females, while cold dressing percentage was 58.35 $\pm$ 2.04% and 55.48 $\pm$ 2.56%, respectively. The mean meat-to-bone ratio was 1.60 in males (1.57–1.72) and 1.53 in females (1.48–1.64).

Table 4. Carcass Characteristics

Trait	Sex	Mean $\pm$ SE	Range	Observation
Age at slaughter (weeks)	Male	52.00 $\pm$ 1.34	49–63	50
	Female	58.00 $\pm$ 1.09	51–67	50
Hot carcass weight (g)	Male	1240.00 $\pm$ 1.11	980–1320	50
	Female	915.00 $\pm$ 1.56	765–975	50
Cold carcass weight (g)	Male	1120.00 $\pm$ 1.78	960–1225	50
	Female	830.00 $\pm$ 0.76	655–875	50
Hot dressing (%)	Male	62.50 $\pm$ 1.34	52.40–67.76	50
	Female	60.58 $\pm$ 2.01	51.64–67.32	50
Cold dressing (%)	Male	58.35 $\pm$ 2.04	49.28–65.34	50
	Female	55.48 $\pm$ 2.56	47.35–62.18	50
Meat-to-Bone Ratio	Male	1.60	1.57–1.72	50
	Female	1.53	1.48–1.64	50

3.8 Reproductive performance

Natural mating and brooding predominated throughout the native breeding tract. Jhargrami hens exhibited strong broodiness and maternal behaviour, enabling efficient natural flock replacement. Mean fer-

tility was 74.00 $\pm$ 2.01% (70–78%). Hatchability averaged 90.00 $\pm$ 0.55% on a fertile-egg basis (85–95%) and 68.00 $\pm$ 0.32% on a total egg-set basis (64–72%). The observed reproductive characteristics included natural brooding, satisfactory fertility and successful hatching under the prevailing village breeding system.

Table 5. Reproductive Performance

Trait	Mean $\pm$ SE	Range	No. of observations
Broodiness	Usual	—	—
Fertility (%)	74.00 $\pm$ 2.01	70–78	270
Hatchability on fertile egg basis (%)	90.00 $\pm$ 0.55	85–95	270
Hatchability on total egg-set basis (%)	68.00 $\pm$ 0.32	64–72	270

3.9 Mortality and survivability

Mortality was highest during the first week of life and declined progressively with increasing age. Mortality during 0–1 week averaged 29.00 $\pm$ 0.83% (24–34%), decreasing to 15.00 $\pm$ 1.01% (10–18%) during 1–8 weeks and 7.00 $\pm$ 0.66% (5–9%) during 8–20 weeks. Field observations indicated that mortality during the early rearing period was principally associated with predation, adverse weather conditions, inadequate brooding and limitations in chick management. Mortality declined substantially after the early brooding period.

Table 6. Age Specific Mortality Pattern (%)

Age group	Mean $\pm$ SE(%)	Range (%)	Observation
0–1 week	29 $\pm$ 0.83	24–34	175
1–8 weeks	15 $\pm$ 1.01	10–18	280
8–20 weeks	7 $\pm$ 0.66	5–9	217

3.10 Adaptive traits

Under the prevailing extensive management system, Jhargrami Fowl displayed several field-observed adaptive characteristics. Birds were active and efficient scavengers and utilized a wide range of locally available feed resources, including insects, termites, earthworms, weed seeds, crop residues and household food waste.

Agility, alertness and stamina were consistently observed during free-range rearing. Adult cocks exhibited an erect posture, strong musculature and pronounced activity, whereas hens commonly displayed broodiness, maternal behaviour and effective chick-rearing ability. These traits were observed in association with the population's persistence under low-input backyard production conditions.

3.11 Socio-economic and cultural importance

Jhargrami Fowl formed an integral component of the livelihood system of tribal and smallholder households within the native tract. Birds contributed directly to household food security through the provision of meat and eggs, while the sale of live birds generated supplementary household income.

In addition to its productive value, the population had cultural importance in several communities. Adult cocks were traditionally used in cockfighting in some areas, particularly during village fairs and local festivals. The combined nutritional, economic and cultural utility of the birds contributed to their continued maintenance by rural and tribal households.

3.12 Conservation significance

Field investigations identified indiscriminate crossbreeding, reduction of scavenging habitats and increasing adoption of improved poultry varieties as major factors potentially affecting the maintenance of the Jhargrami Fowl population. The population's restricted geographical concentration, recognizable phenotypic characteristics and continued dependence on traditional community-based management highlight its importance as an indigenous poultry genetic resource.

