

# Research Note: Characterization of peasant family poultry farming in Southern Chile

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**ABSTRACT** The poultry industry produces most of the meat and eggs for human consumption worldwide. However, family poultry farming still plays an important role in developing countries providing high quality animal products including eggs and poultry meat for family and local consumption.

A field survey was taken to 145 family poultry farmers off the commune of Maullín, Los Lagos Region of Southern Chile, to describe their husbandry and breeding practices, and provide information for future development and conservation priorities. Egg production in these poultry systems of the Maullín commune is a family tradition, run mostly by women, provides an extra income from the sale of extra eggs and chicken meat during autumn and winter months. Flocks of 15 to 30 native, creole or indigenous hens, reach point of lay at 5 or 6 months old. Egg production with a mean rate of

40%, peaks during September. Brown eggs are the most frequent, followed by blue-greenish eggs derived from Mapuche fowl ancestry. A ratio of 10 to 20 females per rooster results in ca. 60% hatching rate from natural incubation. While males are kept for two seasons only, females are kept longer, some until old. Diet is based on locally available or self-produced grains, complemented by pasture browsing, scavenging, and kitchen waste. Sanitary management is low or none and technical knowledge derives from ancestral tradition. Investment in accommodation and feeding is low. Results provide information on these systems in non-tropical areas of developing countries where it is scarce, and highlights how these systems can respond to the challenges of future poultry production, considering both climate change and consumers demand for more wholesome, human and sustainable products.

**Key words:** Creole chickens, backyard poultry, Southern Chile, blue eggs

2023 Poultry Science 102:102339

<https://doi.org/10.1016/j.psj.2022.102339>

## INTRODUCTION

The modern poultry industry, standard of efficiency and technology adoption, has become the number one provider of animal protein for the human population however, the growing concerns about animal welfare are a threat for consumer acceptance and sustainability. These include (1) confinement in restricted space (2) short production cycles (that is, elimination of layers after one laying cycle and slaughter of broilers at less than 40 d old), (3) elimination of day-old males after

sexing for layers, and use of feedstuffs otherwise available for direct human consumption.

Intensive poultry eggs and meat production began in Chile in the 1950s. Currently, 98.2% of industrial egg production still uses conventional battery cages by a few big companies (Aguirre and Pizarro, 2018). The Egg Chilean Association represent 70% of the total egg production in Chile. On the other hand, there is a large but indeterminate number of small flocks managed as backyard production systems that provide eggs and meat for household sufficiency and local sale of surpluses (Berkhoff et al., 2020). These production systems involve little resources and technology, require minor attention by a family and have low productivity.

In Chile, the family or backyard poultry breeding production is officially defined as “an activity developed by poultry owners for self-consumption or local sale, without tax payment registration and with a number of less than 500 total birds” (SAG, 2016). Family poultry

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Received August 9, 2022.

Accepted November 8, 2022.

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farming is widely distributed throughout the country, mainly in rural areas as well as in urban margins (Aguirre and Pizarro, 2018). There are no precise data regarding the actual production of this sector and even less information about their egg production, despite the fact that this production system plays a significant socioeconomic role in domestic economy. Thus, the aim of this study was to describe the husbandry and breeding practices of family poultry farmers from southern Chile and provide information for future development of poultry production, considering both climate change and consumers demand for more wholesome and sustainable products.

## MATERIALS AND METHODS

### Study Area

The study area selected was the Maullín commune in Southern Chile. This commune belongs to the Province of Llanquihue, in the Los Lagos Region, located at Latitude  $-41.6167$ , Longitude  $-73.6$  ( $41^{\circ} 37' 0''$  South,  $73^{\circ} 36' 0''$  West), 945 km south of Santiago, the Capital of Chile. The commune has a population of 14,216 inhabitants in an area of 860.8 km<sup>2</sup> (INE, 2017).

### Sample Selection

Within the geographical area of study, family farms which had small nuclei of Creole chickens inside the property, as a complementary activity to their main source of income, were selected. The selection of farmers was carried out with the guidance of the area chief of the Maullín Agricultural Development Institute (from the Spanish abbreviation "INDAP") and the advisers of this institution, in order to have a representative distribution of the agricultural areas of the commune.

### Sample Size

Following a probabilistic sampling model (Burns and Bush, 2014), a representative sample size of  $n = 138$  was calculated as:

$$n = \left[ \frac{z^2 p(1-p)}{e^2} \right] \quad (1)$$

where:  $n$  = Sample size.  $z$  = is the standard error associate with the chosen confidence level (95%).

$P$  = is the estimated variance of the population, which in this case is low ( $P = 0.1$ ) considering the similarity of the respondent (small farmers with similar production systems).  $e$  = is the accepted error (5%).