The observed threats, together with increasing changes in rural production systems, indicate the need for systematic documentation, genetic characterization and community-based conservation of the population. Maintenance of breeding populations within the native tract, together with farmer-participatory selection and sustainable improvement strategies, would help retain its adaptive and productive characteristics while reducing the risk of genetic erosion.

4. Discussion

The present investigation provides a comprehensive phenotypic and production characterization of the Jhargrami Fowl, an indigenous non-descript chicken population traditionally maintained in the Jangalmahal region of the Western Plateau and Forest Region of West Bengal. The population showed a recognizable phenotypic type, moderate growth and egg production, satisfactory reproductive performance, useful carcass characteristics and several adaptive traits under predominantly low-input backyard conditions. Collectively, these characteristics distinguish Jhargrami Fowl as a locally adapted poultry genetic resource with substantial importance to the tribal and smallholder production systems of southwestern West Bengal.

4.1 Native tract, distribution and low-input production system

Jhargrami Fowl showed a geographically concentrated native distribution in the Western Plateau and Forest Region (Jangalmahal) of West Bengal, mainly across Jhargram, *Purulia* and Paschim Medinipur. Its predominance in forest-fringe and tribal villages and continued maintenance under backyard systems indicate adaptation to local agro-ecological conditions and prolonged natural and farmer-mediated selection. The distribution across specific blocks within these districts further indicates a relatively defined breeding tract rather than a uniformly distributed backyard population. Similar geographical and phenotypic differentiation among indigenous chickens has been reported in eastern India, reflecting the influence of environment, traditional husbandry and farmer preferences (Banerjee, 2012; Padhi, 2016) [2].

The persistence of Jhargrami Fowl within tribal production systems appears to reflect both environmental adaptation and farmer-mediated selection. Santhal, Munda, Bhumij, Lodha and other communities have traditionally retained birds with survivability, scavenging ability, reproductive fitness, broodiness, maternal behaviour and desirable body conformation. Such selection is consistent with the broader role of indigenous chickens, which are valued by smallholders not only for production but also for adaptability, resilience and socio-cultural functions (Padhi, 2016) [2]. Indigenous chickens are particularly suited to environments where purchased feed, housing and veterinary inputs are limited, making adaptive fitness an important component of their production value.

The relatively small household flock size of 8–9 birds, with continuous recruitment through natural reproduction, is characteristic of a subsistence-oriented family poultry system. The retention of one or two breeding cocks and utilization of surplus males for household consumption and local sale indicate that Jhargrami Fowl functions simultaneously as a source of food, income and household livestock

capital. Similar multifunctional roles of indigenous chickens have been reported in rural India, where backyard birds contribute to household nutrition and supplementary income despite modest productive inputs (Padhi, 2016) [2]. The reported cultural use of adult cocks for cockfighting in some communities further demonstrates that the population has value beyond conventional meat and egg production.

Management was predominantly free-range and scavenging-based, with birds utilizing locally available biological and agricultural resources and receiving limited supplementation. Simple housing, natural mating and brooding, and variable access to vaccination and deworming are consistent with the low-input production systems documented for indigenous chickens in other Indian regions. Singh *et al.* (2016), for example, characterized native chicken populations of tribal *Odisha* as being maintained under family-based free-range scavenging systems, while a study from Assam similarly reported scavenging with supplemental feeding, locally constructed housing and limited preventive healthcare. These similarities suggest that the Jhargrami production system forms part of a broader indigenous poultry production strategy in which birds compensate for limited external inputs through scavenging ability, natural reproduction and environmental resilience.

Importantly, the present findings should not be interpreted as evidence that Jhargrami Fowl is genetically distinct solely on the basis of its distribution and phenotype. Phenotypic variation among indigenous chickens can arise from both genetic and environmental influences, and molecular characterization is required to establish population structure and genetic distinctiveness. This is particularly relevant because native chicken populations in eastern India may be affected by admixture and replacement with improved germplasm (Banerjee, 2012). Nevertheless, the defined native tract, sustained community-based management, adaptive characteristics and low-input production system collectively establish Jhargrami Fowl as a valuable indigenous poultry genetic resource.

4.2 Phenotypic distinctiveness

Jhargrami Fowl exhibited a distinct and relatively consistent phenotype characterized by medium-to-large body size, muscular game-type conformation, erect carriage, mahogany to reddish-brown plumage, glossy black tail feathers, yellow shanks and a single red comb. The consistency of these traits across Jhargram, *Purulia* and Paschim Medinipur, with only minor variation in plumage intensity and pattern, indicates a recognizable indigenous population. Such phenotypic differentiation among Indian native chickens is commonly influenced by geographical environment, natural selection and farmer preferences under low-input production systems (Kundu *et al.*, 1999; Dana *et al.*, 2010; Haunshi *et al.*, 2011; Padhi, 2016) [4, 3, 5, 2].

The phenotype of Jhargrami Fowl also shows similarities with other Indian indigenous chickens while retaining its own characteristic combination of traits. Plumage colour, comb type, shank pigmentation and body conformation are important descriptors used to differentiate native populations, as reported for Ghagus, Nicobari and other indigenous chickens (Vali *et al.*, 2006; Ahlawat *et al.*, 2012; Padhi *et al.*, 2015) [7, 6, 8]. In contrast to the black plumage and fibromelanosis of Kadaknath and the distinctive compact conformation of Aseel, Jhargrami Fowl is characterized by mahogany to reddish-brown plumage, yellow shanks and a robust game-type body, together with a strong geographical association with Jangalmahal.

Marked sexual dimorphism was evident, with males showing greater body size, muscular development, shank length and secondary sexual characters than females. Similar male-biased morphological development has been reported in Aseel, Ghagus and Kadaknath (Haunshi *et al.*, 2011; Rajkumar *et al.*, 2017; Haunshi *et al.*, 2022) [5, 9, 10]. The robust male phenotype may reflect both biological sexual dimorphism and prolonged farmer selection for hardy cocks valued for meat and traditional cultural purposes.

Collectively, the consistent phenotype, defined geographical association and long-term community-based selection support the recogni-

tion of Jhargrami Fowl as an important indigenous non-descript chicken population. Nevertheless, phenotypic similarity alone cannot establish genetic distinctiveness; molecular characterization is required to clarify its genetic structure and relationship with other Indian chicken populations. Conservation and genetic improvement should therefore aim to enhance productive traits while retaining its characteristic phenotype and adaptive attributes.

4.3 Growth performance and sexual dimorphism

Jhargrami Fowl exhibited a steady increase in body weight from hatch to maturity, with males consistently outperforming females at all ages, demonstrating pronounced sexual dimorphism. The mature body weights of 2.18 kg in males and 1.75 kg in females classify the population among the heavier indigenous backyard chickens of India, indicating good genetic potential for meat production under extensive scavenging conditions.

The superior growth of males agrees with the well-established pattern in indigenous chickens, where androgen-mediated muscle development and sex-dependent growth regulation result in greater body weight and larger body conformation (Haunshi *et al.*, 2011; Rajkumar *et al.*, 2017) [5, 10]. Similar sexual dimorphism has been reported across Indian native chicken populations, although the magnitude varies with breed, nutrition and management.

Compared with other indigenous breeds, the adult body weight of Jhargrami Fowl exceeds that reported for Kadaknath, Ghagus and most non-descript village chickens of eastern India, while remaining comparable to the heavier Aseel ecotypes (Chatterjee *et al.*, 2007; Padhi, 2016; Haunshi *et al.*, 2022) [11, 2, 9]. Earlier studies by Kundu *et al.* (1999) [4] and Haunshi *et al.* (2011) [5] also demonstrated substantial diversity in growth performance among Indian indigenous chickens, highlighting the influence of genetic background and agro-ecological adaptation.

The ability of Jhargrami Fowl to attain a substantial mature body size despite minimal nutritional supplementation reflects its efficient utilization of locally available feed resources and adaptation to the resource-constrained environment of the Western Plateau and Forest Region. This combination of robust growth, resilience and marked sexual dimorphism enhances its value as a promising indigenous genetic resource for sustainable backyard meat production and rural livelihood improvement.

4.4 Egg production and egg quality

Jhargrami hens attained sexual maturity at 210.00 ± 2.01 days and produced 81.00 ± 0.98 eggs per hen per year under traditional backyard management. The moderate laying rate, together with a relatively late onset of sexual maturity, is characteristic of indigenous chickens maintained under low-input, scavenging systems, where reproductive performance is shaped by genetic adaptation, seasonal feed availability and the retention of broodiness. The annual egg production recorded in the present study falls within the range generally reported for indigenous Indian chickens reared under extensive or semi-scavenging conditions (Dana *et al.*, 2010; FAO, 2011; Haunshi *et al.*, 2013) [3, 12, 13]. Unlike commercial layers selected primarily for sustained egg output, Jhargrami Fowl appears to follow a dual-purpose reproductive strategy in which moderate egg production is accompanied by natural incubation and flock replacement.