### Survey Design and Application

The survey was designed in 2 parts: the first related to personal information and objectives, the second covering information regarding their production and breeding

systems. The surveys were carried out face-to face to 145 respondents, during the summer of 2020. The Research Bioethics Committee approved the study and granted a Constancy No. C24-2019 for the need of consent.

### Survey Development

The survey was divided into 5 sections: (I) Farm data that included 6 general questions regarding farm characteristics; (II) Laying cycle; (III) Feeding and housing conditions; (IV) Sanitary management and; (V) Characteristics of Creole chickens.

### Information Processing

Data was analysed as binary and discrete dependent variables and expressed as proportions, with the SAS GENMOD procedure (version 9.4; SAS Inst. Inc., Cary, NC), defining a binomial distribution and a logarithmic model so that:

$$n_i = \log\left[\frac{p_i}{(1-p_i)}\right] = m + \tau_i \quad (2)$$

Where  $p_i$  corresponds to the probability of success,  $m$  is the general mean of the proportion on a logarithmic scale and  $\tau_i$  the effect of the group. The least squares measurement method was used to establish statistical differences between the evaluated parameters ( $P < 0.05$ ).

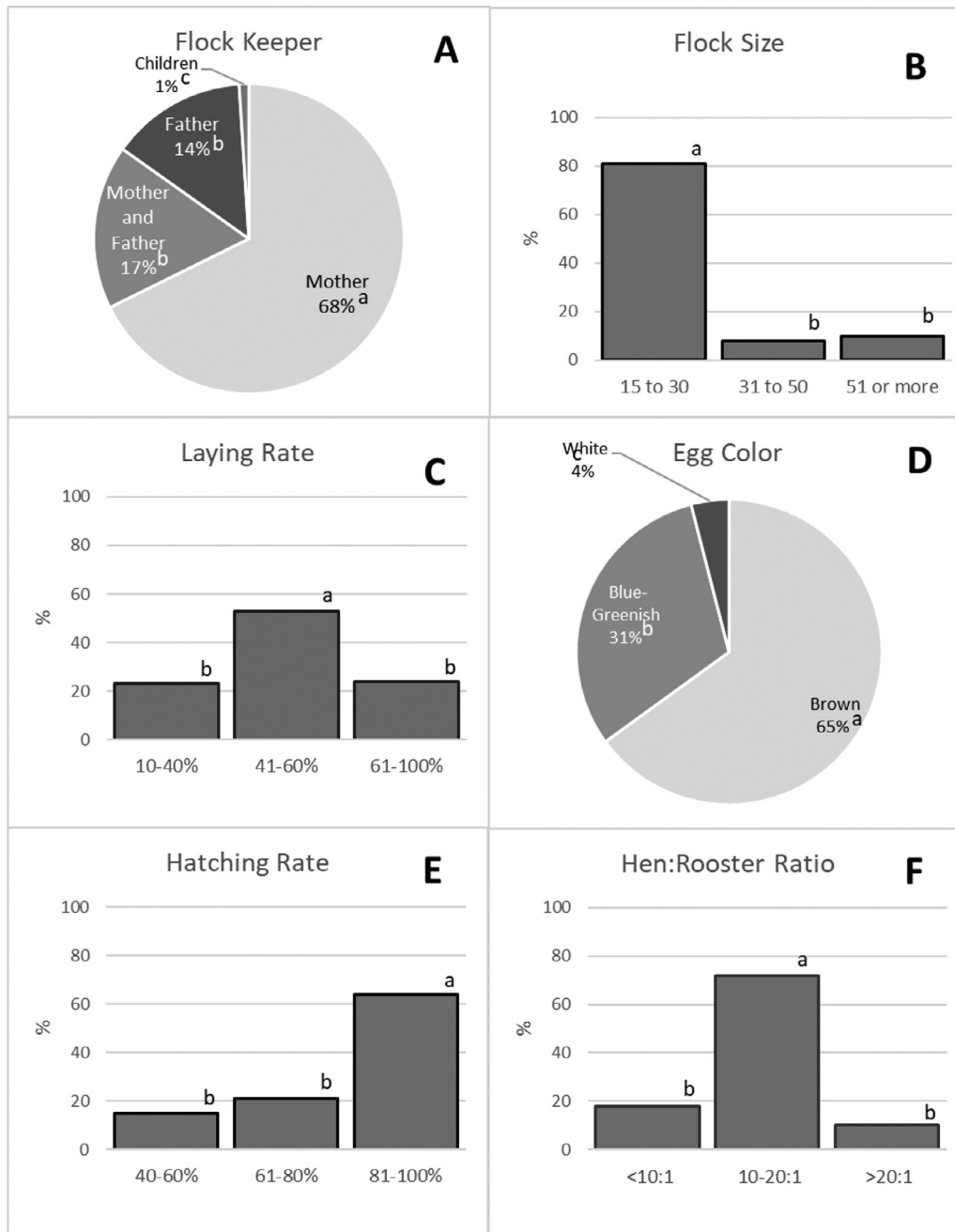
## RESULTS AND DISCUSSION

It is worth mentioning that all data were provided by the surveyors rather than direct measurements, and therefore specific numbers must be managed carefully, and readers should focus on general trends.

The main purpose for keeping poultry is for self-consumption (79%) as compared to selling eggs and/or meat (21%) ( $P < 0.001$ ). Women are the main flock keepers (Figure 1A), which can be explained mainly due to physical effort and investment. A significant proportion of dual-purpose poultry breeding has been focused on family self-consumption as the results here indicate; 94% of surveyed keep dual-purpose chickens, whereas only 6% keep egg layers ( $P < 0.001$ ). When asked if they had received some kind of formal training, 92% of the surveyed respondents answered negatively ( $P < 0.001$ ), indicating they had acquired their skills from the elder and ancestors.

### Egg Production Systems

Flock sizes in the PFA systems are rather small, with a mean of  $26 \pm 13$  hens per household, and 81% ranging between 15 and 30 adult females (Figure 1B). Size variation ranged from 15 to 80 adult females per production unit, with the larger ones explained in part by Government support programs to buy extra chickens to increase flock size and production. As shown in Table 1 the egg laying cycle is eminently seasonal, starting in Winter,



**Figure 1.** General characteristics of Family Poultry Farming Systems from the Maullín Commune, Los Lagos Region ( $n = 145$ ). (A) Main flock keeper. (B) Flock size as number of adult hens. (C) Daily laying rate as percentage. (D) Color of eggs produced. (E) Hatching rate per clutch. (F) Ratio of hens to a rooster. Superscripts a, b, c, d indicate statistical differences ( $P < 0.05$ ).

increasing steadily during Spring when maximum laying rates are achieved, then declining to an end in late Summer or early Autumn. The highest egg production occurs in Spring (81%), particularly during September and October. This seasonal trend is influenced by natural daylength variation along the year, which in studied area (Lat. 41:30 S; Long. 73:30 W) fluctuates between 16:00 h in Summer to 9:54 h in Winter. Daylength extensions with artificial lighting keeping daylength above 16 h per day is not performed in these peasant poultry systems. Most common laying rates are estimated between 41 and 60% (0.41–0.60 eggs per layer per day) during the laying season (Figure 1C). Egg collection is variable

in different systems developed by the PFA, since it depends on the size and composition of the flock, how they are fed and housing conditions. Laying rates of indigenous fowl are usually low, but performance increases easily when feeding and management are improved (Guèye, 1998).

Regarding the colour of eggs, the most frequent eggshell colour in PFA is brown (65%), followed by blue-greenish eggs and white shelled-eggs (Figure 1D). The abundance of brown-shelled rather than white-shelled eggs, a common trait of most Mediterranean breeds introduced by the Spaniards, is explained by the arrival of several world breeds with improved laying

**Table 1.** Laying cycle of Creole hens in a family poultry system in the Commune of Maullín, Los Lagos Region, Chile.

Characteristics	Percentage (%)	<i>P</i> -value
Season with highest production		<0.0001
Spring	81 <sup>a</sup>	
Summer	3 <sup>c</sup>	
Winter	12 <sup>b</sup>	
Does not know	5 <sup>c</sup>	
Laying cycle starts during		<0.0001
Spring	19 <sup>b</sup>	
Autumn	3 <sup>c</sup>	
Winter	73 <sup>a</sup>	
Not know	5 <sup>c</sup>	
Laying cycle ends during		<0.0001
Spring	23 <sup>b</sup>	
Summer	35 <sup>a</sup>	
Autumn	33 <sup>ab</sup>	
Winter	3 <sup>c</sup>	
Does not know	6 <sup>c</sup>	
Feed ingredients		<0.001
Oats (mainly)	31 <sup>a</sup>	
Wheat (mainly)	30 <sup>a</sup>	
Cereal mix (oats, maize and wheat)	17 <sup>b</sup>	
Cereal mix plus wheat by-products or potatoes	9 <sup>c</sup>	
Cereal mix plus commercial concentrate	7 <sup>c</sup>	
Maize (mainly)	6 <sup>a</sup>	
Pasture utilization		<0.001
Yes, they have access	68 <sup>a</sup>	
No, they are enclosed	32 <sup>b</sup>	
Housing at night		<0.001
Chicken coop	83 <sup>a</sup>	
Trees	17 <sup>b</sup>	
Shared together with other poultry		<0.001
Yes	10 <sup>b</sup>	
No	90 <sup>a</sup>	

Superscripts a, b and c represent statistical difference ( $P < 0.05$ ).

performance. The blue-greenish shelled eggs, are a distinctive character of the Mapuche Fowl with ancestral presence in the area, and owe their presence to the dominant nature of the Oocyan trait introgressed into the Creole chickens of Southern Chile (Alcalde, 2015). These blue and greenish eggs combined with brown and cream coloured add market value to eggs sold by PFA farmers, as a signature of their non-industrial origin.