The age at first egg of 210 days was relatively high compared with intensively selected chicken populations, but is broadly comparable with several indigenous Indian populations characterized by slower maturity and greater adaptation to extensive production systems. Such delayed sexual maturity may reflect the combined influence of genotype, nutritional constraints and environmental conditions under backyard management. Similar patterns have been reported in indigenous populations such as Kadaknath and Ghagus, in which reproductive development is generally slower than in improved commercial strains (Chatterjee *et al.*, 2010; Haunshi *et al.*, 2022) [14, 9]. Therefore, the relatively late maturity of Jhargrami hens should be interpreted in the

context of their production environment and adaptive reproductive strategy rather than as an isolated limitation of productivity.

The reproductive pattern was further characterized by a mean clutch size of 10.00 ± 0.23 eggs and a clutch interval of 25.00 ± 0.22 days. This intermittent laying pattern is consistent with the biological tendency of indigenous hens to alternate between periods of egg production and reproductive activities such as broodiness. Such behaviour is particularly advantageous under village conditions because it facilitates natural incubation and replacement of the flock without dependence on artificial hatcheries. Comparable reproductive patterns have been documented in indigenous chickens of India, where broodiness and natural reproduction remain important components of the production system (Kundu *et al.*, 1999; Padhi *et al.*, 2015; Rajkumar *et al.*, 2018) [4, 8, 15]. Thus, the reproductive characteristics of Jhargrami Fowl indicate that its production value extends beyond egg number alone and includes its capacity for self-replacement under low-input management.

The eggs of Jhargrami Fowl were relatively small, with a mean egg weight of 41.20 ± 0.62 g, but showed favourable external and internal quality characteristics. Mean shell thickness (320 ± 5.60 μ m), specific gravity (1.073 ± 0.001) and Haugh unit (76.50 ± 0.68) indicated satisfactory shell strength and albumen quality. The observed values are within the broad range reported for indigenous Indian chickens, although differences among populations may arise from genetic background, hen age, nutrition, season and management system (Ram *et al.*, 2008; Haunshi *et al.*, 2011; Chatterjee *et al.*, 2010) [16, 5, 14]. The comparatively good shell characteristics are particularly relevant under backyard conditions, where eggs may be exposed to prolonged handling and storage before household consumption or local sale.

Overall, Jhargrami Fowl exhibited a moderate egg-production potential combined with satisfactory egg quality and a pronounced natural reproductive capacity. Although its annual egg yield is substantially lower than that of specialized commercial layers, direct comparison with such strains is inappropriate because Jhargrami Fowl has evolved under a different selection environment and production objective. Its value lies in the integrated combination of adaptability, natural brooding, flock replacement, acceptable egg quality and regular household-level egg production. Consequently, future conservation and genetic improvement programmes should aim to enhance productive efficiency without compromising the reproductive and adaptive traits that underpin the sustainability of this indigenous population.

4.5 Carcass characteristics and meat utility

Jhargrami Fowl exhibited favourable carcass traits, particularly in males, with a hot carcass weight of 1.24 kg and a dressing percentage of 62.5%, compared with 0.92 kg and 60.6% in females. The superior carcass yield and meat-to-bone ratio of males corresponded with their greater mature body weight and muscular game-type conformation, indicating efficient meat recovery under extensive backyard production.

The relatively large body size and substantial carcass yield of adult Jhargrami birds reinforce their importance as a meat-producing indigenous population. The practice of retaining birds until adulthood before slaughter indicates that farmers value mature cocks and hens not only for reproduction but also for their meat and market value. Indigenous chicken meat is traditionally preferred in many parts of India because of its distinctive flavour, texture and perceived quality, providing an additional economic advantage over purely quantitative production traits.

The carcass characteristics of Jhargrami Fowl are comparable with the broad range reported for indigenous and improved native chicken populations, although direct comparisons are influenced by slaughter age, sex, body weight, nutritional status and dressing methodology. Rajkumar *et al.*, 2016; Chatterjee *et al.*, 2016; Haunshi *et al.*, 2022 [9] stated that Indian native chickens have demonstrated substantial variation in carcass yield associated with genotype and management. The combination of mature body size and adaptation to low-input rearing

therefore enhances the potential of Jhargrami Fowl as a locally valuable meat bird, particularly in niche markets seeking indigenous chicken products.