In most cases (97%;  $P < 0.001$ ) pullets start laying after 20 wks old, which agrees with researchers who show that creole pullets raised in low-input production systems reach sexual maturity later, as compared to industrial egg production systems.

Regarding hatchings per clutch, 85% of those surveyed have a hatching rate greater than 60% (Figure 1E). Hen to rooster ratio is important to achieve good fertility rates. Ten to 20 hens per rooster is the most frequent ratio found in these poultry systems (Figure 1F).

Regarding replacement, 87% reported changing their roosters within the first 2 yr of age, whereas in the case of hens, this is more variable, yet 10% of those surveyed stated that they keep the hens in production until they die of old age or from diseases. Likewise, most of those surveyed (92%;  $P < 0.001$ ) had never bought chicks from commercial poultry suppliers, instead they obtain their replacements from their own breeding stock or through exchange with neighbours.

## Description of Poultry Management in PFA

Feeding in family poultry farming systems in most cases (61%) is based on a single locally available whole grain temperate cereal such as wheat or oats (Table 1). Others feed a cereal mix made of oats, wheat and maize (which is grown in warmer areas of the Country), or supplement with commercial concentrate and by-products of the flour industry, such as bran and middlings (Table 1). Feeding of poultry in backyard systems is based mainly on grains and what they can browse around when they are free (Gutiérrez et al., 2007).

As of feeding frequency, birds are fed once or twice per day (97%;  $P < 0.001$ ), estimating an average daily allowance of 115 grams per chicken, which agrees with what is recommended in the tables by Rostagno et al. (2017) where a daily intake of an adult hen should range between 100 and 130 grams of balanced feed is recommended, depending on body size. In most cases the amount of food delivered by farmers is not balanced, nor is it focused on production efficiency, but rather on the availability and cost of grains. The role of scavenging or browsing to obtain these nutrients should not be underestimated and deserves further investigation.

## Housing and Appliances

Family poultry farmers feed their flocks on the ground and provide water in recycled kitchen containers. Others use improvised containers such as used tyres or wooden canoes. Regarding the type of nests, the most common are recycled wooden (62%) or plastic fruit boxes (37%), which are durable and involve little investment.

Free grazing is the most frequent in PFA systems (68%;  $P < 0.001$ ). In most cases chickens have their own housing where they are locked down at night (83%). This is similar to what happens in other regions, where birds roam freely around the house during the day but are locked down at night to avoid predation.

## Sanitary Management

Conventional sanitary management of chickens, as is normally practiced in commercial flocks, is minimal or practically absent. Only 8% supplies vitamins, 5% controls internal parasites and practically none applies vaccines ( $P < 0.001$ ). Likewise, the vast majority of PFA farmers did not know how to identify the diseases that affect their chickens. The occasional loss of some birds, along with the maintenance of females for longer periods than in commercial flocks, is the basis of selection for disease resistance and adaptation to environment associated with Creole or indigenous poultry (Lordelo et al., 2020).

## Characteristics of Creole chickens in Southern Chile

Egg size and colour are the result of selecting eggs put to broody hens, which also involves a decision as to

obtain an appealing produce for egg sale, favouring large even-shaped coloured eggs. The use of surplus locally produced grains, as the staple ingredient of the diet, which are seldom traded in the market and are not considered food for humans, imply little capital investment, reduced production costs and the conversion of low value feedstuffs into high quality protein sources such as eggs and meat for local sale or family consumption. Grazing, browsing, and kitchen or farm waste complement the diet for nutrients other than staple carbohydrates, allowing chickens to express their natural behaviour wandering around on wider areas. This also implies that chickens are not crowded in small spaces, an attribute of industrial poultry productions systems which is not well considered by consumers. It has been frequently observed that Creole chickens have considerably higher grazing aptitude than industrial genetic lines reared in free range systems, obtaining a higher proportion of their diet from pasture and assimilating higher amounts of carotenoid pigments into egg yolk and skin. Identifying these aspects may help farm or little producers to be more efficient and therefore sustainable, such as feeding protein supplementation, artificial light incorporation, vaccination and deworming, among others.

## ACKNOWLEDGMENTS

We thank the Animal Production Institute of Universidad Austral de Chile for funding this research project.

## DISCLOSURES

All authors declare no conflict of interest.

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