4.6 Reproductive performance, broodiness and chick survival

Jhargrami Fowl exhibited satisfactory reproductive performance under traditional backyard management, with 74% fertility and 90% hatchability on a fertile-egg basis. The relatively high hatchability indicates effective maternal brooding and favourable embryonic survival despite the absence of artificial incubation facilities. Broodiness was a prominent characteristic, with natural incubation by hens serving as the principal means of chick production and flock replacement. Comparable reproductive traits have been reported in indigenous chickens such as Aseel, Ghagus and Nicobari, where strong maternal behaviour contributes to sustainable flock maintenance (Kundu *et al.*, 1999; Chatterjee *et al.*, 2007; Haunshi *et al.*, 2013) [4, 11, 13].

The persistence of broodiness, unlike in intensively selected commercial layers, is particularly advantageous under tribal and smallholder production systems. Natural brooding reduces dependence on artificial incubation and purchased chicks, thereby lowering production costs and supporting continuous household flock replacement (FAO, 2011; Rajkumar *et al.*, 2018) [12, 15].

Chick mortality was highest during the first week (29%), declining to 15% during 1–8 weeks and 7% during 8–20 weeks, indicating that early life is the most critical period for survival. Similar age-related mortality patterns have been reported in indigenous village chickens, where predation, inadequate brooding, disease exposure, adverse weather and nutritional constraints contribute substantially to early chick losses (Dana *et al.*, 2010; Padhi, 2016; Rajkumar *et al.*, 2016) [3, 2, 17]. The combination of satisfactory hatchability, strong maternal behaviour and increasing survivability with age reflects the adaptive fitness of Jhargrami Fowl under low-input conditions. Improving early chick care through better brooding, predator protection, vaccination and strategic supplementation could enhance flock productivity without compromising its traditional production system.

4.7 Socio-economic and cultural importance

Jhargrami Fowl serves as a multipurpose livelihood resource for tribal, marginal and smallholder households, contributing to household nutrition and supplementary income through eggs, meat and live-bird sales. Its low-input management, scavenging ability and capacity for natural reproduction reduce dependence on purchased feed and infrastructure, making it particularly suitable for resource-constrained production systems. Similar multifunctional roles of indigenous poultry in supporting rural nutrition, income and livelihood resilience have been reported in India (FAO, 2011; FAO, 2012; Padhi, 2016) [12, 18, 2].

The population also has cultural significance, with adult cocks traditionally associated with cockfighting during village fairs, festivals and social gatherings in some communities. This practice may have contributed to farmer preference for vigorous, active and muscular males. However, the principal household value of Jhargrami Fowl remains its contribution to food security, supplementary income and natural flock replacement. Thus, its combined productive, reproductive, livelihood and cultural functions enhance the value of Jhargrami Fowl as an indigenous poultry genetic resource.

4.8 Conservation significance and future utilization

The combined evidence of geographical concentration, recognizable phenotype, adaptation to low-input management, reproductive ability and household utility indicates that Jhargrami Fowl represents a valuable indigenous chicken genetic resource of West Bengal. Its continued existence is closely linked with traditional farming communities and the maintenance of backyard production systems. However, increasing replacement of indigenous birds by commercial germplasm, uncontrolled crossbreeding, changing land-use patterns and gradual erosion of traditional management practices may threaten the integrity of such populations.

Conservation should therefore combine in situ maintenance within the native tract with systematic phenotypic, production and genetic characterization. Community-based breeding programmes could emphasize economically useful traits while retaining adaptive and reproductive attributes. Documentation of the population under national animal genetic-resource programmes is particularly important because scientifically validated characterization provides the foundation for recognition, conservation and sustainable utilization. The Jhargrami Fowl consequently has potential not only as a reservoir of adaptive genetic diversity but also as a resource for developing locally appropriate, climate-resilient and low-input poultry production systems.

5. Conclusion

The present study establishes the Jhargrami Fowl as a distinct and valuable indigenous non-descript chicken population of the Western Plateau and Forest Region of West Bengal. Its distinctive phenotype, hardiness, scavenging ability, natural broodiness, reproductive fitness, and satisfactory egg and meat production demonstrate strong adaptation to low-input backyard systems and highlight its importance to tribal and smallholder households.

The comprehensive baseline information generated on its phenotypic, productive, reproductive, adaptive and socio-economic attributes supports its recognition as an important poultry genetic resource. However, indiscriminate crossbreeding, replacement by improved varieties and declining scavenging resources pose risks to its genetic integrity. Conservation through sustainable utilization, supported by in situ conservation, molecular characterization, population monitoring and farmer-participatory breeding, is therefore essential to safeguard its genetic identity and enhance its contribution to resilient backyard poultry production and rural livelihoods.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Ethical statement

The study involved field observations and non-invasive phenotypic characterization of ducks maintained under farmers' production systems. No experimental procedures causing stress or harm to animals were undertaken. Data were collected with prior consent of the participating farmers.

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